

# REFLEXION

REVIEW

ECONOMIC  
COMMISSION FOR  
LATIN AMERICA AND  
THE CARIBBEAN



UNITED NATIONS

ECLAC

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# CEPAL REVIEW

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# CEPAL REVIEW

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**Explanatory notes**

The following symbols are used in tables in the *Review*:

... Three dots indicate that data are not available or are not separately reported.

(–) A dash indicates that the amount is nil or negligible.

A blank space in a table means that the item in question is not applicable.

(-) A minus sign indicates a deficit or decrease, unless otherwise specified.

(.) A point is used to indicate decimals.

(/) A slash indicates a crop year or fiscal year; e.g., 2006/2007.

(-) Use of a hyphen between years (e.g., 2006-2007) indicates reference to the complete period considered, including the beginning and end years.

The word “tons” means metric tons and the word “dollars” means United States dollars, unless otherwise stated. References to annual rates of growth or variation signify compound annual rates. Individual figures and percentages in tables do not necessarily add up to the corresponding totals because of rounding.

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# Structural constraints and determinants of economic growth in Cuba

*Juan Carlos Palacios C.*

**ABSTRACT**

This study attempts to analyse the growth of Cuba's production sector and to identify the main determinants and constraints that existed during a period when tighter restrictions on trade and financial activity forced the country to reorient its economic model and its position in the world economy. This analysis includes an exploration of the institutional dimension of the gross domestic product (GDP). The model, variables and methodology used for this purpose have all been adapted to the particular features and specificities of the Cuban economy.

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**KEYWORDS**

Economic growth, production, trade in services, exports, imports, gross domestic product, economic policy, economic indicators, Cuba

**JEL CLASSIFICATION**

P20, O43, C33

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# I

## Introduction

The main objective of this analysis, which is by no means a finished piece of work, is to frame an academic discussion on the growth of the Cuban economy. The findings presented here should be viewed with a great deal of caution, since the problems that generally arise in this kind of quantitative analysis are compounded by the need to take the very specific aspects of an economy such as Cuba's into account.<sup>1</sup>

An analysis of Cuba's economic realities has served as the cornerstone for the hypothesis on which the study is based: that between 1986 and 2009, the growth of Cuba's production sector was subject to dual constraints stemming from both supply- and demand-side factors. On the one hand, an overly centralized regulatory framework may have suppressed economic efficiency, thereby reining in the expansion of output through supply-side factors. On the other, the shortage of foreign exchange that is typical of an open, developing economy may

have curbed the country's economic growth through demand-side factors.

The stated objectives of this study are therefore limited to an analysis of the constraints and determinants influencing the country's economic growth. Due to space limitations, the discussion will leave aside a number of other variables that are fundamental for an understanding of the Cuban model, such as economic policy and social justice.

The article is structured as follows. Section II offers a brief overview of the literature on economic growth and the most important empirical studies of the Cuban economy that have been conducted to date. Section III models the Cuban production sector's GDP since 1986 and discusses factors that may have held back the Cuban economy's production potential and that should therefore figure in the explanation of why the GDP of this sector evolved as it did during this time period. Section IV describes the theoretical model underlying the specified production function, explains what data were used in measuring these variables and what corrections were made, builds a synthetic index for use in estimating how decentralized the economy is, and provides estimates, alternatively, of the sectoral and aggregate models that can be used to account for the growth trends seen in the Cuban production sector during the period in question. Section V presents the main findings of the study.

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□ The author is especially grateful for the information, inputs and comments provided by the Cuban professors and researchers with whom he was fortunate enough to work and exchange views, as well as for the valuable suggestions and corrections furnished by an anonymous referee in the course of the preparation of this publication.

<sup>1</sup> Some of the main difficulties were the presence of structural changes in the series and the lack of homogenous statistics or of a closer fit with some of the assumptions underlying the theoretical models.

# II

## Theoretical framework and empirical evidence

Ever since the birth of economics as a scientific field of inquiry, the identification of the determinants of economic growth and of income differences across countries has been one of the recurring topics covered in the economic literature. In the 1930s, Harrod (1939) and, later, Domar (1946) extended the time horizon of analyses of the instability of capitalism to encompass a long-term perspective. Unlike the Keynesian approach, the exploration of growth trends within the framework

of neoclassical models focused on supply-side factors such as technical progress and the available supply of factors of production.

During the 1970s, the need to incorporate countries' historical and cultural landscapes was recognized by proponents of the new institutional economics (NIE) school of thought. At the same time, Kaldor (1975 and 1976), Thirlwall (1979) and others were questioning the exogenous nature of factors of production, and the

approach taken to explaining the dynamics of economic growth shifted to the demand side. Thirlwall was the first to formally describe the economy's dependence on the external sector when he expressed its growth as a function of exports, the terms of trade and the income elasticity of the demand for imports.<sup>2</sup> The main idea behind this approach is that no country can grow more rapidly than its balance-of-payments equilibrium rate unless it can sustain deficits over a lengthy period of time.

In the decade that followed, Romer (1986), Lucas (1988), Rebelo (1991) and others framed what came to be known as the "endogenous growth theory". These authors took the neoclassical models and then reworked some of their basic assumptions, such as the exogeneity of technical progress or the constant returns to scale of the production function.

Growth was not viewed as a priority in the Cuban economic literature until the last few decades. Instead,

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<sup>2</sup> The simplest version of the balance-of-payments constrained growth (BPCG) model assumes constant prices and defines sustainable growth with a balance-of-payments equilibrium as the ratio between export growth and the income elasticity of the demand for imports. This came to be known as Thirlwall's Law.

economic and social development was the pivotal focus of the political and academic agenda. Until the late 1980s, for example, González and others (1989) had not offered up an empirical analysis based on Cobb-Douglas production functions. In later studies, such as those of Mendoza (2003) or Torres (2007), this line of inquiry was pursued, and factors such as human capital and structural change were incorporated into the models. Doimeadios (2007) was the first to underscore the positive effect of a group of variables (proxies for structural change, openness to outside economies and the regulatory framework) on gains in total factor productivity (TFP) in Cuba. Her study is one of the main reference works used by researchers working on the subject now, since it represents the first and only time that a researcher has included the regulatory framework in a growth analysis of the Cuban economy. In other studies, such as those of Mendoza and Robert (2000), Cribeiro and Triana (2005), Vidal and Fundora (2008), and Fugarolas, Matesans and Mañalich (2008), Cuba's economic growth has been modelled on demand, with balance-of-payments constrained growth (BPCG) models being contrasted with foreign-exchange constraints on GDP.

### III

## Modelling the Cuban production sector's GDP from 1986 onward

The approach to modelling growth that has been taken in this study is based on a twofold theoretical tradition. On the one hand, it is based on the approach developed by Barro (1997), who advocated incorporating the institutional dimension into models of Cuban economic growth.<sup>3</sup> On the other, it posits the centrality of external disequilibria as a determinant of a country's economic growth, which is also an assumption underlying BPCG models.

#### 1. The regulatory framework as a supply constraint

The severity of the 1990s crisis forced the Cuban government to move quickly to launch a reform programme to liberalize and decentralize economic activities which, until then, had been centrally planned. It put an end to

the government's monopoly on foreign trade, took steps to attract foreign direct investment (FDI), reorganized the agricultural sector by creating cooperatives and reopening free-trade markets, and authorized self-employment and the introduction of the enterprise optimization initiative in the civilian sector of the economy. The change in direction that began to be seen in the early 1990s was not pursued in the following decade, however, but was instead partially reversed with the creation of the general fund, the re-centralization of foreign trade, changes in the regulations on FDI, tighter restrictions on self-employment and the elimination of enterprise funds or the loss of financial autonomy associated with the new enterprise optimization regulations. Raúl Castro's assumption of power in early 2008 did, however, mark the beginning of changes in the economic model that culminated in the Sixth Congress of the Community Party of Cuba.

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<sup>3</sup> The article referred to here is the study authored by Barro in 1997.

The authors of studies that have applied growth accounting procedures to the Cuban economy (Mendoza, 2003; Doimeadios, 2007) are in agreement that what made the recovery of the 1990s possible was the upswing in TFP rather than increases in factors of production. This finding can be interpreted as a first sign of the possibility that a positive correlation exists between the economic decentralization measures introduced at that time and efficiency gains. Section IV.2 explains how a synthetic index was built for use in analysing this correlation by estimating the centralization-decentralization dynamic characterizing the Cuban production sector during the relevant period.

## 2. Balance-of-payments equilibrium as a demand constraint

A first sign that Cuba's economic growth might depend upon the performance of its external sector was provided by the observation that the periods during which the economy grew the fastest coincided with developments that promoted export growth (such as the country's entry into the Council for Mutual Economic Assistance (CMEA), the introduction of structural reforms in the external

sector, or participation in recent integration schemes launched by the Bolivarian Alliance for the Peoples of Our America (ALBA)). The fact that the crisis of the early 1990s and the growth slump of recent years have been accompanied by serious foreign-exchange shortages constitutes yet another sign.

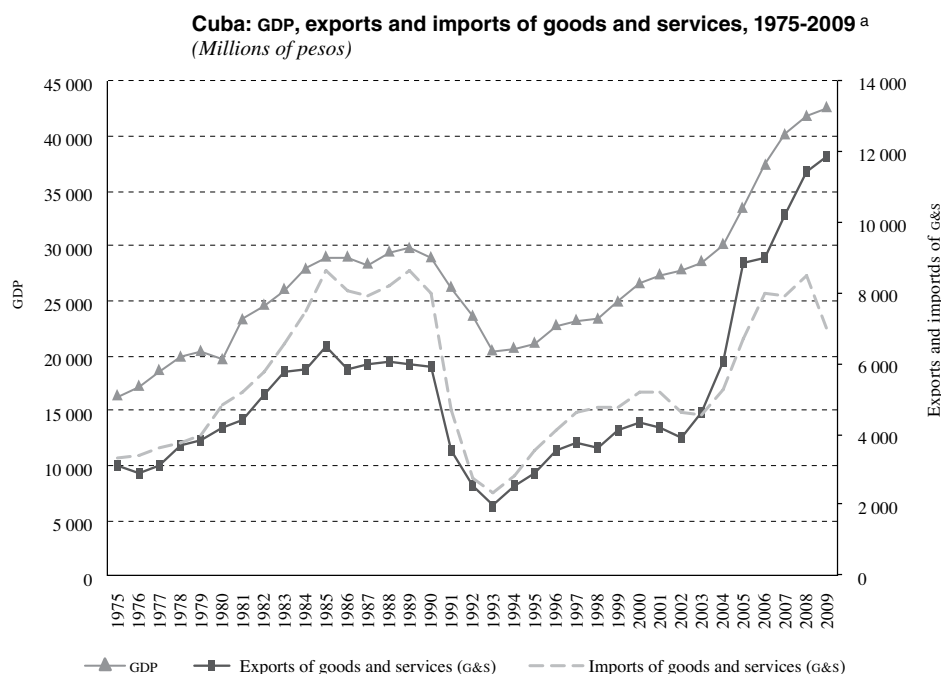
This relationship of dependence became especially evident when the Union of Soviet Socialist Republics (URSS) was dissolved, with Cuban exports plunging by 47%, the supply of hard currency shrinking rapidly and imports falling so sharply that by 1993 their level stood at just 30% of what it had been in 1989. The production sector's extremely heavy reliance on imported inputs brought production capacity to a virtual standstill.

Trends in GDP and external trade flows between 1975 and 2009, as shown in figure 1, also attest to the strong positive correlation between these variables.<sup>4</sup>

The recent history of this island country thus clearly points to the existence of an external constraint on long-term GDP growth.

<sup>4</sup> The GDP correlation coefficient is 0.93 for the import series and 0.77 for the export series.

FIGURE 1



Source: prepared by the author on the basis of National Statistical Office, *Anuario Estadístico de Cuba*, Havana, various years, and data from the National Institute of Economic Research (INIE).

<sup>a</sup> Gross domestic product (GDP) at constant 1997 prices and exports and imports at current prices.

# IV

## The theoretical model

### 1. Empirical analysis

One of the biggest issues to be resolved in any empirical analysis of production is the choice of which function to use in order to model it.

Although the Cobb-Douglas function is useful for representing the optimum position attainable by a steady-state economy, its underlying assumptions are somewhat implausible for economies that are having serious difficulties in financing their imports. In these cases, the constraints on a country's ability to import production inputs can be viewed as a bottleneck that limits production in the various sectors of the economy and prevents factors of production from being perfectly substitutable. Consequently, Cuba's GDP will be modelled here using a Leontief production function, in which GDP is determined in fixed proportions ( $\alpha_i$ ) by production factors ( $X_i$ ), regulatory changes ( $RC_n$ ) and a series of exogenous variables that are particularly influential in the case of Cuba ( $Z_k$ ).

$$Y = F [\min \{\alpha_i X_i\}, RC_n, Z_k] \quad (1)$$

According to Diewert (1971), the above production function can be generally formulated as:

$$Y = \sum \sum \alpha_{ij} (X_i X_j)^{\frac{1}{2}} + \beta_n RC_n + \delta_k Z_k \quad (2)$$

where:  $\alpha_{ij} = \alpha_{ji}$

The generalized Leontief (GL) function offers a series of advantages over other types of functions, including linearity in parameters and the possibility of including null values in the model or of estimating the degree of substitutability existing among the relevant factors. Caves and Christensen (1980) demonstrate that the GL function has satisfactory local properties when the preferences are (or are nearly) homothetic and the elasticity of substitution is zero or near to zero, which makes this a more suitable type of function for modelling the growth of economies such as Cuba's.

### 2. The data

The series used to estimate the endogenous variable (GDP) and the exogenous variables (factors of production, regulatory changes and other external shocks) of the model will be described here. The data being used refer to production during the period 1986-2009.

#### GDP ( $Y$ )

The dependent variable corresponds to the series for GDP at constant prices for 1997 (National Statistical Office, various years).

In 2004, the National Statistical Office modified the methodology it had been using to measure GDP<sup>5</sup> because it had been underestimating the country's social accomplishments. These underestimates stemmed from the fact that the Cuban National Accounting System did not reflect either improvements in quality or the operating surpluses of non-commercial activities. In order to rectify this situation, in 2003 the method for calculating the value of services was switched to a price-based system. The budgetary units providing individual social services then began to bill the sectoral bureaus at the provincial level for these services, which are valued at the sum of the unit cost (plus a 25% labour tax) and a profit ratio that is set by at the ministerial level (Jam, 2006).

The first results generated using the new methodology were published in the 2004 edition of the statistical yearbook *Anuario Estadístico de Cuba*, which also includes recalculations of GDP data for 2001-2003.

As shown in table A.1 of the annex, until 2006 this methodological change related only to the non-productive sector of the economy. In 2001-2003, the recalculations overvalued GDP in this sector of the economy by between 55% and 58%.<sup>6</sup> In 2007, the National Statistical Office modified the methodology again, and this change began

<sup>5</sup> From the early 1990s until that time, Cuba had used the methodology outlined in the System of National Accounts of the United Nations.

<sup>6</sup> Within the non-productive sector, the 80% increase in GDP registered between 2001 and 2003 for community, social and personal services was particularly striking.

to have an impact on the GDP estimates of the production sector as well (with the exception of the agricultural and construction industries), as may be seen from the data appearing in table A.2 of the annex.

The lack of homogeneity in Cuba's official GDP series makes it an unsuitable basis for an econometric analysis, since the outliers in it would skew the estimates of the model's parameters. The following steps have been taken to reduce the bias and give the time series greater consistency:

- (i) The scope of the study has been limited to the production sector so that a more homogeneous series can be constructed using the official data for a longer time period (1986-2006).
- (ii) GDP values for production sectors for 2007-2009 have been corrected by applying, starting with 2006, the growth rates obtained using the new methodology to the GDP value of the preceding year, which reduced the sector's growth rate as of 2007 from 3.8% to 1.9%.

The explanatory variables included in the model and the methodologies and data used to measure them are set out below.

- Factors of production:

- *Stock of physical capital (K)*

The national accounts of a planned economy such as Cuba's offer an advantage in that annual data, by sector, are published on fixed capital accumulation and stock. These figures are available up to 1989 (National Statistical Office, 1989). The rest of the series has been estimated by using the perpetual inventory methodology developed by Benhabib and Spiegel (1994).

$$K_{it} = K_{i0}(1 - \delta_i)^t + \sum_{q=1}^{t-1} I_{iq}(1 - \delta_i)^{t-q} \quad (3)$$

where  $\delta_i$  is the linear depreciation rate for sector  $i$ ,  $I_{it}$  represents the gross fixed capital formation (National Statistical Office, various years) of sector  $i$  in year  $t$ , and  $K_{it}$  represents the capital stock of sector  $i$  in year  $t$ .

The difficulty of estimating capital stock is further complicated, in the case of Cuba, by the repercussions that the disintegration of the socialist bloc in the late 1980s may have had on the depreciation assumptions. The collapse of the bloc put an end to the guaranteed supply of production inputs and machinery, and the technological obsolescence of the country's installed

capacity as compared to that of capitalist economies became glaringly evident.

In this context, assuming a constant rate of depreciation in the capital stock accumulated by the sector during the period when the country was a member of CMEA (as was done in equation No. 3) is no longer reasonable. It is to be expected that the decline in economic value associated with the technological backwardness of the capital stock accumulated during the time that the socialist bloc held sway and the difficulty of maintaining it because of the lack of spare parts would increase over time. Equation No. 3 therefore needs to be adapted to the situation in the Cuban economy in 1990-2009 by assuming an increasing rate of depreciation for the capital stock accumulated up to 1989 and a constant one for the stock created through new investments.<sup>7</sup>

$$K_{it} = \left[ K_{it-1} - \sum_{q=1}^{t-2} I_{iq}(1 - \delta_i)^{t-1-q} \right] (1 - \alpha t \delta_i) + \sum_{q=1}^{t-1} I_{iq}(1 - \delta_i)^{t-q} \quad (4)$$

In equation No. 4, the rate of depreciation of the capital stock accumulated during the time when Cuba was a member of CMEA rises linearly over time ( $t_{1989}=1$ ) under the alternative assumptions of  $\alpha = 1$  and  $\alpha = 0.5$ . Figure 2 shows the estimates for aggregate capital stock obtained using different depreciation assumptions for the stock amassed between 1986 and 1989.

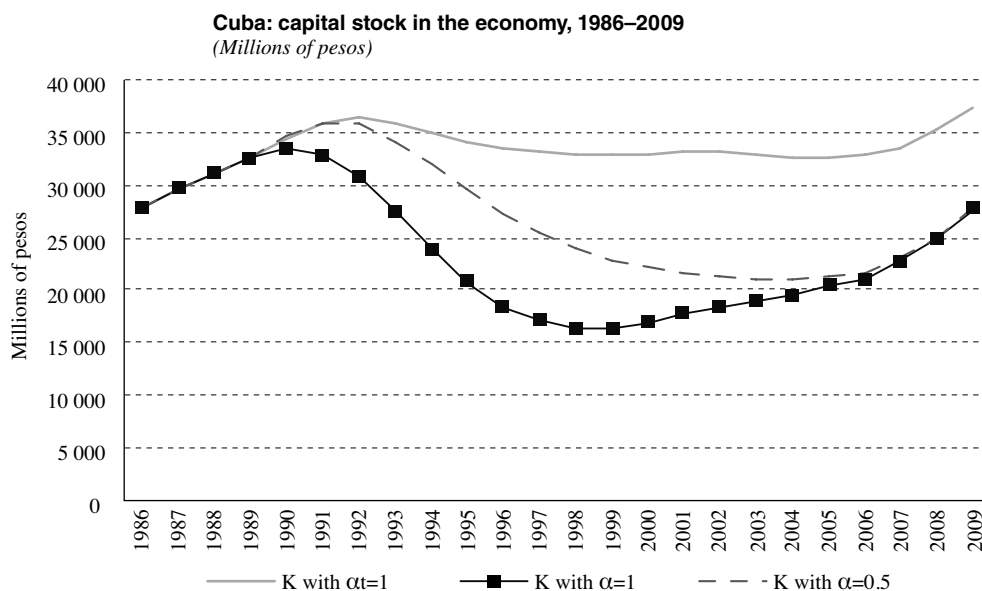
The estimates arrived at using equation No. 4 reflect the capital losses sustained by the Cuban economy in the wake of the disintegration of the socialist bloc, which gave rise to one of its main structural problems (González, 1995).

- *Labour (L)*

Since Cuban workers' high level of education is one of the hallmarks of the country's socialist model, it is reasonable to include the quality of labour in the estimates. One of the most commonly used proxy variables for this purpose is years of schooling completed by members of the economically active population. Barro and Lee (1993) have used the perpetual inventory method to estimate this on the basis of the enrolment rates for the different academic cycles. Using that methodology, the average number of workers in each sector (National Statistical

<sup>7</sup> Estimates for 1986-1989 are based on equation No. 3.

FIGURE 2



Source: prepared by the author on the basis of National Statistical Office, *Anuario Estadístico de Cuba*, Havana, various years.

Note: K with  $\alpha=1$  refers to the estimated capital stock based on the assumption that the rate of depreciation is constant over time; K with  $\alpha=1$  refers to the estimated capital stock based on the assumption that the rate of depreciation increases linearly at a gradient equal to 1; and K with  $\alpha=0.5$  refers to the estimated capital stock based on the assumption that the rate of depreciation increases linearly at a gradient equal to 0.5.

Office, various years; ECLAC, 2000) is multiplied by the average number of years of schooling for each year<sup>8</sup> as calculated by Mendoza (2003) and the growth rates implicit in the computations of Barro and Lee (2010).

Here again, consideration must be given to the repercussions that the changes of the 1990s may have had in terms of the actual extent to which workers' educations have been put to use. When self-employment began to be allowed, the economy's entire incentive structure was altered, as many skilled workers switched over to activities that have a low level of value added but in which there is a greater link between income and the amount of work actually done. Given these circumstances, a second correction should be made in our measurement of labour in order to capture the underutilization of skilled workers who switched over to jobs requiring less education or training. Equation No. 5 therefore uses an alternative labour series in which self-employed workers are assumed to have the equivalent of an elementary-school education (six years of schooling):

$$L_{it}^{co} = (L_{it} - TCP_i \times \alpha_i) YS_t + TSE_t \times \alpha_i \times 6 \quad (5)$$

where  $L_{it}^{co}$  indicates the average number of workers in sector  $i$  in year  $t$ , corrected for years of schooling,  $L_{it}$  indicates the average number of workers in sector  $i$  in year  $t$ ,  $TSE_t$  the number of self-employed workers in year  $t$ ,  $YS_t$  the average number of years of schooling in year  $t$ , and  $\alpha_i$  the percentage of self-employed workers in sector  $i$ .<sup>9</sup>

— Imports of production inputs ( $M$ )

As explained in section III.2, the importation of inputs has represented a considerable constraint on production in Cuba. The parallel movement of the series shown in figure 1 suggests that this constraint has remained constant throughout the period under study. This means that a single regression will suffice, since

<sup>8</sup> These data are not disaggregated by sector, so the average figure is assumed to correspond to all the sectors considered.

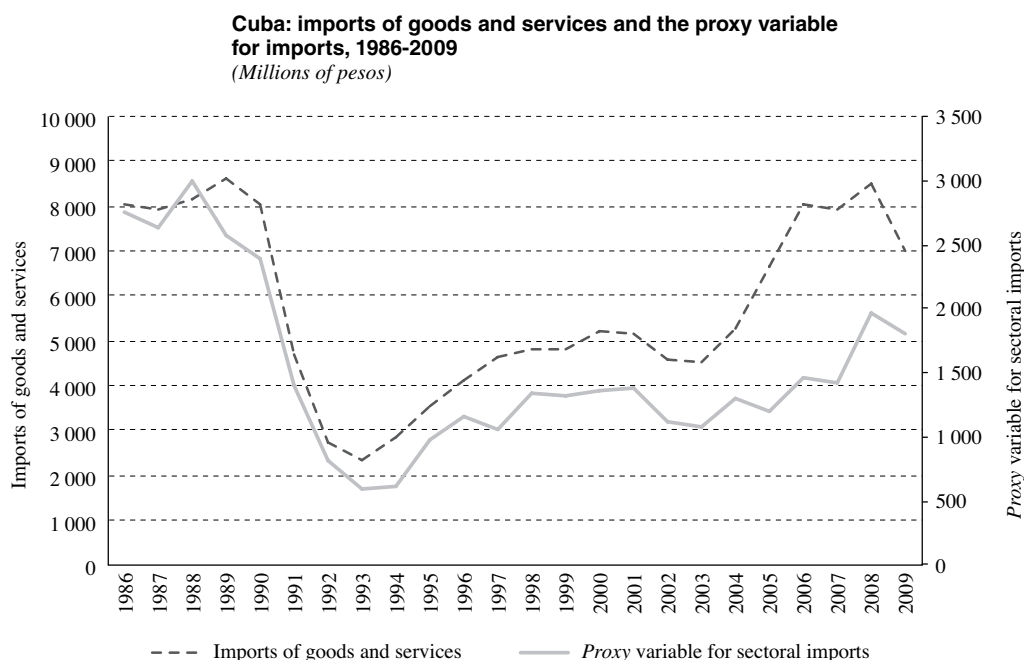
<sup>9</sup> Using the data provided by Pérez-Izquierdo and others (2003) for 1998-2002, it is assumed that, during the period under review, 20% of self-employed workers were employed in the transport and communications sector and another 40% in commerce and tourism, since there is no indication that there has been any significant change in the structure of self-employment in Cuba.

there is no need to identify a predominant constraint at each stage. Taking imported inputs into consideration as a third factor of production also makes it possible to arrive at a more accurate estimate of the constraints associated with the external sector in the Cuban economy. This is because the supply of foreign exchange in the different branches of activity has not only been influenced by trends in those activities' exports but has also been strongly affected by administrative decisions and centralized management mechanisms. Given the absence

of sectorally disaggregated information, this estimate is based on the Standard Foreign Trade Classification used in Cuba's statistical yearbooks, which groups imports of the main inputs (at current prices) by sector. The series used for these estimates cover more than one fourth of total imports of goods and services.

In order to assess the quality of the proxy variable, its trend at an aggregate level has been compared with the trend in imports of goods and services during the period under review (see figure 3).

FIGURE 3



Source: prepared by the author on the basis of National Statistical Office, *Anuario Estadístico de Cuba*, Havana, various years.

The results show that there is a greater than 85% correlation between the two, which confirms the validity of using this proxy in estimating the different production sectors' imports of inputs.

- Regulatory changes

The selection and measurement of proxy variables for regulatory changes are of vital importance, given how damaging it would be to include variables that lack significance or that have been inaccurately measured. These variables have been chosen based on their relevance to the different sectors' economic growth and the availability of statistical data.

The variables chosen to represent regulatory reforms in the analysis are the following:

- Openness to foreign direct investment (FDI)

With the collapse of the socialist bloc, the steep drop in the Cuban economy's hard-currency financing capacity obliged it to relax its policy on FDI and to look to foreign capital for a way to mitigate its loss of capital stock. Over 15 years since the passage of FDI Act No. 77, it is clear that the three main objectives of that law have been achieved: fresh capital has flowed into the economy, technology transfer is taking place and the Cuban economy has gained access to new markets (Pérez, 2006). Because the level of FDI in all the different sectors is unknown, the number of international economic ventures is used as a proxy for each production sector's openness to FDI (ECLAC, 2000; Pérez, 2006, 2008 and

2010; *Cuba: Inversiones y Negocios*, several issues; and *Cuba Foreign Trade*, several issues).

— *Degree of implementation of the Enterprise Optimization Programme (EOP)*

In 1998 the Enterprise Optimization Programme was launched throughout the civil sector of the economy. This programme focuses on introducing a more decentralized and flexible approach to the organization of work, production, the wage system and businesses' financial and investment policies with a view to achieving efficiency gains. This variable is estimated on the basis of the number of businesses participating in the programme in each sector (Marquetti, 2006; *Caminos. Revista Cubana de Pensamiento Socioteológico*, 2010).

— *Linkages with sectors that generate foreign exchange (FX)*

The first business schemes aimed at promoting foreign-exchange self-financing date back to late 1991, when the Financiera para el Turismo S.A. (FINATUR) was founded for the purpose of providing soft loans for the tourism sector. Thanks to this initiative, the country's share in the supply of goods and services to the tourism sector jumped from 12% in the mid-1990s to 67% in 2005 (Pérez, 2006). The participating companies had more scope for flexibility and financial autonomy than companies in the traditional sector, which relied on government allocations for their foreign exchange. This variable has been estimated on the basis of the flow of each sector's annual sales to the tourism sector and to the foreign-exchange stores (*Tiendas de Recuperación de Divisas* (TRD)), expressed in thousands of pesos at current prices. The data were provided by the Tourism Department of the National Institute of Economic Research (INIE).

— *Expansion of non-State forms of ownership (OWN)*

In 1993, with the adoption of Decree-Law No. 142, what were known as Basic Cooperative Production Units were set up in order to bring campesinos closer to the land and to create new incentives (e.g., the ability to sell surpluses on the agricultural market or to share in the profits of cooperatives). In that same year, Decree-Law No. 141/93, on self-employment, was approved as well. In an effort to boost productivity, thousands of underemployed workers in the State sector received authorization to move into the private sector. This variable has been estimated on the basis of the number of workers (expressed in thousands) employed in the

non-State sector. Under current regulations, non-State workers can be employed in the agricultural, transport and communications, and commerce and tourism sectors, and the proxy variable is therefore null for manufacturing and construction. In the agricultural sector, the series has been built by adding together the number of private farmers and cooperative workers (National Statistical Office, various years; Cuban Economic Studies Centre). For the transport and communications and the commerce and tourism sectors, the series have been built on the basis of the series for self-employed workers published by the National Statistical Office. The sectoral weightings are based on data provided by Pérez-Izquierdo and others (2003), as explained in the discussion on the correction introduced for labour as a factor of production.

— *Expansion of free markets (MAR)*

In September 1994, the government authorized the reopening of agricultural markets. The introduction of market mechanisms was designed to trigger two positive externalities: first, a production incentive, since output could be sold at higher prices than those set by the central government; and, second, the changeover from prices set by the government to prices determined by supply and demand was expected to contribute to the measurement of key economic variables, such as prices and profit ratios. This series has been estimated on the basis of sales in free markets, including free agricultural markets and the self-employment market in the transport and communications and the commerce and tourism sectors (National Statistical Office, various years). The sectoral weightings are once again based on data from Pérez-Izquierdo and others (2003) and were calculated in the same way as they were for labour.

— *Economic Decentralization Composite Indicator (ED)*<sup>10</sup>

Although they do pose methodological difficulties,<sup>11</sup> composite indices can synthesize a large volume of information and make it easier to interpret and

<sup>10</sup> The preliminary results of efforts to construct synthetic indices at the sectoral level showed that this methodology was unsuitable for some branches of economic activity (such as manufacturing and construction), since the Kaiser-Meyer-Olkin (KMO) coefficient was below 0.5. Consequently, a single synthetic index for the entire production sector was developed.

<sup>11</sup> Including the results' sensitivity to weightings, to the aggregation criteria used, and to the choice to include or exclude variables from the statistical analysis.



compare (across individuals and across time) complex, multidimensional phenomena.

Generally speaking, composite indicators are constructed with the help of the following equation:

$$IC = \sum_{i=1}^m w_i X_{in} \quad (6)$$

where  $X_{in}$  represents each of the standardized individual indicators  $X_i$  and  $w_i$  the weight assigned to the variable  $X_{in}$ .

The aim here is to obtain an overview of the regulatory environment in Cuba between 1986 and 2009 by looking at the way in which the extent of decentralization in the production sector has evolved. The main components method was used to arrive at these estimates. This method involves linear combinations of the original variables in which the combinations are placed in decreasing order based on the amount of variance that they account for.

In line with Freudenberg (2003), once the theoretical framework and the relevant variables have been defined, the next step is to standardize them<sup>12</sup> and to proceed with a correlational analysis, since, if common factors exist, they will yield a higher inter-variable correlation. To contrast the results, use has been made of the correlations matrix, the Kaiser-Meyer-Olkin ( $\kappa_{MO}$ ) measure of sampling adequacy and Barlett's test of sphericity.<sup>13</sup> The results validate the use of the main components method to build the composite index, since 100% of the correlation coefficients exhibit an absolute value of over 0.5, the  $\kappa_{MO}$  coefficient is over 0.6 and the probability associated with the chi-square statistic is less than 0.05 (see annex B). The next step is to determine the optimum number of factors for inclusion in the composite index. The Statistical Package for the Social Sciences (SPSS) has been used to select factors with a value greater than unity that individually account for more than 10% of the variance and that together account for more than 60%. In this case, a single component explains more than 83% of the variance and thus suffices. The last step is to estimate the weightings for each variable. The values suggested by the SPSS package for the construction of

the composite index are included in the scoring matrix (see table 4 in annex B).<sup>14</sup>

Figure 4 shows the trend in the economic decentralization index for Cuba's production sector from 1986 to 2009.

The changes in this index follow the same path as was described in section III.1, with the periods 1992-2003 and 2007-2009 appearing as stages during which the regulatory framework was being decentralized and the years 2004-2006 being a time during which the economy was partially re-centralized.

- Other external shocks

It is reasonable to think that Cuba's GDP was affected by other external shocks during the years from 1986 to 2009 that have caused it to diverge from its potential path. Given Cuba's geographical and economic characteristics, it is worthwhile to analyse the potential impact on growth of changes in its terms of trade (TOT) (National Statistical Office, various years) and of the moderate and severe hurricanes that have passed over the island (HUR) (National Statistical Office, various years; www.cubahurricanes.org/).<sup>15</sup> This last variable has been built by weighting the number of hurricanes that have swept over Cuba during the period under review by the minimum wind velocity for each category of hurricane.<sup>16</sup> While it may well be that hurricanes have had a greater impact on certain sectors, such as agriculture, tourism and commerce or construction, in view of the huge volume of resources that have to be marshalled in order to repair the damage done by hurricanes, the analysis has been directed towards their effect on the production sector as a whole.

As can be seen from figure 5, the terms of trade turned sharply downward after the demise of the socialist bloc and have remained fairly stable since then. The strong decrease seen in 2008, when both moderate and severe hurricanes (Gustav and Ike) hit the island, largely accounts for the financial difficulties experienced by the country in that year.

<sup>12</sup> The standardized variables are derived from the following expression:  $X_{in} = (X_i - X_n) / s_i$ , where  $X_n$  is the sampling measure and  $s_i$  represents the corresponding standard deviation.

<sup>13</sup> The statistical analysis was conducted using version 20 of the Statistical Package for the Social Sciences (SPSS).

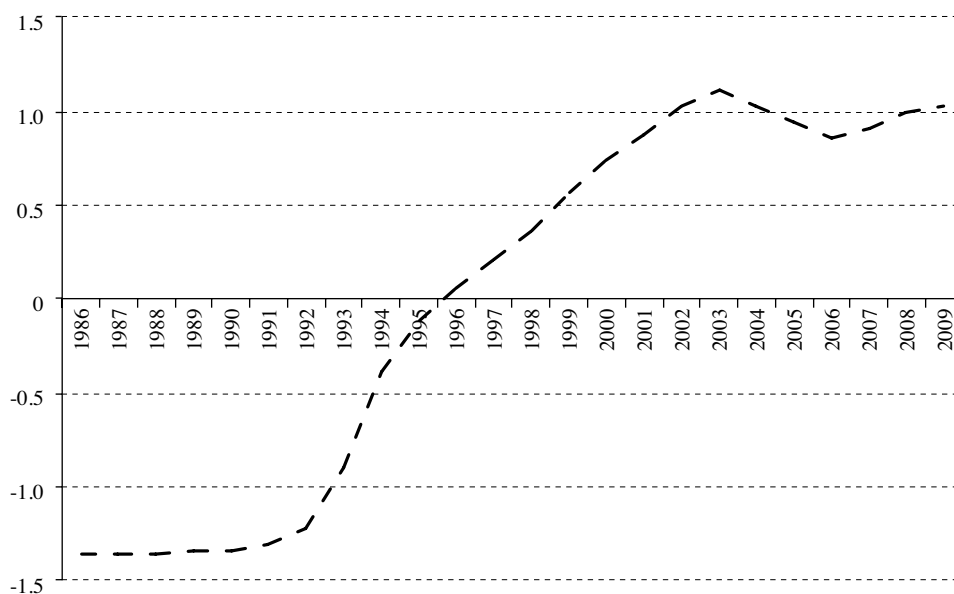
<sup>14</sup> The fact that the weighting obtained for the proxy variable for enterprise optimization is lower may be due to the fact that, unlike other measures, the move towards re-centralization made in 2004 did not affect the number of enterprises participating in the optimization programme, but rather their degree of autonomy, which the series used for this purpose is not capable of capturing.

<sup>15</sup> Based on the Saffir-Simpson scale.

<sup>16</sup> 150 km/h for moderate hurricanes and 210 km/h for severe hurricanes.

FIGURE 4

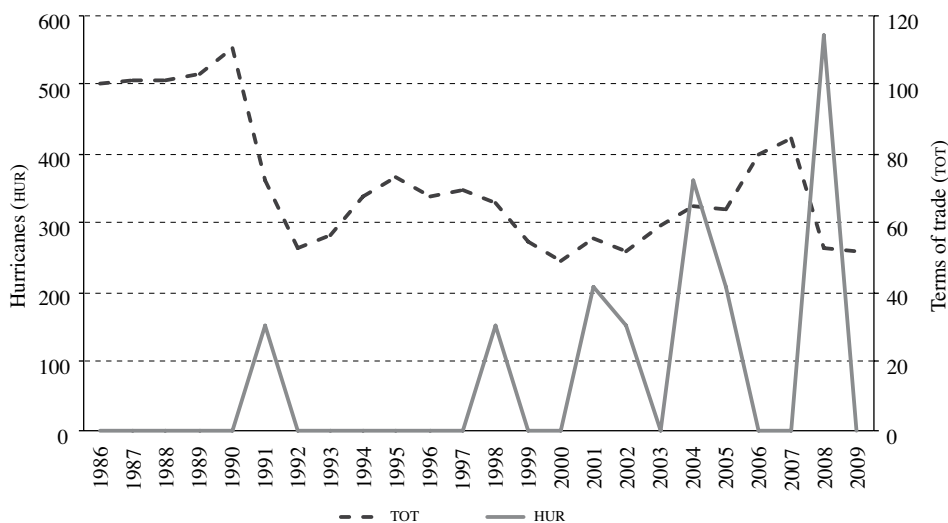
**Cuba: synthetic index of the decentralization of the production sector, 1986-2009**



Source: prepared by the author.

FIGURE 5

**Cuba: terms of trade (1986=100) and number of hurricanes, weighted by their severity, 1986-2009 (Percentages)**



Source: prepared by the author on the basis of National Statistical Office, *Anuario Estadístico de Cuba*, Havana, various years, and [www.cubahurricanes.org](http://www.cubahurricanes.org).

Another external shock that has had a major impact on the Cuban economy's growth is the embargo imposed by the United States. The lack of annual statistics and the fact that the embargo has been in effect throughout the entire period covered by this study make it difficult to estimate the extent of its impact on any empirical basis.

As part of a preliminary analysis of the potential growth impact of these constraints, table 1 depicts the trend of sectoral data for each of the regulatory periods described in section III.1.

Although the crisis of the early 1990s was widespread, some sectors, such as agriculture and construction, experienced particularly harsh setbacks during those years. The trends in the variables used to estimate the impact of regulatory reforms reflect the same pattern of decentralization and re-centralization previously observed in the Cuban production sector during these years, as well as the piecemeal nature of those regulatory reforms.

The data do not provide a basis for determining the existence of any relationships of causality, although they do hint at some degree of correlation among growth, decentralization and trends in the external sector, which calls for a deeper analysis of these variables.

### 3. Estimation methodology and results

The specification of the model is based on the generalized Leontief function described in the discussion on equation No. 2. This includes the stock of physical capital, labour and imports of inputs as factors of production and proxy variables for major regulatory reforms and for exogenous factors that are of particular relevance for Cuba, such as trends in the terms of trade and the impact of moderate and severe hurricanes.

The empirical analysis is a two-stage process. The first step is to estimate a model for each of the economy's production sectors. This provides a basis for checking its validity at the sectoral level and comparing the effects of the different regulatory reforms on each of the various branches of activity. The next step is to estimate panel data for the production sector as a whole in order to bolster the estimates' reliability (Greene, 1997).

#### (a) Sectoral analysis

The limited degrees of freedom of the sectoral regressions imply a lower degree of consistency in the estimated parameters. Consequently, the explanatory variables will be restricted by the following expression:

$$Y_t = \alpha_1 K_{t-1} + \alpha_2 L_t + \alpha_3 M_t + \alpha_4 \sqrt{K_t L_t} + \alpha_5 \sqrt{K_t M_t} + \alpha_6 \sqrt{L_t M_t} + \alpha_7 RC1_{t-1} + \alpha_8 RC2_{t-1} + \alpha_9 D_i HUR_t + e_t \quad (7)$$

where  $Y_t$  represents GDP in  $t$ ;  $K_{t-1}$  the capital stock in  $t-1$ ;  $L_t$  the average number of workers in  $t$ ; and  $M_t$  the volume of imports in  $t$ ;  $RC1_{t-1}$  and  $RC2_{t-1}$  estimate the two most sweeping regulatory changes in each sector in  $t-1$ ;  $HUR_t$  represents the impact on GDP of the moderate and severe hurricanes in  $t$ , while  $D_i$  is a dummy variable that takes a value of one (1) for the agricultural, tourism and construction sectors and a value of zero (0) for the rest. The introduction of both capital stock and the proxies for regulatory changes into the model are lagged. Given the problems posed by the endogeneity of capital stocks, which have been discussed extensively in the literature on growth, it is better to lag this variable and to use the lag as an instrumental variable for the existing capital stock. In the case of the regulatory variables, the lag is based on the idea that it will take at least a year before the effect of the changes on GDP will be felt.

Table 2 shows the results of the estimates arrived at by applying the ordinary least squares (OLS) method in equation No. 7 for each of the branches of activity making up the production sector. Given the small number of observations, in a second regression the variables that proved not to be significant in the first run were omitted.

The probability associated with the F and chi-square statistics reflects the inherent preferences in the model that have an impact on the aggregate model. The high value of  $R^2$  and the trend in estimated errors (see table E.1 in the annex) appear to confirm the validity of the model at the sectoral level and to corroborate its strong explanatory power in terms of the growth of each of the economic activities making up the Cuban production sector. The introduction of measures to promote the decentralization of the economy, including those aimed at opening it up to FDI, appear to have driven the growth of production sectors in which this kind of investment has played an important role, such as manufacturing, communications and tourism. The steps taken to make enterprises more autonomous also appear to have been a significant driver of growth in the basic industrial and manufacturing sectors and in transport and communications. In the agricultural sector, the negative sign of the parameter linked to the development of non-State forms of ownership could be a reflection of the extremely poor production performance of the new cooperatives, which were heavily indebted

TABLE I

## Cuba: trend of sectoral variables, 1986-2009

Agriculture									
	<i>y</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>fdi</i>	<i>fx</i>	<i>eop</i>	<i>own</i>	<i>mar</i>
1986-1989	0.02	0.07	0.07	0.09	0.00	0.00	0.00	2.84	0.00
1990-1994	-0.16	0.01	0.05	-0.24	2.00	0.00	0.00	105.84	181.11
1995-2002	0.03	-0.08	0.03	-0.10	4.29	12 725	12.14	12.59	140.78
2003-2006	0.01	-0.02	-0.01	0.27	-4.33	-8 133	15.00	-25.80	-389.0
2007-2009	0.02	0.04	0.00	-0.05	0.00	4 350	-5.50	-7.05	42.00
Construction									
	<i>y</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>fdi</i>	<i>fx</i>	<i>eop</i>	<i>own</i>	<i>mar</i>
1986-1989	0.04	0.04	0.00	-0.04	0.00	0.00	0.00	0.00	0.00
1990-1994	-0.29	-0.03	-0.06	-0.31	5.25	0.00	0.00	0.00	0.00
1995-2002	0.05	-0.08	0.01	0.08	3.71	65.14	4.86	0.00	0.00
2003-2006	0.22	-0.01	0.03	0.23	-5.33	0.00	27.33	0.00	0.00
2007-2009	0.02	0.20	0.00	-0.05	0.00	0.00	9.00	0.00	0.00
Basic industry <sup>a</sup>									
	<i>y</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>fdi</i>	<i>fx</i>	<i>eop</i>	<i>own</i>	<i>mar</i>
1986-1989	0.06	0.07	0.17	0.07	0.00	0.00	0.00	0.00	0.00
1990-1994	-0.06	-0.03	0.05	-0.22	13.00	0.00	0.00	0.00	0.00
1995-2002	0.06	-0.03	0.00	0.09	3.29	1 967	19.57	0.00	0.00
2003-2006	-0.01	0.03	0.04	0.00	-1.67	-600	8.00	0.00	0.00
2007-2009	0.00	0.19	0.04	0.20	0.00	3 800	1.00	0.00	0.00
Manufacturing									
	<i>y</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>fdi</i>	<i>fx</i>	<i>eop</i>	<i>own</i>	<i>mar</i>
1986-1989	0.00	0.08	0.01	-0.04	0.00	0.00	0.00	0.00	0.00
1990-1994	-0.08	-0.01	0.03	-0.43	10.75	0.00	0.00	0.00	0.00
1995-2002	0.02	-0.05	0.02	0.02	0.86	59 431	3.20	0.00	0.00
2003-2006	0.02	-0.01	-0.01	0.15	-0.67	-2 974	16.40	0.00	0.00
2007-2009	0.02	0.05	0.02	0.06	0.00	44 450	10.40	0.00	0.00
Transport and communications									
	<i>y</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>fdi</i>	<i>fx</i>	<i>eop</i>	<i>own</i>	<i>mar</i>
1986-1989	0.02	0.02	0.02	-0.08	0.00	0.00	0.00	0.00	0.00
1990-1994	-0.12	-0.04	-0.01	-0.35	0.75	0.00	0.00	1.25	297.55
1995-2002	0.08	-0.08	-0.02	-0.02	3.14	2 775.6	2.29	1.42	-60.78
2003-2006	0.07	-0.01	0.03	0.17	-1.33	-4 876	8.67	0.11	-19.43
2007-2009	0.05	0.04	0.02	0.14	0.00	3 400	0.50	0.54	3.50
Tourism and commerce									
	<i>y</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>fdi</i>	<i>fx</i>	<i>eop</i>	<i>own</i>	<i>mar</i>
1986-1989	-0.03	0.03	0.06	0.02	0.33	0.00	0.00	0.00	0.00
1990-1994	-0.12	-0.05	0.00	-0.16	1.50	0.00	0.00	2.50	297.55
1995-2002	0.04	0.15	0.05	0.21	2.71	0.00	1.00	0.85	-60.78
2003-2006	0.09	0.07	0.03	0.18	1.33	0.00	9.67	0.21	-19.43
2007-2009	0.01	0.08	0.02	0.01	0.50	0.00	6.00	1.08	3.50

Source: prepared by the author.

Note: The variables *y*, *k*, *l* and *m* represent the average annual growth rates for the period in question.

The variables *fdi*, *fx*, *eop*, *own* and *mar* represent the average rates of increase in levels where null values appear in the series. The variable *fx* is expressed in thousands of pesos.

<sup>a</sup> Includes mining and quarrying and electricity, gas and water.

TABLE 2

Estimates for each sector obtained using equation No. 7<sup>a</sup>

Y – dep. variable N=24	Agriculture	Construction	Basic industry	Manufacturing	Transport and communications	Tourism and commerce
ℒ.K	ns	ns	0.092 (0.005)	ns	-1.139 (0.001)	ns
L	0.705 (0.000)	-3.022 (0.002)	ns	0.594 (0.000)	-1.731 (0.007)	-4.791 (0.000)
M	ns	ns	ns	0.012 (0.108)	0.001 (0.020)	ns
KL	-0.636 (0.000)	1.211 (0.002)	-0.168 (0.081)	ns	3.853 (0.000)	7.610 (0.000)
KM	0.137 (0.000)	ns	0.006 (0.000)	0.148 (0.002)	ns	-1.601 (0.000)
LM	-0.083 (0.000)	1.029 (0.003)	ns	0.594 (0.000)	ns	1.607 (0.000)
ℒ.FX	ni	ni	ni	ns	ns	ni
ℒ.EOP	ni	ns	1.187 (0.000)	8.659 (0.000)	9.359 (0.000)	ns
ℒ.FDI	ni	ns	4.771 (0.000)	20.908 (0.033)	32.492 (0.000)	4.038 (0.069) <sup>b</sup>
ℒ.OWN	-1.810 (0.015)	ni	ni	ni	ni	-41.891 (0.002)
ℒ.MAR	ns	ni	ni	ni	ns	ni
HUR	-94.41 (0.037)	ns	ni	ni	ni	ns
R <sup>2</sup>	0.887	0.904	0.907	0.934	0.973	0.926
J-B prob.	0.781	0.195	0.436	0.837	0.529	0.639
DW	1.471	1.570	1.748	2.447	1.547	1.771

Source: prepared by the author.

ni: Variable not included.

ns: Variable not significant in the first regression.

<sup>a</sup> ℒ represents the lag operator; K represents capital, L labour, M imports of production inputs, KL the interaction between capital and labour, KM the interaction between capital and imports of production inputs, LM the interaction between labour and imports of production inputs, FX linkages with foreign-exchange-earning sectors, EOP the extent of enterprise optimization, FDI the extent of openness to foreign direct investment, OWN the expansion of non-State forms of ownership, MAR the expansion of free markets, HUR the passage of moderate and severe hurricanes, J-B prob. the probability for the Jarque-Bera statistic, and DW the Durbin-Watson statistic.

<sup>b</sup> For the tourism sector, annual FDI flows are used as a proxy for openness to foreign direct investment (FDI) (data provided by the Department of Tourism of the National Institute of Economic Research (INIE)) because the parameter for that variable turned out to be negative in a preliminary regression.

and whose actual degree of autonomy was virtually nil (Nova, 2002). The growth performance of this sector also appears to have been hurt by the damage caused by hurricanes.

The use of a flexible production function, such as the generalized Leontief (GL) function, makes it possible to discern the complementarities existing among the different factors of production in most sectors of the economy. It comes as no surprise that the agricultural sector is the only one in which labour serves as a substitute for

the other two factors, since this is the sector in which producers were most active in substituting labour for capital in the early 1990s in an effort to counter their strong reliance on imported inputs.

#### (b) *Aggregate analysis*

In the aggregate specification, all the regulatory proxies discussed in section IV.2 are added to the factors of production, as well as the occurrence of major hurricanes and trends in the terms of trade.

$$\begin{aligned}
 Y_{it} = & \beta_1 K_{it-1} + \beta_2 L_{it} + \beta_3 M_{it} + \\
 & \beta_4 \sqrt{K_{it} L_{it}} + \beta_5 \sqrt{K_{it} M_{it}} + \beta_6 \sqrt{L_{it} M_{it}} + \\
 & \beta_7 FDI_{it-1} + \beta_8 EOP_{it-1} + \beta_9 FX_{it-1} + \\
 & \beta_{10} OWN_{it-1} + \beta_{11} MAR_{it-1} + \beta_{12} TOT_{it-1} + \\
 & \beta_{13} HUR_{it-1} + e_{it}
 \end{aligned}
 \tag{8}$$

Equation No. 8 yields an estimate for a balanced six-sector panel, with observations from 1986 to 2009 using panel data techniques. A second regression for the shorter period of 1994-2009 is then run in order to shed light on the impact of the disappearance of the socialist bloc. Table 3 gives the results for both regressions, with estimates for fixed effects, random effects and robust errors.

TABLE 3

Results for estimates prepared using equation No. 8 <sup>a</sup>

Period	1986-2009			1994-2009		
	Fixed effects	Random effects	Robust error	Fixed effects	Random effects	Robust error
Y - dependent variable N=24						
L.K	0.060 (0.483)	-0.001 (0.993)	-0.001 (0.993)	-0.036 (0.759)	-0.024 (0.778)	-0.025 (0.686)
L	-0.333 (0.003)	-0.281 (0.002)	-0.318 (0.045)	-0.311 (0.025)	-0.054 (0.655)	-0.054 (0.379)
M	0.001 (0.279)	0.001 (0.678)	0.001 (0.673)	0.002 (0.124)	-0.001 (0.877)	0.001 (0.804)
KL	0.288 (0.077)	0.262 (0.067)	0.262 (0.202)	0.638 (0.009)	0.106 (0.505)	0.106 (0.195)
KM	-0.031 (0.009)	-0.019 (0.073)	-0.019 (0.029)	-0.043 (0.045)	-0.003 (0.842)	-0.003 (0.772)
LM	0.038 (0.001)	0.021 (0.073)	0.021 (0.003)	0.030 (0.058)	0.002 (0.870)	0.002 (0.549)
L.FDI	4.876 (0.007)	5.286 (0.001)	5.285 (0.056)	5.271 (0.192)	-0.475 (0.819)	-0.475 (0.472)
L.EOP	0.433 (0.505)	0.202 (0.770)	0.202 (0.682)	1.896 (0.043)	0.007 (0.991)	0.007 (0.987)
L.FX	0.001 (0.038)	0.001 (0.539)	0.001 (0.405)	0.001 (0.322)	-0.001 (0.293)	-0.001 (0.054)
L.OWN	0.208 (0.826)	-0.588 (0.400)	-0.588 (0.498)	1.024 (0.386)	-0.419 (0.597)	-0.419 (0.397)
L.MAR	0.489 (0.008)	0.761 (0.000)	0.761 (0.056)	0.390 (0.085)	0.087 (0.654)	0.087 (0.186)
TOT	18.389 (0.000)	13.943 (0.000)	13.944 (0.001)	6.961 (0.049)	5.142 (0.147)	5.142 (0.190)
HUR	-0.062 (0.774)	-0.196 (0.395)	-0.196	-0.205	-0.217	-0.217 (0.170)
L.Y	0.819 (0.000)	0.975 (0.000)	0.975 (0.000)	0.728 (0.000)	1.017 (0.000)	1.017 (0.000)
Constant	-867.09 (0.001)	-733.09 (0.000)	-733.09 (0.003)	-732.95 (0.028)	-169.71 (0.448)	-169.71 (0.440)
R <sup>2</sup>	0.903	0.889	0.889	0.936	0.920	0.920
p - F (14.172)	0.000			(0.000)		
p - Chi <sup>2</sup> (14)		0.000			0.000	
Hausman test	28.75	(0.005)		18.26	(0.108)	

Source: prepared by the author.

Note: the P value is shown in parentheses.

<sup>a</sup> L. represents the lag operator; K represents capital; L labour; M imports of production inputs; KL the interaction between capital and labour; KM the interaction between capital and imports of production inputs; LM the interaction between labour and imports of production inputs; FX linkages with foreign-exchange-earning sectors; EOP the extent of enterprise optimization; FDI the extent of openness to foreign direct investment; OWN the expansion of non-State forms of ownership; MAR the expansion of free markets; TOT the terms of trade; HUR the passage of moderate and severe hurricanes; p-F the probability for the F statistics, and p-Chi<sup>2</sup> the probability for the chi-squared statistic.

The Hausman test can be used to make the choice between the fixed-effects and random-effects models, and its results show that the fixed-effects model is preferable in both cases. The robustness of the fixed-effects estimates is heightened by their similarity to the results obtained when robust errors are included.

The aggregate analysis therefore confirms what the sectoral estimates had indicated about the importance of taking the regulatory framework into consideration when attempting to develop an explanation for the growth of Cuba's production sector. This follows from the 95% significance level with the expected sign obtained for some of the parameters relating to regulatory changes. The steps taken to open the economy up to FDI, to create greater linkages with foreign-exchange-earning sectors and to promote free markets subject to supply and demand appear to have had a positive effect on the growth of the Cuban production sector.

The aggregate results confirm what the sectoral analysis had indicated about the relationship among the different factors of production, which follows along much the same lines: the expansion of labour needs to be coupled with more investment or more imports. These results confirm this factor's complementarity and the wisdom of using flexible production functions such as the generalized Leontief function. The factors' complementarity is underscored by the significant negative effect of expanding the amount of labour used without also increasing capital or production inputs. This may seem counter-intuitive, but it starts to make more sense when considered within the context of the Cuban economy during the period being covered here. Given the high level of underemployment present in the economy during the recovery (as of the end of 2010, government statistics put it at 25% of the economically

active population), it becomes easy to see how the opportunity cost of continuing to increase the number of persons employed in the production sector could exceed the new workers' marginal productivity. This, in turn, would dampen economic growth by increasing the State's wage bill and thereby reducing the amount of funding available for productive investments.

The second hypothesis, according to which the expansion of Cuba's GDP is constrained by the supply of foreign exchange, is strengthened by the statistically significant positive effect of the terms of trade and the significance of imports when they are combined with capital or labour inputs.

The stability of the results when the estimate is limited to 1994-2009 is noteworthy, since this demonstrates that the main findings for the more extensive time period also hold true for the recovery stage.

Finally, a test can be run to see how solid the estimates are based on an analysis of their sensitivity to changes in the variables' construction and the model's specification. To this end, new alternative estimates can be calculated using equation No. 8 (see table D.1 in the annex) by employing different capital depreciation assumptions for the period during which Cuba was a member of CMEA and substituting the synthetic index calculated in section IV.2 for the regulatory changes.<sup>17</sup> These new results match up with the findings obtained from the preceding analysis and thus underscore the importance of taking factors and constraints specific to the Cuban economy into consideration when modelling its GDP.

<sup>17</sup> This also increases the degrees of freedom of the estimate and reduces the possible colinearity of the explanatory variables.

## V

### Conclusions and implications for economic policy

In view of the difficulty of building an econometric model of countries' economic growth patterns, the specific features of the Cuban model and the fact that some of the statistical series are not entirely consistent, a very cautious approach should be taken to the interpretation of this study's results and to their use in arriving at forecasts or projections.

Cuba's recent history shows how close a relationship exists between the trade-offs of regulation versus deregulation and the supply of foreign exchange available in the economy at any given point in time. In the presence of major financial limitations such as those seen after 1986, the production sector's growth appears to have been subject to a twofold structural constraint. In terms

of supply, the overly centralized regulatory framework appears to have lowered efficiency levels and curbed GDP growth. On the demand side, the shortage of foreign exchange appears to have weakened the country's import capacity and curtailed its potential growth rate.

This hypothesis points to two possible approaches for stimulating the Cuban production sector's growth: one revolves around greater decentralization of the regulatory framework, while the other would focus on industrial and commercial policies designed to boost the competitiveness of Cuban exports and improve the country's terms of trade. A number of these types of policies were included in the conclusions reached at the Sixth Congress of the Communist Party of Cuba, where it was decided that public-sector payrolls need to be

cut, that forms of non-State ownership should be fully developed (by granting genuine autonomy, providing material and financial resources, and authorizing the use of such forms of ownership in the industrial sector), that State and business functions should be separated, that free markets should be expanded and that a closer link between labour and income should be forged. Other approaches that would boost production potential have not yet been fully explored, however, as attested to by the limited scope of self-employment, the absence of a strong policy drive to spur foreign investment, which continues to be barred from strategic sectors of the economy (such as the farm sector), and the maintenance of a wage policy that undercuts the competitiveness of semi-public enterprises' exports.



## ANNEX A

## Effect of methodological changes on measurement of GDP

TABLE A.1

**Cuba: official GDP data for 2001-2006 included in the 2003 and 2006 editions of the *Annual Statistical Yearbook***  
(Millions of pesos)<sup>a</sup>

	<i>Statistical Yearbook of Cuba</i>	2001	2002	2003	2004	2005	2006
Agriculture		1 924.1	1 875.7	1 920.6	1 924.6	1 700.5	1 597.7
Basic industry		990.2	1 055.5	1 082.3	1 045	1 035.8	1 064.5
Manufacturing	2003 <sup>b</sup> and 2006 <sup>c</sup>	4 780.6	4 787.8	4 692.9	4 809.3	4 864.7	4 956.9
Tourism and commerce		7 633.3	7 788.7	8 175.1	8 232.8	8 627.3	10 581.5
Transport and communications		2 715.6	2 716.6	2 791	2 925.9	3 166.2	3 458.6
Construction		1 658.1	1 618.7	1 689.6	1 858.4	2 209.1	3 042
Non-productive sector	2003	7 655.8	7 843.2	8 150.7	...	...	...
Non-productive sector	2006	11 745	12 169.9	12 877.9	14 227.8	17 564.3	19 362.6
GDP (previous methodology)	2003	27 267.7	27 686.2	28 475.4	...	...	...
GDP (current methodology)	2006	31 446.9	32 012.9	33 202.6	35 023.8	39 167.9	44 063.8
GDP previous methodology / GDP current methodology	2003 y 2006	1.15	1.15	1.16	...	...	...
Non-productive sector, previous methodology / Non-productive sector, current methodology	2003 y 2006	1.55	1.55	1.58	...	...	...

Source: prepared by the author on the basis of National Statistical Office, *Anuario Estadístico de Cuba*, Havana, various years.

<sup>a</sup> At constant 1997 prices.

<sup>b</sup> Data calculated using the previous methodology.

<sup>c</sup> Data calculated using the new methodology.

GDP: gross domestic product.

TABLE A.2

**Official GDP data for 2004–2009 provided in the *Statistical Yearbook of Cuba for 2009***  
(Millions of pesos)<sup>a</sup>

	<i>Statistical Yearbook of Cuba</i>	2004	2005	2006	2007	2008	2009
1. Agriculture		1 924.6	1 700.5	1 597.7	1 885.9	1 897.9	1 962.7
2. Basic industry		845.7	836.5	873.0	931.5	944.5	940.2
3. Manufacturing		5 199.1	5 266.3	5 511.7	6 043.4	6 358.9	6 348.6
4. Tourism and commerce		8 215.4	8 603.4	10 554.7	10 620.6	10 530.5	10 758.7
5. Transport and communications	2009	2 999.3	3 245.0	3 541.9	3 768.6	4 019.0	4 117.8
6. Construction		1 858.4	2 209.1	3 042.0	2 780.0	2 848.0	2 864.4
7. Non-productive sector		11 787.4	14 646.5	15 791.2	17 853.3	19 091.1	19 359.6
8. GDP		32 829.8	36 507.3	40 912.2	43 883.3	45 689.9	46 352.0

Source: prepared by the author on the basis of National Statistical Office, *Anuario Estadístico de Cuba*, Havana, various years.

<sup>a</sup> At constant 1997 prices.

GDP: gross domestic product.

## ANNEX B

## Validation of the analysis based on the main components method

TABLE B.1

**Correlations matrix**

Variables	OWN	MAR	FDI	FX	EOP
OWN	1.000	0.948	0.931	0.846	0.677
MAR	0.948	1.000	0.980	0.847	0.507
FDI	0.931	0.980	1.000	0.863	0.505
FX	0.846	0.847	0.863	1.000	0.772
EOP	0.677	0.507	0.505	0.772	1.000

Source: prepared by the author.

Note: OWN represents the expansion of non-State forms of ownership, MAR the expansion of free markets, FDI the extent of openness to foreign direct investment, FX linkages with foreign-exchange-earning sectors, and EOP the extent of enterprise optimization.

TABLE B.2

**Total explained variation**

Component	Initial eigenvalues			Sums of the squared saturations of the extraction		
	Total	Percentage variance	Cumulative percentage	Total	Percentage variance	Cumulative percentage
1	4.184	83.671	83.671	4.184	83.671	83.671
2	0.647	12.941	96.612			
3	0.139	2.778	99.390			
4	0.018	0.370	99.759			
5	0.012	0.241	100.00			

Source: prepared by the author.

TABLE B.3

**KMO and Barlett test**

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy	0.648
Barlett's test of sphericity	Chi <sup>2</sup> 192.47
	P-value 0.000

Source: prepared by the author.

TABLE B.4

**Matrix of coefficients for the calculation of component scores**

Component	OWN	MAR	FDI	FX	EOP
1	0.232	0.227	0.227	0.226	0.176

Source: prepared by the author.

Note: OWN represents the expansion of non-State forms of ownership, MAR the expansion of free markets, FDI the extent of openness to foreign direct investment, FX linkages with foreign-exchange-earning sectors, and EOP the extent of enterprise optimization.

## ANNEX C

Proxy variable for imports

TABLE C.1

**Imports of selected production inputs used in estimating the extent of sectoral external constraints**

Agriculture	Livestock fodder, fertilizers, herbicides, anti-germinants and plant-growth regulators, wheeled tractors, accessories and spare parts for agricultural equipment.
Basic industry	Chemicals and related products, non-metallic mineral manufactures, soil mixing and handling equipment, stone, ores and other solid mineral substances, metalworking machinery.
Manufacturing	Untanned hides and skins, textile fibres and wastes, spare parts for machinery used in the production of textiles, footwear, graphics, glass, food-processing, cork and wood, and industrial sewing machines.
Tourism and commerce	Furniture and parts thereof, bedding, mattresses, cushions and similar stuffed furnishings, other metal furniture.
Transport and communications	Transport machinery and equipment, power generators, internal combustion engines for airplanes, telecommunications devices and equipment, sound recording and reproduction equipment, roadway equipment, passenger transport equipment, mass transit equipment, merchandise transport equipment, road tractors for semi-trailers, motorcycles and parts and accessories thereof, trailers and semi-trailers, and other transport equipment.
Construction	Refractory cements, mortars, concretes and similar compositions, ceramic flags and paving, hearth or wall tiles, ceramic mosaic cubes, asbestos-cement and fibre-cement, equipment accessories and spare parts, construction equipment.

Source: prepared by the author on the basis of National Statistical Office, *Anuario Estadístico de Cuba*, Havana, various years.

## ANNEX D

## Aggregate estimate

TABLE D.1

**Alternative estimates of Cuba's GDP, 1986-2009***(Based on different capital depreciation assumptions and a synthetic index of economic decentralization)*

Y - dependent variable N=24	Assumption of increasing rate of capital depreciation $\alpha=1$	Assumption of constant rate of capital depreciation	Synthetic index of economic decentralization
K(-1)	0.055	-0.082	0.132
L	-0.337 <sup>a</sup>	-0.399 <sup>a</sup>	-0.088 <sup>c</sup>
M	0.001	-0.001	0.001
KL	0.286 <sup>c</sup>	0.469 <sup>a</sup>	0.021
KM	-0.027 <sup>b</sup>	-0.019 <sup>c</sup>	-0.025 <sup>b</sup>
LM	0.027 <sup>a</sup>	0.026 <sup>a</sup>	0.032 <sup>a</sup>
$\mathcal{L}$ .FDI(-1)	5.739 <sup>a</sup>	5.392 <sup>a</sup>	---
$\mathcal{L}$ .EOP(-1)	0.056	1.419	---
$\mathcal{L}$ .FX(-1)	0.001 <sup>c</sup>	-0.001	---
$\mathcal{L}$ .OWN(-1)	0.524	0.719	---
$\mathcal{L}$ .MAR(-1)	0.482 <sup>a</sup>	0.413 <sup>b</sup>	---
$\mathcal{L}$ .ED	...	...	219.16 <sup>a</sup>
TOT	17.283 <sup>a</sup>	16.056 <sup>a</sup>	16.50 <sup>a</sup>
HUR	-0.079	-0.099	-0.189
$\mathcal{L}$ .Y(-1)	0.813 <sup>a</sup>	0.842 <sup>a</sup>	0.829 <sup>a</sup>
Constant	-636.69 <sup>a</sup>	-650.17 <sup>b</sup>	-704.79 <sup>a</sup>
R <sup>2</sup>	0.901	0.900	0.901
P - (F, Chi <sup>2</sup> )	0.000	0.000	0.000
Hausman test	0.003	0.047	0.000

Source: prepared by the author.

Note: The estimates for the three models were calculated using fixed effects in line with the results of the application of the Hausman test.  $\mathcal{L}$  represents the lag operator; K represents capital; L labour; M imports of production inputs; KL the interaction between capital and labour; KM the interaction between capital and imports of production inputs; LM the interaction between labour and imports of production inputs; FX linkages with foreign-exchange-earning sectors; EOP the extent of enterprise optimization; FDI the extent of openness to foreign direct investment; ED the composite index for economic decentralization; OWN the expansion of non-State forms of ownership; MAR the expansion of free markets; TOT the terms of trade; HUR the passage of moderate and severe hurricanes; p-F the probability of the F statistic, and p-Chi<sup>2</sup> the probability of the chi-squared statistic.

<sup>a</sup> Significant at a 99% confidence interval.

<sup>b</sup> Significant at a 95% confidence interval.

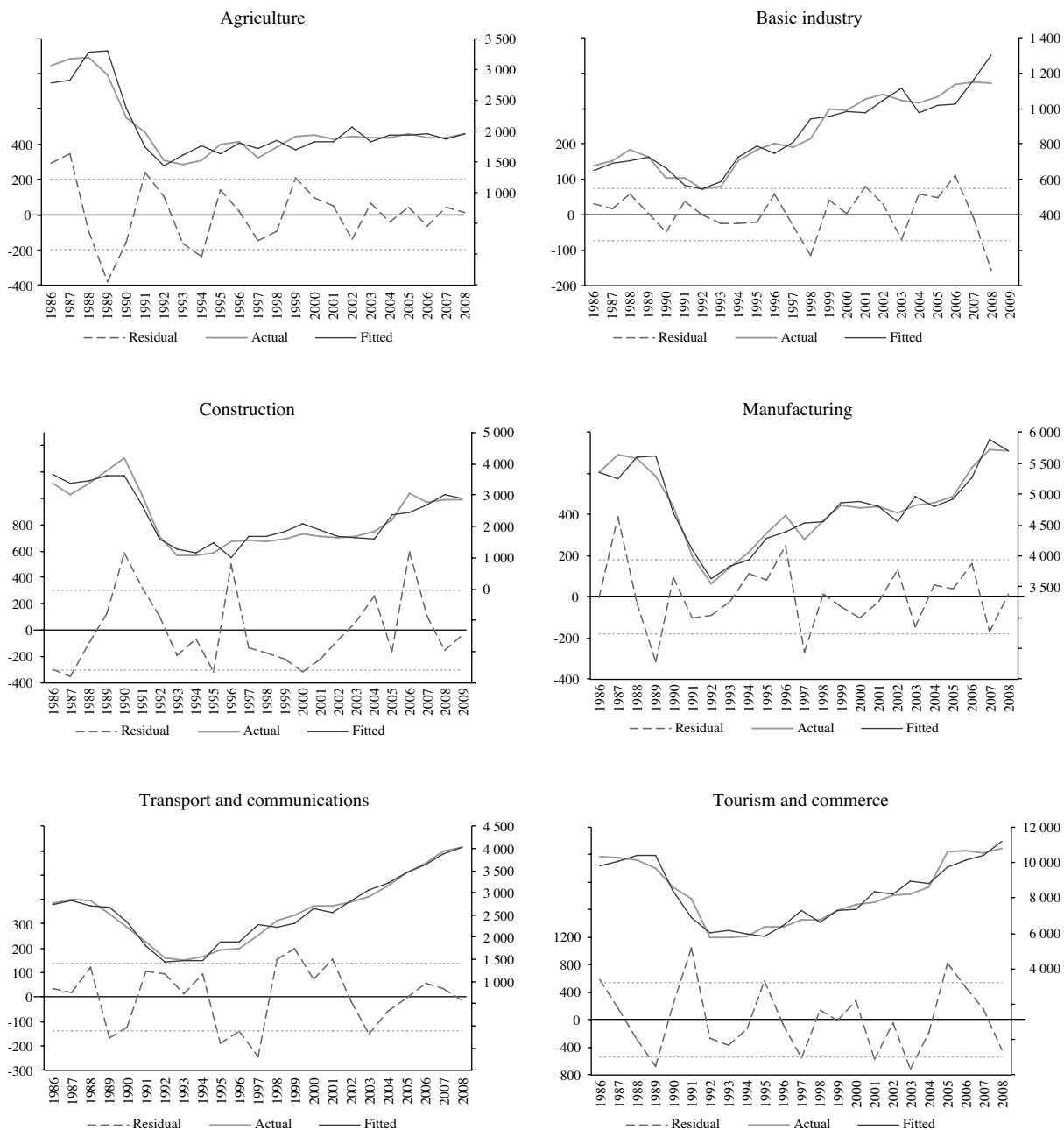
<sup>c</sup> Significant at a 90% confidence interval.

ANNEX E

Sectoral estimate

FIGURE E.1

Comparison of the real GDP of Cuban production sectors in 1986 and 2009 with estimates based on equation No. 7 <sup>a</sup>



Source: prepared by the author.

<sup>a</sup> Trends in the estimate residuals, within the intervals shown in the figure, provide an indication of the model's ability to estimate and project GDP values for each of the areas of activity within the Cuban production sector in 1986-2009.

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# An assessment of green export opportunities for Barbados

*Winston Moore*

**ABSTRACT**

Transitioning towards a green economy —one that focuses on reducing environmental risks and resource scarcities, while also improving well-being— has been put forward as one possible path towards sustainable development. While the potential advantages of pursuing a green development path are clear, moving forward on the green agenda requires guaranteed support for emerging businesses and industries. Consequently, the policy agenda will have to be tailored to these new green business areas. This study assesses various green businesses and their potential suitability for the small island State of Barbados.

**KEYWORDS**

Economic policy, environment, economic development, sustainable development, business, exportstrade in services, Barbados

**JEL CLASSIFICATION**

013; Q37; Q56

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# I

## Introduction

With a fixed exchange rate, Barbados depends on its foreign exchange earnings from the export of goods and services to finance its imports. These imports are used in virtually every aspect of production, from tourism to manufacturing. In 2010 total merchandise exports amounted to US\$ 429 million, equivalent to less than 1% of total world exports. As table 1 shows, these exports were concentrated in a few key areas, mainly agricultural products and manufactures. Most of the country's exports go to the United States (25%) and the European Union (20.4%). Meanwhile, total exports of services in 2010 came to US\$ 1.6 billion, representing about 0.04% of total world exports. These trade patterns reflect not only geographical factors (such as the proximity of the United States), but also historical precedent (for example, the export of sugar to Europe under preferential trading arrangements). Travel accounted for the bulk of these export receipts (67%), with other commercial services making up most of the remainder.

Given the relatively high concentration of the island's exports (both goods and services) in a few key

areas, the export of green goods and services could provide opportunities for diversification into higher value added areas. Indeed, in 2011 Prime Minister Freundel Stuart<sup>1</sup> noted that one of the development objectives for the island over the medium to long term would be to become "the most environmentally advanced, green country in Latin America and the Caribbean". In pursuit of this objective the island completed a Green Economy Scoping Study (Moore and others, 2012), assessing the potential opportunities for pursuing a green growth strategy. One of the recommendations of the study was that an assessment of the trade in environmental goods and services in Barbados should be carried out in order for the island to fully harness the potential of the green economy.

<sup>1</sup> Address given at the launch of the Government of Barbados and United Nations Environment Programme (UNEP) Partnership for a Resource-Efficient Green Economy in Barbados, held at the Faculty of Medical Sciences, University of the West Indies.

TABLE 1

**Barbados: main imports and exports, 2010**  
(United States dollars)

Goods	Trade value
<b>Imports</b>	
Mineral fuels, mineral oils and products of their distillation	484 333 718
Machinery and mechanical appliances; parts thereof	146 735 448
Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles	110 024 097
Vehicles other than railway or tramway rolling stock	73 323 026
Pharmaceutical products	64 181 655
Other commodities	896 805 458
<b>Exports</b>	
Mineral fuels, mineral oils and products of their distillation	202 756 058
Pharmaceutical products	72 023 763
Beverages, spirits and vinegar	45 661 270
Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; clocks and watches; musical instruments; parts and accessories thereof	17 622 731
Animal or vegetable fats and oils	12 702 310
Other commodities	157 680 270

Source: World Trade Organization (WTO), *Report by the Chairman, Ambassador Manuel A.J. Teehankee, to the Trade Negotiations Committee*, Geneva, Committee on Trade and Environment, 2011.

This paper therefore attempts to identify potential green export opportunities for Barbados, assessing both goods and services. For goods, the World Trade Organization (WTO) draft list of the universe of environmental goods (WTO, 2011) is employed to identify areas where the island has comparative advantages and, for services, an assessment is undertaken of how well potential green business opportunities match the business environment in Barbados. The results of the study could be used as an input for the development of industrial, fiscal and trade policies. In relation to trade policy, this exercise could be used as a case study of the potential implications of accepting the WTO draft list of the universe of environmental goods. Where potential comparative advantages are identified, policymakers could spur growth in these areas through incentives<sup>2</sup> and with the support of an appropriate industrial policy framework.

<sup>2</sup> This could be done through education and training, access to credit for entrepreneurs, mentoring and access to trade shows. Many of these incentives are already available in Barbados, but are not specifically targeted at green goods.

The most similar studies found in the existing literature on the topic are those by Huberty and Zachman (2011) and Ernst and Young (2008). Unlike Huberty and Zachman (2011), however, the present study does not attempt to identify green goods, but uses the WTO draft list of environmental goods to identify potential comparative advantages. This analysis could be relevant to trade negotiators examining the potential impact of accepting this list on trade in Barbados (and, to some extent, the Caribbean as a whole). The paper also differs from both Huberty and Zachman (2011) and Ernst and Young (2008) because it considers potential opportunities in both merchandise trade and services.

The remainder of this paper is structured as follows. After the introduction, section II discusses the concept of green goods and services and attempts to show the relationship between the various definitions currently being employed. Section III outlines the methodological approach used in this study to assess potential green export opportunities and section IV presents the results. Section V summarizes the main findings and puts forward some recommendations for future policy changes.

## II

### Identification of green goods and services

The terms “green goods and services” and “environmental goods and services” are used interchangeably in the relevant literature. The Organisation for Economic Cooperation and Development (OECD/EUROSTAT, 1999) identifies the environmental goods and services industry as one that is largely made up of activities that produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems relating to waste, noise and ecosystems. The definition categorizes goods and services according to whether they involve pollution management, cleaner technologies and products or resource management. In each of those categories, activities are further classified into three subgroups: (i) production of equipment and specific materials; (ii) provision of services, and (iii) construction and installation of facilities (see figure 1).

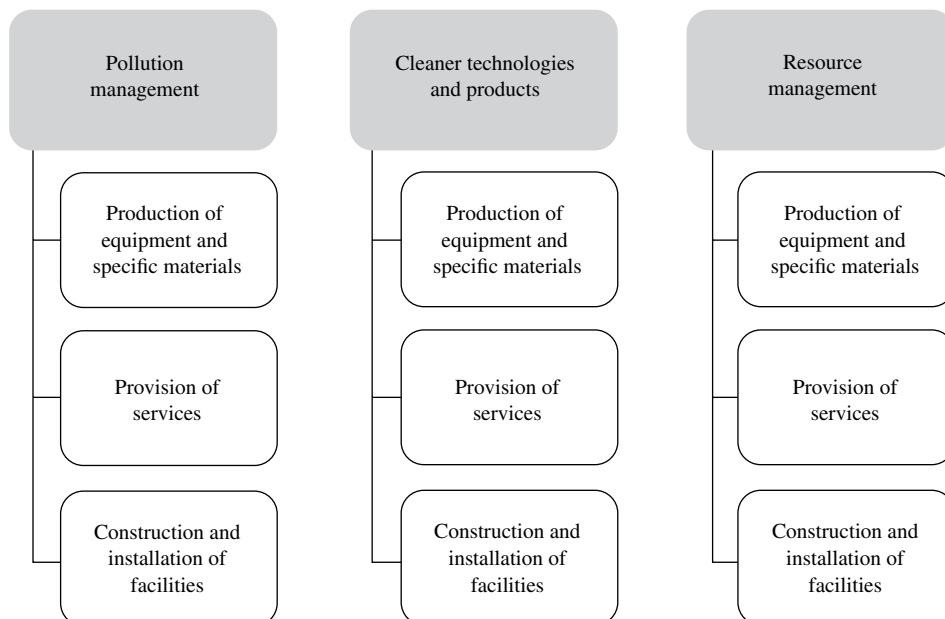
The definition of the environmental goods and services industry is, however, still somewhat contentious and, according to Sinclair-Desgagné (2008), it encroaches on other better-known industrial classifications. For example, rather than including solar cells, windmills

and ethanol in the energy sector and ecotourism as a subcategory of tourism, they would be classified under the environmental goods and services industry. The distinction between environmental and non-environmental goods and services is also somewhat ambiguous. For example, it is not clear if all resource-efficient technological and managerial enhancements should result in an environmental goods and services classification.

Building on this early work, the Bureau of Labor Statistics of the United States Department of Labor uses a similar definition to that developed by OECD/EUROSTAT (1999), identifying green businesses as those that are engaged in the production or provision of services that enhance the environment or conserve natural resources (Bureau of Labor Statistics, 2012). However, it seeks to address some of the criticisms levelled at OECD/EUROSTAT (1999) by providing clear guidance in relation to environmental services companies and natural resources conservation. Figure 2 presents the various green goods categories identified by the Bureau of Labor Statistics along with their subcategories.

FIGURE 1

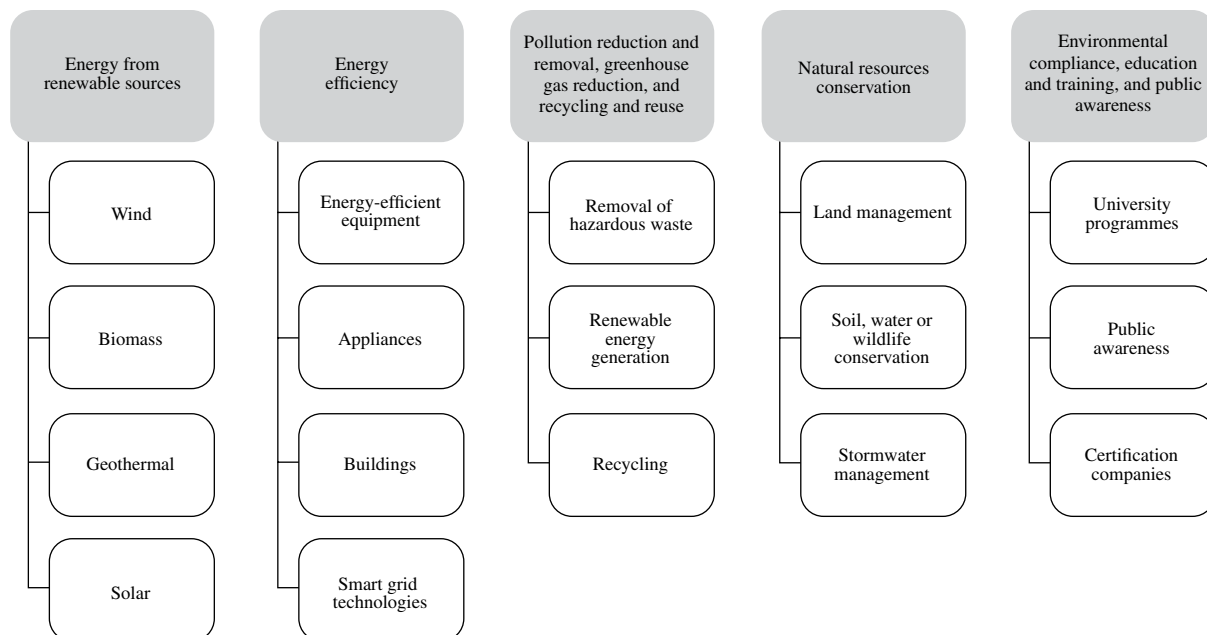
**Organisation for Economic Cooperation and Development and Statistical Office of the European Communities: categories of environmental goods and services**



Source: Organisation for Economic Cooperation and Development/Statistical Office of the European Communities (OECD/EUROSTAT), *The Environmental Goods and Services Industry: Manual for Data Collection and Analysis*, Paris, OECD Publishing, 1999.

FIGURE 2

**Bureau of Labor Statistics: categories of green goods and services**



Source: Bureau of Labor Statistics, "Green Goods and Services", Department of Labor of the United States, 2012 [online] <http://www.bls.gov/ggs/ggsoverview.htm>.

The Bureau of Labor Statistics distinguishes green goods and services from other similar goods or services by their use of either federal standards (for example, organic certification by the United States Department of Agriculture or the Energy Star programme run by the United States Environmental Protection Agency) or widely used industry standards (such as the Leadership in Energy and Environmental Design (LEED) programme). While the use of these industry and national standards addresses the criticism of the relatively arbitrary classification scheme used by OECD/EUROSTAT (1999), the approach still fails to resolve the underlying threshold question: at what point is a business or a good considered green?

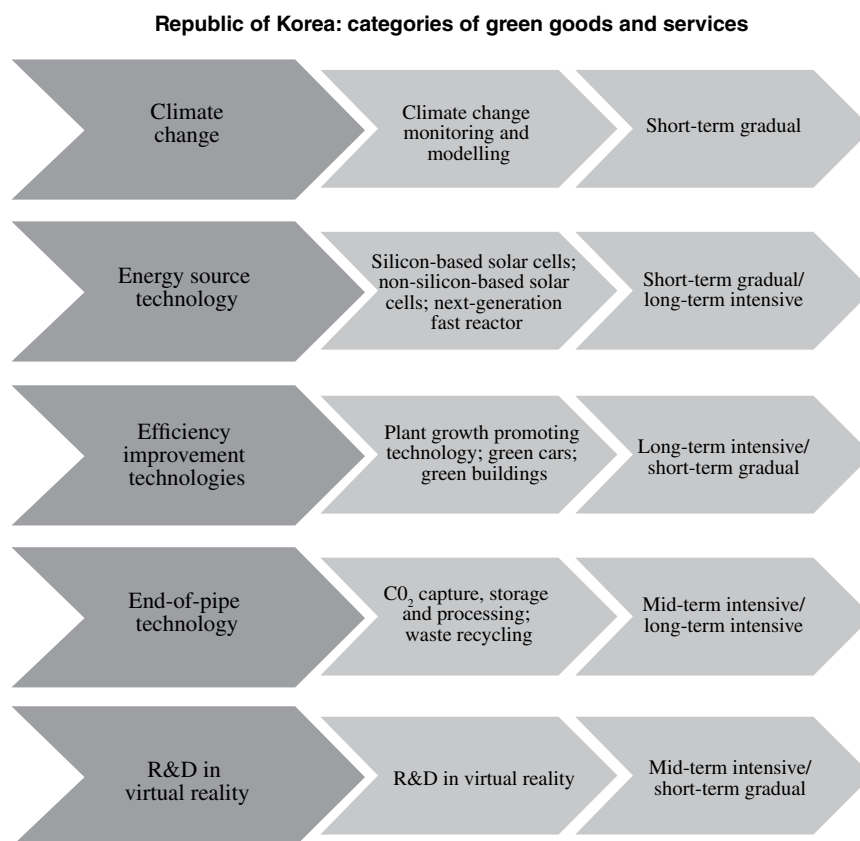
Rather than adopting a broad definition of green goods and services, the Republic of Korea has focused its Green New Deal<sup>3</sup> on 27 core high-technology areas.

The plan aims to build a resource-efficient economy with an enhanced long-term potential output. Each investment is ranked according to its associated time frame: (i) short-term gradual; (ii) medium-term intensive; and (iii) long-term intensive (see figure 3). Figure 3 shows the main export categories, the type of goods and services targeted and the nature of the investment depending on whether it relates to a short-, medium- or long-term objective. While the selection of industries identified for support under the Korean Green New Deal seems somewhat limited, it sends a clear message to the private sector on the areas where there is likely to be current and future government support; and although these 27 core areas were not developed for the purposes of measurement, they leave no doubt as to the sectors that the government considers green.

<sup>3</sup> The Green New Deal in the Republic of Korea is a stimulus plan introduced in 2009 in response to the recession, to stimulate growth

in the short run and reorient the economy in the medium to long term towards more resource-efficient areas.

FIGURE 3



Source: World Bank, “Lessons from the Implementation of Republic of Korea’s Green Stimulus”, INFRA Update, 2010 [online] [http://siteresources.worldbank.org/INTSDNET/Resources/5944695-1247775731647/INFRA\\_Korea\\_Newsletter.pdf](http://siteresources.worldbank.org/INTSDNET/Resources/5944695-1247775731647/INFRA_Korea_Newsletter.pdf).

R&D = research and development.

An alternative definition of the concept of green goods can be obtained from the international trade arena. The central objective of the Doha Development Agenda launched at the fourth World Trade Organization (WTO) Ministerial Conference is to enhance support for trade and environmental policies. At present, negotiations are taking place in three main areas:

- (i) The relationship between WTO rules and multilateral environmental agreements;
- (ii) The collaboration between WTO and secretariats of those multilateral environmental agreements;
- (iii) The elimination of tariffs and non-tariff barriers on environmental goods and services.

In relation to the third area, WTO members are currently holding negotiations on the identification of environmental goods, but have not yet addressed the definition of services. A number of proposals have been put forward in relation to goods: one calls for the use of broad criteria as the basis for their identification; another suggests introducing a request-and-offer process, with members proposing the items to be included and for which they are prepared to assume liberalization commitments. Under a third proposal two lists would be prepared, one for developed countries and another for developing countries, drawn from a single universe of goods; or

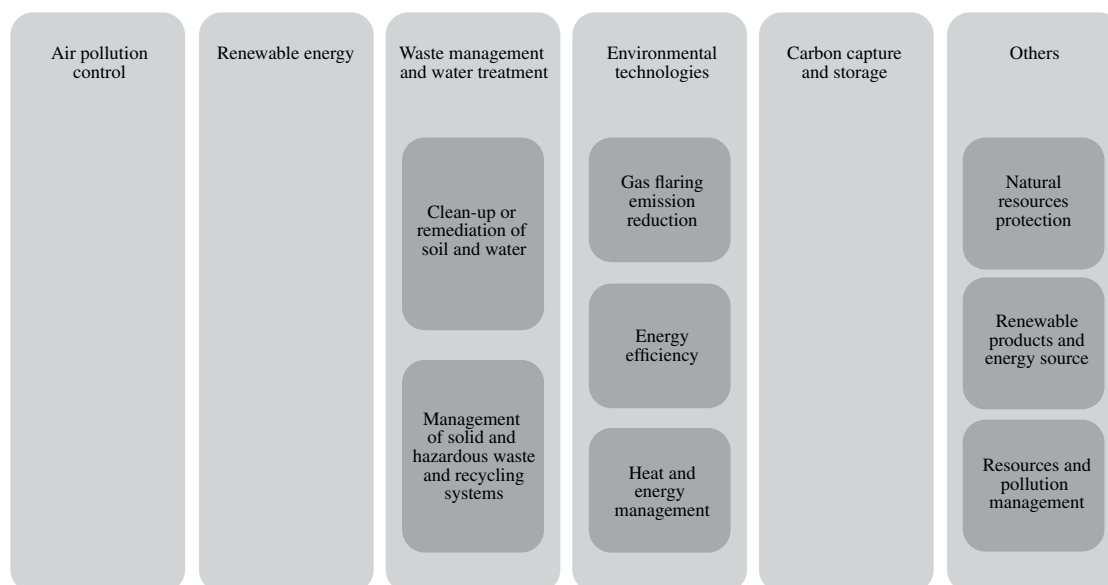
alternatively, a common list could be prepared for all members and a second list would comprise only those products specifically selected by developing countries for exemption or a lower level of tariff treatment. Figure 4 contains an aggregated version of the proposed reference universe of environmental goods and services.

The reference universe is based on the 2002 revision of the Harmonized Commodity Description and Coding System (HS2002) classification at the six-digit level and is available in WTO (2011). A sample core list of goods has been proposed as the starting point for discussion (see table 2).

Without international agreement, these green goods and services will continue to be subject to the same tariff and non-tariff barriers to trade as other less resource-efficient goods and services. Nevertheless, the Green Economy Scoping Study (Moore and others, 2012) for Barbados notes that, given the environmental constraints faced by the island and the demand for decent employment opportunities, a green growth strategy would have significant potential as a means of generating sustainable growth and development. The next section therefore identifies a potential approach to ranking the various green export opportunities that policymakers should consider for future policy support.

FIGURE 4

#### Proposed reference universe of environmental goods



Source: World Trade Organization (WTO) (2011), *Report by the Chairman, Ambassador Manuel A.J. Teehankee, to the Trade Negotiations Committee*, Geneva, Committee on Trade and Environment, 2011.

TABLE 2

## Sample core list of environmental goods

HS2002 code	Description	Category and subcategory
4601	Plaits and similar products of plaiting materials, whether or not assembled into strips; plaiting materials, plaits and similar products of plaiting materials, bound together in parallel strands or woven, in sheet form, whether or not being finished articles	
460120	- Mats, matting and screens of vegetable materials	<b>Waste management and water treatment:</b> - Waste management, recycling and remediation
7308	Structures (excluding prefabricated buildings of heading 94.06) and parts of structures (for example, bridges and bridge sections, lock gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel	
730820	- Towers and lattice masts	<b>Renewable energy</b> <b>Other:</b> - Renewable products and energy source
7321	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel	
732111	- Cooking appliances and plate warmers: for gas fuel or for both gas and other fuels	<b>Environmental technologies:</b> - Cleaner or more resource-efficient technologies and products
7324	Sanitary ware and parts thereof, of iron or steel	
732490	- Other, including parts	<b>Waste management and water treatment:</b> - Waste water management and potable water treatment <b>Carbon capture and storage</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies
8402	Steam or other vapour generating boilers (other than central heating hot water boilers capable also of producing low pressure steam); super-heated water boilers	
840290	- Parts	<b>Carbon capture and storage</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Waste management and water treatment:</b> - Management of solid and hazardous waste and recycling systems - Waste management, recycling and remediation
8404	Auxiliary plant for use with boilers of heading 84.02 or 84.03 (for example, economisers, super-heaters, soot removers, gas recoverers); condensers for steam or other vapour power units	
840410	- Auxiliary plant for use with boilers of 84.02 or 84.03	<b>Waste management and water treatment:</b> - Waste management, recycling and remediation - Management of solid and hazardous waste and recycling systems <b>Carbon capture and storage</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies
8405	Producer gas or water gas generators, with or without their purifiers; acetylene gas generators and similar water process gas generators, with or without their purifiers	

Table 2 (continued)

HS2002 code	Description	Category and subcategory
840510	- Producer gas or water gas generators, with or without their purifiers; acetylene gas generators and similar water process gas generators, with or without their purifiers	<b>Air pollution control</b> <b>Renewable energy</b> <b>Waste management and water treatment:</b> - Waste water management and potable water treatment <b>Carbon capture and storage</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies
8406	Steam turbines and other vapour turbines	
840681	- Turbines for marine propulsion: of an output exceeding 40 MW	<b>Renewable energy</b>
8409	Parts suitable for use solely or principally with the engines of heading 84.07 or 84.08	
840999	- Other: other	<b>Air pollution control</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies - Noise and vibration abatement <b>Carbon capture and storage</b>
8410	Hydraulic turbines, water wheels, and regulators therefor	
841011	- Hydraulic turbines and water wheels of a power not exceeding 1 000 kW	<b>Renewable energy</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>
841012	- Hydraulic turbines and water wheels, power 1 000-10 000kW	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>
841090	- Hydraulic turbines, water wheels, and regulators; parts, including regulators	<b>Renewable energy</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>
8411	Turbo-jets, turbo-propellers and other gas turbines	
841181	- Other gas turbines of a power not exceeding 5 000 kW	<b>Renewable energy</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b> <b>Others:</b> - Environmentally preferable products based on end-use or disposal characteristics
841182	- Other gas turbines of a power exceeding 5 000 kW	<b>Renewable energy</b> <b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b> <b>Others:</b> - Environmentally preferable products based on end-use or disposal characteristics
8418	Refrigerators, freezers and other refrigerating or freezing equipment, electric or other; heat pumps other than air conditioning machines of heading 84.15	
841861	- Other refrigerating or freezing equipment; heat pumps: compression-type units whose condensers are heat exchangers	<b>Renewable energy</b>
8419	Machinery, plant or laboratory equipment, whether or not electrically heated (excluding furnaces, ovens and other equipment of heading 85.14), for the treatment of materials by a process involving a change of temperature such as heating, cooking, roasting	
841919	- Instantaneous or storage water heaters, non-electric: other	<b>Renewable energy</b>

Table 2 (continued)

HS2002 code	Description	Category and subcategory
841950	- Heat exchange units	<b>Renewable energy</b> <b>Environmental technologies:</b> - Gas flaring emission reduction - Efficient consumption of energy technologies - Heat and energy management <b>Carbon capture and storage</b>
8479	Machines and mechanical appliances having individual functions, not specified or included elsewhere in this chapter	
847989	- Other machines and mechanical appliances: other	<b>Air pollution control</b> <b>Waste management and water treatment:</b> - Management of solid and hazardous waste and recycling systems <b>Renewable energy</b> <b>Others:</b> - Renewable products and energy source
8502	Electric generating sets and rotary converters	
850231	- Other generating sets: wind-powered	<b>Renewable energy</b> <b>Others:</b> - Renewable products and energy source
8504	Electrical transformers, static converters (for example, rectifiers) and inductors	
850410	- Ballasts for discharge lamps or tubes	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>
8537	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 85.35 or 85.36, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of Chapter 90, and numerical control apparatus, other than switching apparatus of heading 85.17	
853710	- For a voltage not exceeding 1 000V	<b>Renewable energy</b>
8541	Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes; mounted piezo-electric crystals	
854140	- Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes	<b>Renewable energy</b> <b>Others:</b> - Renewable products and energy source
9001	Optical fibres and optical fibre bundles; optical fibre cables other than those of heading 85.44; sheets and plates of polarising material; lenses (including contact lenses), prisms, mirrors and other optical elements, of any material, unmounted, other than such elements of glass not optically worked	
900190	- Other	<b>Renewable energy</b>
9002	Lenses, prisms, mirrors and other optical elements, of any material, mounted, being parts of or fittings for instruments or apparatus, other than such elements of glass not optically worked	
900290	- Other	<b>Renewable energy</b>
9027	Instruments and apparatus for physical or chemical analysis (for example, polarimeters, refractometers, spectrometers, gas or smoke analysis apparatus); instruments and apparatus for measuring or checking viscosity, porosity, expansion, surface tension or the like; instruments and apparatus for measuring or checking quantities of heat, sound or light (including exposure meters); microtomes	



Table 2 (concluded)

HS2002 code	Description	Category and subcategory
902730	- Spectrometers, spectrophotometers and spectrographs using optical radiations (UV, visible, IR)	<b>Environmental technologies:</b> - Environmental monitoring, analysis and assessment equipment
9032	Automatic regulating or controlling instruments and apparatus	
903210	- Thermostats	<b>Environmental technologies:</b> - Environmental monitoring, analysis and assessment equipment - Gas flaring emission reduction - Efficient consumption of energy technologies <b>Carbon capture and storage</b>

Source: World Trade Organization (WTO) (2011), *Report by the Chairman, Ambassador Manuel A.J. Teehankee, to the Trade Negotiations Committee*, Geneva, Committee on Trade and Environment, 2011.

HS: Harmonized Commodity Description and Coding System.

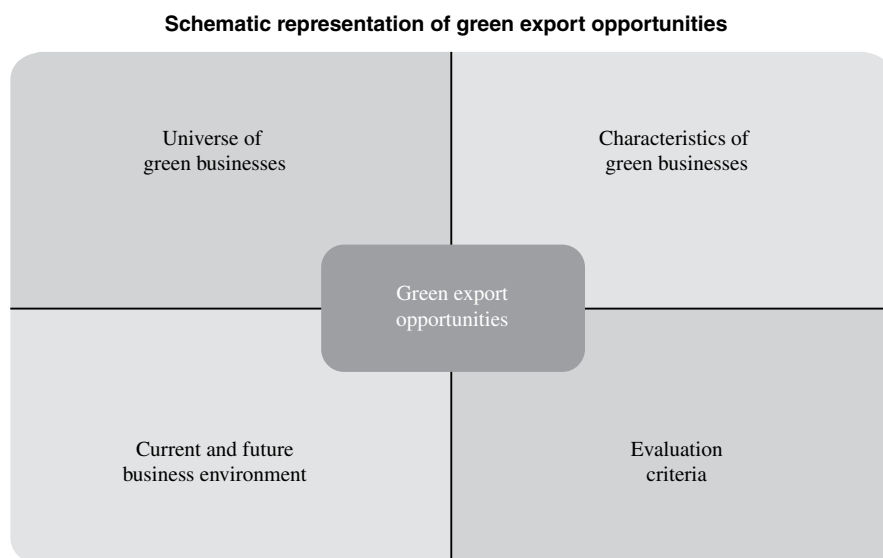
### III

## Methodological approach

As discussed in the previous section, the list of potential green goods and services is long and contentious. To avoid providing an arbitrary list of possible business areas or, even worse, an exhaustive list that is not necessarily relevant to the situation in Barbados, an analytical approach for evaluating business areas is employed. A schematic representation of that approach is presented in figure 5. The approach adopted

must take into account a universe of green business opportunities and, given the focus of this paper on export opportunities, the list proposed in WTO (2011) is a good starting point. However, as that list excludes services—an area in which Barbados is likely to have a comparative advantage—the study also uses the Bureau of Labor Statistics (2012) lists to generate a comprehensive database of green businesses.

FIGURE 5



Source: prepared by the author.

One means of identifying potential green business export opportunities is to calculate indices of revealed comparative advantage (Balassa, 1986 and 1989). These indices provide a simple measure of the extent to which a country or regional group is more specialized in a particular area of goods relative to another. The most popular comparative advantage index is the revealed export advantage (*REA*):

$$REA = \frac{X_{ij} / \sum_{j=1}^J X_{ij}}{\sum_{n=1}^N X_{nj} / \sum_{n=1}^N \sum_{j=1}^J X_{ij}} \quad (1)$$

where  $X_{ij}$  are the exports of good  $j$  by country  $i$  and  $X_{nj}$  are the exports of the same good by country group  $n$ . The country is assumed to have a revealed comparative advantage if  $REA > 1$  and a revealed comparative disadvantage if  $REA < 1$ .

Vollrath (1991) proposes three alternative indices: (i) relative trade advantage (*RTA*); (ii) the logarithm of the relative export advantage ( $\ln REA$ ), and (iii) revealed competitiveness (*RC*). These three indices are calculated as follows:

$$REA = \frac{X_{ij} / \sum_{j=1}^J X_{ij}}{\sum_{n=1}^N X_{nj} / \sum_{n=1}^N \sum_{j=1}^J X_{ij}} \quad (2)$$

$$\frac{M_{ij} / \sum_{j=1}^J M_{ij}}{\sum_{n=1}^N M_{nj} / \sum_{n=1}^N \sum_{j=1}^J M_{ij}}$$

$$\ln REA = \ln \left( \frac{X_{ij} / \sum_{j=1}^J X_{ij}}{\sum_{n=1}^N X_{nj} / \sum_{n=1}^N \sum_{j=1}^J X_{ij}} \right) \quad (3)$$

$$RC = \ln \left( \frac{X_{ij} / \sum_{j=1}^J X_{ij}}{\sum_{n=1}^N X_{nj} / \sum_{n=1}^N \sum_{j=1}^J X_{ij}} \right) - \ln \left( \frac{M_{ij} / \sum_{j=1}^J M_{ij}}{\sum_{n=1}^N M_{nj} / \sum_{n=1}^N \sum_{j=1}^J M_{ij}} \right) \quad (4)$$

For all three indices, positive values would indicate that the country has a revealed comparative advantage. It should be noted that all the indices outlined above can be distorted by government policies and other

interventions. This caveat should be considered when interpreting the results. All values for commodity exports and imports are obtained from the United Nations Commodity Trade Statistics Database (COMTRADE) using the six-digit HS2002 classification and trade data for 2005-2010.<sup>4</sup>

Owing to the limited data available on international services, a similar analysis could not be carried out for service exports. Instead, a SWOT (strengths, weaknesses,

4 The Harmonized System (HS2002) codes for the universe of green goods are: 250300, 271011, 271019, 271111, 271112, 271113, 271114, 271119, 271121, 271129, 281810, 281820, 28183, 290911, 290919, 290920, 290930, 290941, 290942, 290943, 290944, 290949, 290950, 290960, 291411, 291412, 291413, 291419, 291421, 291422, 291423, 291429, 291431, 291440, 291450, 291461, 291469, 291470, 382490, 390210, 390220, 390230, 390290, 390799, 390910, 390920, 390930, 390940, 390950, 391110, 391190, 391211, 391212, 391220, 391231, 391239, 391290, 392010, 401699, 450410, 460120, 470710, 470720, 470730, 470790, 530310, 530410, 530490, 560314, 560710, 560721, 560811, 560890, 630510, 691010, 701931, 730300, 730410, 730421, 730431, 730439, 730441, 730449, 730451, 730459, 730490, 730511, 730512, 730519, 730520, 730531, 730539, 730590, 730610, 730620, 730630, 730640, 730650, 730660, 730690, 730711, 730719, 730721, 730722, 730723, 730729, 730791, 730792, 730793, 730799, 730820, 730900, 731010, 731021, 731029, 731100, 732111, 732190, 732490, 732510, 732690, 761100, 761290, 761300, 840211, 840212, 840219, 840220, 840290, 840310, 840390, 840410, 840420, 840490, 840510, 840590, 840610, 840681, 840682, 840690, 840790, 840890, 840991, 840999, 841011, 841012, 841013, 841090, 841111, 841112, 841121, 841122, 841181, 841182, 841191, 841199, 841210, 841221, 841229, 841231, 841239, 841280, 841290, 841311, 841319, 841320, 841330, 841340, 841350, 841360, 841370, 841381, 841382, 841391, 841392, 841410, 841430, 841440, 841459, 841480, 841490, 841510, 841581, 841610, 841620, 841630, 841690, 841780, 841790, 841810, 841821, 841830, 841840, 841861, 841869, 841919, 841939, 841940, 841950, 841960, 841989, 841990, 842010, 842091, 842099, 842119, 842121, 842123, 842129, 842131, 842139, 842191, 842199, 842220, 842290, 842833, 842940, 846291, 846596, 846599, 846694, 847130, 847160, 847170, 847410, 847420, 847431, 847432, 847439, 847480, 847490, 847710, 847720, 847730, 847740, 847751, 847759, 847780, 847790, 847920, 847982, 847989, 847990, 848110, 848120, 848130, 848140, 848180, 848190, 848210, 848220, 848230, 848240, 848250, 848280, 848291, 848299, 848340, 848360, 850161, 850162, 850163, 850164, 850231, 850239, 850300, 850410, 850421, 850422, 850423, 850431, 850432, 850433, 850434, 850440, 850450, 850490, 850511, 850519, 850520, 850530, 850590, 850610, 850630, 850640, 850650, 850660, 850680, 850690, 850720, 850740, 850780, 850790, 850980, 851140, 851150, 851180, 851190, 851410, 851420, 851430, 851440, 851490, 851629, 851711, 851721, 851730, 851750, 851840, 852090, 852190, 852210, 852390, 852540, 852691, 852812, 852821, 852830, 853661, 853710, 853949, 854140, 854389, 854390, 870210, 870290, 870321, 870322, 870323, 870324, 870331, 870332, 870333, 870390, 870410, 870421, 870422, 870423, 870431, 870432, 870490, 870510, 870520, 870530, 870540, 870590, 871110, 871120, 871130, 871140, 871150, 890790, 900190, 900290, 901510, 901520, 901530, 901540, 901580, 901590, 902410, 902480, 902490, 902511, 902519, 902580, 902590, 902610, 902620, 902680, 902690, 902710, 902720, 902730, 902740, 902750, 902780, 902790, 902810, 902820, 902830, 902890, 903010, 903020, 903031, 903039, 903040, 903082, 903083, 903089, 903090, 903110, 903120, 903130, 903140, 903149, 903180, 903190, 903210, 903220, 903281, 903289, 903290, 903300, 940510, 940520, 940540 and 950720.

opportunities, threats) analysis was undertaken to determine how well the green business characteristics match the current and projected future business environment. Thus, elements of the business environment, such as whether there is an adequately trained labour force and the situation regarding licences and permits, infrastructure and finance, reflect the constraints on new businesses that are likely to influence their viability. This aspect of the model is complicated somewhat by the fact that a particular characteristic might be a constraint in the current business environment, but if it were eliminated by future policy changes, it could ultimately incentivize businesses in this area.

Following the approach outlined by Porter (2000), simple evaluation criteria were developed to examine how well each potential green export area matches the local business environment. For each goods or services category a score of 1-11 was obtained by answering the following questions:

- Is some proprietary technology needed? (Yes=0, No=1)

- Does Barbados have access to distribution channels? (Yes=1, No=0)
- Does Barbados have access to raw materials and other inputs (e.g. labour)? (Yes=1, No=0)
- Are there cost advantages independent of scale? (Yes=1, No=0)
- Are there modest capital requirements for start-ups? (Yes=1, No=0)
- Do product or technological standards already exist? (Yes=1, No=0)
- Are there regulatory barriers that potential start-ups would encounter? (Yes=0, No=1)
- Are there likely to be diseconomies of scale in production? (Yes=1, No=0)
- Does government support exist? (Yes=1, No=0)
- Are there a small number of potential substitutes or competitors? (Yes=1, No=0)
- Are there low exit barriers? (Yes=1, No=0)

The final score for each product group was the sum of the scores for each of these individual questions.

## IV

### Ranking potential green export opportunities

In order to assess the consistency of the revealed comparative advantage indices, pairwise correlation statistics between the four indicators were calculated. In general, the indicators are all positively correlated: if one comparative advantage index suggests that the country has an advantage for a particular good, the other indicators are also likely to provide a similar result. In addition to the positive relationship, all of the bivariate

correlation statistics were greater than 0.7, indicating a high level of consistency in the results.

Given the consistency of the results, only the revealed competitiveness (RC) indices are provided in table 3, averaged over the 2005-2010 period. The results suggest that Barbados holds a revealed competitiveness advantage in relation to 24 goods across various green goods categories (see table 3).

TABLE 3

Indices of revealed comparative advantage for green goods

HS2002 code	Good	Category and subcategory of green goods	Revealed competitiveness index (RC)
847780	- Other machinery	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	5.545
470790	- Other, including unsorted waste and scrap	<b>Renewable energy</b> <b>Others:</b> - Renewable products and energy source	4.802
731029	- Of a capacity of less than 50 litres: other	<b>Waste management and water treatment:</b> - Waste water management and potable water treatment	3.429
841960	- Machinery for liquefying air or other gases	<b>Air pollution control</b>	3.071

Table 3 (concluded)

HS2002 code	Good	Category and subcategory of green goods	Revealed competitiveness index (RC)
847730	- Blow moulding machines	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	2.857
271129	- Other in gaseous state	<b>Environmental technologies:</b> - Gas flaring emission reduction - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	2.515
841919	- Instantaneous or storage water heaters, non-electric: Other	<b>Renewable energy</b>	2.458
850660	- Primary cells & primary batteries, air-zinc	<b>Renewable energy</b> <b>Others:</b> - Renewable products and energy source	1.974
840290	- Parts	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	1.924
841940	- Distilling or rectifying plant	<b>Waste management and water treatment:</b> - Management of solid and hazardous waste and recycling systems	1.762
850162	- AC generators (alternator), of an output exceeding 75 kVA but not exceeding 375 kVA	<b>Renewable energy</b>	1.729
291421	- Cyclanic, cyclic or cycloterpenic ketones without other oxygen function: camphor	<b>Environmental technologies:</b> - Gas flaring emission reduction - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	1.702
841340	- Concrete pumps	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	1.666
730459	- Other, of circular cross-section, of other alloy steel: Other	<b>Waste management and water treatment:</b> - Waste water management and potable water treatment	1.516
841382	- Liquid elevators	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	1.483
846291	- Other: Hydraulic presses	<b>Waste management and water treatment:</b> - Management of solid and hazardous waste and recycling systems	1.345
392010	- Of polymers of ethylene	<b>Waste management and water treatment:</b> - Management of solid and hazardous waste and recycling systems	0.681
530310	- Jute and other textile bast fibres, raw or retted	<b>Others:</b> - Environmentally preferable products based on end-use or disposal characteristics	0.473
732690	- Other	<b>Waste management and water treatment:</b> - Waste water management and potable water treatment	0.442
850239	- Other generating sets: other	<b>Renewable energy</b>	0.331
847432	- Mixing or kneading machines: machines for mixing mineral substances with bitumen	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	0.240
731100	- Containers for compressed or liquefied gas, of iron or steel	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	0.120
841319	- Other pumps fitted or designed to be fitted with a measuring device	<b>Environmental technologies:</b> - Efficient consumption of energy technologies <b>Carbon capture and storage</b>	0.058
560811	- Of man-made textile materials: made-up fishing nets	<b>Others:</b> - Natural resources protection	0.016

Source: prepared by the author.

HS: Harmonized Commodity Description and Coding System.

On the basis of this analysis, Barbados has a comparative advantage in just 6% of the green goods included in the WTO draft universe of environmental goods. Given the island's size, it is unlikely to be a major producer of a diverse set of goods. Nevertheless, the limited extent to which the island is exploiting opportunities in relation to the export of green goods suggests that there remains significant room for growth. This finding is further substantiated by the recent trends in the export of green goods. To assess the extent to which the island has been exploiting these advantages, figure 6 plots the value of green goods exports for Barbados in the period 2007-2009. The figures show that green goods exports still represent just a small share of overall merchandise exports from the island: between 3% and 4%. In addition, the contribution of green goods exports to total merchandise exports has not changed appreciably. To fully leverage the global demand for green goods, export promotion in these areas will be key over the coming years.

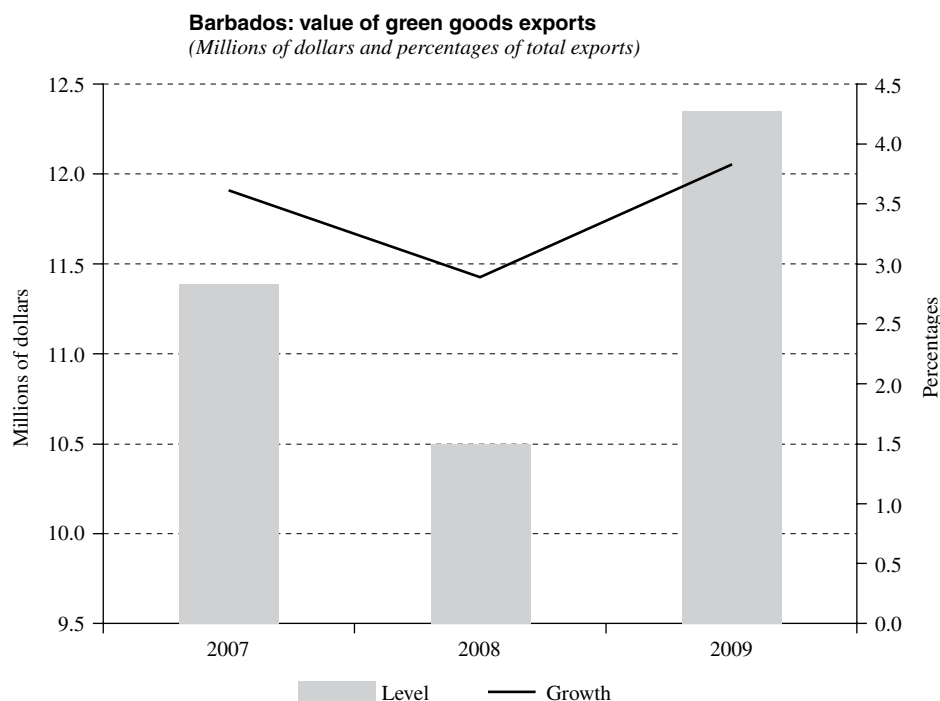
The list in table 3 was limited to green goods, however, since services account for the majority of goods and services exports from Barbados, the island is likely to have comparative advantages in that area as well. Using the questions in section III, each of the

categories in the database was assessed and the final results are provided in figure 7.

The results point to potential opportunities in the following areas (figure 7):

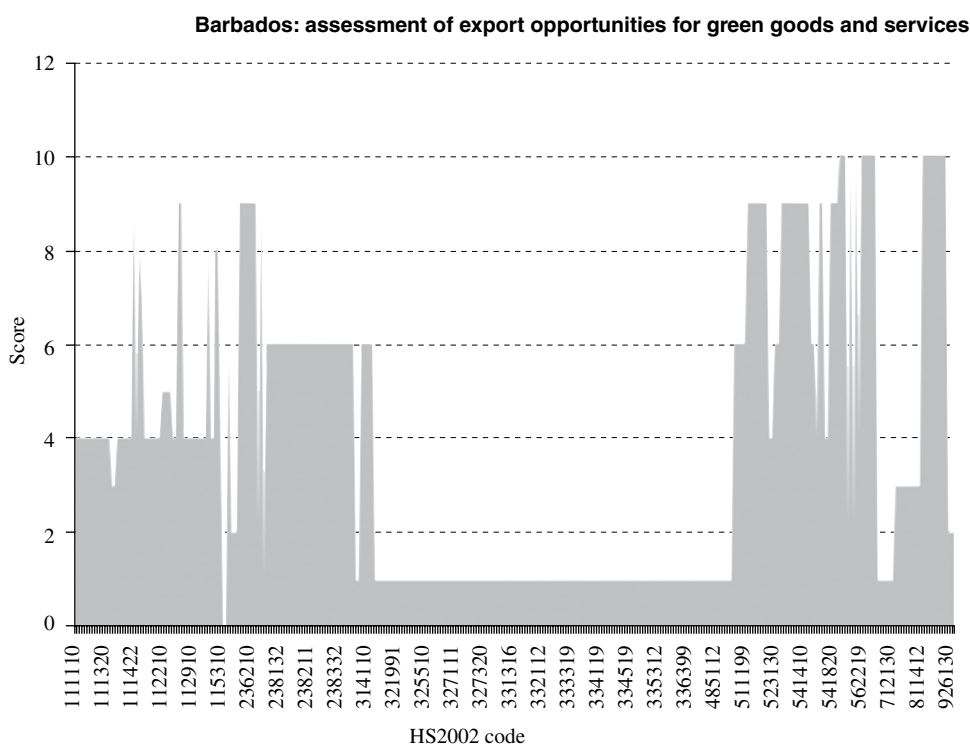
- Environmental education (curriculum for green jobs)
- Environmental conservation organizations
- Air, water and waste programme administration
- Waste management services
- Remediation services (waste management)
- Tour operators (green tours)
- Landscaping services (energy efficient landscaping services)
- Advertising and public relations agencies
- Architectural services (LEED-specific architecture services)
- Engineering services (engineering services for renewable energy projects)
- Testing laboratories (environmental testing services)
- Graphic design services (graphic design services for environmental awareness products)
- Contractors (LEED-certified buildings)
- Residential remodelers (weatherization)
- Commercial building construction (LEED-certified buildings)

FIGURE 6



Source: United Nations Commodity Trade Statistics Database (COMTRADE).

FIGURE 7



Source: prepared by the author.

HS: Harmonized Commodity Description and Coding System.

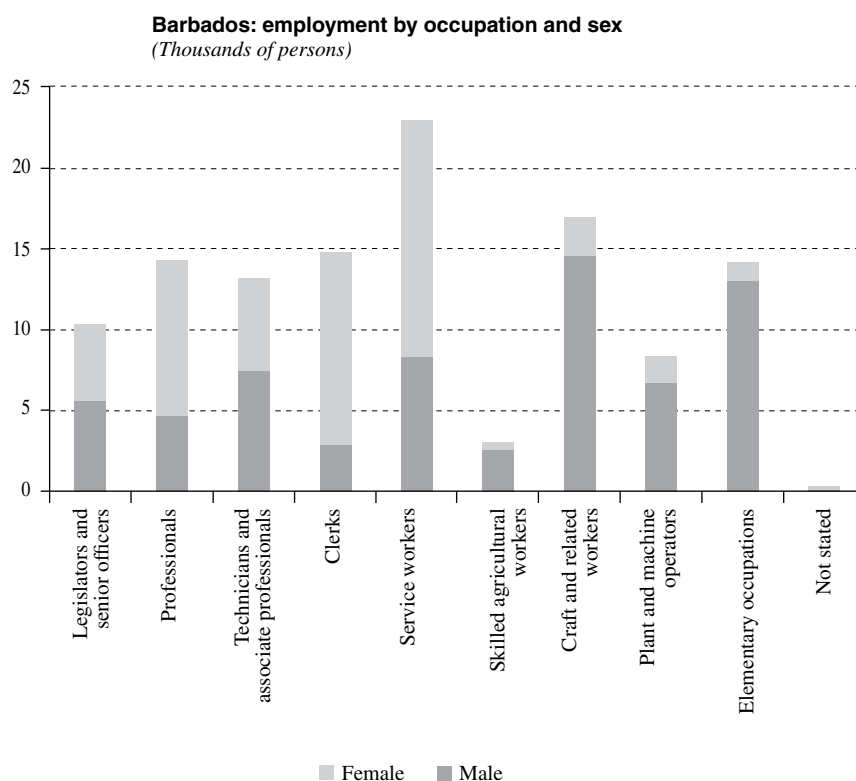
Barbados already has a large workforce of trained individuals in the service industry, however, their skills must be enhanced to take advantage of available opportunities. Figure 8 shows the breakdown of employment by occupation and sex at the end of 2011: of an employed population of 127,800, about 59% can be classified as service workers, with a large number of those individuals engaged in higher level service professions (for example, technicians and associated occupations).

At present, the Samuel Jackman Prescod Polytechnic provides diploma-level training in mechanical engineering, electrical engineering, construction and architectural studies, among other subjects, while undergraduate and graduate qualifications are available

from the University of the West Indies at the campuses in Mona, Jamaica, and Saint Augustine, Trinidad and Tobago. Qualified Barbadian students are eligible to enter the University of the West Indies to pursue studies with full government sponsorship.

Barbados will, however, need to address some training gaps if it is to fully leverage the potential benefits of exporting green services. For example, there is currently no local or regional council to allow skilled service professionals to pursue LEED certifications for their projects; and despite the incentives in place enabling companies and individuals to write off part of the cost of ISO certification, the upfront costs for many small companies can still be prohibitive.

FIGURE 8



Source: Barbados Statistical Service.

## V

### Conclusions and recommendations

Barbados has adopted ambitious targets in relation to pursuing a green economy. These targets are largely based on the recognition that the island faces significant resource constraints and a vulnerability to price shocks from imported resources (Moore and others, 2012). This paper assesses the potential green export opportunities for the island, analysing both green goods and green services. Using disaggregated trade data at the six-digit level (HS2002 system of classification), the study calculates indices of revealed comparative advantage in order to identify areas that the island should consider targeting for support. Given the importance of services to the Barbadian economy, opportunities in green services are also examined.

The results of the study suggest that Barbados has a revealed comparative advantage in about 16 green export areas. The total value of these exports, however, is still quite small (less than 4% of total exports) and has grown at the same rate as total exports in recent years. In relation to services, the number of potential business areas that could leverage the skills and resources of the island was larger. Some institutional support would be needed, however, to help professionals achieve international certification. It should also be noted that developing economies may be able to introduce new goods or services exports, but sustaining that trade is more difficult, with many firms struggling to maintain their market share. These firms need to focus on research

and development in order to keep their market share and enhance efficiency.

While green goods and services might help to diversify the island's export base, many of these goods and services can build on existing industries. For example, green tours can use existing tourism infrastructure and help the island to enhance the earnings from that industry, while providing a more fulfilling experience for visitors. Barbados has a long history in the manufacture of solar technologies (Moore and others, 2012) and, with

sufficient investment, these companies could penetrate a larger number of markets around the world. These are but a few examples, yet they illustrate the potential advantages that can be gleaned from building on the country's knowledge and experience. There would also be potential advantages to pursuing a regional capacity-building strategy on the export of green goods and services. For example, rather than setting up individual certification institutes on each island, a regional initiative could be pursued in this respect.

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# Towards an integrative approach to sustainability: exploring potential synergies between gender and environment

*Isabel Pla Julián and Sandra Guevara de Molina*

## ABSTRACT

In the midst of one of the worst economic crises the Western world has faced, governments are focusing on macroeconomic equilibrium and failing to address the economy-environment disconnect and the social components of development. The ecological degradation of our planet and its implications for human well-being necessitate a sustainable approach. Although some progress has been made since the United Nations Conference on Environment and Development in 1992, we have yet to adopt a development path that takes account of the way that ecosystems work or the persistent social and gender inequalities. Feminist economists have developed theoretical and methodological proposals for recognizing the value of domestic work, which could be strengthened by integrating an ecological perspective. In turn, sustainable development could be enhanced by mainstreaming the gender perspective and the ethics of care. The link between these elements is examined here, as we explore the synergies between gender and the environment and outline an integrative approach to sustainability.

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## KEYWORDS

Economic crisis, sustainable development, economic Aspects, social aspects, gender mainstreaming, women gender equality, ecology, feminism

## JEL CLASSIFICATION

B54, Q01, Q57

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# I

## Introduction

In recent years the world has been facing the most severe crisis since the Great Depression, and the outlook is gloomy. A wide range of economic and financial measures have been implemented, focusing mainly on re-establishing macroeconomic equilibrium, reducing the fiscal deficit, averting the collapse of financial institutions and, more recently, recovering economic growth. Growth is still thought to be the panacea for all the major economic ills of the modern world (Daly, 2005), despite the fact that recent research carried out in some countries finds no significant correlation between growth and human development (UNDP, 2011).

The crisis has exacted a heavy human toll, affecting workers' income, increasing the vulnerability of marginalized people, restricting access to health and education, and exacerbating conflicts. The extent of the impact of these problems is influenced by factors such as gender and geographical region. At the same time, natural catastrophes, desertification and biodiversity losses are also wreaking havoc, particularly among vulnerable groups. It has been 20 years since the United Nations Conference on Environment and Development, which shone a spotlight on the serious ecological deterioration of our planet and its implications for human well-being, and yet we are still facing the same problems, compounded by new challenges that have resulted from the absence of a global perspective and the limited action taken. Some progress has been made, but we are still far from achieving sustainable development. The United Nations Conference on Sustainable Development (Rio+20) emphasized the great importance of growth (but from the perspective of a green economy), as well as the need for institutional arrangements that foster sustainability.

In this context, it is important to acknowledge that sustainable development cannot be achieved without recognizing the services that ecosystems provide for us and the persistent inequalities in our societies, such as those associated with gender, race and sexuality. According to Novo (2007), no one (men and women alike) can make progress without the support of a nature that has not been sacrificed to purely economic interests, and no one, including men, can truly experience dignity in an unequal world in which 70% of the planet's poor are women. In order to recognize the interconnections

between people from different parts of the world, and between human beings and ecosystems, it is necessary to dismantle dualisms such as public/private, feminine/masculine, reason/emotion, and progress/conservation (Plumwood, 2002). These dualisms entail a hierarchical conception (Bosch, Carrasco and Grau, 2003) that permeates the economic model and defines social behaviours and public policies.

These challenges have yielded substantial debate and a broad research base. Ecofeminists have highlighted the need to challenge the invisibility of women, which shares many characteristics with the invisibility of nature. Feminist economists have made valuable efforts to include recognition of domestic work in theoretical and methodological frameworks. Ecological economists, for their part, stress the need to take into account the principles governing nature in order to achieve sustainable development. The power relations and values underpinning the socioecological system that we —human beings and nature— constitute must be revised. These proposals could be enriched by incorporating a wider variety of perspectives, leading to the adoption of the kind of holistic approach that should characterize sustainable development. In this paper, we explore the possible synergies between ecology and feminism, and the ways in which these two areas could be mutually reinforcing, and express our support for public policies, advocacy activities and positive action to propel the urgent changes that are required. Following our reflection on these issues, we outline an integrative approach to sustainability with a view to fostering a better understanding of the challenges that we face and the need for cross-cutting, systemic policies.

Following this introduction, section II examines the possible transformation of the prevailing Western economic model by incorporating ecological and feminist perspectives, with particular reference to ecofeminism and feminist economics. Section III identifies some existing spaces for moving towards an integrative vision that encourages sustainable development through a change in values, development model and power relations, raising the profile of women's work and outlining a integrative vision of sustainability. Lastly, section IV contains the conclusions of the study.

## II

### Changing the prevailing economic model: incorporating different perspectives and identifying commonalities

The call for a transformation of the prevailing economic model is not new and has, in fact, been issued by ecological economists and feminist economists alike, as well as other groups whose emphasis is on examining the roots of our problems. The approach adopted by ecofeminists, for instance, focuses on the close interrelationship between human beings and nature, how gender inequalities impact development in the current structure, and the many challenges being faced by women around the world due to their limited access to economic resources and their relationship with nature. Other approaches highlight the need to revise the very conceptualization of economics and development. There follows an examination of each of the two perspectives that make up ecofeminism.

#### 1. The ecological perspective

Environmental issues currently feature on both international and domestic agendas. It is important to acknowledge the progress that has been made since the 1960s, when ecologism emerged as a groundbreaking movement. In its earliest form, the movement's main concerns were species preservation, pollution control and protection of natural resources. In *Silent Spring*, published in 1962, Rachel Carson sounded a warning concerning the terrible impact of agrochemicals on human health (Nash, 1989). Furthermore, the increasing frequency of civic demonstrations, reports on the severity of widespread ecological damage (for example, *The Limits to Growth*, published by Meadows and others, 1972) and the 1973 and 1979 oil crises all helped to raise public awareness of the impact and extent of environmental damage. As a consequence, new laws to protect species and to prevent and control pollution were enacted at the national level; and significant action was also taken at the international level, examples of which include the Man and the Biosphere Programme (1970) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Conference on the Human Environment (1972), which led to the creation of the United Nations Environment

Programme and the first steps towards constructing an international legal framework on environmental issues (Vig and Axelrod, 1999).

Those initiatives took a structural approach to the problems, using conventional models of economic and technological development (Humphrey, 2001). From an environmental economics perspective, pollution is a negative externality caused by the absence of a market price for the environment. Solutions to this problem could therefore include imposing taxes to internalize the cost, as proposed by Pigou (1946) or assigning value to natural resources through the development of property rights (as suggested by Coase).<sup>1</sup> Other economic tools have subsequently been developed to value biodiversity, address climate change and meet different environmental challenges.

As more is known about the impact of anthropogenic activities on ecosystems, more comprehensive approaches have emerged that consider the functioning of the economic system as a whole. These new approaches call into question the prevailing model, which undermines the very material base that serves as its support (Daly, 1996; Naredo, 2006). As a result of this rupture, an unusual form of economic growth has taken place with complete disregard for the planet's carrying capacity.<sup>2</sup> This has been possible owing to a relatively abundant stock of natural resources and the view that science is capable of generating substitute materials and ensuring a smooth adaptation to the changes brought about in ecosystems as a consequence of their exploitation (Costanza, 2003). Furthermore, economic development has been decoupled from the inequality, exclusion and discrimination it has caused, as these problems are considered to be beyond the scope of economics (Naredo, 2006). Therefore, ecologists would prefer a more

<sup>1</sup> For more on the differences between these two approaches see Grossman (1999, pp. 538-568).

<sup>2</sup> "Carrying capacity" refers to the availability of resources to satisfy a species' needs in order for it to survive, grow and reproduce itself, without having a negative impact on the stability of the system and its resilience.

comprehensive economic model that takes ecosystems and their resilience into consideration,<sup>3</sup> while proponents of ecological economics, human ecology and political ecology (among others) stand for a broader approach that takes into account the interactions between human beings, nature and distribution.

The Millennium Ecosystems Assessment highlights the link between ecosystems, economic activity and well-being, as well as between poverty and the environment. It underlines that ecosystems not only satisfy basic needs in connection with food, medicines, energy, health and safety, for example, but also provide us with services, including the purification of air and water, climatic conditions and spaces for cultural, spiritual, recreational and educational purposes. The assessment drew attention to the fact that our increasing demands have led to unprecedented changes in ecosystems over the last 50 years. These include a considerable—and largely irreversible—loss of the planet's biodiversity and shifts in climatic conditions, which have diminished nature's capacity to offer its key services to humanity. This situation leaves the world population in a vulnerable position, in particular the approximately 2 billion people (DESA, 2009) who live in dry regions and who are prone to suffer disproportionately from deprivation, illness and poverty. This situation exacerbates inequalities and disparities between different groups and generates social conflict (UNEP, 2005). Despite some recent progress, 22% of the total population of Latin America and the Caribbean lacks access to tap water and 45% of the rural population lacks sanitation services—two factors which have a direct impact on health and mortality rates. An estimated 35 million to 40 million people do not have access to basic energy services (electricity and fuel), and around 35,000 people die annually from causes relating to air pollution, while climate change, poverty and biodiversity loss are heightening vulnerability to natural disasters, which has already had a serious impact on the region's economy and population (ECLAC, 2012).

Meanwhile, these problems do not affect only those suffering as a direct consequence of deprivation or natural catastrophes. In their struggle to overcome such situations, the options available to those affected might represent a threat to others and thus lead to social conflict, insecurity, wars or migration flows to more resource-rich, peaceful or stable countries. Similarly,

an economic activity in a particular area might affect not only the immediate environment, but also that of a neighbouring region or country, thus giving rise to international tensions. In short, human beings and nature are not independent from each other; on the contrary, they compose a socioecological system which has to be managed as a whole (Young and others, 2006; Bono, 2008a). Greater understanding of this fact has generated more integrative approaches, such as political ecology, social ecology, human ecology and deep ecology.

Since a world in which poverty and inequality prevail will always be inclined to social, ecological and other crises, the authors of the Report of the World Commission on Environment and Development: *Our Common Future* (also known as the Brundtland Report, 1987) suggested pursuing a form of development “that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations General Assembly, 1987). This does not mean that all generations must leave the world as they found it: what must be preserved are the opportunities so that the future generations can have substantial freedoms, take decisions and enjoy life (Bono, 2008a). The concept of sustainable development seeks to integrate ecology, the economy and society, and was at the heart of the United Nations Conference on Environment and Development (also known as the Rio Summit) held in 1992.

Nevertheless, some authors consider “sustainable development” to be an oxymoron (Naredo, 2006; Redclift, 2009) since it does not question economic growth in itself, only its sustainability from a social and environmental point of view. However, it is vital to bear in mind that in order for any concept of development to receive backing at a multilateral meeting it must satisfy the needs of countries with disparate realities. An impoverished country cannot be denied the right to grow its economy or pursue a better standard of living, even though the way in which it does so is important and growth per se does not necessarily lead to better standards of living for the population. It is therefore crucial to take into account the social, environmental, technological and cultural factors, among others. The situation in developed countries is different: in their case, production and consumption patterns are the key issue and questions can be raised regarding the pursuit of unbounded growth.

This debate is particularly relevant nowadays, since the terms “sustainable development” or “sustainability” are included on most national and international agendas. Since the adoption of Agenda 21 at the Rio Summit in 1992, most countries and many cities have been working

<sup>3</sup> “Resilience” in ecology refers to the capacity of ecosystems to absorb disturbances and reorganize while undergoing change so as to retain—essentially—the same function, structure, identity, and feedbacks (Walker and others, 2004).

on their corresponding sustainable development action plans, with an emphasis on addressing environmental, economic and social issues simultaneously. However, in many instances the term “sustainable development” is used for marketing or publicity purposes, with or without a solid basis. The ecological movement offers several alternative views on the limitations of nature as a system, which can be perceived as determinist, adaptive or innovative depending on whether the natural environment is considered to be cardinal, replaceable or not always replaceable (Costanza, 1994). In the quest for environmentally sustainable human development, technology will play a key role in decoupling growth from pollution and environmental degradation (Almenar, 2008). Certainly technology and knowledge influence the nature of output (Schmid, 1987); however, institutions have the potential to spur ecologically informed technological advances by providing a framework for the transformations that development requires (North, 1990).

All these aspects are brought together in another, more comprehensive notion of sustainable development that goes beyond the interactions between the environment, the economy and society and posits sustainable development as a global transformation of society, not only in terms of goals, but also of means. Thus, in addition to satisfying human needs while respecting the planet’s carrying capacity, this new vision incorporates technology and institutions as two additional fundamental pillars (Tomás Carpi, 2007 and 2008). The core values underpinning this notion include eco-efficiency, solidarity and social activism, which make it a good starting point for exploring synergies with feminist ideology in the quest for an integral conception of sustainability.

The outcome document of the Rio+20 Summit (“The future we want”), in addition to promoting a green economy in the context of sustainable development, calls for a political commitment to reinvigorate the global partnership for sustainable development, as well as to improve capacity and coherence at all levels, integrating sustainability into all levels of both public and private decision-making (United Nations Conference on Sustainable Development, 2012).

## 2. The feminist perspective

Feminism, like ecologism, takes many forms, each one influenced by the particular experiences of women from different parts of the world. Initially, feminist demands related mainly to the right to education (Rivera, 1991) and, later, to the right to vote (Freedman, 2004; Rivera, 1991). *The Second Sex*, published by Simone de

Beauvoir in 1949, is considered the cornerstone of new feminist vindications (Freedman, 2004; Sánchez, 2001). According to Valcárcel (2008), it prompted numerous theoretical explanations of the subordination of women. It also influenced advocacy movements throughout the world, which led to a progressive increase in women’s participation at the institutional and public levels and the introduction of active policies to foster their involvement from then on.

Diverse viewpoints can be found in black feminist theory —referring to African-American stances— and among the views of feminists from developing countries (Freedman, 2004; Mies and Shiva, 1997). Their ideas on multiple identities and the interplay of a range of factors that determine inequalities (such as race, ethnicity, cast, culture, religion, economic level and sex) enriched the feminist perspective, while also introducing some discrepancies. Nonetheless, despite their differences, all of these ideologies share the common goal of ending the oppression of women (Howie and Tauchert, 2002).

It was precisely in the context of black feminism that the concept of “ecofeminism” took shape. The term is attributed to the French writer Françoise d’Eaubonne (Mellor, 1997) and combines a gendered view of humanity (represented by the colour violet) with ecologism (represented by the colour green). The concept represents a challenge, and —at the same time— a significant contribution to both feminism and ecologism (Plumwood, 1993; Moore, 2004). Given the plurality of these two movements, their convergence has generated a wide range of ecofeminist theories. These encompass activism and valuable political and theoretical contributions to sustainable development. The emphasis of ecofeminism varies according to the perception of the link between women and nature (depending on the particular branch of feminism or the depth of the treatment of environmental issues), as well as the specific area of concern or context in which those reflections originated, especially the historical and material conditions of women’s lives (Mellor, 1997; Kao, 2010). Such diversity is easily appreciated by reviewing some of the arguments put forward by ecofeminists. In *Feminism or Death* (1974), D’Eaubonne blamed environmental degradation on the patriarchal system, which exploits nature as it submits women (Agra Romero, 1998). An opinion shared by King, for whom the devastation of the Earth can be attributed to the same masculine mentality that seeks to deny women of the right to control their own bodies and sexuality through various control mechanisms at the personal and State levels (Merchant, 1995; Agra Romero, 1998).

The Chipko movement<sup>4</sup> began as a group of women who sought to stop deforestation in the northern part of India in order to preserve their community's source of well-being in a subsistence economy (Mellor, 1997; Merchant 1995; Mies and Shiva, 1997). Similarly, the Green Belt Movement<sup>5</sup> in Kenya, founded by the Nobel Peace Prize laureate Wangari Maathai in 1977, began by addressing growing deforestation, soil erosion and water scarcity by planting trees (Merchant, 1995). It later evolved into a movement advocating human rights and the sustainable management of resources, as well as supporting good governance, democratic principles and peace. One of the ecofeminist pioneers in Latin America was the Italian-Venezuelan biologist and architect Giovanna Merola, whose vision was to integrate human beings into their natural and urban environment using a feminist approach (Salleh, 1997).

Different classifications of ecofeminism have been proposed (see Agra Romero, 1998; Merchant, 1995; Mellor, 1997; or Puleo 2002 and 2007, among others) and although labelling can be difficult and sometimes limiting or controversial, we believe that reviewing some of those categories here could be helpful. Essentialists or classic ecofeminists argue that women are better prepared than men to solve ecological crises since they are inherently caring and protective, while men are, by contrast, in essence competitive and destructive (Puleo, 2002). Affinity ecofeminists take the more inclusive view that the link between women and nature derives from culture and traditions, rather than being rooted in biology (Mellor, 1997). The constructivist approach is similar as it considers this link to be a sociohistorical construct used to exercise patriarchal control. This view emphasizes the political over the personal (for more on this approach see Biehl, 1991; or Heller, 1999).

There is a tendency to associate ecofeminism with its spiritual strand, that is, the one which assumes that women and nature share a metaphysical or ontological bond, though opinion varies significantly as to what this entails and the desired level of political involvement. A major exponent of ecofeminism, Vandana Shiva (1993 laureate of the Right Livelihood Award, often referred to as the "Alternative Nobel Prize") points out that Western technical development is a source of violence

against women and nature, and calls for an ecologically sustainable model based on the ontological conception of the feminine as a trans-generic principle and on the unbreakable continuum of society and nature. Women and nature are, undeniably, creators of life and productivity beyond the bounds of the processes of capital accumulation (Mies and Shiva, 1997). Ivone Gebara, one of the main proponents of theological ecofeminist thought in Latin America, equates social justice with ecological justice (Puleo, 2002 and 2007; Kao, 2010). Other spiritual approaches, both in the region and in other parts of the world, are influenced by indigenous cosmogonies and by women's daily experiences (Ress, 2003).

Indian economist Bina Agarwal proposes a feminist environmentalism that considers the women/nature bond as rooted in the family economy, where gender responsibilities are assigned. She holds that excellent examples of environmental protection measures that could be scaled up can be seen at the family level. In her view, the connection between development, redistribution and ecology requires a transformative perspective, since the aspiration to technological control undervalues women, nature and feelings (Agarwal, 1992). Alicia Puleo (2008) proposes an enlightened ecofeminism, conceived of as an ethical and political project that calls for equality and women's autonomy —regardless of their social, cultural or ethnic provenance. That approach accepts, with caution, the benefits of science and technology and promotes the globalization of values such as the ethics of care towards human beings and nature, recognizing the unity and continuity between them (from an evolutionist point of view), as well as compassion.

Meanwhile, the distribution of and access to natural resources is a key component of feminist political ecology. The critical variable, according to this approach, is how social class, cast, race and culture interact with gender. For its exponents, there are three key elements: (i) gendered knowledge, that is, the wisdom of survival developed by women in order to maintain and protect a healthy environment at home, as well as in their workplaces and communities; (ii) gendered environmental rights and responsibilities, meaning differential access to property, resources, public space, legal rights and common law, and (iii) gendered organizations, which refers to the political-environmental activism in which women are increasingly involved, thus redefining their identity, the meaning of gender and the kind of environmental problems faced (Rocheleau, Thomas-Slayter and Wangari, 1996).

One point that all of these strands of ecofeminism have in common is the "invisibility" of women and nature owing to their devaluation by male-dominated

<sup>4</sup> A green movement made up mainly of impoverished small-scale farmers and craft workers in India. Women account for a large proportion of this social movement whose philosophy is based on the Gandhian concept of non-violent resistance.

<sup>5</sup> An environmental organization in Africa which promotes biodiversity conservation and empowers communities, particularly women.

systems of scientific knowledge and economic power (Stoddart and Tindall, 2011). According to Novo (2007) the reason is that women do not produce a surplus value. She emphasizes the need to reassess the “civilization footprint”, that is the energy dedicated in terms of time, affection, love or care that people require to satisfy their real needs, as well as the “ecological footprint” left on the planet by the demands of our lifestyle. Both Shiva and Novo state that when life cycles function well and remain effective, they become invisible to our eyes. As a consequence no value is attached to them unless these cycles are disrupted. Plumwood (1993) uses the term “backgrounding” to describe one of the ways in which both women and nature have been devalued.

For feminist economists, considering only paid work to be “productive” makes reproductive and domestic work—performed mainly by women—invisible in economic terms (Durán, 2001 and 2012). Hence, socioeconomic policies and programmes that have been designed from this perspective are ineffective in redressing gender inequities (Carrasco and Mayordomo, 2000). Furthermore, failing to assign an economic value to such work leads to a general underestimation of women’s contribution to development, particularly in relation to intangible elements such as emotional support, encouragement, skills stimulation, family relations and nurturing (Bosch, Carrasco and Grau, 2003). This inequity is not limited to the privacy of homes or the work environment, rather it permeates

all areas of life: from academia to enterprises, as well as the social and political representative institutions of almost all societies.

Australian philosopher Val Plumwood (2002) has stressed the need to transcend the hierarchical dualisms of nature/culture, women/men body/mind, matter/spirit and affection/rationality. These constitute the basis for the debasement of nature and reflect an arrogant Western philosophy that has at its core a dominant male self, separated from his own body and feelings, from women and the rest of humanity, as well as from the Earth that supports him. This has led to calls for a conceptual framework which takes into account the interrelation between the subjugation of women and nature, and for a re-conceptualization of feminism and environmental ethics that opposes the logic of domination and, at the same time, recognizes values such as care, love and friendship (Warren, 2009). Salleh (1997) calls for a new fair and human contract with nature, arguing that men’s oppression of other men, women and nature may only be dismantled by transforming the economic model.

Notwithstanding the achievements of feminism over the last two centuries, significant and unsustainable inequities remain. This explains the aspiration for substantial changes and the need for development policies. In our opinion, a larger development impact could be made by consolidating a more coherent and comprehensive approach that combines gender and sustainability.

### III

## Spaces for synergy: towards an integrative vision of sustainable development

The complexity of the problems addressed by feminists, ecofeminists and ecologists of all shades is undeniable and despite commonalities there are also disagreements.<sup>6</sup> For example, while anthropocentrism is one of the main concerns of ecologists, feminists accuse environmentalists of failing to question the patriarchal system and of

leaning on prevailing mechanisms and control structures (Bosch, Carrasco and Grau, 2003). Instead of adding to the debate, in this article we prefer to explore the areas in which these different movements coincide and try to close the gap between the two schools of thought. First, because positions are not homogeneous on either side and, in any case, have a tendency to evolve. Second, because gender inequities, social tensions, economic and financial costs, and the poverty afflicting billions of people around the world, as well as the accelerated pace of biodiversity loss, climate change, desertification, among other severe environmental problems which affect human

<sup>6</sup> Many articles have been published regarding this debate: Zimmerman (1987); Warren and Cheney (1991); Plumwood (1993); Sessions (1991); and Bosch, Carrasco and Grau (2003) are some of the authors who have discussed in depth the points on which feminism and ecologism coincide and where they differ.



well-being, call for an integrative and multidisciplinary approach that incorporates the diverse aspects of reality (Bono, 2008b; Young and others, 2006).

### 1. The invisibility of women and nature

As mentioned above, domestic and reproductive work has long been underestimated by society in general and by economists in particular, which has resulted in its becoming invisible, despite the fact that homes are akin to service workshops and no other productive sector equals them in terms of the volume or economic relevance of their output (Durán, 2012). Similarly, no value is ascribed to the services and resources provided by nature, whose essential contribution to human well-being is ignored, as are the consequences of disruption to natural cycles, which ultimately leads to the irrational use of resources, the degradation of ecosystems and the interruption of biogeochemical cycles. The absence of a market price appears to denote unimportance and entails invisibility (Novo, 2007). It has therefore been argued that assigning economic value to natural resources and to the negative externalities affecting nature would promote sound environmental management (Kriström, 1995, cited in Salvador del Saz, 2008).

Valuation systems, sustainability indicators, tax reform proposals, environmental management systems and environmental impact assessments, legal frameworks to penalize or prevent further environmental pollution and degradation are all commendable suggestions to help address the invisibility of nature. However, these two areas could be incommensurable (Martínez-Alier, 2007), in which case a more holistic approach that reflects the way in which ecosystems work might be more appropriate.

In the same vein, making visible the total amount of work done by women is a complex task, since it involves a multidimensional conception (in terms of time and space) framed by formal and informal institutions that are difficult to change: all of which represents a far-reaching challenge. Carers carry out many physical tasks, including curing and cleaning, and they must be vigilant (to avoid incidents and prevent illness), but they are also responsible for family management, representation and communication. These elements are difficult to separate conceptually and even more difficult to quantify in terms of time and value (Durán, 2011).

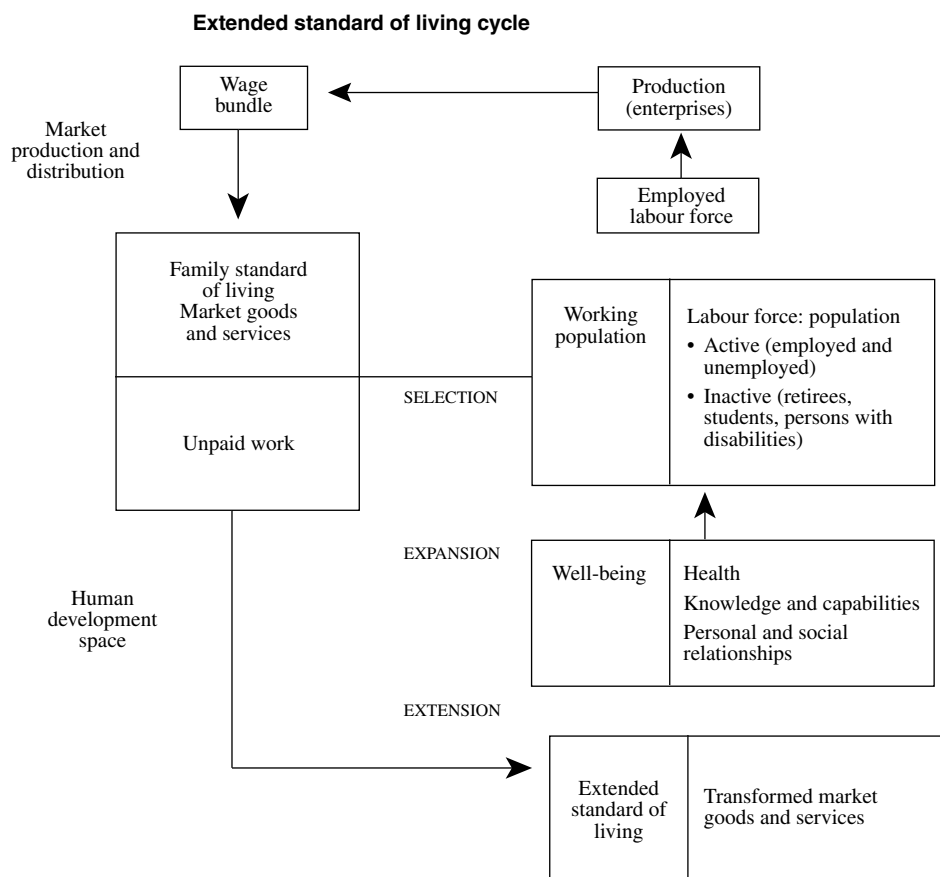
There are several proposals, linked to the mandate emanating from the Beijing Declaration and Platform for Action, aimed at modifying the conceptual framework or improving the statistical tools to make unpaid work

visible. Picchio (2005) suggests reformulating the cycle of market production and distribution; while Durán (2001) proposes improving national accounts by using household satellite accounts that attribute a monetary value to domestic and care work. The Statistical Office of the European Communities (EUROSTAT) and the Economic Commission for Latin America and the Caribbean (ECLAC) have carried out time-use surveys, which for the time being are considered the best available tool (Durán, 2012). Carrasco and Mayordomo (2000) developed a non-androcentric survey of the active population; while Carrasco and Serrano (2011) created a new methodology that captures information on both household and market activities, overcoming some of the limitations of the databases currently used to calculate household satellite accounts. In Latin America, great progress has been made in this area through the use of various methodologies, particularly special modules in regular home surveys (Durán and Milosavljevic, 2012). All these tools have contributed a great deal to demonstrating the extent of prevailing gender inequalities and the subordination of women, which represents a public policy challenge (Rodríguez Enríquez, 2012).

Picchio proposes a reformulation of the cycle of market production and distribution, reframing not only the conditions of market production, but also the conditions for the reproduction of the labour force. She highlights that domestic activities and care work carried out within the family sphere enable family members who engage in paid work outside the home to continue to do so. She distinguishes between three key economic functions for human development at the household level: first, the extension of monetary income or real wages through the provision of goods, meals, clean clothes, etc.; second, the expansion of well-being by fostering human capabilities and effective functioning in the social sphere; and third, the support lent by the family unit to the selective processes that take place in the market economy in terms of the skills used in the process of producing goods and services. Picchio (2001 and 2005) defines an economic space devoted to human development and composed of activities whose direct purpose is the well-being of individuals and not the valuation of goods (see figure 1).

The model addresses key aspects of invisibility and highlights the constant interaction between paid and unpaid work, the difficulty of assigning a monetary value to domestic work (Durán, 2012) and its ability to transform living standards into well-being (Rodríguez Enríquez, 2012). Nevertheless, the economy-nature disconnect of the prevailing economic model is replicated,

FIGURE 1



Source: Antonella Picchio, “La economía política y la investigación sobre las condiciones de vida”, *Por una economía sobre la vida*, Gemma Cairó i Céspedes and Maribel Mayordomo (comps.), Barcelona, Icaria-Más Madera, 2005.

indirectly reinforcing the invisibility of nature. In order to integrate the ecological perspective, the entire cycle would have to be reframed with respect to nature, and this would require an acknowledgement that market production and distribution, as well as all the activities relating to human development, depend on the resources and services provided by ecosystems (biogeochemical cycles, spaces, information) and that such activities generate pollution and waste and lead to the degradation of biodiversity, which sooner or later will have an impact on human well-being. These exchanges with nature (inputs and outputs) should be taken into consideration, in addition to the resilience capacity of nature, in order to ensure sustainability. In this way, both invisibilities would be addressed at the same time.

Introducing a temporal dimension into this model would further widen its scope. Nature needs time to recover from certain impacts, which is similar to human

resilience capacity. Future generations’ right to satisfy their needs is linked not only to the use of goods and services provided by nature, but also to the performance of reproductive activities and the provision of care and support, which have traditionally been carried out by women. Durán (2011) refers to an implicit intergenerational social contract, that is, a deferred exchange in which the care and services received are returned to the providers over the medium or long term, or are passed on to the next generation. In addition, it is necessary to emphasize the need for women and men to share domestic responsibilities. In recent history, that absence of shared responsibility in the home has led to a significant shift as those tasks are transferred between women in different parts of the world. Indeed, global demand for domestic workers constitutes one of the reasons for the feminization of migration, giving way to a global care chain (Durán, 2012; Hochschild,

2004; Pla, 2009). Along the same lines, solidarity with marginalized people is a key consideration for sustainability, and ways to include this element in the model should be explored further.

## 2. A change in values

In order to truly address gender disparities and environmental challenges, the way in which value is ascribed to women and nature must change since that value determines social behaviour towards them. Making visible the tangible and intangible activities that are performed at home and that facilitate the smooth functioning of the whole economic system is certainly important; however, it is also necessary to stop considering these activities as a gender duty, and especially as one which can be replaced by commoditized work in precarious conditions (Pla, 2008). The distribution of domestic work is part of the sexual division of labour determined by cultural patterns and economic rationality (Rodríguez Enríquez, 2012). Dismantling the patriarchal culture that underpins gender inequalities requires new symbolic content in the collective memory (Montaño, 2010). Similarly, reassessing the significance of ecosystems for human well-being and the impact that anthropogenic activities have on them (Costanza, 2003; Nash, 1989) calls for more than conducting environmental impact assessments, assigning economic values to resources or trying to use them more efficiently: rather we must redefine our current lifestyle, which is characterized by excessive consumerism and represents an oversized burden on the planet. That burden compromises ecosystems' capacity for self-regulation and the availability of resources and services, now and in the future. Several proposals have been put forward to address this challenge and longstanding discussions on consumption and production patterns have been taking place under the aegis of the United Nations Commission on Sustainable Development, although no significant progress has yet been made.

To make a change in social behaviour, more emphasis should be placed on education for sustainability in order to raise public awareness and foster the adoption of these new values. Understanding that we do not need to have more but to be better is essential. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has been actively involved in promoting action for the United Nations Decade of Education for Sustainable Development, 2005-2014 (United Nations General Assembly resolution 57/254, 2003). As stated in the Bonn Declaration of 2009, education for sustainable development "should actively promote gender equality,

as well as create conditions and strategies that enable women to share knowledge and experience of bringing about social change and human well-being" (UNESCO, 2009). This has led to important initiatives worldwide on mainstreaming gender equality in all areas under the UNESCO implementation scheme, including the preparation of guidelines and tools for gender sensitizing as part of the guidance provided to teachers within the framework of the Decade of Education for Sustainable Development. Another important step forward is the Earth Charter Initiative, through which civil society organizations all over the world have been promoting the transition to a more sustainable lifestyle (Bosselmann, 2004).

These initiatives should be accompanied by appropriate institutional support at the national and local levels, which would indicate a shift in the priority given to environmental and gender issues in public policies. Those issues should be reflected in all socioeconomic regulations and policies, as well as in formal education programmes (at the primary, secondary and tertiary education levels), which should integrate these subjects into existing programmes of study, particularly economics and business courses, instead of introducing them as separate subjects disconnected from the rest of the curriculum. In terms of informal education and raising public awareness, establishing alliances with the media is critical. Broadcasters should be encouraged to embed topics relating to ecological and gender ethics in their prime time programming, replacing the patriarchal, materialistic and short-sighted vision currently being promoted in the majority of the programmes that are broadcast. The use of gender counter-stereotypes, that is, presenting certain positive values as feminine stereotypes until they are accepted beyond question, (Jolly, 2004) has been powerful tool for effecting change. UNESCO has developed a set of Gender-Sensitive Indicators for Media, which address the intersection of women's empowerment and media development, and has provided training to journalists in order to enhance their reporting activity on issues related directly or indirectly to women.

Another aspect that deserves to be revalued is the contribution of rural women to nature conservation, as mentioned above. This contribution is not motivated by essentialist views or a desire to return to pre-capitalist practices, but by the cumulative experience of these women whose close relationship with the environment is valuable for preserving ecosystems. They have learned not to sacrifice nature for immediate profits and to give priority instead to the steady supply of food, shelter, energy, water, medicines and other goods and services that nature provides for their families. A greater appreciation

of this approach would help to strengthen tolerance and understanding of cultural differences—a major concern of ecofeminist movements in Latin America.

It is necessary to recognize the continuous interrelation between ecosystems and people all over the globe. This interconnection in the socioecological system (Young and others, 2006; Bono, 2008a) is such that impacting just part of it affects the global balance and that is why it is important to conduct global environmental assessments and ensure fairer distribution practices and international justice. The severe poverty afflicting a third of the world population,<sup>7</sup> the feminization of poverty<sup>8</sup> and the transfer of inequities between women of different nationalities, social statuses, races and education levels through the global care chain (Hochschild, 2004) are all factors that point to the need to address this problem. According to Valcárcel (1993), equality should be enjoyed by humanity as a whole, but to date it is not. Instead, our societies marginalize lower-income sectors, and the rest of the world remains oblivious to the problem. She holds that nothing can be done to change the prevailing order without equality. Along similar lines, Tomás Carpi (2007) stated that sustainable development had to be pursued globally or it would not exist at all. The Human Development Report has recently pointed out that a combined approach must be taken to tackle the urgent global challenges of sustainability and equity (UNDP, 2011). The aim here is not to present a catastrophic discourse, but rather to channel our creativity in order to merge the ecosystems approach with the gender approach in order to promote appropriate policies and actions.

### 3. Restructuring power relations

The Gender Inequality Index included in the Human Development Report (UNDP, 2011)<sup>9</sup> and the Gender Equity

Index developed by Social Watch (2012) clearly show that, although there are significant variations between countries, in general, women work more, earn less, make up a larger proportion of the illiterate population among those living in absolute poverty, have less access to education, are less likely to hold managerial positions or participate in representative institutions, have poorer diets, receive worse health services and are more likely to experience gender-based violence or be deprived of the right to be born, among other unfair practices (Social Watch, 2011). According to statistics on the employed population aged 15 years and over produced by the Gender Equality Observatory of ECLAC, Latin American women work between 8 hours and 23 hours more per week than men (paid and unpaid work), and that gap ranges between 22 hours and 28 hours per week for the unemployed population. In addition, an average of 34.7% of women have no income of their own, which reflects their lack of autonomy and lower participation in the labour market.<sup>10</sup> Despite being the main care providers in the home, they are labelled “inactive” for the purposes of traditional labour statistics (Montaño, 2011).

The unequal distribution of power and the various obstacles to women’s active participation in decision-making processes at the household, community and society levels also limit women’s ability to exercise their rights and citizenship, and are directly related to women’s lack of social protection and security (ECLAC, 2004). As mentioned above, feminists argue that gender disparities are linked to hierarchical power relations, a point of view that they share with some ecologists, who draw attention to the dominance exerted by the strong over the weak, whether that refers to people or countries. A redefinition of power relations is as necessary to relations in the private and public domains, as it is to personal and international relations. In this sense, acknowledging and then valuing the other (women or nature) should lead to equal treatment, equal rights, and equal opportunities to develop capabilities, with respect for the relevant cycles and time frames. Ethical and political reasons have not been persuasive enough to bring about a change so far, neither within our societies nor in the world order. Instead, economic interests and resistance to power-sharing have prevailed. Efforts are urgently needed to foster inter-gender and intra-gender justice and equality of rights and opportunities, with a view to bringing democracy and equity to personal and

<sup>7</sup> The Multidimensional Poverty Index, which includes data on 79% of the world population, estimates that 31% of the world population (1.65 billion people) can be identified as multidimensionally poor (UNDP, 2011).

<sup>8</sup> In Latin America, the feminization of poverty index produced by the Gender Equality Observatory of ECLAC clearly shows that in almost all countries and areas (rural and urban) poor women outnumber poor men, a gap which is particularly significant in women aged 20-59 years in the majority of countries.

<sup>9</sup> We are aware of the criticisms levelled at the methodology used by the United Nations Development Programme (UNDP) to calculate the previous Gender-related Development Index and Gender Empowerment Measure; however, these criticisms do not deny the existence of inequalities, but rather the way in which they should be calculated. The suggested adjustments could lead to worse scores for some countries (see Klasen and Schüler, 2011).

<sup>10</sup> Statistics from the Gender Equality Observatory of ECLAC.

international relations. This will put pressure on access to the resources and technologies required to advance towards women's empowerment and to an inclusive conception of sustainable development, but if that does not materialize the negative impact on families, social cohesion, developmental policies, stability and security will intensify, increasing the risks of social, environmental, and economic crisis.

As stated above, environmental problems pose important challenges to global governance owing to the direct and indirect impacts of human activities and the interdependence of ecosystems. Biodiversity loss, for instance, affects the provision of raw materials worldwide; and climate change disrupts ecosystem cycles, also at the global scale. It is therefore crucial to act simultaneously at the local and global levels (Bono, 2008b). Hans Bressers and Walter Rosenbaum (2003) stressed that, because of ecological interdependence, environmental protection must be executed across multiple scales and should be covered by the legal and institutional frameworks in order to address the problems properly. The challenge lies in how to integrate the different geographical scales, as well as the time frames, institutions and sectors involved at each level. That requires collaboration, dialogue and coordinated action among local actors and among countries, based on a non-dominating, integrative and cooperative approach. To that end, a new kind of committed leadership, with a comprehensive understanding of the multidimensionality of the problems, is needed to foster local and global consensus on the required public policies (Tomás Carpi, 2008).

#### 4. Changes in the development model

The questioning of the prevailing economic model is common to both the ecological and the feminist perspectives. The ecological movement and research groups have put forward a number of interesting proposals for change based on a systemic and holistic approach that can accommodate feminist concerns. One example is the contribution by Tomás Carpi (2007), cited above. On the means side of his sustainable development model, he points to technological innovation, the environmental management of production processes, institutional change, regulation mechanisms for the economic system, and the evolution of sociocultural and power relations. Regarding the aim of the model, sustainable development aspires to improve the quality of life of human beings and promote social development, democracy and distributional justice, while preserving natural ecosystems' capacity for self-regulation to provide us with products and services.

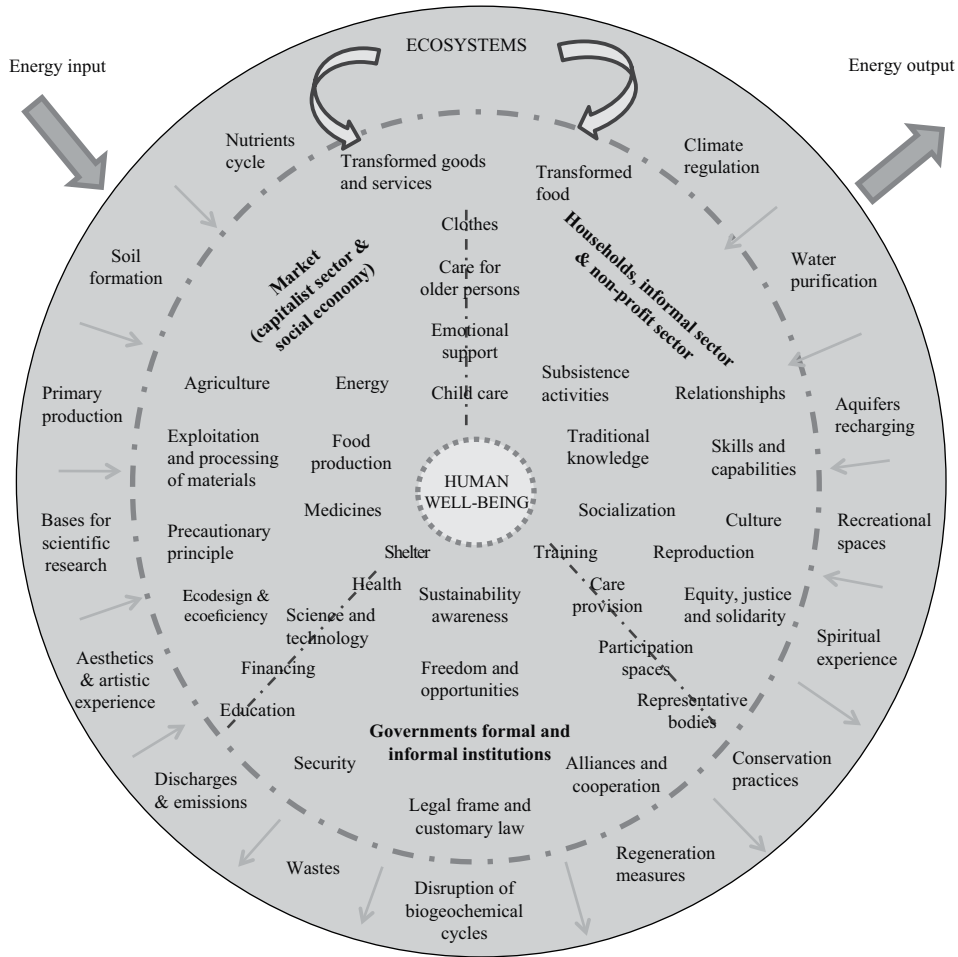
This proposal comprises several important characteristics, some of which coincide with ecofeminist arguments, while others are more in tune with the feminist economist perspective. First, it is striking that the aim of the model is not to pursue endless accumulation, for it places nature (the environmental pillar) at the same level as the social pillar. Furthermore, it takes into consideration the carrying capacity of the planet to satisfy human needs. Likewise, it considers health as one of the most important relations between human beings and the natural environment —thus paying due attention to a major cause of concern for ecofeminists and ecologists alike. His model includes eco-efficiency, eco-effectiveness and sustainability in the economic pillar, which reveals not only the perception of nature as a fundamental base with strategic functions on which we all depend, but also a long-term perspective, which is essential for intergenerational solidarity. Instead of seeking absolute control over nature, it puts knowledge in the service of ecological limits with a view to developing their joint potential and decoupling development from pollution and environmental degradation. The social pillar incorporates aspects such as quality of life (taking into account the diversity of approaches according to the context), social cohesion, level of awareness, learning processes and capacity-building. The model recognizes that a fundamental transformation is required at the social level in order to achieve the change in values required. Finally, the institutional framework (formal and informal) can promote the adoption of those new values by allocating the appropriate resources and fostering technological progress, resource management, education and the development of instrumental freedoms, among many other things (Tomás Carpi, 2008).

This model clearly represents an advanced notion of sustainability, which is compatible with the gender perspective, and demonstrates an important openness to new values. It stresses equality, solidarity and cooperation, and even changing power relations. Nevertheless, the model could be further enriched by integrating the ethics of care (the European Union has recognized the right to care) and by reflecting the contribution and value of domestic and reproductive work, as proposed by Picchio. Therefore the dynamic relationship between the social pillar and the economic pillar should reflect the fact that household chores contribute to economic activity (tangible and intangible), and the economic pillar should include gender equity as one of its guiding principles.

On the basis of the reflections above, we have developed an integrative vision of sustainability in the socioecological system, which is represented in figure 2.

FIGURE 2

**An integrative depiction of sustainability in the socioecological system**



Source: prepared by the authors.

Figure 2 shows a circular and open system. The multiple interactions inside and outside each segment are unlimited and could occur in any number of diverse combinations and in any order. This model recognizes nature as the foundation of all human activities, providing vital goods and services in order to satisfy human needs and absorbing our impact in return. This vision plays down the importance of the market, devoting attention to the non-monetized sphere of the economy too. Care work, essential to the productive and reproductive cycles, is represented not as task to be performed, but as a need to be satisfied (Bosch, Carrasco and Grau, 2003; Carrasco, 2009).

This vision relates to a concept of human well-being that is nurtured by both the material and the

non-material, which includes: food, shelter, health, financial resources, but also emotional support, freedom of choice, active participation, capacity-building, spiritual experiences, and the right to provide and receive care. All of this requires the components of the socioecological system to function harmoniously, without sacrificing any of the suppliers of these elements. The social and environmental responsibilities of the economic agents guide their activities, as do the precautionary principle and eco-efficiency, always taking into account the carrying capacity of nature. Formal and informal institutions adopt this notion of a multidimensional continuum that forms nature and human beings in space and time. In a contextualized way, it promotes the very actions required to maintain its dynamic equilibrium. To that

end, technology and traditional knowledge provide us with a better understanding of nature, harmonizing its rhythms with ours and providing us with the means to adapt to changes.

The challenges faced are cross-disciplinary and require a non-dominating, cooperative and integrative approach, as well as a society that is conscious of its individual and collective impact, resulting from what it produces, how it does so, what it consumes and the effects of that consumption. Citizens must be aware of their rights and responsibilities. The active participation and commitment of society as a whole are essential to propel and facilitate such a change. A population that is educated with regard to local and global sustainability, which fosters justice and equity, intergenerationally and

intragenerationally, is a fundamental part of this conceptual framework. The active involvement of communities and the media in promoting and defending the new values is key to overcoming inter-gender and intra-gender inequities. This can be achieved through effective and active participation in the public arena, in the form of dialogue, alliances and opportunities to present their ideas and proposals. Another priority is creating a new leadership—one that is truly democratic, in tune with needs of today's society and possess a comprehensive understanding of the way that socioecological systems work and their resilience capacity. That type of leadership is vital to ensuring that policies are designed and executed from a holistic perspective and do not need to be adjusted *ex post* to include limited measures on sustainability.

## IV

### Conclusion

As stated in the Report of the World Commission on Environment and Development: *Our Common Future*, a world in which poverty and inequality prevail will always be inclined to social, ecological and other crises. Economics cannot continue to ignore nature and the world population must have a say in the necessary revision of the economic model. Durán (2011) states that in an effort to focus objectively on goods and markets, economics has forgotten the human beings who produce and consume, as well as those who do not have access to goods and services. The prevailing production and consumption patterns compromise ecological stability, as well as world equity and justice, since they pose a risk to humankind, present well-being and that of future generations. At the same time, persistent gender inequities and the feminization of poverty call for a reassessment, in ethical and economic terms, of women's contribution to society and their right to the same opportunities, with a view to making universal equality a reality. In order to achieve sustainable development everyone must be able to enjoy the same spaces, decide how to use their own time, access resources and represent themselves in political and social bodies. The concept required here—and that as yet remains under construction—is that of an active State as a guarantor of rights (Montaño, 2010). But none of this will be possible if we irreversibly disrupt the characteristics that make life on Earth possible.

Proponents of ecologism and feminism are called on to look beyond their disagreements and explore synergies that could help to bring about the necessary transformation of the prevailing model. There is no single, simple or definite formula for achieving this, but there is scope for debate, further research and political action with a view to spurring the changes our society urgently requires.

We should therefore opt for a systemic solution and an integrative vision of sustainability. Picchio's proposed reformulation of the economic cycle to include unpaid domestic and reproductive work would be strengthened by adding an ecological perspective. Her model could be placed within the framework of nature, reflecting the exchanges between humans and nature, and expanding the temporal dimension, thus addressing the concerns of feminists and ecologists alike. But theoretical reforms are not enough to produce the transformations required; both movements agree those reforms must be accompanied by appropriate public policy and changes in fundamental values. There is evidence of advances in legal equality in some contexts, but much remains to be done to expand the scope of those advances and to transform them into effective and consistent behavioural changes on a worldwide scale. A robust alliance is needed to foment appropriate values. Restructuring power relations at the private and public levels is another must if unsustainable inequities

(grounded not only in inter-gender differences, but also in intra-gender ones) are to be overcome. To that end, the involvement of society as a whole is essential, translating the right to participate into an effective tool for forging consensus on how the development model should be changed. In this respect, Tomás Carpi's definition of sustainable development represents an interesting starting point, which could be strengthened if it addressed the issue of care provision and the considerations of feminist economists.

Having explored the potential synergies, we have presented an integrative vision of sustainability that represents the fluid multidimensionality of life in the socioecological system. We have highlighted the fundamental interconnections between humanity and

nature, between the private and public spheres, and between the market economy and households. This holistic approach requires new values, cooperative relations, and a non-dualistic understanding of life. Emotional and material needs are considered equally important for well-being and the model must respect the resilience capacity of nature and human beings.

Since the challenges faced by humanity at this particular moment of crisis call not only for ideas, but also for political action to bring about the required transformation, a committed leadership with a deep understanding of those challenges is essential. Achieving an integrative sustainability, supported by a society that is fully aware of its rights and responsibilities, is feasible, but it will require decisive, collective action.

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# Social mobility and the demand for income redistribution in Latin America

*Cleiton Roberto da Fonseca Silva and Erik Alencar de Figueiredo*

**ABSTRACT**

Alesina and Angeletos (2005) and Alesina and Glaeser (2004) argue that income redistribution preferences vary systematically between the different regions and influence the size of government and the composition of public spending. This article analyses the demand for redistribution in Latin America, paying particular attention to the effects of mobility expectations on this demand. The findings suggest that demand for redistribution is driven primarily by self-interest and by considerations of fairness based on the inequality of opportunities. They also reveal the importance of past mobility, while the prospect of upward mobility (POUM) hypothesis advanced by Benabou and Ok (2001) is rejected in the case of the Latin America region.

**KEYWORDS**

Social mobility, income distribution, surveys, statistics, econometric models, Latin America

**JEL CLASSIFICATION**

D31; D63; H30

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# I

## Introduction

What are the factors determining the demand for income redistribution in different societies? The question is particularly important because the answer can help to explain the size of government (why it is so large in some countries and so small in others) and because it provides a basis for establishing mechanisms to promote efficiency in resource allocation in cases where taxation distorts incentives.

Alesina and Angeletos (2005) and Alesina and Glaeser (2004) concentrate on the first point, arguing that different beliefs about the determinants of social competition can explain the differences in countries' redistribution policies. In this context, two basic types of equilibrium are distinguished. In places where effort is thought to be the main source of income differentials, there is less demand for redistribution. Because limited redistribution means low taxes, this creates a virtuous equilibrium encompassing limited taxation, high investment and incentives to effort. This is what happens in the United States. In Europe, conversely, income is thought to be determined largely by luck or by factors beyond agents' control. In this case, the equilibrium is one of high taxes, low investment and disincentives to effort, so that redistribution is desirable. In other words, different historical experiences lead societies to different stationary states in which the various social beliefs and political situations are self-perpetuating (Alesina and La Ferrara, 2005).

Consistently with these results, Corneo and Gruner (2002) show that the preferences of agents in the former socialist countries differ from those of Western citizens. Individuals' attitudes to redistribution are taken to be a reflection of their value systems. Alesina and Fuchs (2007) use the "experiment" of German separation to test whether the economic situation affects individual preferences. The findings indicate that agents' preferences are modelled more profoundly by the political regime of the societies they live in.

The basic model used as the starting point for these studies was established by Meltzer and Richard (1981), who took a parsimonious context in which the only activities of government were redistribution and taxation in an environment with fully informed voters. In this case, the size of government is determined by the maximization of each agent's individual welfare. The general idea is

that agents with incomes lower than the average voter's are more likely to support redistribution mechanisms.

Even from the "micro" standpoint, the results differ irrespective of whether current income, individual characteristics, self-interest variables or different conceptions of the mechanisms of fairness are considered. Gaviria (2007) and Ravallion and Lokshin (2000), for example, find significant differences between the redistribution preferences of men and women and between agents with different levels of education. Neustadt and Zweifel (2009) identify a positive relationship between income and the demand for redistribution in Switzerland, which contradicts the standard model put forward by Meltzer and Richard (1981).

As figure 1 shows, data from the Economic Commission for Latin America and the Caribbean (ECLAC) reveal that public-sector social spending as a proportion of gross domestic product (GDP) has grown consistently in the region.<sup>1</sup> It is possible that this trend has been influenced by social demands, since (according to *Latinobarómetro 2007* data) an average of 78% of the population of Latin America consider income distribution in their respective countries unfair.

The size of government in some countries that have experienced left-wing revolutionary upheavals suggests an equilibrium similar to that observed in the European countries. Countries like Brazil and Mexico began to open up macroeconomically in the 1980s, and it is natural to expect a shift of this kind to be accompanied by greater income variability and demands for social protection in the face of competition. Ultimately, the expectation for most agents is that redistribution should operate as a form of real "insurance" against the uncertainty of future income.

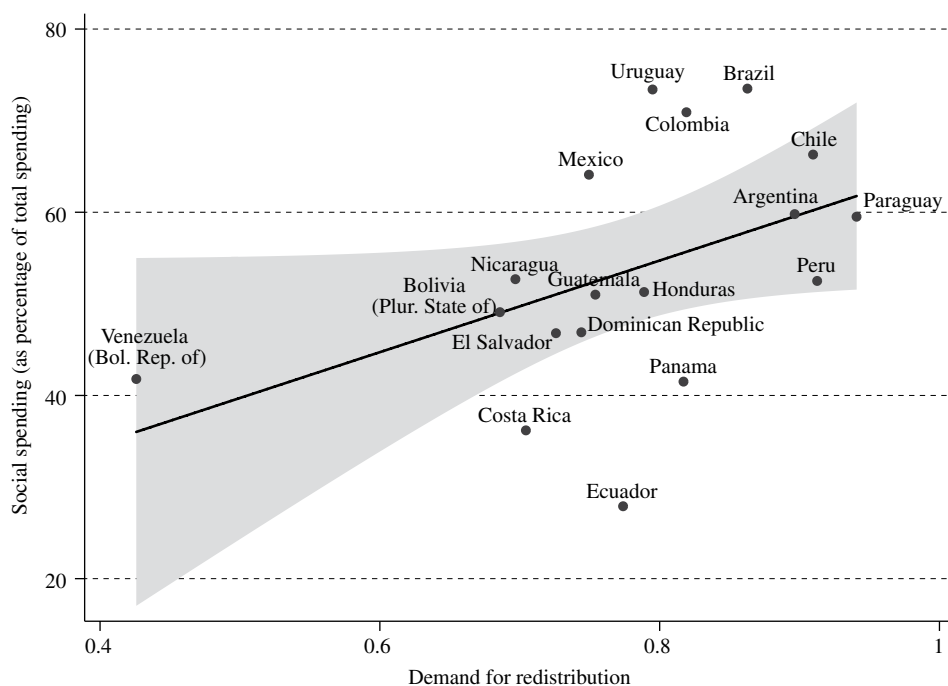
While it is important to establish the factors determining the demand for redistribution, this is not straightforward. Initially, it could be argued, following the logic of Meltzer and Richard (1981), that the agents who support redistribution measures are those who

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<sup>1</sup> In the early 1990s, 11.3% of GDP was allocated to social spending, which represented 44.9% of total public spending. The amount increased until by 2008-2009 the figures were 17.9% of GDP and 62.2% of total spending. Specifically, spending on social security and welfare rose from 4.4% to 7.9% of GDP in the period.

FIGURE 1

**Latin America (selected countries): relationship between social spending and the demand for income redistribution (I), 2007**



Source: prepared by the authors on the basis of data from the Economic Commission for Latin America and the Caribbean (ECLAC) and Latinobarómetro.

immediately benefit from the redistribution mechanisms. Some studies, such as that of Fong (2001), have shown that the matter is not so simple. Redistribution policies usually remain stable over time. Thus, even if some demand is allowed to be driven by pure self-interest, the uncertainty associated with factors such as mobility makes it hard to capture the effects of current income.

Someone who is poor today may be rich tomorrow, and vice versa. People's expectations about the future are crucial (Alesina and La Ferrara, 2005). Particularly important is the prospect of upward mobility (POUM), a phenomenon formalized by Benabou and Ok (2001) and tested in various empirical studies. The argument, in brief, is that the mass of agents with incomes just below the average may be against redistribution because they expect, quite rationally, to move above the average in future. Corneo (2001), Corneo and Gruner (2002)

and Alesina and La Ferrara (2005) conclude that POUM influences the demand for income distribution in the different regions analysed. Will this finding hold good for Latin America too? According to Ravallion and Lokshin (2000), this hypothesis helps to explain tolerance for inequality in developing countries and accordingly merits a more thorough analysis.

The objective of this article is to study the demand for income redistribution in Latin America and, in particular, to analyse the role played by expectations of mobility, extending existing studies in the literature to a region of great interest. To this end, the article is divided into three sections in addition to this Introduction. Section II presents a theoretical discussion tied to the earlier studies as a starting point, after which section III details the empirical results and section IV sets forth the conclusions.

## II

### The demand for redistribution

Studies analysing the demand for redistribution are usually based on the utility derived from agents' decisions. According to Ravallion and Lokshin (2000), expected utility is assumed to be the sum of current utility, known with certainty, and expected future utility.  $f$  is defined as a "felicity" function that is twice-differentiable, strictly increasing and concave in  $y$ , while  $H$  is the distribution of future income and  $x$  is a vector of individual characteristics affecting expected income relative to current income. Utility without redistribution is expressed as follows:

$$u(x, y) = f(y, x) + \int f(\tilde{y}, x) dH(\tilde{y}, x) \quad (1)$$

The analysis with redistribution includes uncertainty about what tax will be imposed and about future income. It is assumed that the tax is given by  $\tau(y, x) + \mu$ , where  $\mu$  is a random variable. Utility after redistribution,  $v[y - \tau(y, x), x]$ , takes the form

$$\int f[y - \tau(y, x) - \mu, x] dG(\mu, x) + \iint f[\tilde{y} - \tau(\tilde{y}, x) - \mu, x] dG(\mu, x) dH^*(\tilde{y}, x) \quad (2)$$

where  $H^*$  is the cumulative distribution function of future income when redistribution takes place. If redistribution is not expected to alter the distribution,  $H = H^*$  and  $u(y^*, x) = v(y^*, x)$ . In this case, the agent is indifferent to the proposed redistribution. If the distribution of future income (after redistribution) is preferred, then  $u(y^*, x) < v(y^*, x)$ . Thus, those preferring the redistribution will have a utility gain given by

$$g(y, x) = v[y - \tau(y, x), x] - u(y, x) \quad (3)$$

The aim of this empirical study is to ascertain why some individuals support redistribution and others do not. The equation  $R = 1$  [ $g(y, x) > 0$ ], where  $R$  is a dummy variable that captures the preference for redistribution and  $1[\cdot]$  is an indicator function, can be constructed for this. Assuming that  $g(y, x)$  is linear in the parameters and has a normally distributed error term, it is possible to estimate it using an approach with a dichotomous

dependent variable. In this case, the multivariate model for agent  $j (= 1, \dots, n)$  is

$$g(y_j, x_j) = \alpha + \beta y_j + \pi x_j + \varepsilon_j \quad (4)$$

The vector of characteristics  $x$  is constructed on the basis of the theoretical discussion. Basic individual characteristics are generally included. The demand for redistribution can be theoretically related to different variables. Alesina and La Ferrara (2005) present a non-exhaustive list that includes present income, expectation of future income, personal history of mobility, risk aversion, altruism and belief in equality of opportunities.

Current and future incomes test demand motivated by self-interest. Risk aversion is included because for some agents redistribution is an "insurance policy" against uncertainty. Belief in equality of opportunities can be used to infer whether the demand for redistribution is connected with a sense of fairness. People who do not believe there is full equality of opportunities probably regard redistribution as a form of social justice.

Mobility, in particular, is a factor of great interest that ties in with the work of Tocqueville (2003). In recent decades, the first seminal article relating the redistributive behaviour of agents to the perception of mobility was that by Hirschman and Rothschild (1973). To summarize, these authors argue that agents who have high incomes but expect to be disadvantaged by the mobility process will be favourable to redistribution.<sup>2</sup> Although Benabou and Ok (2001) were the first to formalize a model in these terms, they constructed their hypothesis the other way around: agents in the lower income strata are against redistribution when they expect upward mobility to place them in a stratum above the average. It is even argued that the possibility of upward social mobility makes people with below-average incomes unwilling to support higher taxes, as they believe that they or their children might move up in the income distribution and therefore be hurt by such policies (Benabou and Ok, 2001, p. 447).

<sup>2</sup> Hirschman and Rothschild (1973) dubbed this behaviour the "tunnel effect" because of an analogy used as an example.

The prospect of upward mobility (POUM) hypothesis, as it is known, is based on three fundamental assumptions: (i) future income is a concave function of current income; (ii) agents are not excessively risk-averse; and (iii) redistribution policies are stable and are maintained over time. According to Neustadt and Zweifel (2009), a simplified formulation of the position put forward by Benabou and Ok (2001) can be discussed using a two-period example. If point (i) is allowed,  $y_{future} = f(y_{current})$ , when  $f''(y) = 0 \forall$  and  $\in [0, y^{max}]$ . Without loss of generality, individuals with average incomes today,  $\mu_0$ , will obtain the same income tomorrow,  $f(\mu_0)$ . The concavity of the function implies that, with redistribution, the total gain to the poor is less than the total loss to the rich, so that  $\mu_1 < \mu_0$ . In this context, agents with a current position between  $\mu_1$  and  $\mu_0$  who hope to receive a future income greater than the average income,  $\mu_i > \mu_1$ , will be against redistribution.

For greater clarity, the simple formalization proposed by Alesina and La Ferrara (2005) should be considered: the income before and after tax of a risk-neutral individual

$i$  is determined respectively by  $y_{it}$  and  $y_{it}^d$ . A two-period model with lump-sum linear taxation of  $\tau$  is assumed. When  $\bar{y}$  is established as the average income of the community (assumed to be constant in both periods), ignoring the deduction and assuming  $E(\cdot)$  as the expected value, the total income available to individual  $i$  in the two periods is

$$y_{i1}^d + E(y_{i1}^d) = (1 - \tau)(y_{i1} + E(y_{i2})) + 2\tau\bar{y} - \tau^2\bar{y} \quad (5)$$

Maximizing this expression gives the preferred tax rate:

$$\tau_i^* = 1 - \frac{1}{2\bar{y}}(y_{i1} + E(y_{i2})) \quad (6)$$

In other words, the higher current and expected future income is, the lower the optimum level of redistribution. When a variable capturing expectations of future mobility is included in the empirical test, POUM means that the expectation of moving to a higher income stratum is associated with a lesser demand for redistribution.

### III

## Empirical analysis

### 1. Data

The data used in the study are based on the 2007 Latinobarómetro study, covering 18 countries of Latin America: Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, the Plurinational State of Bolivia and Uruguay. The questions used are detailed in annex A.

Some studies, like Alesina and Angeletos (2005), consider the following question in order to take respondents' position on the political spectrum as a proxy for the demand for redistribution: "In politics, people normally speak of 'left' and 'right'. On a scale where 0 is left and 10 is right, where would you place yourself?" The demand for redistribution is greater among respondents who place themselves on the left.

This was one of the variables employed by Gaviria (2007), who also used questions dealing with support for privatization and the market economy as dependent

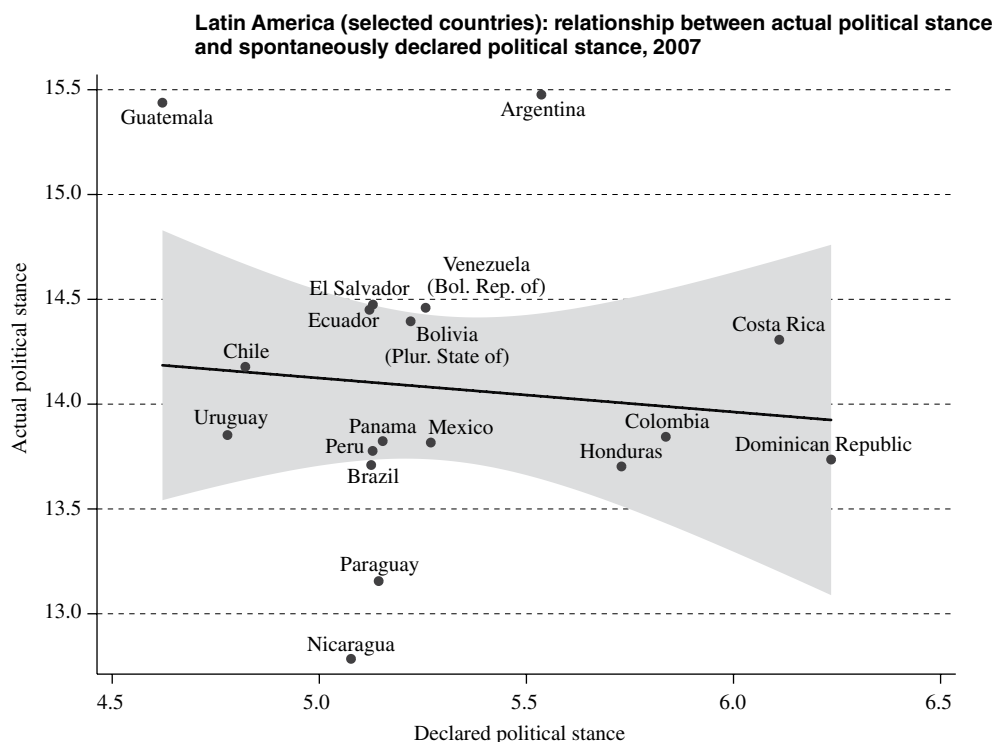
variables in a model for Latin America itself (1996-2000). However, the same author draws attention to the difference in the findings when position on the political spectrum is taken as a dependent variable.

To analyse the soundness of this question, the spontaneous answers were crossed with the answers delimiting the actual political stance of respondents, giving the same weight to individuals' opinions about: (i) the role of the market economy in development; (ii) the role of private enterprise in development; (iii) the effect of private-sector investment on employment opportunities; (iv) the effect of free competition on employment opportunities; (v) the effect of international free trade on employment opportunities, and (vi) the role of the State in solving society's problems.

The variable was formulated so that a higher value for the parameter indicates a more left-wing position. Thus, the equivalence between respondents' spontaneously declared position and their actual one should be manifested in a negative relationship that is fully established in figure 2. Yet it can be seen that



FIGURE 2



Source: prepared by the authors on the basis of Latinobarómetro data.

people's responses do not correspond to their actual political positions. Accordingly, use of respondents' spontaneously declared political stance as a proxy for the demand for redistribution is not advised, as this variable does not even capture their real political positions.<sup>3</sup>

While other studies such as Fong (2001) have used questions about the need for government to restrict the incomes of the rich, no questionnaire of this type is available in the database used. In any event, these questions assume a specific redistribution mechanism, and the answers will partly depend on people's belief in the ability of government to implement a transfer mechanism of this type.

In these circumstances, the decision was taken to use two questions that capture the perception of fairness in income distribution as proxies for the demand for redistribution. Questions of this type are more suitable than those that merely ask whether distribution is unequal,

as respondents who acknowledge the existence of inequality might consider it fair and thus not be calling for redistribution.

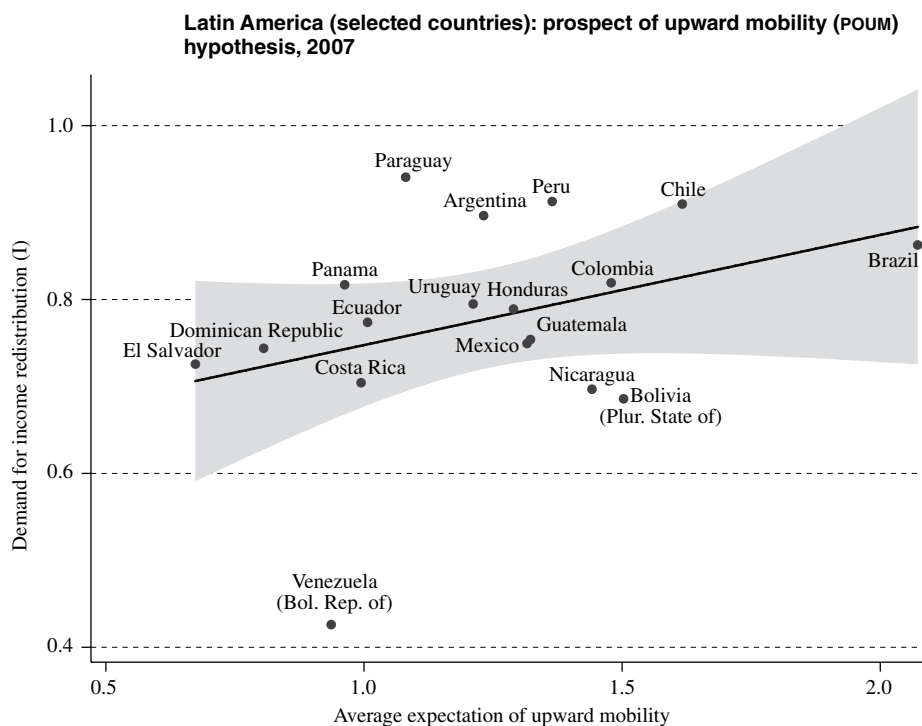
Nonetheless, the limitations of the questions need to be stressed, as they do not directly measure demand for redistribution. Even if respondents do consider the distribution of income to be unfair, they might be against a likely increase in taxes and thus against redistribution too. They might also have the fatalistic belief that "that's just the way it is" and come out against redistribution mechanisms. Because the empirical strategy assumes that the questions used are a good proxy, the results will inevitably be affected if the variables for the unfairness of income distribution cannot be used as proxies for the demand for redistribution itself.

## 2. Preliminary results

As a first step, it is useful to relate the variables of interest. Figure 3 relates the demand for redistribution with the average expectation of future mobility in the countries of Latin America. The mobility variable works as a measure of optimism: the greater people's

<sup>3</sup> It is not part of this article's purpose to investigate the issue. Ames and Smith (2010) have carried out a tightly focused but helpful discussion of the difficulty of establishing ideological identification in Brazil.

FIGURE 3



Source: prepared by the authors on the basis of Latinobarómetro data.

belief that their children will attain a better position, the higher it is. Consequently, POUM predicated an inverse movement between these variables. The relationship actually proves to be direct, however, since the greatest demand for redistribution is found precisely in countries where, on average, people expect their children to be better placed than them. The case of Brazil sums up this interpretation well.

To examine the relationship between the prospect of mobility and the demand for redistribution, table 1 presents the demand for redistribution relative to every combination between the income strata of the respondent and the respondent's parents and children. The purpose of this strategy is to determine how the demand for redistribution varies with the prospects perceived by individuals. In other words, does mobility actually matter?

According to the data, it does: respondents calling for the redistribution of income are considering the perceived position of their parents and the position they expect for their children. Of individuals stating that their incomes are below the average and that their parents are in the same position, 80.57% call for redistribution. The proportion is about 4% higher when agents infer that their parents were better off. In other words, even

among those considering themselves poor today, the demand for redistribution differs systematically with the position they believe they are in relative to their parents. An intergenerational drop in income level increases the demand for redistribution, which indicates the importance of past mobility. The opposite also holds: even among agents with high incomes, views differ by the declared stratum of the parents, with respondents who consider their parents to have been at a lower level being more receptive to redistribution mechanisms.

TABLE 1  
**Latin America (selected countries): demand for redistribution by mobility prospects**  
(Percentages)

		Low incomes	High incomes
Parents	Low incomes	80.57	75.47
	High incomes	84.06	70.21
Children	Low incomes	82.69	70.58
	High incomes	80.91	70.51

Source: prepared by the authors on the basis of data from Latinobarómetro, 2007.

Note: low incomes = 1 to 4 and high incomes = 7 to 10.

Where respondents' children are concerned, the analysis produces identical results, except at the upper income level. Among agents who see themselves as poor, there is a differentiation, albeit a small one, by the level of income they expect for their children. When the children are expected to move up in society, the demand for redistribution is less. This finding tells in favour of POUM in Latin America. However, there is no differentiation among respondents who consider themselves rich, since demand for redistribution is almost the same regardless of the position they expect for their children. This runs counter to the "tunnel effect" of Hirschman and Rothschild (1973).

In summary, these findings indicate that past mobility has a greater influence than expectations of future mobility, even when current income levels are controlled for. Of all the possible combinations, the greatest demand for redistribution is found in the group of those on low incomes who perceive themselves to be worse off than their parents. There is greater demand in this group even than in the group of respondents who consider themselves poor and expect this status to continue into the next generation. This is not exactly

surprising. Piketty (1995) showed that the experience of past mobility could have persistent effects on attitudes to the redistribution of current income.<sup>4</sup> Among other things, this explains why people with the same level of income display different redistribution preferences. Empirically, past mobility is thus an important control variable when the effect of current income on redistribution preferences is estimated.

Table 2 shows the percentages of respondents calling for redistribution in four categories: (a) the total; (b) those expecting their children to have higher incomes (future mobility > 0); (c) those expecting their children to have lower incomes (future mobility < 0); and (d) those who

<sup>4</sup> Another explanation can be found in behavioural economics, where questions are used to capture perceptions based on respondents' prior experience. Following Kahneman, Wakker and Sarin (1997), it can be seen that the strategies adopted work with the utility experienced and not with the utility of the decision. Furthermore, according to the authors, losses have greater repercussions than equivalent gains. This helps to explain why an intergenerational reduction in income affects demand for redistribution. Lastly, it also helps to explain why POUM findings are rebutted and serves as a critique of the strategy adopted by Ravallion and Lokshin (2000) and in much of the literature.

TABLE 2

**Latin America (selected countries): respondents calling for income redistribution**  
(Percentages)

Region	Total (a)	Best stratum (b)	Worst stratum (c)	POUM <sup>a</sup> (d)
Latin America	78.05	77.82	82.22	80.91
Argentina	89.64	89.82	94.59	83.96
Bolivia (Plurinational State of)	68.59	66.46	77.33	60.46
Brazil	86.27	86.81	82.35	86.44
Colombia	81.91	81.48	92.15	80.31
Costa Rica	70.43	68.60	69.11	72.50
Chile	90.97	91.18	87.87	93.06
Ecuador	77.39	74.53	82.08	80.64
El Salvador	72.58	71.56	85.84	74.07
Guatemala	75.40	73.60	77.58	74.19
Honduras	78.89	78.93	76.25	80.80
Mexico	74.95	72.88	82.27	76.99
Nicaragua	69.68	68.92	71.42	77.55
Panama	81.71	84.53	87.77	86.95
Paraguay	94.08	94.76	92.47	96.09
Peru	91.26	90.45	98.75	93.69
Uruguay	79.50	78.46	84.37	86.92
Venezuela (Bolivarian Republic of)	42.59	37.53	63.97	54.23
Dominican Republic	74.40	72.85	83.49	74.35

Source: prepared by the authors on the basis of data from Latinobarómetro, 2007.

<sup>a</sup> Prospect of upward mobility.

are in a lower stratum and expect their children to move up to a higher one.<sup>5</sup>

At this point, a proviso should be mentioned. Alesina and Giuliano (2009) distinguish two interpretations of POUM. According to the first, which is the weaker, social mobility interacts with redistribution preferences. From this point of view, the earlier analysis confirms the hypothesis, at least where respondents with below-average incomes are concerned. In the context of table 2, it is only required that  $(c) > (a) > (b)$ . The second interpretation, which is more rigorous because based on a fuller context of rationality, is actually the one put forward by Benabou and Ok (2001). The idea is that agents base their thinking on the average income level and only cease to call for redistribution if they expect a move to the higher income level in future. Thus, agents who expect their children to be better off than them but not necessarily to move up to a higher level will still call for redistribution. Consequently, in the context of table 2,  $(d) < (b)$ .

To sum up, the findings show that the demand for income redistribution is greatest among respondents who expect their children to be worse positioned than them in society. This holds true for Latin America generally and for most of the countries. Only Brazil, Chile, Costa Rica, Honduras, Panama and Paraguay are exceptions to this model. Although POUM is confirmed insofar as mobility influences redistribution preferences, strictly speaking the hypothesis is not supported by the results. Overall, the demand for redistribution in group (d) is greater than total undifferentiated demand (a).

Strictly speaking, the expected behaviour is found in Argentina, Colombia and the Plurinational State of Bolivia. The Plurinational State of Bolivia is an emblematic case, as 68.59% of respondents there call for income redistribution. However, the proportion is lower (66.46%) among those expecting a higher level of income for their children (b) and lower still (60.46%) under the conditions proposed by POUM (d). In other words, POUM does seem to operate in this specific case.

### 3. Regressions for Latin America

The regression results are detailed in table 3. The estimates will make use of a logistic model with robust standard deviations for the two variables serving as proxies for the demand for redistribution. Since the questions are similar, a solid result should agree on both measures.

<sup>5</sup> Once again, 1 to 4 were taken as the lower stratum and 7 to 10 as the upper stratum.

The individual characteristics used were not significant. It cannot be argued, for example, that demand for redistribution is higher among women and older adults than others, as Ravallion and Lokshin (2000) found on the basis of Russian data. The positive and significant income variable represents demand deriving from self-interest. Those who consider their incomes inadequate call for redistribution. This result is not maintained for the second variable, however, which confirms the difficulty discussed earlier of capturing the effect of income level on the dependent variable.

Self-interested demand was confirmed from expectations of future income. Agents expecting their situation to worsen over the next 12 months are more likely to call for income redistribution. Other data can be captured by analysing the subjective mobility and inequality of opportunities variables. In the first place, there is greater demand from those who do not believe in the potential of effort: the subjective mobility variable is positive and quite significant. This finding for Latin America is close to that for the European countries analysed in Alesina and Angeletos (2005) and Alesina y Glaeser (2004). Consistently with this result, agents who perceive an inequality of opportunities are more sensitive to redistribution mechanisms, which bears out the finding of Gaviria (2007).<sup>6</sup> Alesina and La Ferrara (2005) and Fong (2006) reached the same conclusion using United States data.

The significance and effect of education on the demand for income redistribution are striking. The preference for mechanisms of redistribution increases systematically with education, contrary to the model of Meltzer and Richard (1981) and most empirical studies. Although this result may be due to an education-correlated variable that was not included in the model, it does at all events indicate that the demand for redistribution increases with education.<sup>7</sup>

<sup>6</sup> Initially, it can be argued that the inequality of opportunities variable becomes "confused" with the dependent variable, employed as a proxy for the demand for redistribution. However, the standard of fairness on which respondents form their preferences is unknown a priori. The findings presented indicate that the Latin American perception is similar to the view taken by modern egalitarians. It is possible to perceive inequality of opportunities yet not to call for redistribution of income because the standard taken for this is strict inequality, for instance. In any event, the perception of inequality of opportunities is widely used as a proxy in the literature.

<sup>7</sup> Analysing the exact reasons for this is beyond the scope of this study. Nonetheless, if the theory of the omitted variable is accepted, and bearing in mind the relationship between political stances and the demand for redistribution, a positive correlation between education and "left-wing" political views could produce this result. That would imply a powerful system of ideological perpetuation.

TABLE 3

**Latin America (selected countries): income redistribution preferences**

	Demand for redistribution (I)	Demand for redistribution (II)
Constant	-0.3163* (0.1741)	-0.2955* (0.1780)
<b>Individual characteristics</b>		
Female	0.0834 (0.0659)	-0.0405 (0.0653)
Age	-0.0005 (0.0025)	0.0022 (0.0025)
Married	0.0188 (0.0660)	0.0754 (0.0655)
<b>Education</b>		
Basic	0.4414*** (0.1199)	0.1344 (0.1230)
Secondary	0.6359*** (0.1226)	0.4368*** (0.1264)
Higher	0.8220*** (0.1340)	0.5309*** (0.1369)
<b>Self-interest</b>		
Current income	0.2304*** (0.0685)	0.0230 (0.0667)
Future income	0.8394*** (0.1051)	0.4578*** (0.0939)
Risk aversion	-0.1596** (0.0674)	-0.0733 (0.0664)
<b>Perception of mobility</b>		
Subjective	0.4870*** (0.0689)	0.3063*** (0.0677)
Past	-0.0422** (0.0176)	-0.0407** (0.0178)
Future	0.0227 (0.0172)	-0.0104 (0.0170)
<b>Fairness</b>		
Inequality of opportunities	0.9726*** (0.0627)	1.4823*** (0.0638)
<i>Number of observations</i>	5 848	5 911
<i>Pseudo R<sup>2</sup></i>	0.0771	0.1047

Source: prepared by the authors on the basis of the estimation results.

Note: standard deviation in parentheses.

\*p < 0.10, \*\*p < 0.05 and \*\*\*p < 0.01.

The past mobility variable is negative and significant. Agents call for redistribution when they perceive their living standards to be lower than their parents'. Given the preliminary data, this is a predictable finding that demonstrates the importance of the yardsticks against which people measure their economic situation. Individuals may come out in favour of redistribution even when they are not at a low income level, as it is enough for them to feel that they are worse off than the previous generation.

This variable is an important control mechanism for the POUM test. When it is excluded from the model,

the reason for agents not to be calling for redistribution may be that they perceive they have better incomes than their parents, and not that they expect their position to improve in future. In some studies, such as Corneo and Gruner (2002), past mobility is used in the POUM test in the absence of a measure of future expectations. The basic argument is that, in an information-poor context where individuals do not know exactly what their prospects of social advancement are, experience of past mobility might be extrapolated into the future. The results analysed, and especially those in table 1,

indicate that this is not a reasonable assumption. Because the experience of mobility is an important determinant of demand for redistribution, this strategy could result in unjustified acceptance of the hypothesis.

As expected, the data for the Latin American countries do not bear out the POUM hypothesis. As can be seen from figure 3, the parameter associated with future mobility, while not significant, is positive with respect to the first variable. The bar is not set high: a negative and significant parameter would indicate a lesser demand for redistribution on the part of individuals optimistic about their children's position, irrespective of the income levels expected. POUM, it should be recalled, is linked to a very important premise: that redistribution policies persist for long periods. This premise can lose credibility in, essentially, two situations: (i) when agents do not believe that redistributive policies will be maintained, so that there would be no point in opposing redistribution, even if there were an expectation of future upward mobility; (ii) when agents think in terms of shorter periods than the one required by POUM. Point (i) is especially important in contexts of political instability. For expectations of future income, which proved significant, a period of 12 months was taken. Contradicting the underlying premise, this finding indicates that agents work to a shorter planning horizon than the one required by the POUM hypothesis.

It is interesting to observe the marginal effect of the variables on the likelihood of income redistribution being called for (see table 4). Other things being equal, those who believe that equality of opportunities is not guaranteed are 19.36% more likely to call for redistribution than those who believe that it is. This is the largest marginal effect in relation to the significant variables. The likelihood of redistribution being called for also tends to increase with education level.

TABLE 4

**Latin America (selected countries):  
probability of respondents calling for income  
redistribution relative to the base group  
(Percentages)**

Variable	Probability
Basic education	10.51
Secondary education	14.39
Higher education	17.43
Current income	5.68
Future income	17.68
Subjective mobility	11.48
Inequality of opportunities	19.36
Past mobility	-1.05

Source: prepared by the authors on the basis of the estimation results.

Respondents who expect their situation to worsen in the next 12 months are 17.68% more likely to call for income redistribution than those who expect their situation to improve. For each level of improvement perceived by respondents relative to their parents, they become about 1% less likely to call for redistribution. Applying the same reasoning, the marginal effects of the subjective mobility and income variables are 11.48% and 5.68%, respectively.<sup>8</sup>

This indicates that the sense of fairness may have a greater effect than self-interest variables such as current income and expectations of future income, and than belief in the role of effort in determining income (summarized in this case by subjective mobility). This being so, reducing inequality of opportunities would not only have a positive effect in itself but would help to reduce the demand for redistribution and break the vicious circle of high taxes, low investment and disincentives to effort.

The specific regression by countries yields further data on top of those of the aggregate analysis. The main results are detailed in annex B. The parameters relating to the perception of inequality of opportunities stand out, since that variable is significant in the great majority of countries. Thus, the demand for income redistribution in Latin America is definitely motivated in part by a sense of fairness. On the whole, these results do not have the same explanatory power as the aggregate results, as they are not a good match in respect of the two proxies used. Furthermore, the results of some variables that were significant for the region as a whole did not hold up in specific cases. In summary, income redistribution preferences vary from country to country. As Alesina and Giuliano (2009) emphasize, differences in religion, culture and macroeconomic variability may account for the variation in results.

According to the preliminary analysis, the POUM hypothesis is not rejected in the Plurinational State of Bolivia. By virtue of the results for both variables, it cannot be ruled out in the Bolivarian Republic of Venezuela, El Salvador, Nicaragua or Peru. Although they do not strictly meet the requirements (see table 2), these are countries where expectations of future mobility are incorporated into the demand for redistribution ( $c > a > b$ ).

<sup>8</sup> To calculate the marginal effects,  $k(1-k)\beta$  was taken, where  $k = e^{(\beta x)} / (1 + e^{(\beta x)})$ . In the case of the dichotomous variables,  $x = 1$  in this formula. The parameter estimated for the first redistribution demand variable was used in the calculation.

## IV

### Final considerations

Data on the evolution of social spending and government size in Latin America have fed into the debate on the demand for income redistribution. This study has analysed the formation of redistribution preferences in the region. The results bear out some of the findings reported in the literature. The demand for redistribution in Latin America is not due to specific individual characteristics but is determined above all by education level, self-interest and a sense of fairness associated with belief in equality of opportunities.

A perceived reduction in inequality of opportunities can reduce the demand for redistribution and help to break the vicious circle of high taxes, low investment and

disincentives to effort. Rewards for effort and recognition of their existence by agents set the Latin American situation apart from that of the European countries.

The hypothesis that there is less demand for redistribution among agents who expect to rise in the social scale was also tested. In contrast to what has been stated by Alesina and La Ferrara (2005), Ravallion and Lokshin (2000) and other authors in respect of various regions, Latin Americans do not present the behaviour expected by Benabou and Ok (2001). Agents do not think in terms of average income, and they call for income redistribution even when they expect their children to attain a higher level of income.

## ANNEX A

## Questionnaire

**Demand for income redistribution (I)**

In your opinion, how fair is the distribution of income in the country?

(1) Unfair or very unfair; (0) Fair or very fair.

**Demand for income redistribution (II)**

How fairly is wealth distributed in the country?

(1) Not very or not at all; (0) Somewhat or completely.

**Female**

(1) Female; (0) Male

**Married**

(1) Married/Cohabiting; (0) Single/Separated/Divorced/Widowed

**Education**

Seven groups are distinguished in the survey: illiterate, incomplete basic education, complete basic education, incomplete secondary (intermediate, technical) education, complete secondary (intermediate, technical) education, incomplete higher education and complete higher education. The level was taken irrespective of completion or non-completion. In other words, basic education = incomplete basic + complete basic. The same holds for secondary and higher education. The illiterate group was omitted from the regression and taken as the base group for comparing the results.

**Current income**

Are the pay you receive and your family's total income enough to meet your needs satisfactorily? Which of the following describes you? (1) They are not enough. You have difficulty or great difficulty; (0) They are enough for you to live on without great difficulty.

**Future income**

In the next 12 months, do you think your own and your family's situation will be:

(1) Somewhat or much worse? (0) Somewhat or much better?

**Risk aversion**

How concerned would you say you are about becoming jobless or unemployed in the next 12 months?

(1) Concerned or very concerned; (0) Not very or not at all concerned.

**Subjective mobility**

In (country of reference), do you think that someone who is born poor and works hard can become rich, or don't you think it is possible for someone born poor to become rich?

(1) It is not possible for someone born poor to become rich; (0) Someone who is born poor and works hard can become rich.

**Perceived inequality of opportunities**

How equal are the opportunities people have in the country, regardless of their origin?

(1) Not very or not at all equal; (0) Somewhat or completely equal.

**Past mobility and future mobility**

These variables were constructed following Gaviria (2007). Consider the following questions: "Imagine a 10-point scale, with 1 being the poorest people and 10 the richest. Where are you on the scale? Where would your parents be? Where do you think your children will be?" From the respondent's point of view:

Past mobility =  
where I am - where my parents were

Future mobility =  
expectation of where my children will be - where I am

Note that these variables lie along the range of -9 (1-10) to 9 (10-1). The higher the value assigned to past mobility, the better the current situation will be compared to that of the past. The higher the value assigned to future mobility, the better off the respondents' children will be relative to themselves.



## ANNEX B

TABLE B.1

**Latin America (selected countries): income redistribution preferences (I)**  
(Dependent variable: demand for income redistribution)

	Argentina	Bolivia (Plurinational State of)	Brazil	El Salvador	Mexico	Nicaragua	Peru	Venezuela (Bolivarian Republic of)
Constant	1.9098*	-0.5375	-0.6246	-2.9916***	-0.6641	0.2693	17.0669***	0.5058
<b>Individual characteristics</b>								
Female	0.3705	-0.1428	0.1635	0.9243**	-0.0815	0.5797*	-0.1396	0.3669
Age	-0.0093	0.0077	0.0240*	0.0161	0.0228	-0.0188**	-0.0292*	-0.0231*
Married	-0.5511	0.0356	0.1704	0.4216	-0.4888	0.6566**	0.1783	-0.0566
<b>Education</b>								
Basic	-1.0921***	0.8040*	0.9232	0.4730	0.7507	0.3520	-13.6711***	-1.7593**
Secondary	-1.2616**	0.6135	1.9284***	1.0199*	0.8463	0.0802	-15.1011***	-2.0923***
Higher	n/a	1.4800***	1.6537**	3.6116**	0.9893	0.9741	-14.4336***	-1.5446*
<b>Self-interest</b>								
Current income	1.0710	0.1657	-0.2198	0.1423	0.2397	0.1941	0.8083*	0.0598
Future income	1.8864**	0.5052	n/a	1.6224***	0.7986**	0.3260	-0.5797	1.6862***
Risk aversion	0.4009	-0.2813	0.0525	0.3958	-0.0307	-0.6367**	0.2328	0.2246
<b>Perception of mobility</b>								
Subjective	0.4711	-0.0549	0.3482	0.5438	0.4479	0.0740	0.3020	0.6266**
Past	0.2542*	-0.0942	-0.1830**	-0.0579	-0.0097	-0.0976	-0.0512	-0.0684
Future	0.1150	-0.1221*	-0.0369	-0.2985**	-0.0130	-0.0905	-0.0781	0.0046
<b>Fairness</b>								
Inequality of opportunities	1.4587***	1.0529***	0.5352*	1.9534***	0.2794	0.7562***	1.0600***	1.9807***
<i>Number of observations</i>	243	367	433	228	384	288	345	501
<i>Pseudo R<sup>2</sup></i>	0.1838	0.0893	0.0722	0.3246	0.0474	0.0842	0.1028	0.2914

Source: prepared by the authors on the basis of the estimation results.

Note: \*p < 0.10, \*\*p < 0.05 and \*\*\*p < 0.01.

TABLE B.2

**Latin America (selected countries): income redistribution preferences (II)**  
(Dependent variable: demand for income redistribution)

	Argentina	Bolivia (Plurinational State of)	Brazil	El Salvador	Mexico	Nicaragua	Peru	Venezuela (Bolivarian Republic of)
Constant	1.7739**	-0.7246	0.3928	-0.3062	-1.1874	0.3308	1.8490**	-0.9072
Individual characteristics								
Female	-0.3626	0.2282	0.3352	-0.9797***	-0.1485	-0.1415	0.1627	0.1948
Age	-0.0105	0.0105	0.0047	0.0000	0.0097	0.0028	-0.0179	-0.0286**
Married	0.0586	-0.4030	0.0136	-0.2760	0.1774	-0.1804	-0.0127	0.6790***
Education								
Basic	-1.0169	0.5487	0.2874	0.3668	1.0259	-0.0912	-0.2370	0.2185
Secondary	-1.6857***	0.6367	1.2301*	0.5728	1.1935*	0.8314**	-0.5039	-0.4329
Higher	n/a	0.2771	1.2670	1.4211**	1.7112**	2.2843***	-0.6491	-0.2078
Self-interest								
Current income	0.3773	-0.0507	0.6375**	0.2567	0.1500	0.4917	-0.5672*	0.1747
Future income	1.7895*	0.2029	1.1799	0.8611**	0.5174	0.4204	0.1252	0.1984
Risk aversion	0.5985	0.1729	-0.5217	-0.2204	-0.4296	-1.0442***	0.1552	0.1988
Perception of mobility								
Subjective	1.0410**	-0.3939	-0.1159	0.1345	0.5185	-0.1667	0.7776**	0.6572**
Past	0.1294	-0.0646	0.0349	-0.0770	-0.2192***	-0.0943	0.0301	0.0007
Future	-0.0454	0.0170	0.0230	0.0209	-0.0690	-0.1314**	-0.1531**	-0.1609**
Fairness								
Inequality of opportunities	1.8584***	1.1458***	0.9705***	1.6448***	1.3800***	1.1167***	1.3669***	2.4973***
Number of observations	248	373	455	232	383	296	350	512
Pseudo R <sup>2</sup>	0.2143	0.0697	0.0937	0.1854	0.1350	0.1365	0.1160	0.2703

Source: prepared by the authors on the basis of the estimation results.

Note: \*p < 0.10, \*\*p < 0.05 and \*\*\* < 0.01.

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# NAFTA's uninvited guest: China and the disintegration of North American trade

*Enrique Dussel Peters and Kevin P. Gallagher*

## ABSTRACT

This paper examines the extent to which China's entry into the World Trade Organization (WTO) in 2001 and subsequent surge in global exports affected the composition of trade between the United States and Mexico through 2009. The authors found that China's entry had a significant impact on the trade relations between these two North American countries, replacing and displacing many of the export strongholds in place before China joined the WTO and after the first stage of the North American Free Trade Agreement (NAFTA) (1994-2000). Based on this research, the authors offer a variety of policy options for reinvigorating United States-Mexico trade and cooperating with China in the global economy.

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## KEYWORDS

International trade, China, international economic relations, free trade, Mexico, United States, nafta, trade policy, case studies, textile industry, automobile industry

## JEL CLASSIFICATION

O11, O24, O53, O54

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# I

## Introduction

Many promises were attached to the North American Free Trade Agreement (NAFTA) between Mexico, the United States and Canada. In Mexico and the United States (the two NAFTA countries focused on in this paper), there was no lack of rosy predictions of export, employment and gross domestic product (GDP) growth for each country. Indeed, traditional theory predicted such an outcome, with the agreement allowing each nation to specialize in those sectors where each had a comparative advantage. Such an arrangement would create new winners and losers, but most predictions had the winners winning more than the losers would lose, thus holding out the possibility of the winners compensating the losers and all members being better off. However, the models assumed, among other things, that trade arrangements outside of NAFTA would remain constant. In 1994, none of the analyses or models reflected concern that China

might enter the World Trade Organization (WTO) in 2001 with comparative advantages in a handful of sectors that were dear to both the United States and Mexico.

This paper analyses the extent to which China's rise has posed a competitive threat to United States-Mexico trade and NAFTA as a trade bloc. The paper is divided into five sections, including this brief introduction. Section II reviews the literature on NAFTA and its expected effects on the region's economy. Section III presents a quantitative analysis of the extent to which China has penetrated NAFTA members' import markets in Mexico and the United States. Section IV presents the results from two case studies, one in the yarn, textiles and garments commodity chain and the other in the autoparts and automobile chain. The final section summarizes our main findings and makes suggestions for further research and policy efforts.

# II

## Review of the literature

NAFTA has been a source of controversy for over 20 years. In general, it was predicted that the agreement would bring economic gains to all parties, with relatively larger benefits for Mexico (USITC, 1992). For the United States, Mexico's geographical proximity and existing level of integration made an agreement very attractive (Erzan and Yeats, 1992). Whereas the United States Congressional Budget Office (CBO) predicted that Mexico could grow between 6% and 12% thanks to NAFTA, predictions for the United States economy were around 0.25% (CBO, 1993; Kehoe, 1994). The agreement was not expected to lead to significant job losses in the United States: perhaps half a million jobs over more than a decade (CBO, 1993). Moreover, although it would lead to a rise in average wages in the United States, it would have little or no effect on low-wage workers there (Burfisher, Robinson and Thierfelder, 2001). Indeed, several models predicted a growing trade surplus for the United States with Mexico. According

to the boldest predictions, "with NAFTA, U.S. exports to Mexico will continue to outstrip Mexican exports to the United States, leading to a U.S. trade surplus with Mexico of about \$ 7 billion to \$ 9 billion annually by 1995, rising to \$ 9 billion to \$ 12 billion between the years 2000 and 2010" (Hufbauer and Schott, 1993, p. 14).

At the time it was signed, NAFTA was expected to impact both Mexico and the United States in a number of other ways. First, most analyses assumed that NAFTA would have general positive effects on Mexico's exports in the long run, specifically those to the United States, based largely on the argument that free trade has positive and automatic effects on growth.

Second, some authors stressed that Mexico would require a number of general and sectoral adjustments in the short and medium run and that there could be negative effects for Mexico in specific sectors. The authorities of some nations outside NAFTA also expressed concern that

the agreement's rules of origin would take comparative advantages away from non-NAFTA trading partners and create trade diversion. From this perspective, the three NAFTA members could potentially incur welfare losses due to increased prices related to rules of origin. The potential inclusion of other countries was discussed only in the 1990s for the case of Chile and has not been addressed again since. The potential impact of the trade activities of other nations—such as those in Asia, and China in particular—was not seriously considered during the NAFTA negotiations (Dussel Peters, 2000). For the “founders” of the agreement, NAFTA would be an active and offensive strategy vis-à-vis the world market rather than representing a “fortress” or defence against third countries—a view that coincided with expectations in the first stage of NAFTA.

Third, a number of authors saw NAFTA as guaranteeing Mexican exports to the United States over the long run. Some (Hufbauer and Schott, 1993; Weintraub, 1991) emphasized that Mexico's efficiency would improve because NAFTA included regimes such as intellectual property rights, eliminated national value added requirements and explicitly included the services and transport sectors. The substitution of quotas with tariffs in specific sectors, the elimination of tariffs in the long run, national treatment for regional firms and investments, the inclusion of labour and environmental standards as side agreements and a general notion of complementarity between Mexico and the United States fed expectations of positive results for Mexico in general, and for manufacturing and services in particular. Nevertheless, results in the agricultural sector were expected to be mixed and negative for Mexico. NAFTA integration and free trade, from a theoretical perspective, would thus have positive effects on Mexico's exports, foreign direct investment (FDI) flows, employment and wages (Hufbauer and Schott, 1993) and, therefore, political expectations were extremely high.<sup>1</sup>

Fourth, regarding the sectoral effects on Mexico's economy, it is important to differentiate between the short- and long-term impacts. While practically all the analyses stressed that Mexico's economy would require deep adjustments in all sectors—also as a result of

liberalization of imports and capital flows—there was a widespread consensus that Mexico's manufacturing sector would benefit from NAFTA in terms of exports, employment, wages and productivity growth.<sup>2</sup> Other authors highlighted that Mexico's socioeconomy would shift even more towards maquiladora processes (Kopinak, 1993), to the detriment of employment quality and the environment.<sup>3</sup> However, there was a consensus that particularly the agricultural sector and services, such as the banking sector, were the sectors in Mexico that would suffer most under NAFTA (Arroyo Picard and others, 1993; Grinspun and Cameron, 1993; VanGrasstek and Vega, 1992).

Only a few authors suggested that both countries could see a negative general impact on employment, business creation and competitiveness as a result of NAFTA (Donahue, 1991). Issues such as weak regional institutions were explicitly raised, for example, in comparison with the integration process in the European Union (Baer, 1991; Donahue, 1991; Piore, 1991; Shelburne, 1991).<sup>4</sup> According to estimates for the manufacturing sectors in general, intra-industry trade within the region would increase substantially. The Congressional Budget Office (CBO) predicted that NAFTA would boost exports of motor vehicles and autoparts to Mexico and increase imports at

<sup>2</sup> INFORUM (1991, VII-A-1) was one of the few models that attempted to make estimates at the regional and sectoral level in Mexico. On the basis of tariff removal (scenario 1) and removal of tariffs and non-tariff barriers (scenario 2), it was calculated that in 1989 United States exports to Mexico would increase most in agriculture, computers and motor vehicles, and to a lesser extent in apparel and television sets. From this perspective, under scenario 2, United States exports to Mexico would increase by 27% and imports from Mexico by 7% during the period 1989-2000. The same model assumed negative impacts in the agricultural sector for 1989-2000, while manufacturing sectors would mainly benefit during the period.

<sup>3</sup> “American jobs have moved across the border to pay predominantly young women far less than one dollar per hour ... The maquiladoras constitute a model of economic development tied to having the lowest wages in the world to attract multinational corporate investment that produces for foreign, not domestic, markets. Poorly paid workers can't afford to buy “internationally competitive” products. We have not seen Mexican workers' living standards raised by this economic development strategy” (Steve Beckman, United Auto Workers Association, quoted in United States International Trade Commission, 1990, pp. 1-23).

<sup>4</sup> Several chambers of industry, such as the National Chamber of Manufacturing Industries (CANACINTRA), were skeptical in 1994 regarding the potential for macroeconomic change and NAFTA: “We believe it is not sufficient to stabilize the vital signs of the economy. It is also not sufficient to modify the bases for the national development, nor to reconsider our insertion in the international flows of goods and capital, or to redefine the regulatory framework, if all of this is not complemented with a profound and intense restructuring of the activities and firms that integrate the economic network of the country” (CANACINTRA, 1994, p. 16; see also Caballero Urdiales, 1991, p. 65 et seq.).

<sup>1</sup> According to then President Salinas de Gortari of Mexico, “The Treaty will mean more jobs and better pay for Mexicans. This is fundamental as it will lead to more capital, more investment, which will mean more employment opportunities here, in our country, for our countrymen. Put simply, we will be able to grow more quickly and thus better focus our attention to benefit those that have the least” (quoted in SECOFI, 1992, p. 1).

a slower rate, therefore leading to a surplus or a narrower deficit. The CBO also foresaw increases in textile and garment trade between the United States and Mexico in both directions (CBO, 1993). However, some industry analysts expressed concern over China at an early stage in the discussions on the impact of NAFTA on the yarn-textile-garment value added chain. Although Chinese (and other Asian) exports were more competitive than Mexico's in terms of the United States import market, it was hoped that the agreement might boost Mexico's share so that the United States and Mexico might be able to join forces to meet challenges from abroad.

Lande (1991, p. 244) wrote "exchange-rate relationships will continue to favor labor-intensive

operations in Mexico and the Caribbean over traditional Far Eastern sources". That same analyst stated that NAFTA would be most welcome in the United States: if Mexico's access is increased as Far Eastern exports are reduced, there is a greater chance for success. Imports from Mexican industries are seen as less threatening to United States producers than those from the Far East or from Far Eastern controlled facilities in third countries. Far Eastern producers do not market through United States apparel companies, but often sell directly to retailers or to contractors in the United States. In contrast, Mexican producers are more likely to use normal United States distribution channels, including United States apparel companies (Lande, 1991, p. 243).

### III

## Analysis: China crashes the NAFTA party

In this section we examine the extent to which China is penetrating markets in the United States and Mexico, with a particular focus on Mexico. From the moment in which China joined the WTO in 2001 and up to 2009, we find that China outcompeted Mexico in the United States market and began to compete with the United States in the Mexican market. Interestingly, we find 53 sectors in Mexico where the United States is losing market share and China is gaining, thus appearing to allow Mexico to make efficiency gains and become more competitive in United States markets. However, in those 53 sectors—which represent 49% of all Mexico's exports to the United States—Mexico is losing market share in the United States. The case studies that follow will more closely examine these trends for the Mexican economy.

This section is divided into four parts. First, we outline trends in trade between the United States, Mexico and China from a historical perspective. Second, we examine the extent to which Mexico is competing with China in United States import markets. Third, we look at the extent to which the United States is competing with China in Mexican markets. Finally we examine a subset of 53 sectors in which the United States is losing market share to China in the Mexican market and in which Mexico is losing market share in the United States.

#### 1. NAFTA: conditions and trends

China is becoming an important trading partner for both Mexico and the United States. By 2009 China had become the second largest trading partner for both countries, whereas in 1995 China had not been among the top five trading partners for either one. Table 1 shows how China has gained significant ground in both the United States and the Mexican import markets since it joined the WTO in 2001.

As shown in table 1, in 2005 China leapfrogged over Mexico to become the second largest trading partner of the United States; it has remained in that position ever since.

As the United States market has become more open, both Mexico and China have gained ground. Mexico and China have very similar export profiles (Blázquez-Lidoy, Rodríguez and Santiso, 2006; Feenstra, 2007) and have been competing for United States market share in low-skilled manufactures for some time. Figure 1 shows that the market share of Mexican products in the United States was on the rise until it reached 11.6% in 2002 (just one year after China entered the WTO). In 2003, China's share leaped to 12.1% and has continued to gain ground ever since. In 2010, China accounted for 19.1% of all United States imports, and Mexico's share was 12.1%.

TABLE 1

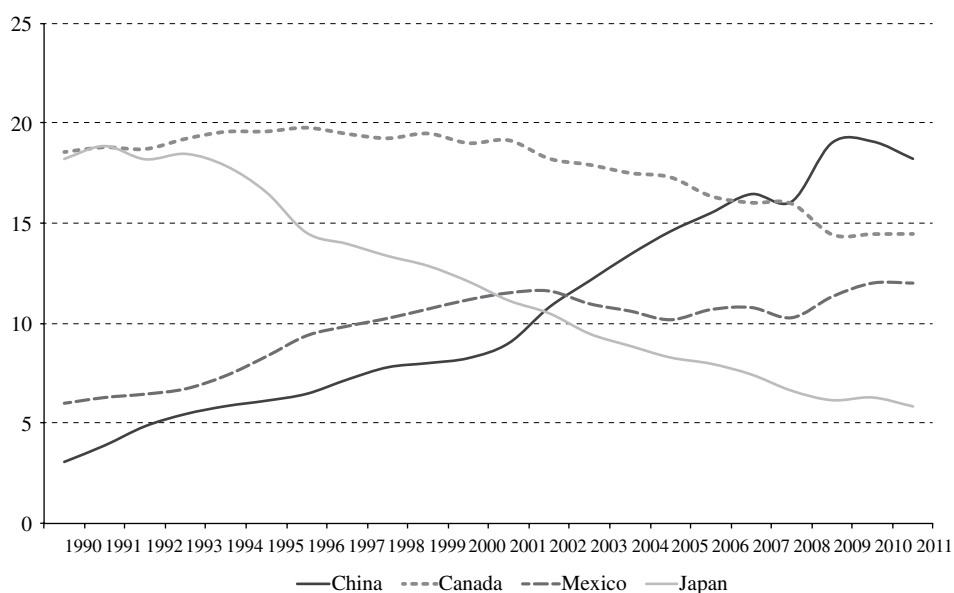
**Top trading partners of Mexico and the United States, 1993-2009**  
(Share of total trade)

Mexico					
	1	2	3	4	5
1994	United States	Japan	Germany	Canada	Spain
2000	United States	Canada	Japan	Germany	Republic of Korea
2003	United States	China	Japan	Germany	Canada
2009	United States	China	Canada	Japan	Germany
United States					
	1	2	3	4	5
1993	Canada	Japan	Mexico	United Kingdom	Germany
1999	Canada	Mexico	Japan	China	Germany
2003	Canada	Mexico	China	Japan	Germany
2005	Canada	China	Mexico	Japan	Germany
2009	Canada	China	Mexico	Japan	Germany

Source: prepared by the authors, on the basis of United Nations Commodity Trade Statistics Database (COMTRADE).

FIGURE 1

**United States: share of total imports, 1991-2011**  
(Percentages)



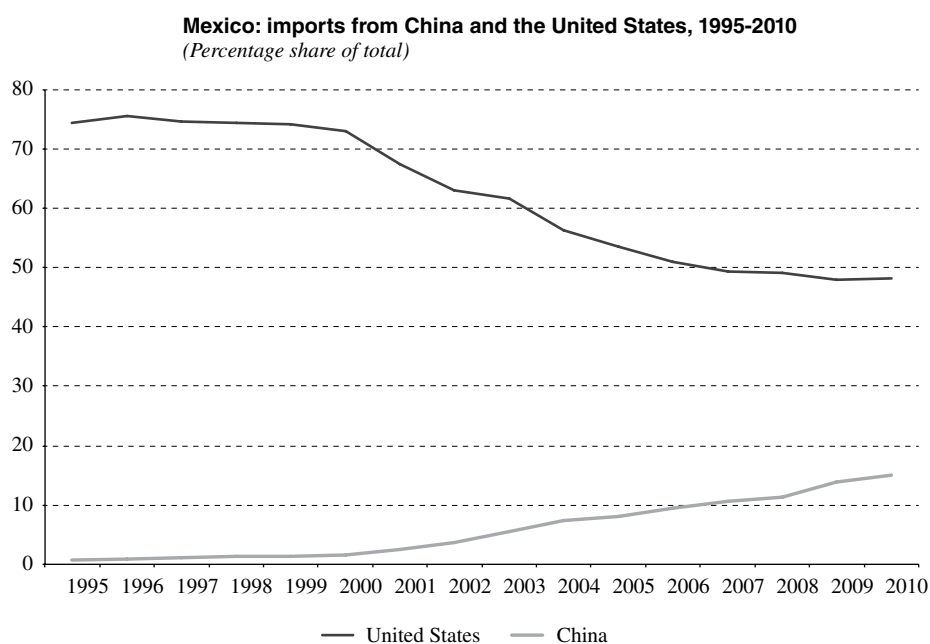
Source: prepared by the authors, on the basis of United States International Trade Commission, 2011.



Albeit in a less dramatic manner, the United States is losing ground in Mexican markets and China is gaining. In the first five years after NAFTA was signed, the United States had close to 75% of Mexican import markets, but that share shrank to 48% in 2009. China has gained market share, but it still accounts for a relatively small part of Mexican imports. As shown in figure 2, China held less than 0.75% of the Mexican market in 2000, but had captured 15.13% of that market by 2010. As the analysis will later show, in some sectors the trend is even more dramatic.

Table 2 shows the top 20 Mexican exports to the United States and the top 20 United States exports to Mexico in 2000. This year was chosen because it provides a benchmark before China entered the WTO and because 2000 was a high point for United States-Mexico trade. While China's share in the top 20 exports to the United States jumped from 6.22% in 2000 to 19.42% in 2009, Mexico's share faltered from 16.61% to 16.06% in the same period. Meanwhile, the United States' share in its top 20 exports to Mexico plummeted from 72% in 2000 to 41.54% in 2009, and China's share shot up from 1.09% in 2000 to 17.83% in 2009.

FIGURE 2



Source: prepared by the authors, on the basis of World Trade Atlas, 2011.

TABLE 2

**Mexico and the United States: main exports, 2000**

<i>Top 20 United States exports to Mexico</i>			<i>Top 20 Mexican exports to the United States</i>		
1	S2-776	Thermionic, microcircuits, transistors, valves, etc.	S2-781	Passenger motor vehicles (excluding buses)	
2	S2-784	Motor vehicle parts and accessories, nes	S2-333	Crude petroleum and oils obtained from bituminous minerals	
3	S2-772	Electrical apparatus for making and breaking electrical circuits	S2-764	Telecommunication equipment, nes; parts and accessories, nes	
4	S2-699	Manufactures of base metal, nes	S2-752	Automatic data processing machines and units thereof	

Table 2 (concluded)

<i>Top 20 United States exports to Mexico</i>			<i>Top 20 Mexican exports to the United States</i>		
5	S2-893	Articles, nes of plastic materials	S2-931	Special transactions, commodity not classified according to class	
6	S2-778	Electrical machinery and apparatus, nes	S2-773	Equipment for distribution of electricity	
7	S2-764	Telecommunication equipment, nes; parts and accessories, nes	S2-782	Lorries and special purposes motor vehicles	
8	S2-773	Equipment for distribution of electricity	S2-784	Motor vehicle parts and accessories, nes	
9	S2-583	Polymerization and copolymerization products	S2-761	Television receivers	
10	S2-713	Internal combustion piston engines, and parts thereof, nes	S2-772	Electrical apparatus for making and breaking electrical circuits	
11	S2-781	Passenger motor vehicles (excluding buses)	S2-821	Furniture and parts thereof	
12	S2-334	Petroleum products, refined	S2-778	Electrical machinery and apparatus, nes	
13	S2-749	Non-electric parts and accessories of machinery, nes	S2-713	Internal combustion piston engines, and parts thereof, nes	
14	S2-752	Automatic data processing machines and units thereof	S2-842	Men's and boys' outerwear, textile fabrics not knitted or crocheted	
15	S2-874	Measuring, checking, analysis, controlling instruments, nes, parts	S2-759	Parts, nes of and accessories for machines of headings 751 or 752	
16	S2-642	Paper and paperboard, precut, and articles of paper or paperboard	S2-843	Women's, girls', infants' outerwear, textile, not knitted or crocheted	
17	S2-771	Electric power machinery, and parts thereof, nes	S2-771	Electric power machinery, and parts thereof, nes	
18	S2-759	Parts, nes of and accessories for machines of headings 751 or 752	S2-874	Measuring, checking, analysis, controlling instruments, nes, parts	
19	S2-728	Other machinery, equipment, for specialized industries; parts nes	S2-716	Rotating electric plant and parts thereof, nes	
20	S2-931	Special transactions, commodity not classified according to class	S2-762	Radio-broadcast receivers	

Source: prepared by the authors, on the basis of United Nations Commodity Trade Statistics Database (COMTRADE).

Abbreviation: nes, not elsewhere specified.

## 2. Does China constitute a “threat” to North American trade?

Can we pinpoint the extent to which Chinese firms are outcompeting their Mexican and United States counterparts at a more specific sectoral level? For this analysis we draw on an established methodology developed by Lall and Weiss (2005). These authors study the changes in China's and Latin America and the Caribbean's export shares in both the world and the United States markets and look for evidence of increased Chinese competition in sectors where the penetration of Chinese exports is rising as the penetration of exports from Latin America and the Caribbean falls.

As shown in table 3, Lall and Weiss (2005) define various categories of competitive interaction between China and other countries in export markets. When China's market share in the United States market is rising and the share of Latin America and the Caribbean is falling, the authors classify the region as experiencing a “direct

threat” from China. Similarly, when the shares of both China and Latin America and the Caribbean are increasing, but China's share is growing faster, it would be a case of the region experiencing a “partial threat” from China.

Table 4 presents the results computed using the Lall and Weiss 2005 methodology. For these calculations we look at trade between 2000 (the year before China entered the WTO) and 2009. We conduct this analysis for 118 sectors covering all trade, disaggregated at the three-digit level using the United Nations Commodity Trade Database (COMTRADE) classification system, for the economies of the United States and Mexico. For each sector we calculate the market share in 2000 and in 2009, and the percentage-point change in market share during the period under consideration. Again, when market share for the United States or Mexico shrinks in a sector where China gains, that is called a “direct threat”. When the United States or Mexico increases its market share, but at a slower rate than China, it is termed a “partial threat”.

TABLE 3

**Matrix of competitive interactions between China and other countries in export markets**

		China's export market shares	
		Rising	Falling
Other countries' export market shares	Rising	<p align="center">A. No threat</p> <p>Both China and the other country have rising market shares and the latter is gaining more than China</p>	<p align="center">C. Reverse threat</p> <p>No competitive threat from China. The threat is the reverse, from the other country to China</p>
	Falling	<p align="center">B. Partial threat</p> <p>Both are gaining market share but China is gaining faster than the other country</p>	<p align="center">D. Direct threat</p> <p>China gains market share and the other country loses; this may indicate causal connection unless the other country was losing market share in the absence of Chinese entry</p>
			<p align="center">E. Mutual withdrawal: no threat</p> <p>Both parties lose market shares in export markets to other competitors</p>

Source: Sanjaya Lall and John Weiss, "China's competitive threat to Latin America: an analysis for 1990–2002", *Oxford Development Studies*, vol. 33, No. 2, Taylor & Francis, 2005.

TABLE 4

**The "threat" posed by China in Mexican and United States markets**  
(Percentages)

		Direct	Partial	Total
United States	Percentage of manufactures exports to Mexico	96	0	96
	Percentage of total exports to Mexico	62	0	62
Mexico	Percentage of manufactures exports to United States	52	29	81
	Percentage of all exports to the United States	36	20	56

Source: prepared by the authors, on the basis of United Nations Commodity Trade Statistics Database (COMTRADE), 2011; and Sanjaya Lall and John Weiss, "China's competitive threat to Latin America: an analysis for 1990–2002", *Oxford Development Studies*, vol. 33, No. 2, Taylor & Francis, 2005.

Table 4 shows that 96% of United States manufacturing exports to Mexico, which represent 62% of total United States exports to Mexico, are under threat from China. It is interesting to note in this case that none of the exports are experiencing a partial threat, rather all are considered to be under direct threat. For Mexico, 81% of Mexican manufactures exports and 56% of total Mexican exports to the United States are under threat from China. In the case of Mexican manufactures, 52% of Mexican exports to the United States are under direct threat, and 29% are under partial threat. The only sector in which Mexico is not under threat from China or is gaining market share with respect to China is in relation to cars, trucks and related parts and accessories. This is because such items are physically heavy to

transport from China and because the North American auto sector enjoys protection under NAFTA (Gallagher, Moreno-Brid and Porzecanski, 2008). In terms of total Mexican exports, 36% are under direct threat and 20% are under partial threat from China. Unlike Mexico, China does not export petroleum or other commodities to the United States, which explains why its total export share is not as significant.

Table 5 shows 53 sectors that we term under "triple threat." In these sectors, which represent 49% of all Mexican exports, the United States is losing market share to China in the Mexican market and Mexico is losing market share to China in the United States market. First let us examine the United States and China in the Mexican market. For the 53 sectors under consideration,

the United States share in the Mexican market was on average 69% in 2000. By 2009, that share had fallen to 43%, representing a 26 percentage point change in just nine years. For example, in 2000 the United States held 68% of the Mexican market for synthetic fibres and China had 0.1% of that market. By 2009 the United States' share had shrunk by 20 percentage points and China had increased its share by almost 14 percentage points. Likewise, in 2000 the United States supplied Mexico with 60.8% of its office machine and computer imports and 70% of the peripheral parts for those machines. By 2009 those shares had dropped by 51 percentage points and 60 percentage points, respectively. By 2009 the United States held only 10% of the Mexican import market in each. By contrast, China held 13% of the office machine import market and 5% of the parts market in Mexico in 2000 and, by nine years later, it had 48% and 58% of those markets, respectively. The United States commanded 60% of Mexico's telecommunications market in 2000, but lost 44 percentage points of market share and held just 16% of the market in 2009. In 2000 the United States supplied 90% of all Mexican imports of base metals manufactures, but that percentage dropped by 30 percentage points in 2009 when China increased its share in the Mexican market from 0% to 15%.

If the United States is losing market share to China in the Mexican market, that would indicate that export-oriented firms operating in Mexico may have the opportunity for efficiency and productivity gains. The United States is presumably losing ground because Chinese imports are cheaper than their United States counterparts. To the extent that Chinese exports to Mexico represent inputs to Mexican firms, firms in Mexico should be able to export at a more competitive price (Lederman, Olarreaga and Rubiano, 2008). However, for the same 53 sectors where the United States is losing market share to China, Mexico is actually losing market share to China in the United States market. On average, Mexico held 14% of the United States import market for these sectors in 2000, but that share dropped to 9% in 2009. Returning to the example of the synthetic fibre sector, in 2000 Mexico had 15% of the United States import market, but that share dropped by 14 percentage points to just 1% in 2009. In 2000 Mexico supplied the United States with 9% of its office machine and computer imports and 11% of the peripheral parts for those machines. By 2009 those shares dropped by 9 percentage points and 5 percentage points, respectively, to stand at approximately 1% and 2%, respectively, of the United States import market. With regard to telecommunications, Mexico is also losing market share in the United States.

TABLE 5

**The "triple threat"**  
(Percentages)

Products	Change in United States exports to Mexico (2000-2009)	Change in Chinese exports to Mexico (2000-2009)	Change in Mexican exports to the United States (2000-2009)
1 Synthetic fibres suitable for spinning	-20.5	13.4	-14.1
2 Other man-made fibres for spinning, and waste	-2.6	8.0	-7.1
3 Alcohols, phenols, etc., and their derivatives	-11.1	1.4	-1.2
4 Soap, cleansing and polishing preparations	-8.8	0.9	-5.9
5 Fertilizers, manufactured	-7.0	5.4	-0.04
6 Regenerated cellulose; derivatives of cellulose; vulcanized fibre	-19.0	3.2	-0.3
7 Pesticides, disinfectants	-1.0	2.8	-3.7
8 Miscellaneous chemical products, nes	-11.0	2.5	-0.3
9 Manufactures of leather or of composition leather, nes; etc.	-36.9	8.4	-7.6
10 Furskins, tanned or dressed; pieces of furskin, tanned or dressed	-45.8	1.5	-0.6
11 Cotton fabrics, woven (not including narrow or special fabrics)	-21.3	11.2	-6.0
12 Fabrics, woven, of man-made fibres (not narrow or special fabrics)	-5.7	9.0	-1.0
13 Knitted or crocheted fabrics (including tubular, etc., fabrics)	-13.1	15.8	-4.0

Table 5 (concluded)

Products	Change in United States exports to Mexico (2000-2009)	Change in Chinese exports to Mexico (2000-2009)	Change in Mexican exports to the United States (2000-2009)
14 Tulle, lace, embroidery, ribbons, trimmings and other small wares	-30.0	9.4	-4.6
15 Made-up articles, wholly or chiefly of textile materials, nes	-44.3	25.9	-8.0
16 Floor coverings, etc.	-19.7	3.2	-0.4
17 Pottery	-9.1	46.7	-1.9
18 Universals, plates, and sheets, of iron or steel	-13.5	1.9	-1.9
19 Tube, pipes and fittings of iron or steel	-12.5	11.3	-1.7
20 Nails, screws, nuts, rivets, etc., of iron, steel or copper	-28.6	8.9	-0.9
21 Cutlery	-19.4	11.5	-0.9
22 Household equipment of base metal, nes	-26.8	28.5	-9.8
23 Manufactures of base metal, nes	-29.6	14.9	-1.5
24 Steam boilers and auxiliary plant; and parts thereof, nes	-5.1	9.0	-0.4
25 Rotating electric plant and parts thereof, nes	-16.2	15.6	-12.2
26 Civil engineering, contractors' plant and equipment and parts, nes	-12.3	2.5	-0.2
27 Food-processing machines (non-domestic) and parts thereof, nes	-11.3	1.9	-1.2
28 Non-electric parts and accessories of machinery, nes	-22.4	8.3	-2.7
29 Office machines	-51.1	35.0	-8.1
30 Parts, nes of and accessories for machines of headings 751 or 752	-60.3	53.4	-4.8
31 Television receivers	-28.4	27.2	-11.3
32 Radio-broadcast receivers	-2.8	8.0	-9.1
33 Gramophones, dictating machines and other sound recorders	-42.2	53.4	-4.5
34 Telecommunication equipment, nes; parts and accessories, nes	-43.6	37.0	-2.5
35 Electric power machinery, and parts thereof, nes	-51.5	36.7	-7.0
36 Equipment for distribution of electricity	-27.6	15.7	-16.8
37 Electro-medical and radiological equipment	-16.2	5.1	-1.4
38 Passenger motor vehicles (excluding buses)	-26.8	0.3	-2.0
39 Trailers, and other vehicles, not motorized, nes	-9.0	6.7	-2.0
40 Railway vehicles and associated equipment	-31.3	7.2	-16.4
41 Furniture and parts thereof	-32.4	18.3	-4.5
42 Travel goods, handbags etc., of leather, plastic, textile, others	-22.6	20.6	-2.4
43 Men's and boy's outerwear, textile, not knitted or crocheted	-47.9	8.7	-5.9
44 Women's, girls', infants' outerwear, textile, not knitted or crocheted	-66.7	3.0	-9.9
45 Outerwear knitted or crocheted, not elastic nor rubberized	-61.4	5.0	-7.6
46 Under-garments, knitted or crocheted	-72.7	0.5	-13.1
47 Clothing accessories, of textile fabrics, nes	-45.6	14.1	-5.7
48 Articles of apparel, clothing accessories, non-textile, headgear	-57.2	38.1	-0.7
49 Footwear	-8.2	9.5	-0.7
50 Meters and counters, nes	-13.7	6.4	-5.1
51 Measuring, checking, analysis, controlling instruments, nes, parts	-26.1	5.7	-4.1
52 Photographic and cinematographic supplies	-4.2	1.0	-3.6
53 Baby carriages, toys, games and sporting goods	-26.7	34.1	-1.5

Source: prepared by the authors, on the basis of United Nations Commodity Trade Statistics Database (COMTRADE), 2011.

Abbreviation: nes, not elsewhere specified.

## IV

### Case studies

NAFTA has gone through at least two stages since its implementation: 1994-2000, in which integration deepened in terms of trade and investments, and 2001-2010, when most of the prior processes reversed.<sup>5</sup> Table 6 accounts for these trends and the profound changes in Mexico's trade in the last decade: Mexico's trade with

the United States declined from 81.03% of its total trade in 1999 to 63.95% in 2010, mainly as a result of the drop in Mexico's imports (from 74.15% to 48.10% of total imports for the same period), although its share of exports to the United States also fell by almost 9%.

In order to understand these trends, two specific value added chains in Mexico are analysed in the context of NAFTA and the country's relations with the United States. As mentioned in the previous section, both chains were expected to post outstanding performances in the context of NAFTA.

<sup>5</sup> For a detailed analysis of intra-industry trade between Mexico, China and the United States, see Cárdenas Castro and Dussel Peters (2011). Intra-industry trade peaked in 2000 and has declined steadily ever since.

TABLE 6

**Mexico: main trade structures, 1993-2010**  
(Share of total)

	Total	United States	European Union	Asia (including China)	China	Other
<b>Exports</b>						
1993	100.00	82.70	5.21	2.60	0.09	9.49
1994	100.00	84.78	4.72	2.54	0.07	7.96
1995	100.00	83.32	4.24	2.57	0.05	9.87
1996	100.00	83.93	3.72	2.71	0.04	9.64
1997	100.00	85.46	3.69	2.17	0.04	8.68
1998	100.00	87.63	3.42	1.87	0.09	7.08
1999	100.00	88.19	4.02	1.56	0.09	6.23
2000	100.00	88.73	3.46	1.30	0.12	6.51
2001	100.00	88.53	3.41	1.40	0.18	6.66
2002	100.00	88.11	3.50	2.06	0.41	6.34
2003	100.00	87.57	3.77	2.24	0.59	6.42
2004	100.00	87.51	3.63	2.10	0.52	6.76
2005	100.00	85.68	4.27	2.23	0.53	7.82
2006	100.00	84.75	4.40	2.55	0.68	8.30
2007	100.00	82.07	5.35	2.80	0.70	9.77
2008	100.00	80.15	5.93	2.96	0.70	10.95
2009	100.00	80.59	5.06	3.29	0.96	11.06
2010	100.00	79.97	4.84	3.59	1.40	11.61
<b>Imports</b>						
1993	100.00	69.29	12.10	11.28	0.59	7.33
1994	100.00	69.11	11.59	11.93	0.63	7.37
1995	100.00	74.40	9.43	10.63	0.72	5.55
1996	100.00	75.49	8.80	10.06	0.85	5.66
1997	100.00	74.68	9.25	10.30	1.14	5.77
1998	100.00	74.38	9.57	10.24	1.29	5.81

Table 6 (concluded)

	Total	United States	European Union	Asia (including China)	China	Other
1999	100.00	74.15	9.28	10.66	1.35	5.92
2000	100.00	73.10	8.79	11.62	1.65	6.49
2001	100.00	67.56	10.00	15.05	2.39	7.39
2002	100.00	63.17	10.16	18.59	3.72	8.08
2003	100.00	61.78	10.93	18.68	5.51	8.61
2004	100.00	56.31	11.07	22.56	7.30	10.06
2005	100.00	53.44	11.71	24.19	7.98	10.66
2006	100.00	50.89	11.33	26.91	9.54	10.87
2007	100.00	49.47	12.00	28.18	10.55	10.36
2008	100.00	49.04	12.70	27.94	11.24	10.33
2009	100.00	47.97	11.62	30.79	13.88	9.63
2010	100.00	48.10	10.78	31.82	15.13	9.31
<b>Total trade</b>						
1993	100.00	75.23	9.05	7.44	0.37	8.28
1994	100.00	75.91	8.61	7.85	0.39	7.62
1995	100.00	79.07	6.71	6.41	0.37	7.81
1996	100.00	79.86	6.17	6.25	0.43	7.72
1997	100.00	80.09	6.46	6.22	0.59	7.23
1998	100.00	80.79	6.59	6.19	0.71	6.42
1999	100.00	81.03	6.71	6.20	0.74	6.07
2000	100.00	80.73	6.19	6.59	0.91	6.50
2001	100.00	77.74	6.80	8.43	1.32	7.04
2002	100.00	75.35	6.90	10.51	2.10	7.23
2003	100.00	74.45	7.41	10.60	3.09	7.53
2004	100.00	71.55	7.44	12.56	3.99	8.45
2005	100.00	69.28	8.06	13.40	4.32	9.26
2006	100.00	67.61	7.91	14.88	5.16	9.60
2007	100.00	65.47	8.73	15.72	5.71	10.07
2008	100.00	64.15	9.41	15.81	6.12	10.63
2009	100.00	64.12	8.37	17.17	7.48	10.34
2010	100.00	63.95	7.82	17.77	8.30	10.45

Source: prepared by the authors, on the basis of data from Banco de México (Banxico).

## 1. The yarn-textile-garment chain

The yarn-textile-garment chain has been one of the fastest changing worldwide over the past few decades. The patterns seen in this sector over the past 10 years include the increasing saturation of garments in developed countries; the deepening of full packaging processes in which suppliers are increasingly responsible for manufacturing costs, from buying all required inputs to financing these inputs (this is also seen in the services sector), including transportation, customs, logistics and coordination and distribution of goods in the final

consumer market; increasing product differentiation, including those meeting ethical and ecological standards; the growing influence over and control of the chain by retailers; a dramatic shortening of production and delivery times; and stiff global competition affecting prices. As a result, the existence and strengthening of a local supplier system is critical for facing these challenges (Dussel Peters, 2010a). At the beginning of the twenty-first century, the chain (which is controlled by its buyers and clients) seems to find itself in a more liberal period compared with recent decades, considering the end of the Multifibre Arrangement (MFA) in 2005, the marked

reduction of public interventions (in terms of tariff and non-tariff barriers and government subsidies) and the concentration of support instruments in the textile and accessories industry, and, to a lesser degree, in the clothing industry (Frederick and Gereffi, 2009).

In addition to these trends, there has been a rapid “reorientation” of the yarn-textile-garment chain. While China, India, Bangladesh and Pakistan, among other countries, substantially increased their share of global production and trade in the first decade of the twenty-first century, developed countries have witnessed a continuous fall in production and trade since the 1980s. In the case of the United States, for example, textiles and apparel accounted for 1.1 million jobs in 2000, but that figure had more than halved by 2008 and is expected to fall by a further 22.6% by 2016 (Bureau of Labor Statistics, 2009).

In Mexico the yarn-textile-garment chain is one of the symbols of global and NAFTA integration. Based on the latest input-output matrix for the Mexican economy for 2003 (Dussel Peters, 2010a), this chain has several distinctive features. On the one hand, there are marked differences between the segments that make use of the maquiladora industry and the rest. The levels of imported inputs as a proportion of total inputs are higher for the chain than for all other areas of manufacturing: 33.1% for the yarn-textile-garment chain and 38.2% for the textile segment. In 2003, foreign trade accounted for 51% of output and 60% of the apparel segment. Despite the high level of integration in the world market, the chain has a profound structural weakness: its high component of net imports. In the case of the maquiladora industry, domestic content for the entire economy, manufacturing, the yarn-textile-garment chain and the textile segment was 0.3%, 3.1%, 4.7% and 15.7%, respectively. This structure is the result of complex incentives linked to temporary imports to be exported (Cárdenas Castro and Dussel Peters, 2007). On the other hand, the chain stands out for paying taxes (on output) that are 45% higher than in the Mexican economy as a whole (for apparel, taxes were 63% higher), for payments per employee (23% lower than the overall economy, with the exception of the textile segment) and for being particularly job-creation sensitive as a result of import substitution: a 10% increase in final demand owing to import substitution would lead to the creation of 17,000 jobs in the chain, particularly in the garment segment. Only 5 of 75 activities in the entire economy would generate more employment than the yarn-textile-garment chain (Dussel Peters, 2010a).

Considering the yarn-textile-garment chain’s growing orientation towards foreign trade (and a 60%

share of apparel production in 2003), what are the main features in terms of production, employment, trade and integration in the United States market and its relationship with China?

First, the yarn-textile-garment chain accounted for 0.9% and 5% of Mexico’s total and manufacturing gross value added, respectively, in 2009. Table 7 reflects the strong cyclical movement of the chain during the first NAFTA stage (until 2000) and the fall of GDP and employment indicators since then. In terms of GDP, while manufacturing has recovered slowly since 2005 (in 10 years its GDP grew by just 7%), the chain’s gross value added as a proportion of the total was lower than prior to NAFTA and was down by more than one quarter in 2010 compared with 2000. This performance, which is also a result of productivity growth and new forms of industrial organization discussed in the previous chapter, had a particularly marked impact on employment: while Mexico’s manufacturing sector as a whole lost almost a million jobs during 2000-2010 (or a quarter of total manufacturing employment), the yarn-textile-garment chain has lost almost half of its jobs since 2000 despite initial gains in the period 1994-2000. These losses have been particularly profound in the garment segment. The entire chain accounted for more than half a million jobs in 2009 (INEGI, 2010a).

Second, in 1995-2010, 69.76% of Mexican exports from the yarn-textile-garment chain were in the apparel segment,<sup>6</sup> followed by textiles (9.6%), yarn (8.97%) and other accessories (12.40%). Figure 3 reflects Mexico’s differentiated yarn-textile-garment dynamics before and after 2000, with an average annual growth rate of exports of 20.7% and -5.4% for 1995-2000 and 2000-2010, respectively. Over the period 1995-2010, the United States accounted for 90.6% of Mexico’s yarn-textile-garment chain exports. This differentiated performance is particularly striking for the garment segment (see figure 4). Rather surprising is the fact that Mexico’s trade balance in the chain turned negative in 2006 (figure 4) as a result of a drop in apparel exports since 2001 and a rise in imported inputs.

<sup>6</sup> The yarn-textile-garment chain is an aggregation of 5,503 fractions at the 10-digit level of the Harmonized Tariff System. For the case of United States trade, which registers trade at the 10-digit level, for example, we account for fibres and yarn (493 items), textiles (1,575 items), garments (2,985 items) and other inputs (450 items) at the 8-digit level (for Mexico, for example). The items change over time as new products appear and old ones disappear from the Harmonized Tariff System. For more information on this issue, see Cárdenas Castro and Dussel Peters (2007) and Dussel Peters (2004).



TABLE 7

**Mexico: GDP and employment trends in manufacturing and the yarn-textile-garment chain, 1994-2010**  
(Percentages)

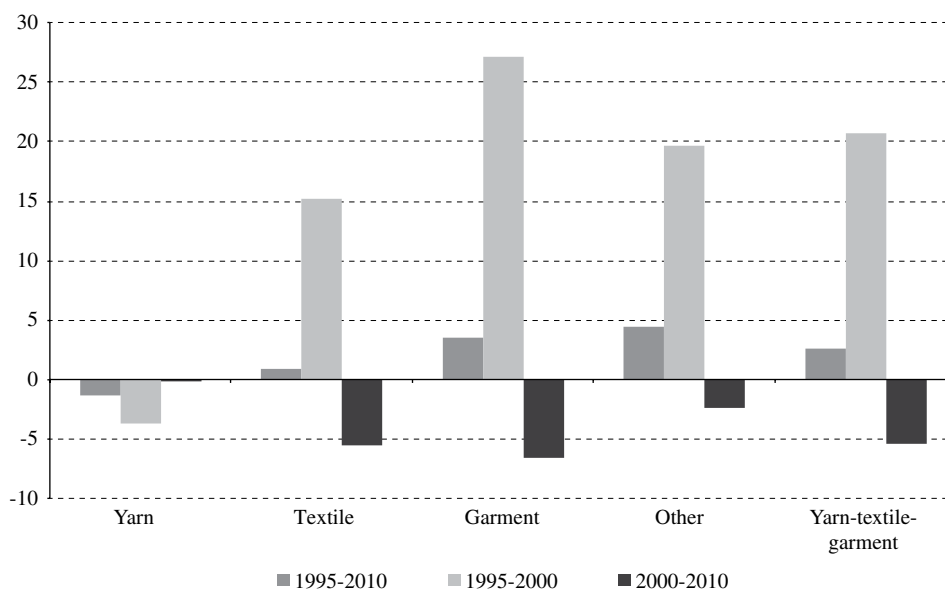
	1994	1995	1996	1997	1998	1999	2000	2001	2002
GDP (2000=100)									
Manufacturing	72.77	68.77	75.94	83.90	89.93	93.90	100.00	96.13	95.10
Yarn-textile-garment chain	76.42	71.51	82.33	89.44	92.54	96.63	100.00	90.15	84.46
Employment (2000=100)									
Manufacturing	71.84	70.07	74.97	83.48	88.54	93.95	100.00	95.99	90.84
Yarn-textile-garment chain	94.34	85.38	90.99	96.38	98.26	98.85	100.00	90.91	83.65
Garment	91.34	81.02	86.98	92.05	100.30	101.45	100.00	91.74	83.56
	2003	2004	2005	2006	2007	2008	2009	2010	
GDP (2000=100)									
Manufacturing	93.75	97.44	100.91	106.89	108.74	107.95	97.38	107.03	
Yarn-textile-garment chain	78.58	79.68	77.61	78.07	75.10	73.83	69.11	74.04	
Employment (2000=100)									
Manufacturing	87.20	86.86	87.24	88.60	88.83	85.88	77.30	80.70	
Yarn-textile-garment chain	77.27	71.67	68.65	66.52	64.52	60.11	54.86	55.47	
Garment	77.60	71.97	67.15	66.07	63.74	58.68	53.27	52.75	

Source: prepared by the authors, on the basis of National Institute of Statistics and Geography (INEGI), Monthly Manufacturing Survey (EIM) and Mexican System of National Accounts.

Abbreviation: GDP, gross domestic product.

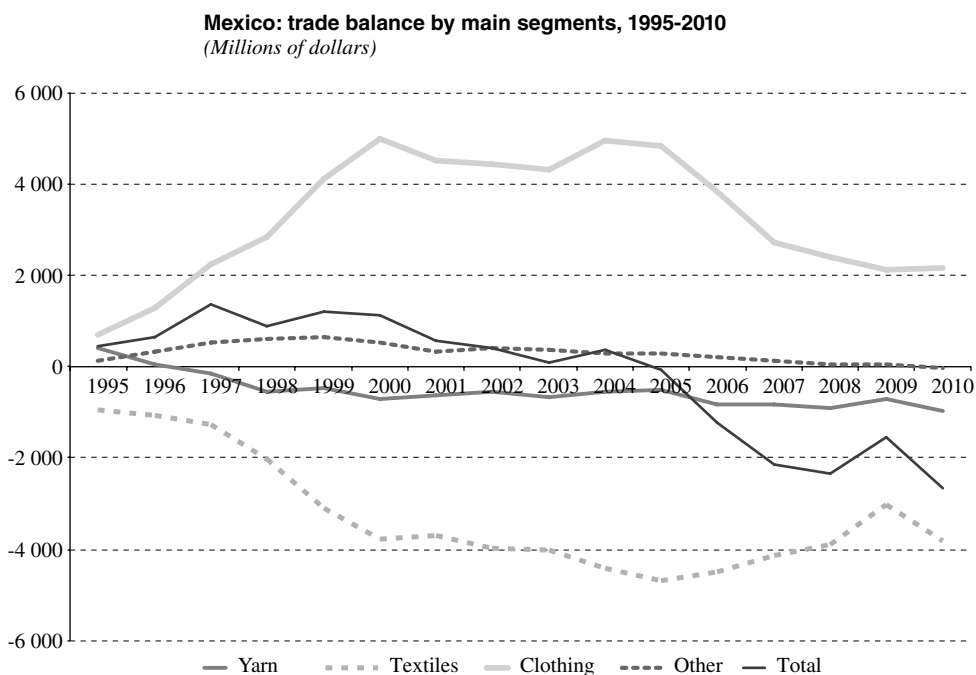
FIGURE 3

**Mexico: yarn-textile-garment chain exports by segment, 1995-2009**  
(Average annual growth rate)



Source: prepared by the authors, on the basis of data from United States International Trade Commission (USITC), 2010.

FIGURE 4



Source: prepared by the authors, on the basis of data from the Center for Chinese-Mexican Studies (CECHIMEX), 2011.

Third, considering the high concentration of Mexican yarn-textile-garment chain exports to the United States, several issues highlight the increasing disintegration of the regional chain's industrial organization in the NAFTA region. Table 8 shows that Mexico's yarn-textile-garment exports to the United States increased substantially during the 1990s and subsequently declined, growing by an average annual rate of 30.7% in 1990-2000 and contracting by 4.4% in 2000-2010. Mexico's share of total United States imports in the chain peaked in 1999 at 13.27%, and then fell continuously to 6.51% in 2010. Meanwhile, China's share expanded from 12.41% to 42.1% in the same period. Two other aspects are important: (i) the import/export coefficient of the United States (also a proxy for measuring the United States content of United States imports) shows that Mexico and Central America are major consumers of the United States yarn-textile-garment chain, in contrast with the rest of the world and China (in other words, Mexico is not only a major exporter to the United States, but also the country with the highest United States value added in its exports, which reflects an important degree of regional integration); and (ii) also as a result of NAFTA, Mexico still benefits from massive tariff incentives, paying in

2000-2010 only 4.62% of the tariffs paid on all United States yarn-textile-garment imports. Tariffs in this chain are substantial and those paid by Asian countries are much higher than those paid by Mexico (see table 8).

Fourth, as Mexico faces increasing competition in the United States market, production of supplies (fabric and textile accessories) has fallen, especially in the case of synthetic fibres such as polyester and rayon, while wool and cotton products remain quite competitive and have not yet been displaced by Asian and Chinese products.<sup>7</sup>

Finally, and in qualitative terms, Mexican businesses (Dussel Peters, 2010a) have been outspoken in calling for the modernization of NAFTA. After more than 17 years, the agreement's regional integration framework is outdated since it was developed at the beginning of

<sup>7</sup> At a disaggregated level, Mexico is still a critical exporter to the United States in denim and cotton products for men and women. Some examples are items 6203424011 (men's cotton and blue denim trousers and breeches of cotton not knitted) and 6204624011 (women's cotton and blue denim trousers and breeches of cotton, not knitted). But in products related to synthetic fibres and nylon, such as items 6203434010 (men's synthetic fiber pants and underwear, not stitched) and 6204633510 (women's synthetic fiber pants and underpants, not stitched), Mexico's share of United States imports and absolute exports has fallen drastically.

the 1990s and based on the industrial organization of the late 1980s that does not exist today: most of the textile and accessories producers have left the region, and Asia has become the main global producer of these items. In addition, the United States has granted significant benefits to other countries with which it has signed free trade agreements that are not part of NAFTA. Thus, from this business perspective, the rules of origin and other legal requirements of NAFTA are increasingly obsolete and

impossible to fulfil, and the United States authorities have developed a number of annual instruments to overcome these regional limitations. However, the current NAFTA framework and these annual incentives to enable certain products, which would otherwise fail to comply, to meet rules of origin requirements have weakened the regional and Mexican yarn-textile-garment chain, since firms cannot depend on monthly and annual decision-making for long-term operations and strategies.

TABLE 8

**United States: yarn-textile-garment chain imports, 1990-2010**

	Share of total imports				
	1990	2000	2010	1990-2000	2000-2010
China	11.44	12.02	42.10	13.07	27.13
Viet Nam	0.00	0.06	4.80	0.04	3.28
Mexico	2.98	13.22	6.51	9.34	8.45
India	3.17	3.85	2.48	3.77	4.48
Indonesia	2.64	3.11	1.68	2.97	3.36
Total imports	100.00	100.00	100.00	100.00	100.00
Import/export coefficient (percentages)					
China	5.498	20.518	25.329	10.070	26.956
Viet Nam	...	6.093	95.909	3.043	91.020
Mexico	309	754	783	674	732
India	10.398	25.542	10.849	14.323	26.933
Indonesia	16.005	28.242	24.579	17.729	38.757
Total imports	1.289	1.774	3.122	1.513	2.461
Tariffs on imports (total = 100)					
China	92.66	105.24	118.45	99.23	114.14
Viet Nam	...	371.4	5.09	316.41	137.48
Mexico	85.76	3.38	2.16	14.29	4.62
India	86.12	109.69	8.78	101.99	102.71
Indonesia	124.88	159.46	19.39	147.27	163.39
Total imports	100	100	100	100	100

Source: prepared by the authors, on the basis of data from the United States International Trade Commission (USITC), 2011.

## 2. The autoparts-automobile chain

The autoparts-automobile chain was not only one of the first that began transferring segments of its value chain at the international level (Piore and Sabel, 1984), it is also producer-driven (unlike the yarn-textile-garment chain). As a result of consumer preferences, tariff considerations and public sector interventions to incentivize local and national production and firms, the autoparts-automobile chain has

increasingly regionalized. In addition, the chain has been characterized by (i) the formation of “modules” that can be transferred; (ii) significant ecological, environmental and efficiency concerns and standards that have generated a new dynamic of innovation and competition in hybrid and electric vehicles; and (iii) massive mobilization of national resources to enhance domestic production, particularly since the 2007-2008 international crisis (Rodrik, 2010; Sturgeon, Biesebroeck and Gereffi, 2008).

Several international trends are relevant for understanding the specific industrial organization in the NAFTA region and its relationship with China. First are the profound spatial readjustments of the autoparts-automobile chain over the past few decades (see table 9). While the United States has lost substantial market share, falling from levels close to 50% of global production in the 1960s to 15% in the first half of the 1990s to 10% in 2010,<sup>8</sup> Japan's output increased until the 1990s to levels above 25% and fell continuously after that, to 12.9% in 2010. On the other hand, a group of emerging countries including Brazil, China, India, Mexico and the Republic of Korea substantially increased their production to account for more than 40% in 2010. China, which became the main global producer in 2009 and accounted for 23.5% of global output in 2010, is probably one of the most outstanding cases in the history of automobiles, considering that in the first half of the 1990s its share of output was less than 1%. Mexico, on the other hand, increased its share in the 1990s to 3.3% in 2000-2001, but saw its participation slip back to 3% by 2010.

<sup>8</sup> The United States has not only witnessed a substantial fall in sales of new vehicles, from more than 17 million units in 2000-2006 to 10.6 million and 11.5 million in 2009 and 2010, respectively, but also a massive penetration of Asian brands in overall United States imports, which accounted for more than 35% in 2010 (SE, 2011).

Second, these regional patterns have deepened since the global crisis in 2008-2009: while vehicle production fell and the average annual growth rates for the European Union, the United States, Japan and the world as a whole were -5.1%, -5.5%, -8.8% and 4.7%, China posted an average annual growth rate of 40.1% for 2008-2010. Only a few emerging countries, such as India and Mexico with average annual growth rates of 23.1% and 4.0%, respectively, also recovered quickly following the crisis or saw no fall in production at all.

Third, although companies based in Japan, the United States and Europe continued to predominate in 2009 (Toyota, General Motors, Volkswagen, Ford and Hyundai headed total vehicle output), 21 Chinese companies now rank among the world's top 50 automobile producers. None of these companies is among the top 10 producers, but they are already beginning to edge into the top 20.

What are the main trends for the Mexican autoparts-automobile chain in respect of the United States and NAFTA? In Mexico, the automotive market and its segments represented 2.7% of total GDP and 16% of manufacturing output in 2009 and was the manufacturing sector that recovered most quickly after the global crisis in 2008-2009 in terms of production, employment and exports (*Monitor de la Manufactura Mexicana*, 2012). There are currently 13 original equipment manufacturer

TABLE 9

**Share of international automobile output, 1961-2010**  
(Percentages)

	1961	1971	1981	1991	1999	2000	2005	2008	2009	2010
United States	48.5	32.5	22.8	15.4	23.2	21.9	18.0	12.3	9.3	10.0
United Kingdom	8.8	6.6	3.5	3.5	3.5	3.1	2.7	2.3	1.8	1.8
Italy	6.1	6.4	4.6	4.6	3.0	3.0	1.6	1.5	1.4	1.1
Germany	15.8	14.5	13.7	13.3	10.1	9.5	8.7	8.6	8.4	7.6
France	8.7	10.2	9.5	9	5.7	5.7	5.3	3.6	3.3	2.9
Mexico	...	0.6	1.3	2	2.8	3.3	2.5	3.1	2.5	3.0
Japan	2.2	14.1	25.4	27.6	17.6	17.4	16.2	16.4	12.9	12.4
China	...	...	...	0.2	3.3	3.5	8.6	13.3	22.4	23.5
Spain	0.5	1.7	3.1	5.5	5.1	5.2	4.1	3.6	3.5	3.1
Brazil	0.9	1.3	1.5	2	2.4	2.9	3.8	4.6	5.2	4.7
Republic of Korea	...	...	0.3	3.3	5.1	5.3	5.6	5.4	5.7	5.5
India	0.2	0.2	0.2	0.5	1.5	1.4	2.5	3.3	4.3	4.6
Total world output (millions of vehicles)	11.391	26.453	27.407	35.287	56.259	58.374	66.482	70.527	61.715	77.610

Source: prepared by the authors, on the basis of data from the International Organization of Motor Vehicle Manufacturers (OICA), 2011.

(OEM) plants dedicated to passenger-vehicle production and another 11 for commercial vehicles. Exports are the primary destination of autoparts-automobile chain output in Mexico, accounting for 78% of the total (INEGI, 2010a). From this perspective, the 1994-1995 crisis and the launch of NAFTA marked a turning point in the shift towards export orientation. Table 9 shows that vehicle production almost doubled in the first stage of NAFTA (1994-2000), but remained relatively stable during the period 2006-2010, with a sharp downturn during the crisis and a rapid recovery in 2010.

The autoparts-automobile chain in Mexico is the result of a long history of incentives, which include the adoption of five decrees between 1962 and 1993 (the last of which was aimed at achieving certain levels of value added in Mexico), as well as technological provisions and requirements related to the trade balance, among other purposes. With NAFTA, regional rules of origin govern Mexico's industrial organization: the regional content value (measured based on either the transaction value or the net cost) established under article 401 of NAFTA enables regional production to benefit from tariff reductions. Since 2002, the level of value added has been replaced by regional rules of origin (62.6% for automobiles) in order to prevent foreign companies from using Mexico as an export platform to the United States (Dussel Peters, Ruiz Durán and Taniura, 1997; Hufbauer and Schott, 2005). On the other hand, Mexico has its own legislation to promote competitive advantages for the autoparts-automobile chain (DOF, 2003) and several later decrees dating up to 2010. In general, Mexican legislation requires compliance with a series of provisions by new manufacturers of vehicles (but not for autoparts and accessories) weighing up to 8,864 kg:

- (i) To manufacture at least 50,000 units;
- (ii) To invest in Mexico at least US\$ 100 million in fixed assets for automotive production;
- (iii) To establish agreements with distributors of vehicles;
- (iv) For new manufacturers without previous production in Mexico, in addition to items (i)-(iii), exceptional permission is granted for importing vehicles with zero ad-valorem tariff rates during the first three years following installation of a new manufacturer for 10% of production.<sup>9</sup> This criteria continues even after the first three years of production.

<sup>9</sup> The import tariff was 40% until 2009, 30% in 2010-2011 and 20% in 2012. According to some firms, this sharp decline may result in

The autoparts-automobile chain in Mexico presents a set of specific features (Dussel Peters, Ruiz Durán and Taniura, 1997; INEGI 2010b; SE 2008). First, in Mexico this chain is made up of four large segments (assemblers, larger components and subassembly, parts and components and raw materials) and none of the 18 assembly companies in the first segment is Mexican. The automotive parts and components segment is made up of about 1,000 national and foreign manufacturers, of which 345 are first-tier firms (AMDA/AMIA/INA, 2009; SE, 2011). Second, the autoparts-automobile chain is paradigmatic for Mexico since it has shifted dramatically towards exports. And, unlike its structure in the 1980s (which changed with the signing of NAFTA), this chain in Mexico is profoundly integrated with that of the United States, to such a degree that we could refer to a regional autoparts-automobile chain with regional models, inputs, products and processes. Table 10 shows how all segments in the chain have experienced this export orientation in relation to both cars and trucks.<sup>10</sup>

However, the domestic market has not recovered significantly, and in 2008-2010 it still posted levels well below those of the early 2000s. Third, the autoparts-automobile chain has acquired more and more importance in Mexico's foreign trade, accounting in 2010 for 28% of exports and 17% of imports, with an annual trade surplus above US\$ 20 billion since 2006, making it the chain with the largest trade surplus in Mexico. Exports from the autoparts and components segment have increased significantly and accounted for 57% of the chain's exports during the period 1995-2010. Fourth, a country by country analysis shows that, although 93% of Mexico's autoparts-automobile chain exports were directed to the United States and Canada during the period 1995-2010, the proportion of United States imports from Mexico declined substantially. The United States share peaked at 76% in the mid-1990s and dropped to below 50% by 2009. In other words, the United States has experienced a notable loss in market share in Mexico (Dussel Peters, 2010b) (see table 11).

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substantial new investments and imports from third countries. With respect to autoparts in 2010, 80% of the 1,837 tariff items were duty-free, while the rest did not pay tariffs above 5% (SE, 2011).

<sup>10</sup> The autoparts-automobile chain is made up of 491 items at the 10-digit level of the Harmonized Tariff System (96 items relating to automobiles and 395 relating to autoparts).

TABLE 10

**Mexico: total production of vehicles (domestic markets and exports), 1988-2010**

	1988	1993	1994	1995	2000	2005
Total production (units)	505 202	1 055 221	1 097 381	931 178	1 889 486	1 606 460
Share of total production (percentages)						
<b>EXPORTS</b>						
Vehicles	34.49	46.74	52.40	83.62	75.84	74.25
Cars	40.99	53.34	58.79	85.33	72.80	69.59
Trucks	19.31	21.65	29.67	78.47	82.21	83.13
<b>DOMESTIC MARKET</b>						
Vehicles	65.51	53.26	47.60	16.38	24.16	25.75
Cars	59.01	46.66	41.21	14.67	27.20	30.41
Trucks	80.69	78.35	70.33	21.53	17.79	16.87
<b>IMPORTS</b>						
Vehicles	3.87	3.99	10.01	4.00	23.69	46.98
Cars	0.36	1.08	7.20	2.12	19.95	36.18
Trucks	12.07	15.07	20.01	9.66	31.54	67.52
<b>TOTAL DOMESTIC SALES</b>						
Vehicles	69.38	57.26	57.61	20.37	47.85	72.73
Cars	59.38	47.74	48.41	16.79	47.15	66.60
Trucks	92.76	93.42	90.34	31.19	49.33	84.39
	2008	2009	2010	1988-1993	1994-2000	2000-2010
Total production (units)	2 103 801	1 507 527	2 260 776	5 005 406	9 388 600	20 009 039
Share of total production (percentages)						
<b>EXPORTS</b>						
Vehicles	79.20	81.36	82.97	37.92	72.41	77.71
Cars	79.99	80.26	80.66	45.59	70.47	74.40
Trucks	77.54	83.58	87.25	15.66	76.63	84.15
<b>DOMESTIC MARKET</b>						
Vehicles	20.80	18.64	17.03	62.08	27.59	22.29
Cars	20.01	19.74	19.34	54.41	29.53	25.60
Trucks	22.46	16.42	12.75	84.34	23.37	15.85
<b>IMPORTS</b>						
Vehicles	29.93	30.77	19.26	4.38	14.36	33.29
Cars	20.94	22.27	14.96	1.29	9.86	26.99
Trucks	48.73	48.01	27.24	13.35	24.15	45.56
<b>TOTAL DOMESTIC SALES</b>						
Vehicles	50.73	49.41	36.29	66.46	41.95	55.58
Cars	40.95	42.01	34.29	55.70	39.40	52.59
Trucks	71.19	64.43	39.99	97.69	47.52	61.41

Source: prepared by the authors, on the basis of data from the Mexican Automotive Industry Association (AMIA), 2011.

Mexico: autoparts-automobile chain trade by main countries, 1995-2010

	1995	2000	2005	2008	2009	2010	1995-2010
Value (millions of dollars)							
<b>IMPORTS</b>							
1	United States	7 242	24 918	22 198	25 708	18 242	321 524
2	Germany	662	2 396	3 296	4 483	3 887	39 288
3	Japan	821	1 733	2 814	4 239	2 696	37 119
4	China	17	178	1 255	3 894	3 749	20 623
5	Brazil	77	914	2 845	2 541	1 837	23 800
	Subtotal	8 819	30 140	32 408	40 864	30 410	442 354
	Rest	702	5 361	6 853	10 446	7 415	87 923
	Total	9 521	35 501	39 261	51 310	37 825	530 277
Share (percentages)							
1	United States	76.06	70.19	56.54	50.10	48.23	60.63
2	Germany	6.95	6.75	8.40	8.74	10.28	7.41
3	Japan	8.62	4.88	7.17	8.26	7.13	7.00
4	China	0.18	0.50	3.20	7.59	9.91	3.89
5	Brazil	0.81	2.58	7.25	4.95	4.86	4.49
	Subtotal	92.63	84.90	82.54	79.64	80.40	83.42
	Rest	7.37	15.10	17.46	20.36	19.60	16.58
	Total	100.00	100.00	100.00	100.00	100.00	100.00
Growth rate							
1	United States	...	28.0	-2.3	5.0	-29.0	9.0
2	Germany	...	29.3	6.6	10.8	-13.3	12.0
3	Japan	...	16.1	10.2	14.6	-36.4	12.2
4	China	...	60.5	47.7	45.9	-3.7	46.3
5	Brazil	...	64.0	25.5	-3.7	-27.7	25.4
	Subtotal	...	27.9	1.5	8.0	-25.6	11.0
	Rest	...	50.2	5.0	15.1	-29.0	18.9
	Total	...	30.1	2.0	9.3	-26.3	11.9

Table 11 (concluded)

	1995	2000	2005	2008	2009	2010	1995-2010
Value (millions of dollars)							
<b>EXPORTS</b>							
1	United States	17 056	43 058	50 983	58 819	46 788	651 400
2	Canada	1 375	1 892	1 492	2 298	4 286	27 224
3	Germany	93	882	1 362	3 668	2 312	21 403
4	Argentina	61	13	393	631	522	4 373
6	Brazil	213	134	187	1 895	1 182	7 561
7	China	0	20	94	260	264	1 902
	Subtotal	18 798	45 999	54 510	67 571	55 354	713 863
	Rest	895	749	2 272	5 146	3 217	32 630
	Total	19 694	46 748	56 783	72 717	58 572	746 493
Share (percentages)							
1	United States	86.60	92.11	89.79	80.89	79.88	87.26
2	Canada	6.98	4.05	2.63	3.16	7.32	3.65
3	Germany	0.47	1.89	2.40	5.04	3.95	2.87
4	Argentina	0.31	0.03	0.69	0.87	0.89	0.59
6	Brazil	1.08	0.29	0.33	2.61	2.02	1.01
7	China	0.00	0.04	0.17	0.36	0.45	0.25
	Subtotal	95.45	98.40	96.00	92.92	94.51	95.63
	Rest	4.55	1.60	4.00	7.08	5.49	4.37
	Total	100.00	100.00	100.00	100.00	100.00	100.00
Growth rate							
1	United States	...	20.3	3.4	4.9	-20.5	9.5
2	Canada	...	6.6	-4.6	15.5	86.5	9.6
3	Germany	...	56.8	9.1	39.1	-37.0	24.8
4	Argentina	...	-27.0	99.0	17.1	-17.3	21.4
6	Brazil	...	-8.8	6.8	116.5	-37.6	15.2
7	China	...	126.6	36.5	40.2	1.3	66.9
	Subtotal	...	19.6	3.5	7.4	-18.1	9.9
	Rest	...	-3.5	24.9	31.3	-37.5	12.2
	Total	...	18.9	4.0	8.6	-19.5	10.1

Source: prepared by the authors, on the basis of data from the United States International Trade Commission (USITC), 2011.



Considering the critical importance of the United States for Mexican autoparts-automobile chain trade, table 12 illustrates the profound integration of this chain between Mexico and the United States. Since the signing of NAFTA, Mexico has consolidated itself as the primary importer from the United States; and while Mexican autoparts-automobile chain imports represented barely 8% in 1990, by 2010 Mexico was the third-ranking autoparts-automobile chain exporter to the United States (21.32%), after Canada and Japan. China (which in 1990 represented only 0.11% of United States imports from this chain) has recorded the highest average annual growth rate (24.9% in 1990-2010) of the primary exporters to the United States, with exports representing 3% of the United States total in 2010. Additionally, Mexico has impressive tariff benefits as a result of NAFTA, with only Canada paying lower tariffs than Mexico. China, for example, paid a tariff that was 38 times higher than that paid by Mexico in 2010. While the average tariff rate in 2010 was relatively low (China paid 3.29% on average), because of small profit margins this difference can play a critical role in final firm-level decision-making (see table 12).

Five final points are relevant:

- (i) The 2008-2010 crisis had profound repercussions for the autoparts-automobile chain in North America and Mexico, and it has been the most severe since comparative information started to be compiled. The production of 1.6 million units in Mexico in 2009 fell by 28.9%, while employment dropped by 21.3% between August 2007 and January 2010.
- (ii) Mexico started an impressive recovery trajectory early in 2010 and exports, trade and investments, with the exception of the domestic market, all increased dramatically.
- (iii) United States firms in Mexico are by far the largest producers and exporters. The “big three” (General Motors, Chrysler and Ford) accounted for well above 60% prior to the signing of NAFTA and 52.4% in 2009.
- (iv) Mexico’s autoparts-automobile chain attracted more than US\$ 10 billion in foreign direct investment (FDI) in 2000-2010 and is a major player owing to the knowledge it has acquired over several decades of investments, trading, training and supplier systems, new forms of organization of local firms, links with higher education and initiatives to provide plants in 17 Mexican states with infrastructure and urban services.
- (v) Mexico’s export performance has been particularly strong in the autoparts and components segment,

TABLE 12

**United States of America: imports from selected countries  
in the autoparts-automobile chain, 1990-2010**

	1990	1995	2000	2005	2008	2009	2010	1990-2010	Growth rate 1990-2010	
Share (percentages)										
1	Japan	36.68	30.48	24.13	21.91	23.85	21.40	22.81	25.27	3.2
2	Canada	33.87	36.15	32.61	29.64	22.94	22.64	26.26	30.31	4.4
3	Mexico	8.03	14.96	20.55	18.42	21.06	24.29	21.32	18.57	11.0
4	Germany	9.27	7.44	9.61	11.54	11.35	10.42	10.47	10.05	6.4
5	Republic of Korea	2.08	1.86	3.07	4.88	4.94	5.36	5.43	3.76	10.9
6	China	0.11	0.52	0.85	2.30	3.82	4.65	3.13	1.76	24.9
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	5.7
Effective tariff (paid by total imports = 100)										
1	Japan	12.37	9.50	4.73	5.84	186.61	189.71	174.12	7.14	
2	Canada	150.25	166.53	157.68	143.37	3.45	2.86	2.69	159.87	
3	Mexico	154.81	45.23	10.61	7.47	7.66	7.52	8.44	26.01	
4	Germany	144.12	168.81	210.41	192.29	177.29	175.39	212.14	181.99	
5	Republic of Korea	156.43	173.12	209.82	195.81	182.50	201.56	183.50	184.09	
6	China	183.81	240.64	217.08	195.50	201.17	272.36	235.58	204.59	
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	

Source: prepared by the authors, on the basis of data from the United States International Trade Commission (USITC), 2011.

where it has been the main exporter to the United States since 2000 (32.83% of total United States autoparts imports in 2010). In the automobile segment Mexico ranks third (at 15.13% in 2010), after only Japan (27.56%) and Canada (26.58%). In the autoparts segment Mexico has maintained its leading position in items such as bodies and parts, chassis and drivetrain parts, electrical components, and engines and parts, while China has become the main exporter of tyres and tubes.

Unlike the yarn-textile-garment chain, the autoparts-automobile chain is at an advanced stage of integration in the NAFTA region. While the former has already been losing ground in the region, and particularly in the United States, autoparts-automobile chain integration between Mexico and the United States has continued. The latter trend is also reflected in Mexico's large share in United States imports and the continuing expansion of FDI from United States firms in Mexico. However, there are also several regional trends that might in the

short term create scenarios similar to the patterns seen in the yarn-textile-garment chain over the past 10 years (Dussel Peters, 2010b). First, NAFTA output fell drastically in 2008-2010, while output by Asia and China seems to be unstoppable in the medium run. Second, in addition to the financial and technological crisis of the "big three" in 2008-2010, they have been losing substantial market share in Mexico, as the United States has in total autoparts-automobile chain imports. Thus, the chain has not only contracted in absolute terms in the NAFTA region, it has also been surpassed by its competitors from Asia and China. Indeed, China has not yet started to export automobiles or, for all practical purposes, autoparts on a significant scale, as domestic consumption has surged by more than 25% over the past five years — a growth rate that cannot continue. The impact of China exporting in the coming years at levels of around 30% of its output, based on production levels in excess of 20 million vehicles, will be substantial worldwide and in the NAFTA region.

## IV

### Summary and policy alternatives

The analyses set out in this paper suggest that NAFTA has gone through two distinct phases. In the first phase (1994-2000), the region integrated profoundly as a result of trade, investments, rules of origin and specific segments of industrial chains, such as the autoparts-automobiles and yarn-textile-garments chains. In this first phase, NAFTA evolved in line with some of the predictions and estimates outlined in the literature review in the second section of this paper: on the whole the region experienced growth in terms of GDP, trade, investment, employment and wages, among other variables, and intra-industry trade also increased substantially. While some of the gaps between the United States and Mexico were closing slowly, this was true for only a small part of Mexico's highly polarized socioeconomic and territorial structure. Even in segments of Mexican industry that were highly integrated in NAFTA, the integration process did not lead to a wider process that promoted backward and forward linkages in Mexico. In the second phase (since 2000), NAFTA has been deteriorating in terms of trade, investment and intra-industry trade, among other

variables, and both Mexico and the United States have been losing ground to third countries such as China.

The first part of our analysis finds that from the point at which China entered the WTO in 2001 and up to 2010, China outcompeted Mexico in the United States market and began to compete with the United States in the Mexican market. We found 53 sectors in Mexico where the United States is losing market share and China is gaining, which should allow Mexico to make efficiency gains and become more competitive in United States markets. However, in those 53 sectors (representing 49% of all of Mexico's exports to the United States) Mexico is losing market share in the United States. We then use two case studies to examine these trends in the Mexican economy in more detail.

The second part of the document highlights changes in competitiveness during these different stages of NAFTA. The trade analysis clearly shows how Mexico increased its share of total United States imports, ranking second only to Canada in 2001-2004, only to be subsequently displaced by China. And while the United States has historically been

Mexico's main trading partner, its share of total Mexican imports fell from more than 75% in the first five years after NAFTA came into effect to less than 50% since 2009. As shown by different calculations, in both cases China is the main factor behind this disintegration. China's share of Mexico's top 20 exports to the United States and the United States exports to Mexico has increased substantially since 2000. The United States' share of Mexico's total exports fell from 72% to 41.54% in the period 2000-2009, while China's share jumped from 1.09% to 17.83%. In all, 96% of United States exports to Mexico, and 81% of Mexican exports to the United States are under "threat" as defined in this paper. Finally, the "triple threat" is examined: sectors in the Mexican market in which the United States is losing market share to China and those in the United States market in which Mexico is losing market share to China.

The two case studies illustrate the clearly defined stages that NAFTA has gone through since 1994. The yarn-textile-garment chain reflects the profound integration at the firm level and in terms of industrial organization between Mexico and the United States. From a Mexican perspective, the sector has been symbolic for integration with the United States: it is a very dynamic export-oriented, labour-intensive sector that is highly dependent on imports from the United States and that produced a trade surplus (that has surprisingly turned into a trade deficit since 2005) based on massive imports of parts and components and exports of finished and assembled garments. However, the sector shed more than 50% of its jobs during the period 2000-2010 and is in a deep crisis region-wide: NAFTA incentives have lost their impact, and both Mexico and the United States lost hundreds of thousands of jobs over the decade. The erosion of NAFTA rules of origin, the signing of other free trade agreements since NAFTA took effect, and competition with Asia and China took their toll within the NAFTA region: China's share of total United States imports expanded from 12% to 42.1% in 2000-2010, while Mexico's fell from 13.22% to 6.51%. The crisis and loss of competitiveness of key inputs for the yarn-textile-garment chain, particularly in synthetic fibres, has profoundly affected Mexico's output and exports to the United States, although Mexico does still maintain a substantial share in exports of natural fibres, including cotton and fabric such as denim.

The autoparts-automobile chain differs from the yarn-textile-garment chain in that, to date, competition from China has been quite limited. Even though China became the leading producer of automobiles in 2010 (almost a quarter of vehicles worldwide and more than

twice the figure for the United States), it consumes 100% of its output, in addition to imports. However, as a result of massive investments by the Chinese public sector, new Chinese brands are entering the market, with increasingly sophisticated technologies, and now account for almost 40% of total vehicle production. China will very soon start competing with vehicles produced in Latin America, Mexico and the United States, thus, the sector could be very important in terms of policy responses in the NAFTA region regarding relations between the treaty members and, specifically, Mexico-United States bilateral relations. Policies in the United States during 2008-2009 reflected its strategic significance. Mexico is at present one of the major suppliers and players in this sector in the United States, while China still lags behind in this respect. Mexico is still the leading supplier of autoparts for NAFTA and the United States, particularly in segments such as bodies and parts, chassis and drivetrain parts, electrical components and engines and parts, while China is already the main exporter of automotive tyres and tubes and is expected to increase its share in all other segments of the chain.

Several policy recommendations result from this analysis. On the one hand, there are substantial arguments for deepening a regional and NAFTA policy framework. Since 2000, China has profoundly changed the socioeconomic and territorial integration framework provided by NAFTA, with enormous effects on production, trade, employment and wages, among other variables. The aggregated analysis in this paper and the two case studies show that Mexico and the United States are deeply integrated in many value added chains. The question is when policymakers will start proposing a short-, medium- and long-term development agenda with explicit reference to Asia and China.

First, NAFTA nations would do well to identify strategic sectors that are deeply integrated in the region and structure policies to enhance their competitiveness and further integration. NAFTA has a number of forums and institutions that could be bolstered for such a task, including the North American Development Bank (NADB). Whereas the China Development Bank has played a key role in providing credit for the development and expansion of Chinese export industries, the NADB has played a secondary role, limited to water, sanitation and related projects. The original idea that the NADB would serve regional development and provide adjustment assistance could be revisited (Fishlow, Robinson and Hinojosa-Ojeda, 1991).

Second, direct bilateral negotiations between NAFTA and China seem inevitable. Although the NAFTA members

could achieve relevant results in bilateral meetings and rounds with China, some of the issues in the balance are strictly regional and go beyond any bilateral agenda. As we saw in both case studies, regional integrated structures call for regional responses, since concrete policies will otherwise be too general and obsolete.

Third, these regional competitiveness policies have to be designed and implemented with a sense of urgency: as seen in both case studies, structures, industrial organization, trade, investment and employment are shifting rapidly from the region to Asia and China. In only a few years the respective segments of interest might have disappeared completely. From another perspective, starting a NAFTA-China dialogue might also help to ease tensions in United States-China and Mexico-China relations and allow for a long-term dialogue within the institutional framework of NAFTA.

Fourth, the yarn-textile-garment chain shows that deepening integration in the NAFTA region must go beyond tariffs in the future, since they only had an impact until the late 1990s. Future strategies for a regional development agenda must focus on the production of key inputs for the entire chain (such as new materials, equipment and fabrics and other inputs for the synthetic segments), improve distribution channels, transportation, the creation of own brands and the incorporation of new production techniques (for example, improving the modular form of production

for apparel and adopting new full packaging modalities). The successful cases of integration in natural fibres could serve as a basis for policymakers in the NAFTA institutions in each of the countries in the region.

Fifth, the autoparts-automobile chain has not, so far, experienced massive competition from China given its particularities in China, including the relatively recent explosive production and even higher domestic consumption, in addition to a rapid learning process by Chinese brands. Experience with other chains (such as the electronics and yarn-textile-garment chains) shows, however, that China will start exporting automobiles on a large scale in the short run. The three NAFTA countries (individually and as a region) should therefore consider how to prepare for this new and strong competition. Regional negotiations with China specifically regarding this chain could anticipate future trade tensions.

All the former policy proposals could include a mixture of trade, industrial, research and development (R&D) and fiscal policies and incentives from a regional perspective, in addition to national policies and the respective negotiations with China. Decisions that are only national in scope (as they have been so far) are clearly insufficient both in terms of competitiveness and in connection with negotiations with China as they do not take into account the existing regional integration under the NAFTA framework.

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# Terms of trade and output fluctuations in Colombia

*Gonzalo Hernández*

**ABSTRACT**

This paper explores the impact of the terms of trade on output fluctuations in Colombia, a developing country where as much as 62% of export earnings come from just four commodities: oil (42%), coal (14%), coffee (5%), and nickel (1%). This research was prompted by: the particular role of short-run fluctuations in developing economies, the fact that the Colombian terms of trade are procyclical, and the discussion on economic policies towards sterilization of the effects of commodity prices. Following time series analysis for the period 1994 -2011, robust evidence was found indicating that around one third of Colombia's quarterly growth is attributable to changes in the terms of trade.

**KEYWORDS**

International trade, terms of trade, economic growth, productivity, time series analysis, Colombia

**JEL CLASSIFICATION**

F41, F44, O54

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# I

## Introduction

The role of short-run output fluctuations in developing economies is particularly important. Developing countries are usually more exposed than developed economies to the effects of macroeconomic ups and downs. In addition, welfare implications may be asymmetrical, depending on the degree of development. Some examples of a possible uneven effect are: first, that developing economies lack the proper social safety nets to mitigate the impact of bad phases on the poorest population; second, poverty and unemployment in developing countries make people less capable of adjusting their consumption when temporary shocks appear;<sup>1</sup> and third, the more variable tax base may constrain both the ability of the public sector to implement long-run projects necessary to remove the obstacles that hinder the development of these economies as well as the responsiveness of short-run fiscal policy.

This study focuses on the terms of trade to explain these output fluctuations. This decision is motivated by the literature on development macroeconomics based on a small open economy framework.<sup>2</sup> In particular, the dependent economy model (with its three goods variant: exportable, importable and non-tradable) assumes that small economies face an infinitely elastic global demand for their goods, and an infinitely elastic supply of imported goods.<sup>3</sup> This means that prices of exports and imports are determined in the international markets where the

domestic economy has no market power. The framework predicts that external shocks to terms of trade may be an important source of output fluctuations in the domestic economy. An improvement in the terms of trade, say, because of a boom in commodity prices, works as an incentive to expand output in the sectors that benefit from a higher price. However, the shock may result also in an appreciation of the real exchange rate that increases real wages in the sectors that compete with importable goods. Therefore, the initial aggregate output increase might be offset by the loss of competitiveness in the sectors that compete with importable goods (Dutch Disease). The same mechanism may be easily extended to other exportable goods. The net result, however, depends theoretically on critical assumptions regarding the labour markets and the degree of price flexibility (market-clearing conditions). The most common assumption is that the non-tradable sector clears through price variations rather than through an adjustment in output. Furthermore, whether these effects are displayed in the short run will depend not only on the type of market adjustment but also on its speed, the reaction of the economic policy authorities to changes in this relative price, the degree of openness, the degree of specialization in exportable goods, and the exchange-rate regime, among other elements.

Some facts justify the selection of Colombia as a case study. First, recent Colombian exporting structure seems to support the role of exogenous terms of trade as in the three goods model. Annual data for 2010 show that Colombian exports (62%) are concentrated mainly in four commodities in respect of which Colombian market power is negligible: petroleum and derivatives (42%), coal (14%), coffee (5%), and nickel (1%). Second, quarterly information for the period 1994-2011 reports a positive correlation between quarterly variations in terms of trade and quarterly growth of gross domestic product (GDP) equal to 0.35. This magnitude is important relative to other studies on developing economies (see section II). Lastly, the period 1994-2011 shows high variability in both the terms of trade and GDP. This variability is useful for testing the validity of the results from the time series analysis.

Although this study is limited to aggregate results, there are other channels that can illustrate the relevance of terms of trade in Colombia's economic performance in the short run. Let's take again a commodity price boom as an

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<sup>1</sup> Economic theory usually assumes that more volatile consumption decreases individuals' utility in the presence of risk and incomplete financial markets.

<sup>2</sup> See, for example, Agénor and Montiel (2008).

<sup>3</sup> For this study, the dependent economy with three goods seems to be a more convenient framework than the Mundell-Fleming model, where the terms of trade, when variable, are endogenous. The endogeneity in the Mundell-Fleming model occurs because there is some degree of producer market power in the exportable good. The price of the exportable good may be altered by internal conditions (that is, domestic demand) even if the economy is a price taker regarding the importable goods. Likewise, the two goods dependent economy model (traded and nontraded) has its own limitation: both exportable and importable goods are aggregated in a composite good (the traded good). Therefore, the variability of the terms of trade is not defined and cannot be the origin of macroeconomic fluctuations. See, for example, Greenwood (1984) and Buitel (1988), for other dependent economy model specifications.

example. Once the commodity price rises, extra profits will be generated for the firms involved directly or indirectly in the production of that commodity. Thus, this shock fosters the expansion of consumption and output in other sectors. In addition, a higher level of wealth allows investors to access financial credit more easily. This credit is available due to the greater availability of foreign currency, which relaxes the monetary constraints. Therefore, the process boosts credit, investment and consumption, and also profits for the financial system, which currently accounts for around 18% of total Colombian value added. This mechanism is clearly plausible in Colombia where there has been a large accumulation of international reserves, and where, despite the central bank's inflation targeting policy, some interventions have been made to curb the appreciation of the exchange rate.

Another reason for the procyclical terms of trade in Colombia may be found in the public sector. Around 60% of the total volume of exported oil is exported by Empresa Colombiana de Petróleo (ECOPETROL). Some of the revenues obtained by this institution make up part of the revenues of the non-financial public sector. In addition, it is reasonable to expect that by increasing profits of the firms, and stimulating the economy, a commodity price boom will also expand tax revenues. The result is not necessarily a fiscal surplus. For instance, Kaminsky (2010) finds evidence of a procyclical fiscal policy in middle income countries when terms-of-trade shocks occur.<sup>4</sup>

Regarding international trade, after the United States and the European Union, the Bolivarian Republic of Venezuela and Ecuador are the most important markets for Colombian exports. These two countries are oil exporters and net buyers of Colombian manufactures. This means that a commodity price boom that increases the income of these trading partners may also increase the demand for Colombian products. However, preliminary evidence shows that the Colombian current account is not positively correlated with the terms of trade.<sup>5</sup>

This paper sets out to resolve the theoretically ambiguous relationship between terms of trade and output. Specifically, this paper presents a time series analysis that examines the relationship between quarterly GDP growth and quarterly variations in the terms of trade.

For that purpose, a price index has been constructed for the four main exportable commodities, and a simple econometric methodology (Box-Jenkins methodology) is used, which is consistent with: the exogeneity of the Colombian terms of trade, the non-co-integration between GDP and terms of trade, and the stationarity of the key variables. The study offers different robustness tests, starting with the inclusion of relevant control variables whose absence may cause a potential bias in the estimate for terms of trade. For example, real and nominal exchange rates are two such control variables because a negative effect of the variations in the terms of trade on short-run output fluctuations could be associated with a Dutch disease mechanism. Nevertheless, it is not clear a priori either that positive terms of trade shocks result in an appreciation or that an appreciation is going to decrease aggregate output unambiguously. First, non-traded goods production could increase with the shock while the expansion of the real income would be adjusted by a change in output rather than by a change in prices. Second, an eventual appreciation of the nominal exchange rate, given a larger supply of foreign currency, could have expansionary effects on output just as a nominal devaluation may have contractionary effects. In a seminal theoretical model, Krugman and Taylor (1978) describe this possibility.<sup>6</sup> Among different mechanisms presented by the authors, one of them, following the Kaleckian tradition, states that an appreciation may redistribute income from profits and rent to wages. The reduction in the price of imported inputs is automatically translated into a reduction in the price of home goods, which increases real wages. Because the marginal propensity to consume is higher for workers than for capitalists, the redistribution from wages to profits increases aggregate demand and domestic output.

Thus, following a review of the related literature in section II, the empirical strategy in section III is essential to evaluate the direct effect of changes in the terms of trade after taking into account eventual indirect effects through other variables. Concluding remarks are presented in section IV.

<sup>4</sup> See, for example, Tornell and Lane (1999) and Frankel (2010) for institutional aspects explaining procyclical public expenditure in developing economies. For Latin America, see, for example, Medina (2010).

<sup>5</sup> See Obstfeld (1982), Svensson and Razin (1983) and Kent and Cashin (2003) for discussions about the effects of the terms of trade on the balance-of-payments current account.

<sup>6</sup> See Lizondo and Montiel (1989) for a detailed overview of the theory on contractionary effects of devaluation applied to developing countries. Razmi (2007) extends the theoretical framework of Krugman and Taylor (1978). This extension, including the role of transnational corporations and the type of trading partners for exports (developing or industrialized economy), suggests that the likelihood of contractionary short-run effects of devaluation may be greater for developing economies. As an opposite example, Reinhart and Reinhart (1991) find that a devaluation is expansionary in the short run in Colombia in a simulation-based model with a neo-Keynesian structure.



## II

### Related literature

Empirical evidence on the effects of the terms of trade on output fluctuations in developing economies may be classified in three groups: (i) studies that describe a correlation between business cycles and cycles in terms of trade as a stylized fact; (ii) simulation-based models; and (iii) vector autoregression models (VAR).

Agénor, McDermott and Prasad (2000) find, for instance, a strong positive correlation for Colombia, Mexico and the Republic of Korea between the cyclical components of industrial output and the terms of trade (with both the Hodrick Prescott and the band-pass methodologies using quarterly data). Also in this group of papers, Parra (2008), with quarterly data from 1994 to 2007, reports a correlation equal to 0.24 for Colombia, and Mahadeva and Gómez (2009), a positive correlation between the terms of trade and real GDP per capita for Colombia equal to 0.32 (using annual data for 1970-2007).<sup>7</sup> However, this type of stylized fact becomes more persuasive when it is used either for the calibration of simulated-based models or for the specification of an econometric model.

For instance, Mendoza (1995), in a seminal work in the second category, not only reports a positive correlation between terms of trade and GDP but also claims that his intertemporal model predicts that terms of trade shocks may account for between 37% and 56% of the actual variability of GDP in developing countries. This outcome depends of course on the particular setup of his three goods model (exportable, importable, and non-traded goods). In that framework, the dominant effect that explains the short-run effect of the terms of trade on output is basically that terms-of-trade gains induce an increase in the marginal profitability of the exportable sector, which fosters an investment boom in that sector. Investment corresponds to an international and domestic reallocation of capital where the importable goods sector is the only source of domestic capital (not the non-traded sector). On the other hand, labour supply is inelastic in traded-sector industries, and the labour supply response in the non-traded sector is assumed to be negligible. After the short-run impact, adjustment mechanisms start to work to drive the economy to a long-run equilibrium, which is by definition equal to the initial equilibrium.

The adjustment of the real exchange rate towards its long-run equilibrium reduces the short-run interest rate differential, and thus, the foreign capital that entered the domestic economy during the investment boom flows back out. As expected, the initial GDP boom weakens.

Although Mendoza's framework (1995) presents a plausible scenario for the positive correlation between the terms of trade and GDP in the short run, different theoretical assumptions could obviously tell a different story. Indeed, empirically, in his own sample, some countries displayed a negative correlation: Algeria (-0.234), Democratic Republic of the Congo (-0.107), Egypt (-0.455), Philippines (-0.285) and Tunisia (-0.309). These cases are not, however, covered by the general equilibrium model in his paper.

Kose and Riezman (1999) and Kose (2002) offer other examples of how empirical evidence may be conditioned by the particular theoretical setup. Kose and Riezman (1999), developing a general equilibrium model for a small open African economy with two sectors (exportable primary goods and non-traded goods), find that world price shocks can explain around 45% of output fluctuations, basically because both the primary good and the non-traded sectors use imported capital goods as factors of production. Therefore, a decline in the international prices of imports leads to an expansion of aggregate output. On the other hand, Kose (2002) finds that disturbances in the prices of capital goods and intermediate goods may account for 87.6% of the output variability. The greater effect in this case occurs because the author focuses on main export and import prices (which are more sensitive than terms of trade to productivity shocks), and the role of intermediate inputs in the non-traded sector, which, according to his small open economy model, does not face any limit on the supply of capital.

The third group of studies have used VAR techniques to examine the effects of terms of trade on output fluctuations in developing countries. They include Hoffmaister, Roldós and Wickham (1998); Hoffmaister and Roldós (2001); Ahmed (2003); Broda (2004); Izquierdo, Romero and Talvi (2007), and Raddatz (2007). These analyses are usually based on long-run theoretical models whose reduced forms become specific structural VARs. For instance, Hoffmaister, Roldós and Wickham (1998) point out that terms-of-trade shocks act through the price of intermediate inputs, assuming that a positive change in

<sup>7</sup> See Rand and Tarp (2002) for a description of stylized facts of the business cycles in developing countries.

this price behaves as negative technological progress. This way, positive terms-of-trade shocks are positive supply shocks that relax the intermediate inputs constraint.

Regardless of the specifics of the technique, most of the literature suggests a positive effect of terms of trade on output fluctuations in developing countries. However, some of the documented literature undermines the role of international prices. For example, Broda (2004) affirms that his evidence contradicts that from Mendoza (1995). Broda, working with a sample of 75 developing countries with annual data from 1973 to 1996, finds that the contribution of terms-of-trade shocks accounts for less than 10% of actual real GDP volatility in countries with flexible exchange regimes. Similarly, Ahmed (2003), who studied the economic fluctuations of six Latin American economies (Argentina, Bolivarian Republic of Venezuela, Brazil, Chile, Colombia and Mexico), concludes that the terms-of-trade shocks may account for (although significant in statistical terms) less than 8% of domestic output fluctuations.

The terms of trade have also been used as a control variable in explaining the relationship between the

short-run fluctuations in GDP and other variables in Latin American countries, for example, in Barro (1979) and Edwards (1983 and 1986). Consistent with the studies described before, the effect is usually positive. However, Edwards (1983) finds that the estimate of the effect of terms of trade on output is only significant for Chile and Mexico, and not significant for Brazil, Colombia and Peru. Furthermore, Edwards (1986), who checks whether a devaluation of the nominal exchange rate may display contractionary effects in the short run, concludes that the terms-of-trade effect on real output in developing countries is negligible.

To the author's knowledge, no previous study determines the extent to which output fluctuations in the recent Colombian context are attributable to the terms of trade. Colombia's own specific features and status as a developing economy may allow the use of a simple but powerful econometric tool to pursue that quantification and test its robustness. Given that the background literature contains several cases of positive, negative and null effects of the terms of trade, the question examined in the Colombian case is fundamentally empirical.

### III

## Empirical strategy

This section aims to offer a parsimonious model for Colombia for the period 1994-2011 to describe its output fluctuations, to estimate the partial effect of the terms of trade on GDP variations, and to test the significance of that estimate, using quarterly data.

This period of analysis was selected for several reasons. First, the data are available without substantial methodological changes in the national accounts and the balance of payments.<sup>8</sup> Second, the analysis excludes one of the most important structural break points in the Colombian economic policy: trade liberalization in the early 1990s. Third, the period includes: the commodity price boom that started in 2003, the subsequent downturn at the end of 2008 (for the Colombian terms of trade), and a recovery starting in 2009. In the same way, this period also includes the sharpest recession known in

Colombian economic history (year 1999) and a period of high growth (2003-2007) (see figure 1).

Regarding the statistical procedure, this paper follows the Box-Jenkins technique for a univariate model. The type of model that is estimated is usually known in the literature as the autoregressive moving average model with exogenous variables (ARMAX), a model for stationary series with three components: (i) the autoregressive part (AR), (ii) the moving average part (MA), and (iii) the set of other explanatory variables ( $x$ ). The general model is thus:

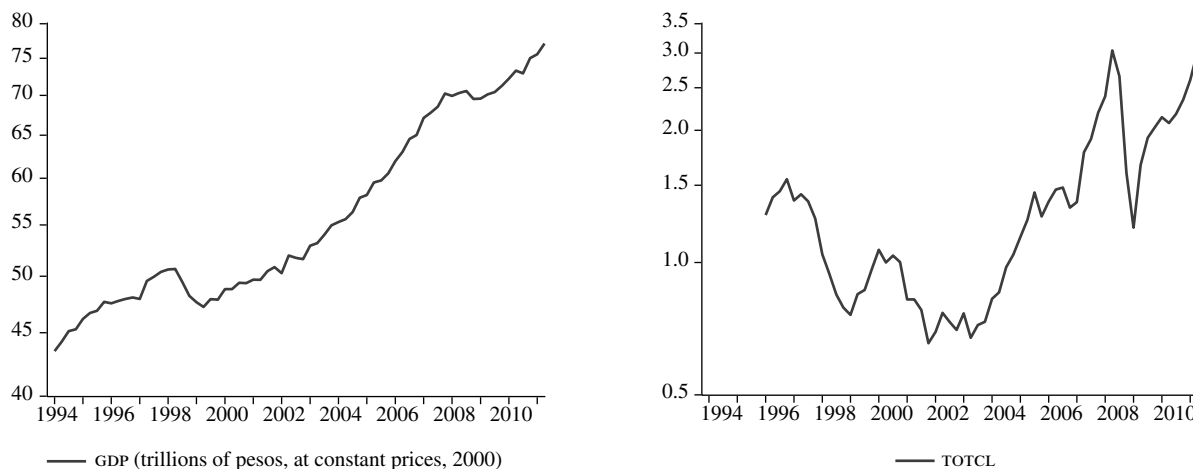
$$y_t = \alpha + \sum_{p=1}^n \lambda_p y_{t-p} + \sum_{q=1}^n \theta_q \mu_{t-q} + \sum_{m=0}^n \gamma_{i,m} X_{i,t-m} + \mu_t \quad (1)$$

Where  $y$  represents the dependent variable (a stationary series of GDP in this paper),  $t$  indexes time,  $\mu$  is the error term,  $X$  is the set of explanatory variables (stationary, and that includes the terms of trade), and  $\alpha$ ,  $\lambda$ ,  $\theta$ , and  $\gamma$ , the parameters to estimate.

<sup>8</sup> The information was obtained directly from the National Administrative Department of Statistics (DANE) of Colombia; the dataset of International Financial Statistics (IFS) does not report quarterly GDP data for Colombia until 1994.

FIGURE 1

**Real GDP and terms of trade**  
(Logarithmic scaling)



Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (Banco de la República de Colombia).

TOTCL: terms of trade for four commodities (oil, coal, coffee and nickel).

There are several reasons that justify the specification in equation (1) given that GDP and terms of trade are not cointegrated (see table A.1).<sup>9</sup> First, stationary series reduce the possibility of spurious correlations due to similar trends between the dependent and an explanatory variable. Second, the Wold decomposition shows that any stationary process can be approached through the combination of both the autoregressive and the moving average models. Third, the combination of both components contributes to the parsimony of the model, once the autocorrelation of the errors that would affect the significance tests is taken into account. Lastly, the use of an ARMA model allows one to control for any possible persistence of output fluctuations.<sup>10</sup> In addition to estimating the contemporaneous effect, this specification allows an estimate of the total effect of the terms of trade on GDP over time.

Besides the ARMA specification and the terms of trade, control variables must be considered in the set of explanatory variables. The main reason is that their omission may result in a biased estimate for the effect

of the terms of trade. From the aggregate demand side,<sup>11</sup> robustness tests include two groups of monetary variables: lending interest rates, and exchange rates. Interest rates may be important in the determination of the investment component, which explains most of the variability in GDP, and may also be responsive to changes in the terms of trade through the relaxation of balance-of-payment constraints. On the other hand, by including the nominal and real exchange rates, it is possible not only to test the robustness of the effect of the terms of trade but also to examine if the short-run effect of a depreciation (or an appreciation) of the exchange rate is contractionary (or expansionary). Lastly, quarterly growth of United States GDP (GDPUS) and net financial flows (inflows minus outflows) in the Colombian balance of payments (NFF) will also be treated as control variables. Both variables might also be correlated simultaneously with the terms of trade and Colombian GDP.

The specification leaves aside technological shocks, which are an important element in the literature on real business cycles.<sup>12</sup> This decision is justifiable on three

<sup>9</sup> See, for example, Montenegro (2002).

<sup>10</sup> See, for example, Nelson and Plosser (1982), Campbell and Mankiw (1987), and Blanchard and Quah (1989), for more information on the persistence of output fluctuations.

<sup>11</sup> See Shapiro and Watson (1989), in whose work the source of output fluctuations is divided between demand and supply components.

<sup>12</sup> See Mankiw (1989) for a criticism of the real business cycle theory and Holland and Scott (1998) for an empirical defence of the technical change explaining the business cycle in the United Kingdom.

counts. First, given the volatility of the quarterly data, technological shocks correlated with the terms of trade and that can explain variations of GDP quarter to quarter are unlikely (even if some amplifiers are considered). Second, proxies of technical change, like total factor productivity, are not usually reliable, especially in developing countries. Third, despite the fact that a clear identification is impossible, the ARMA specification is already controlling for the new information (innovations) through its moving average term, including non-observable shocks that affect output.<sup>13</sup>

The study does not take into account the expectations of economic agents or the management of these expectations as an instrument of economic policy through,

<sup>13</sup> The El Niño Phenomenon, another supply-side shock not correlated with the terms of trade but potentially useful for understanding the nature of the Colombian business cycle, was examined in a previous analysis not reported in this paper. Using the multivariate El Niño-Southern Oscillation index, I used different alternative definitions to create a dummy variable, according to whether the quarter was in the warm phase or not, whether the quarter was in a warm phase with an index that was one standard deviation higher than the average or not, or whether the absolute value of the index was relatively high to its average. No clear relationship between El Niño and GDP was found for the period under analysis.

for example, monetary policy. This is a limitation of the study, despite the difficulty of finding a good proxy for that variable.

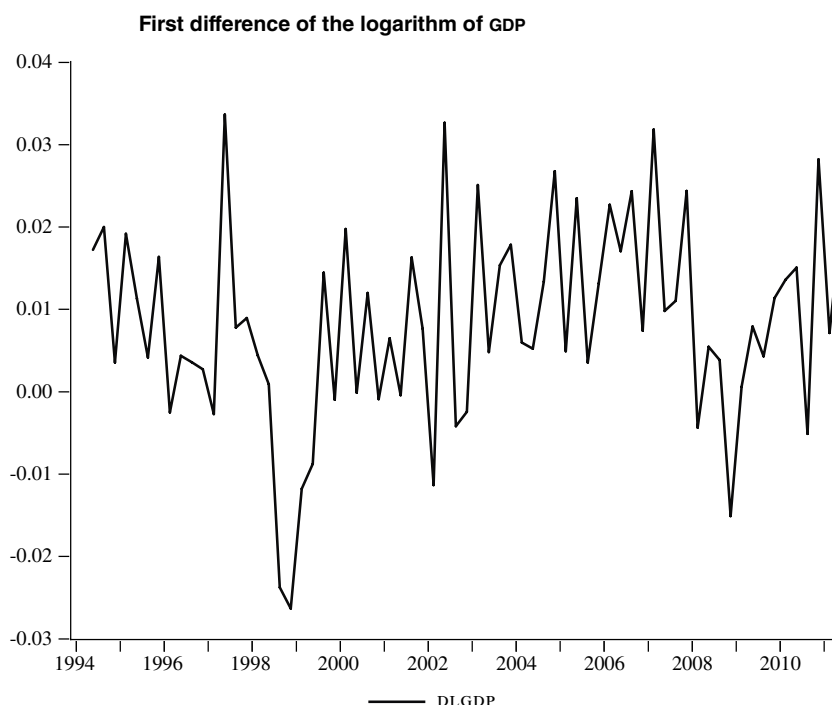
While further research can explore whether particular variables may improve the fit of the model, the main purpose of the study is not to obtain a forecasting model, but to evaluate the role of the terms of trade.

## 1. Variables and data description

### — Gross domestic product (GDP)

The quarterly data for real GDP, seasonally adjusted, was obtained from the National Administrative Department of Statistics (DANE) of Colombia (see table A.2). The dependent variable is the first difference of the logarithm of GDP (DLGDP) for Colombia (approximately quarterly GDP growth) (see figure 2). This transformation is necessary for two reasons: it defines the variable in terms of output fluctuations, and it fulfils the stationarity requirement in the Box-Jenkins technique. According to different tests, weak stationarity of DLGDP is verified by rejecting the null hypothesis that this series has a unit root (see table A.3).

FIGURE 2



Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia.

DLGDP: first difference (quarter to quarter) of the logarithm of real GDP.

As an alternative definition of output fluctuations, the cyclical component of GDP (GDP CYCLE) was estimated by means of the Hodrick-Prescott filter. This series is also stationary.

— *Terms of trade and related prices*

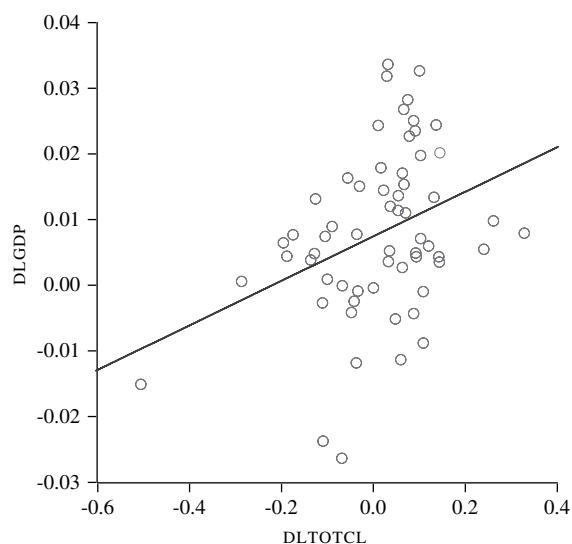
Two definitions for the terms of trade are used in this paper. The first was constructed with statistical information from the balance of payments and the wholesale imports price index from the central bank of Colombia. This definition, called TOTCL, corresponds to the ratio  $(PXCL/PI)$ , where the denominator is the wholesale imports price index and the numerator is a Laspeyres index<sup>14</sup> for the basket of the most important Colombian exportable commodities (oil, coal, coffee and nickel). I use the variable DLTOTCL (unit value of all Colombian exports). The second definition is called TOTTT, available also from the central bank of Colombia, and is the ratio of the wholesale exports price index to the wholesale imports price index  $(PX/PI)$ . The transformed variable is called DLTOTT (first difference of logarithm of TOTTT).

As a preliminary graphical diagnosis of the key relationship in this paper, figures 3 and 4 present the correlation between the output fluctuations and the variations in the terms of trade in Colombia. Figure 3 depicts the simple correlation (the correlation coefficient is 0.35). Figure 4 shows the correlation between the cyclical components of GDP and TOTCL (the correlation coefficient is 0.48). Besides the positive correlation, both scatter plots suggest that these correlation coefficients are not augmented by potential outliers. Most of the observations in the sample follow the same pattern described by the simple ordinary least squares (OLS) regression between DLGDP and DLTOTCL in figure 3 and between GDP CYCLE and TOTCL CYCLE in figure 4.

This empirical analysis assumes, based on the dependent economy framework, and the construction of our series related to terms of trade, that the terms of trade are exogenous and that they cause the output fluctuations, not the other way around. Although this is a very plausible assumption for Colombia as described in the introduction, a Granger causality test was performed. The test suggests the non-rejection of this assumption (see table 1).

FIGURE 3

**Correlation DLGDP and DLTOTCL**  
(Correlation coefficient simple: 0.35)

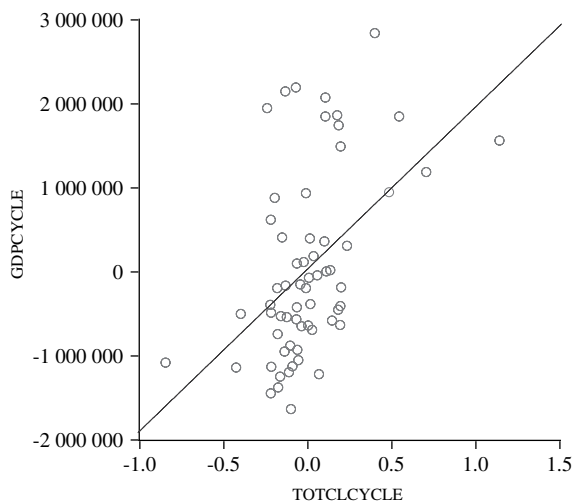


Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (Banco de la República de Colombia).

DLGDP: first difference (quarter to quarter) of the logarithm of real GDP. DLTOTCL: first difference (quarter to quarter) of the logarithm of the terms of trade for four commodities (oil, coal, coffee and nickel).

FIGURE 4

**Correlation cyclical components of GDP and TOTCL**  
(Correlation coefficient simple: 0.48)



Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (Banco de la República de Colombia).

TOTCL CYCLE: cyclical component of the terms of trade for four commodities (oil, coal, coffee and nickel). GDP CYCLE: cyclical component of real GDP.

<sup>14</sup> A Paasche index was also calculated but it did not exhibit a substantial difference from the Laspeyres one.

TABLE 1

**Granger causality test**

Null hypothesis: DLGDP does not Granger cause DLTOTCL				
	Lag length 1	Lag length 2	Lag length 3	Lag length 4
<i>P</i> value	0.80	0.79	0.82	0.52
Observations	60	59	58	57
Null hypothesis: DLTOTCL does not Granger cause DLGDP				
<i>P</i> -value	0.15	0.41	0.33	0.22
Observations	60	59	58	57

*Source:* prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (*Banco de la República de Colombia*).

DLGDP: first difference (quarter to quarter) of the logarithm of real GDP.

DLTOTCL: first difference (quarter to quarter) of the logarithm of the terms of trade for four commodities (oil, coal, coffee and nickel).

This diagnostic test also suggests that DLTOTCL does not Granger cause DLGDP (although the *p* values are relatively smaller than those in the other hypothesis in table 1). More formal empirical results on the relationship DLTOTCL and DLGDP will be presented in the following section. In addition to the terms-of-trade definitions above, four more related prices are used (as alternative to TOTCL) in the right hand side of the regressions: a Laspeyres index for the prices of oil, coal, coffee and nickel (PXCL), the oil prices (OILPR), the wholesale imports price index (PI), and the wholesale exports price index (PX). The transformed and stationary variables are called DLPXCL, DLOILPR, DLPIIFS and DLPXIFS, respectively.

— *Lending interest rates, exchange rates, net financial flows, and United States output fluctuations*

Four stationary control variables are included in the right hand side of the regression. The first is the first difference of the nominal lending interest rate (DNIR) which was obtained from International Financial Statistics (IFS) and corresponds to a weighted average of effective rates for the whole banking system including all types of credit. As an alternative, the first difference of the real interest rate (DRIR) was calculated using the inflation in the producer price index.

The second variable is the nominal depreciation of the exchange rate (the first difference of the logarithm of the nominal exchange rate (DLNER). DLNER corresponds to quarterly depreciation of the exchange rate when the value is positive. Likewise, the first difference of the logarithm of the real exchange rate (DLRER) is also used.

The third variable is the first difference of the net financial flows (inflows minus outflows in the Colombian balance of payments). Although interest rates and exchanges rates should capture the role of financial flows to some extent, this variable is included as a potential omitted variable.

Lastly, the econometric analysis controls for the quarterly growth of United States GDP (DLGDPUS). This series is available in IFS. The United States is the destination for approximately 40% of total Colombian exports and 70% of Colombian oil exports.

Control variables may be correlated with each other. For instance, changes in the structure of interest rates along with some degree of capital mobility may put pressure on the exchange rates and such correlation could affect the respective significance tests. However, the key issue in this paper is a possible bias that may exist if these control variables are omitted given their simultaneous correlation with terms-of-trade and output fluctuations.

## 2. Econometric results

The specification of the ARMA component of the model was based on the correlogram for the dependent variable (see table A.4), and a set of regressions (see table A.5) that evaluate the significance of the estimated coefficients for the ARMA elements (DLGDP as the left hand side variable). Both the autocorrelation and the partial correlation functions suggest a specification around the ARMA (3, 3). However, the set of regressions (even including a fourth lag with an possible economic interpretation) reveals a robust and

parsimonious specification. Table A.5 shows the results for regressions, including: (i) only the autoregressive elements (column 1); (ii) only the moving average elements (column 2); (iii) a baseline regression with all the ARMA elements (column 3); (iv) a specific regression obtained after removing one by one the elements whose estimated coefficients were not significant at the 5% level in the baseline regression (column 4); and (v) individual regressions for the elements AR(2), MA(3) and MA(4) (columns 5 to 7), which along with the regressions in columns 1 and 2 show that the elements AR(2) and MA(3) are the most robust. Therefore, a parsimonious version of the ARMA (2, 3) was used without including the first lag for the autoregressive component and without the first and second lags for the moving average (column 8). The estimates in the ARMA (2, 3) are robust to the inclusion of the terms-of-trade and control variables. The number of lags was reasonable for interpreting the effects on the dependent variable in the short run. Given the quarterly

data, the second lag in the autoregressive component refers to a half-year lag.

Table 2 (column 1) reports positive and significant estimates for the ARMA coefficients. While the estimates for the moving average coefficient can be associated with the effect of the statistical innovations, the estimate in the autoregressive part suggests the existence of an important degree of persistence in the Colombian GDP fluctuations. All the estimates for this ARMA model are significant at least at the 5% level. The ARMA model can explain 17% of the total variation in the dependent variable. The Durbin h's statistic, the p value of the Chi-Square test, the Breusch-Godfrey test for the residual, and the correlogram of the residual (see table A.6) suggest the absence of autocorrelation. Furthermore, given the assumption of weak stationarity, DLGDP does not face heteroskedasticity. This means that the t-statistics and the p-values used to establish significance at the 1.5% and 10% are reliable.

TABLE 2

### Terms of trade and output fluctuations I

Dependent variable: DLGDP (quarterly growth rate of real GDP)				
	(1)	(2)	(3)	(4) Standardized variable
Constant	0.0082*** (3.00)	0.0075*** (4.87)	0.0082*** (2.72)	
AR(2)	0.3273*** (3.14)		0.3227*** (2.96)	0.3227*** (2.96)
MA(3)	0.3377** (2.40)		0.3659** (2.56)	0.3659** (2.56)
DLTOTCL		0.0339*** (3.95)	0.0215*** (4.08)	0.2315*** (4.08)
Total effect (including persistence)			0.0318*** [10.24]	0.3418*** [10.24]
$R^2$	0.17	0.12	0.26	0.26
$R^2$ adjusted	0.14	0.11	0.22	0.22
Durbin-Watson statistic		1.96		
Durbin h	0.71		0.14	0.14
Prob. Chi-square (Breusch-Godfrey)	0.20		0.32	
S.E. of regression	0.01		0.01	
Akaike's information criterion	-6.06		-6.04	
Schwarz information criterion	-5.96		-5.90	
F-statistic (p-value)	0.00	0.00	0.00	
Observations	67	61	59	59

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (Banco de la República de Colombia).

Note:

(t-statistic), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , [Chi-square].

Least squares and MA derivatives that use accurate numeric methods.

Consistent standard errors.

DLGDP: first difference (quarter to quarter) of the logarithm of real GDP.

DLTOTCL: first difference (quarter to quarter) of the logarithm of the terms of trade for four commodities (oil, coal, coffee and nickel).

Column 3 of table A6 corresponds to the regression including DLTOTCL:

$$DLGDP_t = \alpha + \gamma_1 DLTOTCL + \lambda_2 DLGDP_{t-2} + \theta_3 \mu_{t-3} + \mu_t \quad (2)$$

The estimate for the effect of DLTOTCL on DLGDP is significantly positive at the 1% level. The magnitude of the estimate for the contemporaneous effect means that a 1% increase in the growth of the terms of trade increases by 0.02% the quarterly growth of GDP (holding other variables constant). This magnitude is important. One standard deviation in DLTOTCL (equal to 13.22%) will change the quarterly growth of GDP by 0.28%. This change is around 23% of one standard deviation in the quarterly growth of GDP (column 4, table A.6). Once the persistence effect is calculated, the same standard

deviation of DTOTLC is associated with a change around 34% of one standard deviation in the quarterly growth of the GDP. Therefore, one third of the quarterly variability in GDP is driven by the terms of trade for the four most important Colombian commodities.

The terms of trade effect holds when the definition of the terms of trade is extended to include the unit value of all Colombian exports (DLTOTT) (column 1, table 3). The estimate is higher but the standard deviation of DLTOTT is lower (5.79%). The independent variable still accounts for around 27% of one standard deviation of the GDP growth (column 2, table 3). Table 3 (columns 5, 6, 7 and 8) and table 4 (using cyclical components) also offer evidence confirming that prices of the four most important Colombian export goods, in particular oil, are the ones that lead the short-run effect on output.

TABLE 3

**Terms of trade and output fluctuations II**

Dependent variable: DLGDP (Quarterly growth rate of real GDP)									
	(1)	(2) Standard deviation	(3)	(4)	(5)	(6)	(7)	(8)	(9) Standard deviation
DLTOTT	0.0364* (1.69)	0.1715* (1.69)							
DLPXI			0.0253 (1.33)		0.0365* (1.69)				
DLPII				0.0028 (0.09)	-0.0367 (-1.03)		0.0197 (0.61)		
DLPXCLT						0.0252*** (4.29)	0.0260*** (3.96)		
DLOILPRI								0.0147*** (3.29)	0.2043*** (3.29)
Total effect (including persistence)	0.0566 [2.37]	0.2664 [2.37]				0.0377*** [11.96]		0.0219*** [7.24]	0.3052*** [7.24]
R <sup>2</sup>	0.20	0.20	0.19	0.17	0.20	0.27	0.28	0.25	0.25
R <sup>2</sup> adjusted	0.16	0.16	0.15	0.13	0.15	0.23	0.22	0.21	0.21
Durbin h	0.15	0.15	0.47	0.75	0.08	0.28	0.50	0.65	0.65
Prob. Chi-Square (Breusch-Godfrey)	0.22		0.23	0.20	0.22	0.33	0.33	0.31	
S.E. of regression	0.01		0.01	0.01	0.01	0.01	0.01	0.01	
Akaike's information criterion	-6.07		-6.06	-6.03	-6.04	-6.06	-6.03	-6.03	
Schwarz information criterion	-5.94		-5.93	-5.90	-5.88	-5.92	-5.85	-5.89	
F-statistic (p-value)	0.00		0.00	0.01	0.01	0.00	0.00	0.00	
Observations	67	67	67	67	67	59	59	59	59

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (Banco de la República de Colombia).

Note:

(t-statistic), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , [Chi-square]

Least squares and MA derivatives that use accurate numeric methods. Consistent standard errors.

The ARMA component is included in all the regressions but not reported.

DLTOTT: first difference (quarter to quarter) of the logarithm of the terms of trade (wholesale export and import prices).

DLPX: first difference (quarter to quarter) of the logarithm of the total exports price index (wholesale).

DLPI: first difference (quarter to quarter) of the logarithm of the total imports price index (wholesale).

DLPXCL: first difference (quarter to quarter) of the logarithm of the Laspeyres price index for exports of four commodities (oil, coal, coffee and nickel).

DLOILPR: first difference (quarter to quarter) of the logarithm of the Laspeyres price index for oil.



TABLE 4

**Terms-of-trade and output fluctuations III**  
(Cyclical components)

	Estimate	Adjusted R <sup>2</sup>	Durbin h.	Prob. Chi-square (Breusch-Godfrey)	S.E. of regression (x 100,000)	Akaike's information criterion	Schwarz information criterion	F-statistic (p-value)	Observations
TOTCLT	542 217** (2.42)	0.75	0.59	0.80	5.7	29.41	29.58	0.00	61
TOTT	2 170 543** (2.36)	0.74	0.73	0.85	5.3	29.29	29.45	0.00	69
PXT	14 030* (1.95)	0.74	0.72	0.66	5.4	29.31	29.47	0.00	69
PIT	-105.4 (-0.01)	0.72	0.89	0.72	5.6	29.36	29.52	0.00	69
PXCLT	5 928*** (3.00)	0.74	0.53	0.75	5.6	29.39	29.56	0.00	61
OILPRI	12 718** (2.64)	0.74	0.59	0.75	5.7	29.41	29.6	0.00	61

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (Banco de la República de Colombia).

Note:

(t-statistic), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Least squares and MA derivatives that use accurate numeric methods.

Consistent standard errors. AR(1) MA(2) and MA(3) are included but not reported.

TOTCL: terms of trade for four commodities (oil, coal, coffee and nickel).

TOTT: terms of trade (wholesale export and import prices).

PXT: total exports price index (wholesale).

PIT: total imports price index (wholesale).

PXCL: Laspeyres price index for exports of four commodities (oil, coal, coffee and nickel).

OILPR: Laspeyres price index for oil.

### 3. Robustness tests

The results in section III.2 are robust to the inclusion of the control variables: lending interest rates, exchange rates, net financial flows, and quarterly growth of United States GDP (see table 5). The estimate for  $DLTOTCL$  not only remains significant at 1% in most of the regressions (at 5% in column 4, table 6) but also its magnitude is stable.

In order to expose the results to a stronger robustness test, lagged control variables were included that were independently significant when a regression for  $DLGDP$  was run. These variables are:  $DNIR$  and  $DLGDPUS$  (both lagged two quarters). Once these variables are included, only  $DNIR$  (-2) remains significant (columns 1 and 3,

table 6). The estimates for standardized  $DLTOTCL$  are still robust and the total effect, including persistence, accounts for 30% of GDP variability (column 4, table 6).

Results for standardized variables (column 4, table 6) also report a theoretically consistent negative effect of  $DNIR$  (-2), which is significant and important in magnitude. Although the estimate is not robust when ARMA components are removed, the inclusion of  $DNIR$  (-2) increases the  $R^2$  from 0.17 to 0.39. Although it is true that the purpose of this paper is not to evaluate either the model's forecasting properties or the robustness in the estimate for the effect of  $DNIR$  (-2), the negative estimate, along with a higher  $R^2$ , may reflect the fact that  $DNIR$  is acting through investment, which is the aggregate

TABLE 5

## Robustness to additional variables I

Dependent variable: DLGDP (quarterly growth rate of real GDP)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.0082*** (2.72)	0.0082*** (2.72)	0.0081*** (2.70)	0.0079** (2.60)	0.0081*** (2.71)	0.0086*** (3.07)	0.0078** (2.66)
AR(2)	0.3227*** (2.96)	0.3204** (2.29)	0.3231*** (2.90)	0.3356*** (3.12)	0.3241*** (3.06)	0.3105*** (3.00)	0.2855** (2.44)
MA(3)	0.3659** (2.56)	0.3624** (2.19)	0.3626** (2.50)	0.3657** (2.52)	0.3581*** (2.53)	0.3627** (2.42)	0.3843** (2.58)
DLTOTCL	0.0215*** (4.08)	0.0221*** (3.86)	0.0217*** (4.11)	0.0279** (2.57)	0.0226*** (4.02)	0.0237*** (2.69)	0.0201*** (3.63)
DNIRT		0.0144 (0.23)					
DRIRT			-0.0008 (-0.29)				
DLNERT				0.0234 (0.77)			
DLRERT					0.0127 (0.56)		
DLGDPUS						-0.0878 (-0.32)	
DNFF							0.0000 (0.48)
$R^2$	0.26	0.26	0.26	0.27	0.26	0.26	0.26
$R^2$ adjusted	0.22	0.21	0.20	0.21	0.21	0.21	0.20
Durbin h	0.14	...	0.15	0.27	0.26	0.25	0.41
Prob. Chi-square (Breusch-Godfrey)	0.32	0.29	0.34	0.36	0.33	0.29	0.35
S.E. of regression	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Akaike's information criterion	-6.04	-6.00	-6.01	-6.02	-6.01	-6.01	-6.00
Schwarz information criterion	-5.90	-5.83	-5.94	-5.84	-5.84	-5.83	-5.93
F-statistic ( $p$ -value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	59	59	59	59	59	59	58

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia, the central bank of Colombia (Banco de la República de Colombia) and International Financial Statistics (IFS).

Note:

(t-statistic), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Least squares and MA derivatives that use accurate numeric methods. Consistent standard errors.

DLTOTCL: first difference (quarter to quarter) of the logarithm of the terms of trade for four commodities (oil, coal, coffee and nickel).

DNIRT: first difference (quarter to quarter) of the nominal lending interest rate.

DRIRT: first difference (quarter to quarter) of the real lending interest rate.

DLNER: first difference (quarter to quarter) of the logarithm of the nominal exchange rate.

DLRER: first difference (quarter to quarter) of the logarithm of the real exchange rate.

DLGDPUS: first difference (quarter to quarter) of the logarithm of the real GDP of the United States.

DNFF: first difference (quarter to quarter) of net financial flows.

TABLE 6

**Robustness to additional variables II**  
(Including lags)

Dependent variable: DLGDP (quarterly growth rate of real GDP)						
	(1)	(2)	(3)	(4) Standard variation	(5) Non-ARMA	(6) Non-ARMA standard variation
DLTOTCL	0.0182*** (3.81)	0.0189*** (3.08)	0.0146** (2.33)	0.1961*** (3.81)	0.0319*** (4.05)	0.3432*** (4.05)
DNIRT-2	-0.1777** (-2.61)		-0.1813*** (-2.72)	-0.3552** (-2.61)	-0.1251 (-1.28)	-0.2500 (-1.28)
DLGDPUS -2		-0.1762 (-1.19)	-0.2637 (-1.61)			
Total effect DLTOTCL (including persistence)				0.3076*** [8.46]		
Total effect DNIRT-2 (including persistence)				-0.5573** [4.96]		
$R^2$	0.39	0.27	0.41	0.39	0.18	0.18
$R^2$ adjusted	0.34	0.21	0.35	0.34	0.15	0.15
Durbin-Watson statistic					2.09	2.09
Durbin h	-2.33	0.34	-1.77	-1.77		
Prob. Chi-square (Breusch-Godfrey)	0.43	0.24	0.42			
S.E. of regression	0.01	0.01	0.01		0.01	
Akaike's information criterion	-6.20	-6.02	-6.19			
Schwarz information criterion	-6.02	-5.84	-5.98			
F-statistic ( $p$ -value)	0.00	0.00	0.00	0.00	0.00	0.00
Observations	59	59	59	59	61	61

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia, the central bank of Colombia (Banco de la República de Colombia) and International Financial Statistics (IFS).

Note:

(t-statistic), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , [Chi-square].

Least squares and MA derivatives that use accurate numeric methods. Consistent standard errors.

The ARMA component is included but not reported in (1) to (4).

DLTOTCL: first difference (quarter to quarter) of the logarithm of the terms of trade for four commodities (oil, coal, coffee and nickel).

DNIRT: first difference (quarter to quarter) of the nominal lending interest rate.

DLGDPUS: first difference (quarter to quarter) of the logarithm of the real GDP of the United States.

demand component whose variations explain most of the short-run variation in GDP. Although investment is one fourth of Colombian GDP, while consumption is two thirds, investment is the most volatile component of GDP (its standard deviation is 8 times greater than for consumption). An initial exploration of the channels in aggregate demand relevant to understanding more deeply the significant and robust effect of terms of trade on output fluctuations in Colombia (see table 7) suggest that investment (DLI) is the main channel. One standard deviation in DLTOTCL seems to explain

one third of the variability in investment (only for the contemporaneous effect). Future research will be oriented towards examining what type of investment terms-of-trade shocks are fostering in the short run. This might also require a better understanding of the mechanisms through which terms of trade may affect credit markets and interest rates. The next channel suggested in table 7, but apparently less responsive, is public expenditure (DLG). Lastly, the current account (DLX for exports and DLM for imports) does not seem to be correlated with terms of trade in the short run.

TABLE 7

**Terms of trade and aggregate demand components**  
(*Ordinary least squares (OLS) regressions*)

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	DLC	DLI	DLG	DLX	DLM	DLI
Constant	0.0068*** (4.53)	0.0086 (0.82)	0.011*** (4.18)	0.0099** (2.36)	0.0129** (2.04)	0.0037 (0.36)
DLTOTCL	0.0130 (1.36)	0.2096*** (3.30)	0.0330** (2.22)	-0.0296 (-0.74)	0.0972 (1.65)	0.1939*** (3.22)
DNIR-2						-1.0042 (-1.65)
$R^2$	0.02	0.10	0.04	0.01	0.06	0.19
$R^2$ adjusted	0.004	0.09	0.03	-0.003	0.05	0.16
Durbin-Watson statistic	1.33	2.05	1.93	1.98	1.42	2.25
S.E. of regression	0.01	0.09	0.03	0.03	0.05	0.08
F-statistic ( $p$ -value)	0.26	0.01	0.11	0.37	0.05	0.00
Observations	61	61	61	61	61	61

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia, the central bank of Colombia (Banco de la República de Colombia) and International Financial Statistics (IFS).

Note:

(t-statistic), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

DLI: first difference (quarter to quarter) of the logarithm of real aggregate investment.

DLC: first difference (quarter to quarter) of the logarithm of real aggregate consumption.

DLG: first difference (quarter to quarter) of the logarithm of real aggregate public spending.

DLX: first difference (quarter to quarter) of the logarithm of real exports.

DLM: first difference (quarter to quarter) of the logarithm of real imports.

DLTOTCL: first difference (quarter to quarter) of the logarithm of the terms of trade for four commodities (oil, coal, coffee and nickel).

DNIR: first difference (quarter to quarter) of the nominal lending interest rate.

## IV

### Concluding remarks

Although it is sometimes claimed that a positive correlation between the terms of trade and aggregate output can be established a priori, a vast literature describes the complexity of the relationship of these two variables. First, a positive as well as a negative correlation have been found in some developing countries. Second, the usual theoretical framework used to describe small open economies permits outcomes in which the relationship may be negative or null. A lot depends on the plausibility of the assumptions made for a particular economy and the way in which domestic markets adjust after external shocks. The idea of an ambiguous effect has lately been part of a

debate in Colombia about the perverse effects of the terms of trade and the well-known Dutch Disease. This outcome, which is commonly associated with the long run, might also act in the short run depending on how fast possible contractionary effects of a commodity price boom can be transmitted.

The estimate of the impact of the terms of trade on GDP is found not only to be significantly positive but also to be very great in magnitude. One standard deviation in the growth of the terms of trade results in around one third of one standard deviation of quarterly GDP growth. The results are robust to different specifications that include: price components of the terms of trade,

alternative definitions of business cycles, and control variables whose omission might lead to a biased estimate.

In addition, depreciation of the nominal exchange rate does not seem to have a significant short-run effect as stated by the contractionary devaluation hypothesis. This might be important when analysing potential new policies, costly or distortionary, oriented towards controlling the appreciation of the nominal exchange rate that Colombia and other developing countries have been experiencing lately. Likewise, this short-run dynamic might complement analysis that suggests that devaluation is a useful tool for growth. On the other hand, this paper finds preliminary evidence that supports the belief that the lending interest rate can have a negative effect on output fluctuations.

In summary, robust evidence was found in support of the hypothesis that the terms of trade played an important role in determining the short-run variations in GDP in Colombia over the period 1994-2011. Results from simple specifications for stationary series, justified by time series tests (cointegration and Granger), along

with the particular features of the Colombian economy, suggest that the terms of trade are exogenous and a source of the output fluctuations as described in the three goods model for a dependent economy. At least in the short run, evidence does not indicate that eventual negative effects of the terms of trade (Dutch Disease), if they exist, can offset the positive effects on aggregate output.

Preliminary evidence also indicates that investment may be the most important demand component driving the aggregate outcome. One limitation of this study is the use of aggregate data. Therefore, a future extension would be to study the relationship between terms of trade and investment demand disaggregated by components and by industrial sectors to determine the foundation of the observed fast adjustment of the external shocks in the short run. Future research related to this finding will also explore short-run effects of terms of trade fluctuations on credit markets, interest rates, and investment in Colombia. These studies would allow a more detailed evaluation of the mechanisms behind the quick investment and output responses to external shocks.

## ANNEX

TABLE A.1

**Summary of cointegration tests (GDP and TOTCL)**

Sample: 1993Q4 2011Q2

Included observations: 59

Series: TOTCL GDP

Lags interval: 1 to 2

Selected (0.05 level\*) Number of cointegrating relations by model

Data trend:	None	None	Linear	Linear	Quadratic
Test Type	No intercept	Intercept	Intercept	Intercept	Intercept
	No trend	No trend	No trend	Trend	Trend
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

\* Critical values based on MacKinnon, Haug and Michelis (1999).

Information criteria by rank and model

Data trend:	None	None	Linear	Linear	Quadratic
Rank or	No intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No trend	No trend	No trend	Trend	Trend
Log likelihood by rank (rows) and model (columns)					
0	-864.2456	-864.2456	-860.4798	-860.4798	-858.4805
1	-860.1549	-859.1981	-856.0961	-854.2298	-852.4016
2	-859.5365	-855.9931	-855.9931	-851.0928	-851.0928
Akaike's information criterion by rank (rows) and model (columns)					
0	29.56765	29.56765	29.50779	29.50779	29.50781
1	29.56457	29.56604	29.49478	29.46542	29.43734*
2	29.6792	29.62689	29.62689	29.52857	29.52857
Schwarz information criterion by rank (rows) and model (columns)					
0	29.84935*	29.84935*	29.85991	29.85991	29.93036
1	29.98712	30.0238	29.98776	29.99361	30.00074
2	30.2426	30.26071	30.26071	30.23282	30.23282

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia and the central bank of Colombia (Banco de la República de Colombia).

TABLE A.2

**Data and sample definition**

Code	Definition	Source	Coverage
D	First difference (quarter to quarter) of...		
DL	First difference (quarter to quarter) of the logarithm of...		
GDP	Real GDP	National Administrative Department of Statistics (DANE)	1994 I - 2011 II
TOTCL	Terms of trade for four commodities (oil, coal, coffee and nickel)	Central bank, author's calculations	1996 I - 2011 II
TOTT	Terms of trade (wholesale export and import prices)	Central bank	1994 I - 2011 II
PX	Total exports price index (wholesale)	Central bank	1994 I - 2011 II
PI	Total imports price index (wholesale)	Central bank	1994 I - 2011 II
PXCL	Laspeyres price index for exports of four commodities (oil, coal, coffee and nickel)	Central bank, author's calculations	1996 I - 2011 II
OILPR	Laspeyres price index for oil	Central bank, author's calculations	1996 I - 2011 II
NIR	Nominal lending interest rate	International Financial Statistics	1994 I - 2011 II
RIR	Real lending interest rate (using inflation of the producer price index)	International Financial Statistics, author's calculations	1994 I - 2011 II
NER	Nominal exchange rate (pesos per United States dollar)	Central bank	1994 I - 2011 II
RER	Real exchange rate (using producer price index)	Central bank	1994 I - 2011 II
GDPUS	Real GDP of the United States	International Financial Statistics	1994 I - 2011 II
NFF	Net financial flows (inflows-outflows)	Central bank	1996 I - 2011 II
C	Real aggregate consumption	National Administrative Department of Statistics (DANE)	1994 I - 2011 II
I	Real aggregate investment	National Administrative Department of Statistics (DANE)	1994 I - 2011 II
G	Real aggregate public spending	National Administrative Department of Statistics (DANE)	1994 I - 2011 II
X	Real exports	National Administrative Department of Statistics (DANE)	1994 I - 2011 II
M	Real imports	National Administrative Department of Statistics (DANE)	1994 I - 2011 II

Source: prepared by the author on the basis of information from National Administrative Department of Statistics (DANE) of Colombia, the central bank of Colombia (Banco de la República de Colombia) and International Financial Statistics (IFS).

TABLE A.3

**Augmented Dickey-Fuller unit root tests**

Variable	MacKinnon one-sided <i>p</i> -values	
	Null hypothesis: variable has a unit root	
DLGDP		0.002
DLTOTCL		0.000
DLTOTT		0.000
DLPX		0.000
DLPI		0.000
DLPXCL		0.000
DLOILPR		0.000
GDP (CYCLE)		0.001
TOTCL (CYCLE)		0.000
TOTT (CYCLE)		0.000
PX (CYCLE)		0.000
PI (CYCLE)		0.008
PXCL (CYCLE)		0.000
OILPR (CYCLE)		0.000
DNIR		0.000
DRIR		0.000
DLNER		0.000
DLRER		0.000
DLGDPUS		0.000
DNFF		0.000
DLC		0.000
DLI		0.000
DLG		0.000
DLX		0.000
DLM		0.000

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia, the central bank of Colombia (Banco de la República de Colombia) and International Financial Statistics (IFS).

Note: Schwarz information criterion.

DLGDP: first difference (quarter to quarter) of the logarithm of real GDP.

DLTOTCL: first difference (quarter to quarter) of the logarithm of the terms of trade for four commodities (oil, coal, coffee and nickel).

DLTOTT: first difference of the logarithm of TOTT.

DLPX: first difference (quarter to quarter) of the logarithm of the total exports price index (wholesale).

DLPI: first difference (quarter to quarter) of the logarithm of the total imports price index (wholesale).

DLPXCL: first difference (quarter to quarter) of the logarithm of the Laspeyres price index for exports of four commodities (oil, coal, coffee and nickel).

DLOILPR: first difference (quarter to quarter) of the logarithm of the Laspeyres price index for oil.

GDPCYCLE: cyclical component of real GDP.

TOTCLCYCLE: cyclical component of the terms of trade for four commodities (oil, coal, coffee and nickel).

TOTT: terms of trade (wholesale export and import prices).

PI: total imports price index (wholesale).

PX: total exports price index (wholesale).

PXCL: Laspeyres price index for exports of four commodities (oil, coal, coffee, and nickel).

OILPR: Laspeyres price index for oil.

DNIR: first difference (quarter to quarter) of the nominal lending interest rate.

DRIR: first difference (quarter to quarter) of the real lending interest rate.

DLNER: first difference (quarter to quarter) of the logarithm of the nominal exchange rate.

DLRER: first difference (quarter to quarter) of the logarithm of the real exchange rate.

DLGDPUS: first difference (quarter to quarter) of the logarithm of the real GDP of the United States.

DLG: first difference (quarter to quarter) of the logarithm of real public spending.

DLX: first difference (quarter to quarter) of the logarithm of real exports.

DLM: first difference (quarter to quarter) of the logarithm of real imports.



TABLE A.4

**Specific ARMA**  
(*Correlogram for DLGDP*)

Lag	Autocorrelation	Partial correlation	Q-statistic	Prob. Q statistic
1	0.09	0.09	0.52	0.47
2	0.30	0.30	7.17	0.03
3	0.24	0.22	11.48	0.01
4	-0.07	-0.20	11.82	0.02
5	-0.04	-0.20	11.93	0.04
6	0.00	0.04	11.93	0.06
7	0.04	0.23	12.06	0.10
8	-0.10	-0.09	12.88	0.12
9	0.19	0.09	15.78	0.07
10	0.01	0.00	15.78	0.11
11	-0.03	-0.07	15.83	0.15
12	0.11	0.03	16.93	0.15
13	0.00	0.07	16.93	0.20
14	-0.08	-0.09	17.50	0.23
15	0.02	-0.05	17.52	0.29
16	-0.10	-0.10	18.48	0.30
17	-0.01	0.14	18.48	0.36
18	-0.20	-0.23	22.24	0.22
19	0.03	0.01	22.30	0.27
20	-0.07	0.08	22.78	0.30
21	-0.11	-0.05	23.96	0.30
22	0.04	-0.08	24.09	0.34
23	-0.14	-0.07	26.06	0.30
24	-0.02	0.03	26.11	0.35
25	-0.08	0.02	26.86	0.36
26	-0.01	-0.03	26.87	0.42
27	-0.12	-0.04	28.57	0.38
28	-0.05	-0.07	28.81	0.42

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia.

TABLE A.5

**Specific ARMA**  
(Regressions for ARMA components)

Dependent variable: DLGDP (quarterly growth rate of real GDP)								
	(1)	(2)	(3)	(4) Specific I	(5)	(6)	(7)	(8) Specific II
Constant	0.0081*** (3.33)	0.0085*** (3.82)	0.0082*** (3.27)	0.0082*** (3.48)	0.0079*** (3.80)	0.0085*** (4.43)	0.0082*** (6.08)	0.0082*** (3.00)
AR(1)	0.0498 (0.33)		-0.5984* (-1.89)					
AR(2)	0.3426*** (3.69)		-0.5704** (-2.36)	0.3724*** (2.79)	0.3055*** (3.12)			0.3273*** (3.14)
AR(3)	0.2285* (1.98)		0.2419 (1.02)					
AR(4)	-0.2163* (-2.00)		-0.1293 (-0.65)					
MA(1)		0.0096 (0.07)	0.6289*** (2.81)					
MA(2)		0.4205*** (3.97)	1.0886*** (5.75)					
MA(3)		0.3443** (2.33)	0.2901 (1.51)	0.5052*** (6.24)		0.3593** (2.55)		0.3377** (2.40)
MA(4)		-0.0671 (-0.48)	0.6383*** (3.91)	-0.4013*** (-4.36)			-0.0981 (-0.94)	
$R^2$	0.18	0.24	0.28	0.27	0.09	0.08	0.01	0.17
$R^2$ adjusted	0.12	0.19	0.17	0.23	0.08	0.07	-0.01	0.14
Prob. Chi-square (Breusch-Godfrey)	0.23	0.86	0.72	0.69	0.46	0.03	0.01	0.20
S.E. of regression	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Akaike's information criterion	-5.99	-6.10	-6.00	-6.16	-6.00	-6.00	-5.92	-6.06
Schwarz information criterion	-5.82	-5.94	-5.70	-6.03	-5.98	-5.93	-5.86	-5.96
F-statistic ( $p$ -value)	0.02	0.00	0.01	0.00	0.01	0.02	0.50	0.00
Observations	65	69	65	67	67	69	69	67

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia.

Note:

(t-statistic), \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Least squares and MA derivatives that use accurate numeric methods. Consistent standard errors.

TABLE A.6

Correlogram of residuals for the selected regression <sup>a</sup>

Lag	Autocorrelation	Partial correlation	Q-statistic	Prob. Q statistic
1	0.03	0.03	0.08	
2	0.07	0.07	0.47	
3	-0.03	-0.03	0.53	0.47
4	-0.22	-0.23	4.13	0.13
5	-0.16	-0.15	5.98	0.11
6	0.01	0.05	5.99	0.20
7	0.09	0.12	6.62	0.25
8	-0.04	-0.11	6.75	0.34
9	0.22	0.15	10.59	0.16
10	-0.01	0.00	10.60	0.23
11	-0.09	-0.09	11.33	0.25
12	0.04	0.04	11.43	0.33
13	0.00	0.08	11.44	0.41
14	-0.10	-0.08	12.21	0.43
15	0.07	0.02	12.58	0.48
16	0.00	-0.03	12.59	0.56
17	0.09	0.16	13.25	0.58
18	-0.13	-0.22	14.88	0.53
19	0.08	0.06	15.46	0.56
20	-0.02	0.07	15.49	0.63
21	-0.05	-0.05	15.78	0.67
22	0.07	-0.03	16.23	0.70
23	-0.10	-0.06	17.28	0.69
24	0.01	0.01	17.30	0.75
25	-0.02	0.01	17.33	0.79
26	0.06	-0.02	17.70	0.82
27	-0.06	0.00	18.16	0.84
28	0.01	-0.05	18.16	0.87

Source: prepared by the author on the basis of data from the National Administrative Department of Statistics (DANE) of Colombia.

<sup>a</sup> See column (1) of table 2.

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# Argentina: recent dynamics in the software and IT services industry

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**ABSTRACT**

This article examines the impact of organizational and absorptive capacities and networking on the performance of Argentine software and IT services firms, within an evolutionary theoretical framework. The models estimated show that innovation outcomes depend on quality management, the existence of research and development (R&D) staff and on occupying intermediate positions in the network architecture. Firms' economic performance cannot be assessed using a single set of indicators: whereas productivity is explained by the qualifications of human resources and employment growth by R&D personnel, export probability is associated with obtaining certifications, adopting agile methodologies and occupying intermediate positions in the network architecture. The heterogeneity of business models suggests that it is not possible to establish a single type of relationship between innovation and performance for all firms in the industry.

**KEYWORDS**

Industry, informatics, software, services trade, innovation, research and development, quality management, measurement, evaluation, Argentina

**JEL CLASSIFICATION**

O14, O30, L86

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# I

## Introduction

Since Argentina's currency devaluation of 2002, the software and IT services industry has been one of the fastest growing sectors in the economy. Between 2003 and 2010, jobs in the industry overall were up by an annual average of 17.8%, sales by 17.6% and exports by 21.4% (OEDE, 2012; CESSI, 2012). These figures were well above the 3.8%, 8.3% and 13.0%, respectively, posted by Argentina's manufacturing industry,<sup>1</sup> and stood out at the regional level, as well.<sup>2</sup> This performance appears to be attributable to the Argentine economy's enhanced competitiveness following the currency devaluation and to domestic market growth, as well as the spread of outsourcing and global software development, which boosted a large number of software and IT services

firms. In addition, a set of public policies in place since 2004 has promoted quality certification, exports and innovation. These include the Fiduciary Fund for the Promotion of the Software Industry (FONSOFT) created under the Software Industry Promotion Act passed in 2004, infrastructure development and the promotion of informatics courses in tertiary education (Zuckerfeld and others, 2012). The rationale for these public policies was that building up firms' organizational capacities and innovation efforts would raise innovation performance, which would boost firms' production levels with benefits for employment, productivity and exports.

However, unlike in the manufacturing industry during this period, the rapid growth in employment, exports and even the export-to-sales ratio in software and IT services firms did not lead to higher levels of productivity. Consistently with evolutionary arguments on capacities and innovation, these outcomes appear to reflect the interrelations between internal and external knowledge sources (development of organizational and absorptive capacities and positioning in the network architecture), in a context of very different business models within the sector, which benefited innovative behaviour unequally (Yoguel and others, 2004). That is, the aggregate pattern of expanding sales, employment and exports masks sharp heterogeneities inasmuch as capacities, linkages, innovation and productive performance are not always related and the different measures of performance are only weakly associated.

At the same time, the importance of customized development, outsourcing and diversification strategies throws doubt—for services in general and software and IT services in particular—on the scope of the conventional definition of innovation performance, which is based on technology surveys and understood as the introduction of new or upgraded products and processes. This leads, in turn, to discussion of the importance of developing firms' capacities not only as a determinant of innovation outcomes, but even as the very definition of innovation in services.

In this framework, the following research questions arise: did the global, local and policy context affect all the firms in the sector equally, or does the aggregate performance hide sharp heterogeneities associated

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□ This work further develops the final report of the project on absorption capacities and connectedness in local production and innovation systems financed by Carolina Foundation of Spain.

<sup>1</sup> Notwithstanding strong growth in Argentina's software and IT services industry since the devaluation of 2002, the State made notable efforts in the preceding decades, in the context of the fluctuations of the Argentine economy since the 1970s (Aspiazu, Basualdo and Nochteff, 1986 and 1990; Babini, 2003). Around 1962, a group of engineering researchers built the first Argentine computer, named *Census*, which led to another two prototypes in that decade. By the mid-1960s Argentina had made great strides in informatics, in the Latin American context. In those early stages of the industry, in Argentina and elsewhere, software development was directly linked to hardware. In the early 1970s, IBM set up a plant producing printers and other peripherals. The crisis of import substitution industrialization and the opening of the economy in the 1976-1983 period hurt the development of the sector. After the debt crisis of 1982, policies between 1983 and 1991 centred on subsidies for the industry and the creation of a joint Argentine-Brazilian informatics research programme, which drew attention to the need for personnel highly skilled in software development. As a result, the Latin American School of Informatics (ESLAI) was created in 1986, only to be dismantled in 1991. During the market opening and deregulation phase (1991-2001) the idea prevailing was that technical progress gained from importing hardware and software would produce knowledge spillovers throughout the production structure. Before the 2002 devaluation, Argentina's software and IT services industry showed minimal domestic sales and exports, employment and productivity compared to the same industry in more developed countries and in India, Ireland and Israel (Arora and Gambardella, 2005; López and Ramos, 2007; OECD, 2002).

<sup>2</sup> Employment in the software and IT services industry was twice as high in Argentina as in Uruguay in 2003, and five times as high in 2010 (CUTI, 2012; CESSI, 2012). From 14% of Brazil's figure in 2003, the Argentine sector's employment went to 21.5% in 2010 (SOFTEX, 2012; RAIS, 2012; OEDE/MTSS, 2012). The ratio of exports to sales in 2010 (19%) lay between the ratio for Brazil (5%) and Uruguay (39%), and was much lower than in India (76%), Ireland (85%) and Israel (73%).

with different business models, uneven capacities and unequal connectedness? To what extent did this heterogeneity produce differentiated impacts on productivity, employment and exports? Lastly, to what extent are capacity-building and firms' network position and different commercial strategies related to innovation outcomes?

In this context, this article studies the characteristics of recent development in the software and IT services industry, using an evolutionary theoretical framework which emphasizes the role of absorptive and organizational capacities and the development of linkages on the basis of economic performance and innovation. A sample of 189 software and IT services firms in Argentina provides information for the period 2008-2010. This article offers a key contribution for examining the sector's recent development, since most previous works are either based on case studies or do

not include post-devaluation performance (Chudnovsky, López and Melitsko, 2001).

Section II explains the conceptual structure of the article, combining evolutionary literature on innovation, the networking approach and literature on innovation in services (Gallouj and Weinstein, 1997; Djellal and Gallouj, 2001; Coombs and Miles, 2000; Gallouj and Savona, 2009), from which the working hypotheses are derived. Section III gives a brief overview of the empirical literature on innovation in the software and IT services industry. Section IV sets out the methodology used, the building of the indicators and the descriptive statistics. Section V discusses the main results of the models estimated, on which basis we may assess the extent to which innovation results and performance are explained by organizational and absorptive capacities, firms' position in the network architecture and their business model heterogeneity. Lastly, section VI sets forth the main conclusions.

## II

### Theoretical framework and hypotheses

The theoretical framework combines the evolutionary approach to the systemic nature of innovation (Nelson and Winter, 1982; Saviotti and Metcalfe, 1984; Silverberg, Dosi and Orsenigo, 1988; Dosi, 2000) with the social networking approach to knowledge generation and circulation (Powell, Koput and Smith-Doerr, 1996; Gulati, 1999; Barabási and Albert, 1999; Cowan and Jonard, 2004) and the literature on the nature of the innovation process in services (Gallouj and Weinstein, 1997; Djellal and Gallouj, 2001; Coombs and Miles, 2000; Drejer, 2004; Gallouj and Savona, 2009).

First, the evolutionary approach treats innovation as a systemic phenomenon which does not occur exclusively inside firms, but depends largely on their interaction with other agents in the system, such as other firms and innovation promotion agencies, consultants, technology centres, business chambers and universities. Both firms' capacities and the linkages they build in the effort to increase those capacities impact their possibilities of achieving innovations and of improving their productive and economic performance. Innovation is understood as the pairing of internal and external knowledge. Access to external knowledge depends on the linkages organizations

create among themselves and the development of internal capacities. These capacities have to do with the concepts of absorptive capacity, defined as the ability to recognize, assimilate and apply external knowledge (Cohen and Levinthal, 1990), and organizational capacity, which refers to skills for codifying tacit knowledge through quality management and prevailing ways of organizing work with respect to the circulation of knowledge within the organization.

In this context, innovation is the outcome of a non-linear dynamic in the learning process, and is driven by mutual support between capacities and connectivity. The local contexts in which firms act are crucial in order to understand their innovation behaviour. Contexts include institutional framework, policy context, competition processes, firms' position in the network of connections determined by their direct and indirect linkages, and the structural characteristics of the network. Insofar as innovation is the outcome of a systemic process, the evolutionary approach complements the networking approach.

As applied to evolutionary theory of innovation, the networking approach showed up the importance of indirect —not only direct— linkages in innovation



processes. Evolutionary literature on innovation has long emphasized the importance of linkages with different agents and institutions in the innovation process (Freeman, 1991). In this framework, the literature has focused mainly on analysis of the impact of direct linkages between agents. However, the study of indirect linkages, i.e. firms' connectedness through their neighbours' linkages and the structural features of the global network, is relatively new. Research incorporating these dimensions of analysis—indirect linkages and network characteristics—has essentially used the social networks approach to describe the circulation and creation of knowledge within organizational networks (Boschma and ter Wal, 2006; Giuliani and Bell, 2005).

The literature on interorganizational and innovation networks has debated extensively the tension between the spread and the creation of knowledge (Cowan and Jonard, 2003; Watts, 2006). High local density makes a network good at spreading knowledge, but less so at introducing novelty, since all the agents in the industry have full information. By contrast, a completely random network constantly fuels novelty in a specific local environment, but is less helpful in spreading knowledge. An intermediate point is one that combines the characteristics of both regular high local density networks and random networks in which the paths between any two extremes are relatively short. These are small-world networks—those in which “cliques”<sup>3</sup> of firms are linked by nodes acting as “bridges” (Watts, 2006). In this type of network, intermediate positions are associated with the introduction of innovations and with better performance than firms in central and peripheral positions. Several authors (Watts 1999; Hargadon, 2003; Cowan and Jonard 2003; Cowan and Jonard 2004; Verspagen and Duysters, 2004; Schilling and Phelps, 2004) stress that small-world networks stimulate capacity-building in firms and therefore improve innovation trajectories. In small-world network, very dense, clustered linkages can coexist with other, weaker linkages having more distant nodes within the network. Denser linkages promote trust and collaboration between firms, while relations with distant nodes bring new, non-redundant knowledge to the network core. Small-world networks thus help to mobilize information and

innovation, routines, experiences and other resources that do not circulate within the firm's local environment, thereby boosting their learning processes.

However, the theoretical model discussed does not capture the specific innovation traits that may exist in services in general, and knowledge-intensive services in particular. The literature has shown that innovation in services is affected by certain specific aspects of their nature, such as nonmateriality, continuous reconfiguration of supply and the simultaneity of provision and consumption—involving major client interaction—which distinguish them from the manufacturing industry. At the same time, as services have become more important and it has thus become necessary to be able to compare innovation processes in services with those in industry, an interesting theoretical and methodological discussion has arisen on how to address issues of innovation in services. This discussion has focused on three perspectives: (i) an assimilation approach (ii) a demarcation approach, and (iii) a synthesis approach.

The assimilation approach was supported by authors who have argued that differences in innovation activity were greater within sectors than between industry and services each taken as a whole (Hughes and Wood, 2000; Sirilli and Evangelista, 1998). On this basis, innovation processes would require a similar theoretical and methodological treatment in both services and industry.

In opposition to the assimilation argument, several authors (Gallouj and Weinstein, 1997; Djellal and Gallouj, 1999 and 2001; Coombs and Miles, 2000) have developed a demarcation approach, which attributes characteristics to innovation in services which are not applicable to manufacturing. These authors identified several types of innovation found in services which could not, in principle, be applied to manufacturing activities. For example, innovations arising from interactions with clients or the codification of tacit knowledge generated during these interactions. So, for example, customized developments could lead to product innovations almost constantly, without entailing radical changes or even increasing firms' capabilities and routines. This position was questioned by Drejer (2004), who argued that the demarcation approach attributes particularities to services which are in fact present in manufacturing, including : (i) the importance of networks and external knowledge sources in innovation (De Bresson and Amesse, 1991), (ii) the centrality of the interactive, non-linear model of innovation (Landau and Rosenberg, 1986), and (iii) the importance of tacit knowledge codification.

<sup>3</sup> The clique concept refers to a set of nodes which have all possible connections (“everyone connected with everyone”). Cliques can be of varying sizes depending on the number of nodes they comprise: a dyad and triad are the simplest forms of clique found in a network.

In response to these critiques, a synthesis position has emerged which basically recognizes services attributes in the provision of manufactured products, and vice versa. This reflects the Lancastrian view of the nature of products and services, which was reprised by Saviotti and Metcalfe (1984) and by Gallouj and Savona (2009). In this view, innovation occurs because of changes in: (i) characteristics of the service in terms of the value attributed to it by the end user, (ii) material and nonmaterial technical characteristics of the product, (iii) competence sets (capabilities) of suppliers and end users. Here, product innovations are not merely about adjusting to demand changes, but entail shifts in the competence sets of suppliers and users, and changes in the perceived characteristics (material and nonmaterial) of the service arising from that demand.

In light of the literature review, our arguments are based on the following premises: (i) innovation processes in software and IT services firms depend on learning derived from feedback between capabilities and linkages all through the service life cycle, and (ii) these processes occur at different levels of absorptive and organizational capacities which affect innovation outcomes in a differentiated manner.

From these premises the following hypotheses arise:

### **Hypothesis 1**

Innovation outcomes in Argentine software and IT services firms depend on the development of absorptive and organizational capacities.

Interactions between firms and institutions form the architecture of connections that supports the circulation of information and knowledge. In particular, firms in intermediate network positions may be expected to be more dynamic innovators, since they draw upon knowledge and capacities from both firms at the network core and those on the periphery. This last point leads to hypothesis 2.

### **Hypothesis 2**

Innovation outcomes in Argentine software and IT services firms depend on the position they occupy in the network

architecture. In particular, intermediate positions are associated with greater likelihood of obtaining positive innovation outcomes.

The third hypothesis aims to capture certain characteristics of the production processes discussed in the literature on innovation in services, such as nonmateriality or innovation linked to solving specific problems raised by clients. These characteristics show up in several of the business models of Argentine software and IT services firms, and are determined by the importance of supplier-client relations, the standardization of the service and the degree of diversification of the services firms offer.

### **Hypothesis 3**

Innovation outcomes in Argentine software and IT services firms are determined by micro-heterogeneity within the sector, as manifested in their different business models. Firms whose main business lines are customized developments and own-brand products may be expected to achieve better innovation outcomes.

Lastly, on the basis of the theoretical approaches discussed, we may identify various determinants of innovation, in general, and in services, in particular. However, it remains to be established how these determinants (absorptive and organizational capacities, firms' network position and business models) relate to the recent growth in the sector in terms of employment, productivity and exports.

### **Hypothesis 4**

The performance of Argentine software and IT services firms in terms of productivity, employment growth and exports depends on: (i) the level of development of absorptive and organizational capacities, (ii) the firms' position within the network architecture, and (iii) the micro-heterogeneity evident in the different business models.

These hypotheses are expected to bring us closer to the research questions posed in introduction, referring to determinants of innovation and the sector's recent performance.

### III

## Empirical background on estimating innovation in software and IT services firms

A number of attempts have been made in the past few years to conceptualize and measure the determinants of innovation in software and IT services firms (Romijn and Albaladejo, 2002; Segelod and Jordan, 2002; Boschma and Weterings, 2005; Grimaldi and Torrìsi, 2001; Parthasarathy and Aoyama, 2006; Corrocher, Cusmano and Morrison, 2009; Cusumano and Yoffie, 1999; Cusumano, 2012, among others). Generally speaking, these works have explored the links between capacity-building, linkages and innovation using both panels of microdata and case studies. Studies have identified some of the key characteristics of the industry that make the respective learning processes so very specific. These include: (i) the high ratio of R&D spending to sales, (ii) the large proportion of highly skilled workers in relation to total staff, (iii) the importance of links with universities and technology institutes, and with suppliers; and (iv) the high frequency of collaborative work between clients and suppliers in the framework of customized developments, outsourcing and communities of practice. The ways in which these characteristics affect innovation outcomes is not always evident, and suggest that the very definition of innovation, as well as how it is measured, needs to be rethought. Of these works, three concern us here as central to the current research, because they address the role of interactions and client relations in producing innovation, and examine the determinants of firms' performance.

First, Segelod and Jordan (2002) analyse the effect of the supplier-client relationship in introducing innovation in 92 software projects, mainly in Europe. These authors remark on the importance of links with clients in learning processes *vis-à-vis* links with technology centres and universities. They also show that the number of links firms have is positively correlated with the innovation level of the project and with the possibility of opening new markets and therefore increasing the firm's competitiveness. From a theoretical and conceptual point of view, Segelod and Jordan emphasize the importance of user-driven innovation in developing software and gaining access to new markets.

As these authors explain it, the clients of software and IT services firms have little clarity at the start of the development process about the problem they wish

the software to solve, or indeed of the technological and organizational possibilities that it can offer once developed. The developers have the technical knowledge, but are unfamiliar with the area of application of the software. As a result, it takes many meetings between clients and providers of software and IT solutions to define the requirements of the software, because they have to narrow the knowledge gap and translate information in both directions. These interactions are not confined to the design stage, however, since technical incompatibilities can arise as the project progresses which require the design to be reviewed. So, projects start with unclear parameters which become clearer over time, but are subject to review throughout the development process, and this makes the process inherently collaborative. Accordingly, implementing a software project is more akin to an R&D project than to developing a tangible product. As described by Gallouj and Savona (2009), feedback to and from the client is key to the requirement definition, design and development stages.

Second, Romijn and Albaladejo (2002) study the determinants of innovation performance in small electronics and software firms in the United Kingdom on the basis of internal and external knowledge sources. Internal sources include: (i) the educational level and experience of owners and managers, (ii) the professional qualifications of the labour force, and (iii) technology effort in the form of formal and informal R&D, formal and informal training and investment in technology licences. External sources include: (i) intensity of networking with different agents and institutions, (ii) geographical proximity advantages associated with networking, and (iii) institutional support. These authors focus on product innovation as a measure of innovation performance. They propose three indicators: new products, number of patents and an innovation index—constructed on the basis of qualitative information—that captures the scope and significance of the firms' innovation outcomes. Their findings show that, among the internal sources, owners' previous experience and the proportion of engineers to total staff have a positive effect on firms' innovation performance. They also stress that having specialized knowledge and experience in science and engineering

is a precondition for achieving innovation outcomes in high-tech firms. However, neither networking intensity nor geographical proximity contributed to innovation performance. Only linkages with R&D institutions and with suppliers had a positive effect.

Lastly, Boschma and Weterings (2005) analyse 265 software and IT services firms in the Netherlands and find that firms' productivity, spin-off business opportunities and capacities are greater in ICT-intensive geographical areas. As a dependent variable these authors use innovation productivity, defined as the ratio of sales of new products developed by the firm to the number of staff employed in R&D. This indicator is treated as a proxy for efficiency of routines and competences in the firm. The authors show that developing radically new products or services has a positive effect on innovation productivity. They also find that client and supplier involvement in designing the product/service and the firms' and the owners' previous experience had no effect on innovation productivity. The findings also show that firms with the least difficulties in securing clients have greater techno-organizational capacities. Lastly,

they find three combined effects: (i) having previous experience in the software industry impacts positively on the link between development of a radical innovation and high innovation productivity; (ii) firms experiencing problems in capturing clients need to develop a more radically innovative product, which lowers productivity, and (iii) firms experiencing problems in securing new staff have higher innovation productivity when they are located in ICT-specialized regions.

Finally, the most significant previous work on software and IT services firms in Argentina was carried out in the last year of the convertibility scheme with a sample of 89 firms and was descriptive in nature (Chudnovsky, López and Melitsko, 2001). That work found that, although most of the firms had launched new products onto the market, the Argentine ones—especially those working in products rather than services—were the most innovation-dynamic. The authors note, however, that these findings must be seen in context, since software development is per se an innovative activity, which points up the need to develop specific innovation indicators for the industry.

## IV

### Methodology, construction of indicators and descriptive statistics

The database used consists of 189 software and IT services firms interviewed in 2011.<sup>4</sup> On average, they employ just under 60 staff, have annual sales of around US\$ 1.8 million and are active in the export market. These are mainly Argentine-owned firms, mostly established in

1990s. Most are located in the City of Buenos Aires and in Greater Buenos Aires (74%) with the rest distributed in the provinces of Córdoba (21%) and Santa Fe (5%). Between 2008 and 2010 average staffing numbers grew by 20%, well above the average for the economy at large (1%).

A set of indicators was constructed to estimate firms' internal capacities. The indicators reflected two dimensions: absorptive capacities and organizational capacities. Absorptive capacity was estimated on the basis of two indicators. The first captured the level of education of workers across three ordinal categories: firms with a below-average proportion of university graduates<sup>5</sup> and no postgraduates (29%); firms with an

<sup>4</sup> The sample design was based on a previous work of universe characterization conducted jointly with the Employment and Business Dynamics Observatory of the Ministry of Labour, Employment and Social Security. The sample took into account two variables: firm size and the impact of public subsidies awarded by the Ministry of production through the Software Industry Promotion Act, and by the Ministry of Science, Technology and Production Innovation through the Argentine Technological Fund (FONTAR) and the Software Industry Promotion Fiduciary Fund (FONSOFT). In 2010, there were around 1,600 firms with five or more workers in the sector, employing almost 57,000 people. Firms with fewer than five workers showed a low rate of continuity in the market, and so were excluded from the analysis of the universe and from the sample design. The firms benefiting from public schemes represented 22% of the universe of firms with five or more employees.

<sup>5</sup> The average of university graduates (40%) is significantly higher than in the manufacturing industry (13%); see the National Survey on Technological Innovation (ENIT) of the National Institute of Statistics and Censuses (INDEC), 2005.

above-average proportion of university graduates and no postgraduates (26%); and firms with more postgraduates than university graduates on the total staff (45%). The second indicator reflects the availability and degree of formality of the firm's R&D staff, across four categories: no R&D staff (11%), occasional informal staff (32%), regular informal staff (28%) and formal staff (29%). Organizational capacities are estimated on the basis of: (i) an additive variable to capture firms' quality management<sup>6</sup> efforts, with three possible values: one for firms which made up to 1 effort (25% of firms), two for firms which made between 2 and 3 efforts (37%), and three for firms which made between 4 and 5 efforts, (ii) a variable for the quantity of quality certifications, including ISO 9000 standards, the capacity maturity model (CMM), TickIT<sup>7</sup> and the Service Level Agreement (SLA). This variable takes three possible values: one for firms with no quality certification (39%), two for firms with one certification (43%) and three for firms with two or more certifications (18%). Finally, (iii) a variable for the use of agile methodologies,<sup>8</sup> which takes three values depending on whether firms never use these methodologies (18%), use them sometimes (44%) or always use them (38%). Table 1 shows the matrix of correlations between indicators of internal capacities, which allows us to identify a number of statistically significant relationships. The presence and formality of R&D staff is positively correlated with quality management. Workers' qualifications level, meanwhile, was positively correlated with quality certification.

The structural variables considered were firm size, estimated by the number of employees, and geographical location, age and access to promotion instruments.<sup>9</sup> The relations between the capacities indicators and structural variables are shown in annex A. The significant results from the contingency tables include the following

correlations: (i) all the capacities indicators correlate with firm size; (ii) firm age correlates positively only with the quality indicator, which means that older firms are overrepresented among those making the greatest quality efforts; (iii) access to subsidies shows a positive correlation with the indicators for quality management and certification, given that in general promotion schemes support this type of activity, (iv) lastly, there is no link between the capacities indicators and firms' geographical location.

In order to evaluate firms' connectedness we have built a knowledge network of firms and innovation promotion agencies. The network included the linkages that firms maintain with other firms and institutions—such as universities, technological centres and consultants—involved in R&D, quality and technical assistance (see annex B). Connectedness level was estimated on the basis of each firm's coreness,<sup>10</sup> a measure of centrality indicating proximity to the nucleus in a centre-periphery structure. This indicator is then used to establish a hierarchy.<sup>11</sup> Peripheral firms thus receive a low coreness coefficient, while those closer to the centre are attributed a higher rating, irrespective of the number of linkages they have. Table 2 shows that there is a positive correlation between size and coreness and that firms located in Buenos Aires and Córdoba have greater coreness than those in Santa Fe. Conversely, there are no significant differences in coreness by age and subsidies received.

Firms were also asked about their innovation outcomes in the period 2008-2010, from a range of six alternatives: (i) new products; (ii) new services; (iii) significant product upgrades; (iv) new or significantly upgraded processes; (v) new marketing channels, and (vi) organizational changes. These alternatives were used to build an indicator with three possible values: 1

<sup>6</sup> Five alternatives were considered for quality management: traceability, internal audits, risk management, availability of staff specifically for quality management and a formally established department for quality management.

<sup>7</sup> A quality-management certification programme for software development, supported primarily by the United Kingdom and Swedish software industries.

<sup>8</sup> Agile methodologies are a new way of organizing work in the software and IT services industry based on iterative and incremental development, where requirements and solutions evolve through continuous collaboration with clients and different functional teams. This method is particularly suited to outsourcing and customized development, since it aids oversight of progress throughout the development life cycle.

<sup>9</sup> Those firms are those participating in the Software Act and receiving assistance from FONTAR or FONSOFT under the Ministry of Science, Technology and Production Innovation.

<sup>10</sup> Closeness of each node to the set of densely interconnected nodes in the network. Coreness was calculated using the nucleus/periphery algorithm in the continuous version of the UCINET software (Borgatti, Everett and Freeman, 2002). The algorithm is as follows:

$$\rho = \sum_{i,j} \alpha_{i,j} \delta_{i,j} \text{ where } \delta_{i,j} = 1 \text{ if at the nucleus and } 0 \text{ if not}$$

We chose to use coreness, rather than other measures of centrality, such as degree, betweenness and closeness, because coreness allows us to pinpoint the complementarity between density and structural holes. Greater density of direct linkages may not benefit firms, because it does not necessarily incorporate new information, unless the links can connect nodes that would otherwise be isolated.

<sup>11</sup> This goes further than the estimates conducted by Romijn and Albaladejo (2002) and Segelod and Jordan (2002), which examine connectedness from an egocentric perspective similar to a degree indicator in social networks.

TABLE 1

**Matrix of correlations between capacities indicators**  
(Coefficients of correlation)

		Absorptive capacities		Organizational capacities		
		R&D staff	Worker qualifications	Agile methodologies	Quality	Certification
Absorptive capacities	R&D staff	1				
	Worker qualifications	0.2005*	1			
Organizational capacities	Agile methodologies	0.1132	0.0992	1		
	Quality	0.3152*	0.2179*	0.1055	1	
	Certification	0.0976	0.1823*	0.1041	0.4943*	1

Source: prepared by the authors on the basis of a survey conducted in the framework of the project financed by Carolina Foundation.

\*Significant at 10%.

Note: coefficients not marked with an asterisk (\*) are not statistically significant.

TABLE 2

**Relation between coreness and structural variables**

Size	Coreness	Age	Coreness	Location	Coreness	Subsidy	Coreness
Up to 10 employees	0.004	Up to 1990	0.016	Buenos Aires	0.016	No	0.015
11 to 50 employees	0.016	1991 - 2001	0.020	Córdoba	0.014	Yes	0.016
51 or more employees	0.028	2002 - 2005	0.009	Santa Fe	0.004		
		2006 or later	0.014				

Source: prepared by the authors on the basis of a survey conducted in the framework of a project financed by the Carolina Foundation.

Note: Coreness = coefficient measuring network centrality.

for firms achieving up to one innovation,<sup>12</sup> 2 for firms achieving between 2 and 4 innovations and 3 for firms with 5 or 6 innovation outcomes. Most of the firms (58%) fell into the second group, with the first group comprising 24% of firms, and the third, 19%.

Three indicators were constructed to evaluate firms' performance: external-market participation in 2010, variation in employment between 2008 and 2010 and labour productivity in 2010. "External-market participation" was estimated using a binary variable indicating whether they exported in 2010 or not. "Variation in employment" between 2008 and 2010 considered four categories: (i) firms in which employment decreased (19%); (ii) firms in which employment held steady (19%); (iii) firms in which employment rose by up to

45% (33%), and (iv) firms in which employment rose by over 45% during the period (29%). This indicator was positively correlated with firm size, signalling that a concentration process was under way during the period.

"Labour productivity" was estimated on the basis of sales per employee in 2010. This continuous variable was codified in four categories based on quartiles of the distribution of sales per employee. It correlated positively with firm age.

The industry's micro-heterogeneity is reflected in the different business models adopted by firms: (i) customized development; (ii) own-brand developments and services; (iii) outsourcing; (iv) services for third-party developments, and (v) diversified models. Looking at these alongside the structural variables (see table 3) shows that among firms that received subsidies, those producing customized developments or applying more diversified business models stood out. Firms developing their own brand and providing related services predominated among those with between 11 and 50 employees, while those

<sup>12</sup> Given that most firms (90%) achieved innovation outcomes, the control group comprised those who achieved one or none.

producing customized developments stood out among firms with over 50 employees. With regard to age, firms established between 1991 and 2001 tend to be more diversified, while newer firms work in outsourcing or provide services for third-party developments. Lastly, with regard to geographical location, firms in Buenos Aires follow a more diversified business model, those in Córdoba are geared mainly towards customized developments and those in Santa Fe mostly develop own brand products and services.

Lastly, we analyse the relation between capacities and the various business models (see table 4). The group of firms making customized products stand out for having formal R&D staff, employees with postgraduate qualifications and the largest number of quality efforts and certifications. This reflects the fact that firms dealing with specific client demands have a higher capacities threshold. The business model geared towards outsourcing stands out for quality certifications and absence of R&D staff.

TABLE 3

**Relation between business models and structural variables**  
(Percentages)

	Classification of business models					
	Customized products	Own products and services	Outsourcing	Services for third-party products	Diversified	Total
<b>Subsidy:</b>						
- no	26.3	30.5	38.5	66.7	25.0	34.9
- yes	73.7	69.5	61.5	33.3	75.0	65.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
<b>Size:</b>						
- up to 10 employees	15.8	27.1	40.7	33.3	38.9	29.9
- 11 to 50 employees	47.4	55.9	37.1	37.1	41.7	46.0
- 51 or more employees	36.8	17.0	22.2	29.6	19.4	24.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
<b>Age (year established):</b>						
- up to 1990	10.5	16.9	7.5	3.7	8.3	10.7
- 1991-2001	42.1	44.1	29.6	44.5	47.2	42.2
- 2002-2005	23.7	23.7	29.6	37.0	27.8	27.3
- 2006 onwards	23.7	15.3	33.3	14.8	16.7	19.8
Total	100.0	100.0	100.0	100.0	100.0	100.0
<b>Province</b>						
Buenos Aires	60.5	74.6	74.1	88.9	75.0	73.8
Córdoba	34.2	16.9	22.2	11.1	22.2	21.4
Santa Fe	5.3	8.5	3.7	0.0	2.8	4.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: prepared by the authors on the basis of a survey conducted in the framework of a project financed by the Carolina Foundation.

TABLE 4

**Relation between business models and capacities indicators**  
(Percentages)

	Classification of business models					
	Customized products	Own products and services	Outsourcing	Services for third-party products	Diversified	Customized products
<b>R&amp;D staff:</b>						
- none	0.1	1.7	37.1	14.8	13.9	10.8
- occasional informal	36.8	31.0	33.3	33.4	30.6	32.8
- regular informal	18.4	34.5	22.2	25.9	30.5	27.4
- formal	44.7	32.8	7.4	25.9	25.0	29.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
<b>Absorptive capacities:</b>						
- low	28.9	33.9	23.1	19.2	33.3	29.1
- medium	18.5	25.0	34.6	23.1	27.8	25.3
- high	52.6	41.1	42.3	57.7	38.9	45.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
<b>Quality efforts:</b>						
- up to 1 effort	21.1	24.1	16.7	37.1	27.8	25.1
- 2 to 3 efforts	26.3	31.1	45.8	44.4	44.4	36.6
- 4 or 5 efforts	52.6	44.8	37.5	18.5	27.8	38.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
<b>Certifications:</b>						
- none	34.2	39.6	29.2	42.3	47.2	39.0
- one certification	42.1	48.3	45.8	42.3	33.3	42.9
- two or more certifications	23.7	12.1	25.0	15.4	19.5	18.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: prepared by the authors on the basis of a survey conducted in the framework of a project financed by the Carolina Foundation.

R&D: research and development.

## V

### Main findings of the models estimated

This section presents a set of econometric models estimated to test the effect of building organizational and absorptive capacities, firms' network location and their business models on innovation behaviour and performance. The model proposed is as follows:

$$Y_i = f(\text{absorption\_cap}_i; \text{technology\_cap}_i; \text{organizational\_cap}_i; \text{business\_model}_i; \text{nwk\_position}_i; \text{control\_vbles}_i; \text{error\_term}_i)$$

Four models were estimated on the basis of this equation. As the dependent variable was a discrete ordinal

one (innovation, labour productivity and variation in employment), we have used a probabilistic model for ordered data. Firms' external-market participation was estimated on the basis of a probabilistic model. The independent variables used included: (i) capacities indicators (*absorption\_cap*, *tecnology\_cap* and *organizational\_cap* in the equation); (ii) each firm's network coreness and coreness squared (*nwk\_position*) to take into account the possibility of a quadratic relation between this indicator, innovation and performance measurements, and (iii) the business model (*business\_model*), using four dummy variables, with the diversified



business model as the base category. Lastly, availability of subsidies and firm size, age and location were included as control variables (*control\_vbles*). The first model estimated the determinants of the quantity of innovations produced by firms. Partially confirming the first hypothesis presented in the theoretical framework, presence and degree of formality of R&D staff were significant, showing the importance of absorptive capacities in producing innovations.<sup>13</sup> Among organizational capacities, quality management showed up as significant. Consistently with hypothesis 2, the firm's network position has a positive impact on the number of innovations. In particular, both coreness and coreness squared are statistically significant, with a positive sign in the first case and a negative sign in the second. This result indicates that as firms' network coreness increases, the odds rise of them achieving a larger number of innovation outcomes, but after a certain threshold this probability begins to recede. This suggests that firms in intermediate network positions draw upon the knowledge and capacities both of more peripheral firms, and of those at the core. In terms of hypothesis 3, the indicator which captures the different classifications of business model indicates that firms providing services for third-party products or geared towards outsourcing achieve fewer innovation outcomes on average than those with a diversified business strategy. These results do not corroborate the hypothesis proposed, because customization and own-brand products and services have no particular effect on innovation outcomes as compared with the diversified strategy.

The second model analyses the determinants of firms' productivity. In this case, only absorptive capacity, estimated on the basis of staff qualifications, had a positive impact. That is, the firm's productivity increased as the proportion of professionally qualified staff rose above the average for the industry, but it climbed even more for firms which—regardless of the proportion of university graduates in the total staff—had professionals with postgraduate qualifications on their staff. Lastly, of the control variables only firm age was significant, inasmuch as the older firms were the more productive.

Notably, none of the other variables used to estimate capacities, connectedness and business models were significant in explaining productivity. This may be because many firms have to expand their staff before allocating workers to specific projects: given the significant limitations imposed in this industry by the quantity and quality of available human resources, firms are forced

to engage in major internal training efforts in order to prepare the existing human resources. But it is also partly because there are both low- and high-capacity firms within the low-productivity group, making it impossible to establish significant relations in the model. This result also reflects the nature of competition in the sector, where the current high growth rate makes it possible to sustain low productivity levels in general, regardless of firms' capacities and future prospects. In Schumpeterian creative destruction terms, it may be said that the industry is at the stage of generating variety more than resolving it through selection.

The third model addresses determinants of employment variation. The results in this case indicate that of the independent variables proposed, only absorptive capacity, estimated on the basis of the availability and degree of formality of R&D staff, is significant. That is, variation in employment rises as R&D staff increase, from firms which have no R&D staff, through those which have informal staff to those that have formal R&D departments. In this case, neither business models nor the firm's network position are significant in explaining employment variation.

Of the control variables, firm size is positively associated with increased employment. This suggests that employment rose most in larger firms, which is in keeping with the trend towards higher concentration in the software and IT services industry observed in recent years (OEDE/MTSS, 2012). There was also a positive and significant link between firm age and employment variation, indicating that newer firms are more likely to increase employee numbers.

The fourth model shows that the probability of participating in external markets is correlated positively with network coreness and negatively with coreness squared. The reading of these results is similar to our earlier reading, insofar as firms located in intermediate positions in the network architecture are more likely to export. In turn, only organizational capacities are linked with export probability, with possession of certifications and the use of agile methodologies having a prominent effect. This may be because firms need to meet international standards in order to enter export markets, and because agile methodologies are important in fulfilling the oversight and monitoring requirements of developments for those markets. The results also show that, unlike in much of the manufacturing industry, the prevailing type of external-market participation does not necessarily need highly developed internal capacities.

Lastly, in terms of the role played by business model micro-heterogeneity, firms providing services

<sup>13</sup> Romijn and Albaladejo (2002) produced similar findings.

for their own developments showed a greater export propensity than those with a diversified strategy. Of the control variables, firm size was not significant, which may be because —unlike in manufacturing— exports of software and IT services do not involve high logistical costs.

In sum, the analysis of the last three models suggests that hypothesis 4 is partly borne out, with results differing depending on the measure of performance used. Consequently, the heterogeneity of the results points to the impossibility of explaining each firm's performance on the basis of a homogenous set of indicators.

TABLE 5

**Results of the models**

Independent variables		Dependent variables: performance indicators			
		Innovation (1)	Productivity (2)	Employment (3)	Exports (4)
		Ordered probit	Ordered probit	Ordered probit	Ordered probit
Network position	Coreness	9.716*	7.099	1.239	44.550***
	Coreness squared	-36.883*	-11.38	-5.22	-318.693**
Absorptive capacities	R&D staff	0.200*	0.111	0.239**	0.027
	Staff qualifications	0.096	0.260**	-0.024	0.206
Organizational capacities	Quality management	0.277*	0.037	-0.099	-0.094
	Quality certifications	-0.145	-0.021	-0.081	0.590***
	Agile methodologies	0.115	0.008	-0.041	0.421***
Business models	Customized developments	-0.036	0.285	-0.042	0.427
	Own products and services	-0.212	0.348	-0.244	0.724**
	Services for third-party developments	-0.562*	0.245	-0.226	0.085
	Outsourcing	-0.629*	0.071	-0.086	0.627
Control variables	Subsidies	-0.006	-0.028	0.163	0.337
	Size	-0.134	-0.289	0.418**	-0.059
	Age	0.006	-0.303***	0.394***	0.153
	Location	0.041	-0.118	-0.1	0.269
	Constant	***	***	***	***
	No. of observations	189	189	189	189

Source: prepared by the authors, on the basis of a database constructed in the framework of the project on absorption capacities and connectedness in local production and innovation systems financed by the Carolina Foundation.

Note: \*significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

## VI

### Conclusions

This research has examined innovation processes and performance in Argentine software and IT services firms on the basis of organizational and absorptive capacities built up over their life cycle, and their position in the network architecture. We attempted to provide an evolutionary explanation for the industry's recent growth, taking into account capacity-building

and the linking of external and internal knowledge. Differences between firms in terms of their business models show that this is a highly heterogeneous sector and that uneven capacity development has to do with the specific needs of each subsegment, and has a differentiated impact on employment, productivity and exports.

We have incorporated into the analysis some key dimensions for understanding firms' capacities and their linkages they form with other agents and institutions to upgrade those capacities, partly in line with the proposals of Gallouj and Savona (2009). In this regard, indicators were designed for organizational and absorptive capacities that, given that this is a knowledge-intensive sector, went beyond those traditionally used in innovation surveys. In the case of organizational capacities, these included the use of agile methodologies, quality management and the application of specific quality standards. Absorptive capacities were estimated on the basis of: (i) the proportion of professionally qualified staff and the presence of postgraduate employees in the firm's total staff, and (ii) the presence and formality of R&D staff in an indicator that captured a range of situations from the absence of even a troubleshooting team to the presence of a formal R&D department. This is especially relevant in this industry, in which scale is not all-important, especially for business models such as customized developments.

The results of the models partly bear out the first three hypotheses. Innovation outcomes depend on quality management, R&D staff and an intermediate network position. With regard to the fourth hypothesis, the models show that the different measures of performance in the software and IT services industry cannot be explained by a single set of indicators. The differences between firms within the industry not only in terms of capacities and connectedness, but also performance, cannot be disregarded. While the level of labour productivity can be attributed to worker qualifications, the employment dynamic correlates positively with firm size and the existence and formality of R&D staff, while external-market participation depends on quality certification, the use of agile methodologies and an intermediate position in the network architecture.

This work highlights the theoretical and methodological difficulties involved in approaching innovation processes in knowledge-intensive software and IT services sectors, given that the estimate of

innovation activity based on methodologies used in the manufacturing industry—centred on the development of new products and processes—loses explanatory power. This is particularly true for firms producing customized developments, since developing new products or processes is the very nature of the business and does not necessarily constitute an innovation. Accordingly, both the literature review and the discussion of the descriptive statistics and the model raise issues that would have to be included in a research agenda on the relations between capacities, innovation efforts and performance in an industry such as this one, which is becoming increasingly important in the region's occupational structure. Consistently with the arguments of Gallouj and Savona (2009), analysis of the results of this study point to the need to consider the specificities of the software and IT services industry and, in turn, to take into account those aspects of the innovation process in the manufacturing industry which can be assimilated into the development of the software and IT services industry (Drejer, 2004). In this context, it is particularly important to study innovation processes as interactive or systemic phenomena, in which client-supplier linkages, network presence and the use of external knowledge sources are crucial.

This raises new questions and future lines of research surrounding the need to: (i) advance towards a conceptualization of innovation for services in general and software and IT services in particular, and (ii) determine which measures explain the success of software and IT services in the market. This would require, as well, a study of what type of technological trajectories and evolutionary paths are associated with good performance, and how feedback mechanisms arise between connectedness and technological and organizational capacities that can lead to innovation as an emerging property. This range of dimensions would require case studies in firms with very different technological, organizational, commercial and absorptive capacities, and very uneven business models and network architecture position.

## ANNEX A

TABLE A.1

**Relation between capacities and structural variables**  
(Percentages)

	Firm size by number of workers, 2010			
	Up to 10	11-50	51 or more	Total
<b>R&amp;D staff:</b>				
- none	50.0	35.0	15.0	100.0
- occasional informal	44.3	44.2	11.5	100.0
- regular informal	30.8	44.2	25.0	100.0
- formal	7.3	54.5	38.2	100.0
Total	30.3	46.3	23.4	100.0
Pearson chi2(6) = 27.0685 Value P = 0.000				
<b>Worker qualifications:</b>				
- low	50.9	45.3	3.8	100.0
- medium	46.8	44.7	8.5	100.0
- high	9.5	50.0	40.5	100.0
Total	31.0	47.3	21.7	100.0
Pearson chi2(4) = 48.5641 Value P = 0.000				
<b>Agile methodologies:</b>				
- never	40.6	50.0	9.4	100.0
- sometimes	35.9	42.3	21.8	100.0
- always value P	18.2	50.0	31.8	100.0
Total	30.1	46.6	23.3	100.0
Pearson chi2(4) = 10.5076 Value P = 0.033				
<b>Quality management:</b>				
- Up to 1 effort	45.7	47.8	6.5	100.0
- between 2 and 3 efforts	41.2	45.6	13.2	100.0
- 4 or 5 efforts	8.6	45.7	45.7	100.0
Total	29.9	46.2	23.9	100.0
Pearson chi2(4) = 40.3733 Value P = 0.000				
<b>Certifications:</b>				
- none	47.9	42.2	9.9	100.0
- one	23.8	56.3	20.0	100.0
- two or more	3.1	33.3	63.6	100.0
Total	29.3	46.8	23.9	100.0
Pearson chi2(4) = 48.2325 Value P = 0.000				
<b>Receives subsidy</b>				
	No	Yes	Total	
<b>Quality management:</b>				
- Up to 1 effort	58.7	41.3	100.0	
- between 2 and 3 efforts	29.4	70.6	100.0	
- 4 or 5 efforts	20.0	79.7	100.0	
Total	33.3	66.7	100.0	
Pearson chi2(2) = 19.0684 Value P = 0.000				
<b>Certifications:</b>				
- none	47.9	52.1	100.0	
- one	22.5	77.5	100.0	
- two or more	25.0	75.0	100.0	
Total	32.0	67.2	100.0	
Pearson chi2(2) = 12.0686 Value P = 0.002				

Source: prepared by the authors on the basis of a survey conducted in the framework of a project financed by the Carolina Foundation.

Note: Pearson chi2: 6, 4 or 2 degrees of freedom.

R&D: research and development.

## ANNEX B

## Structure of firms' linkages network

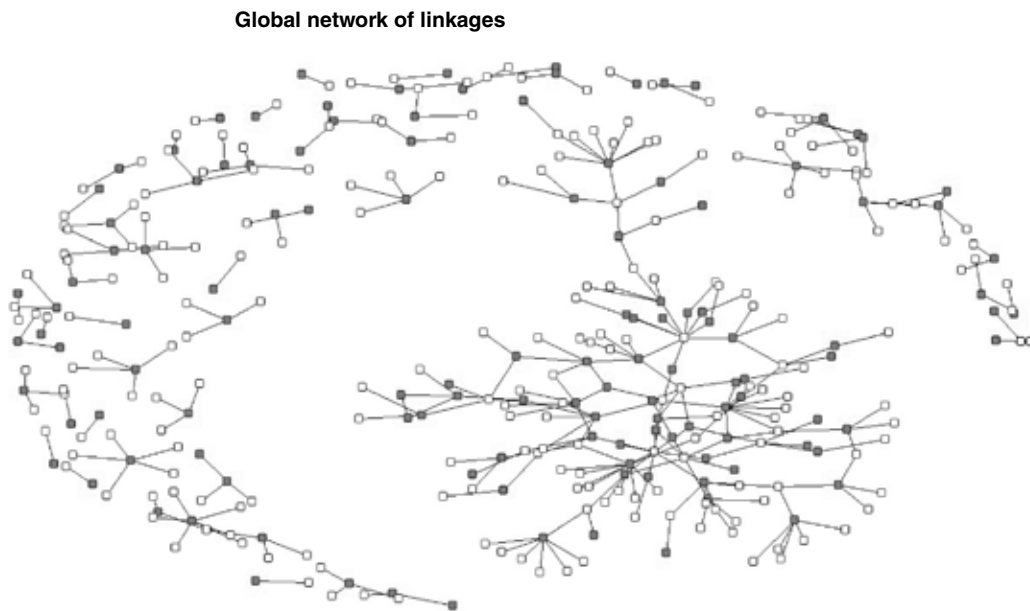
On the basis of the information obtained in each firm, we built a database recording linkages geared towards improving three aspects of techno-organizational capabilities: (i) quality management, (ii) technical assistance, and (iii) joint R&D activities. The database was processed using UCINET software. This identified the interviewed firms' linkages with clients, suppliers, competitors, business chambers, scientific

and technical organizations and consultants, all in a single network.

Figure 1 shows the linkages structure of the firms interviewed. The black nodes represent firms interviewed and the white nodes represent partners who were not interviewed.

Linked firms (65%) registered an average of 2.7 linkages per node.

FIGURE 1



Source: prepared by the authors on the basis of a survey conducted in the framework of a project financed by the Carolina Foundation.

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# The international trade position of Argentina. Towards a process of export diversification?

*Marta Bekerman and Federico Dulcich*

**ABSTRACT**

This study analyses how far the strong expansion of Argentine exports since 2003 has been due simply to favourable external conditions and how industrial manufactures have behaved. It finds that the country's pattern of international specialization has not greatly altered at the major category level, but that both primary products and manufactures of agricultural origin, which account for much of the trade surplus, have undergone significant changes in composition. In addition, regional trade has consolidated and traditional partners such as the European Union and the United States have been displaced to some extent by China. Industrial manufactures have continued to suffer from a strong comparative disadvantage, but certain high-technology industrial sectors, such as agricultural machinery and pumps and compressors, have started to become competitive, while seamless oil and gas tubing is already highly competitive.

**KEYWORDS**

International trade, exports, export diversification, industrial products, agricultural products, manufactured products, competitiveness, trade statistics, Argentina

**JEL CLASSIFICATION**

F10, F15, F63

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# I

## Introduction

In the period following the end of the convertibility regime, Argentina displayed high levels of growth while maintaining a positive trade balance. This made it possible to implement a debt service policy that sharply reduced the level of external debt relative to output, giving the trade balance a very important role in determining the current-account balance. This made it important to consolidate a pattern of international trade that would ensure steady growth untrammelled by external constraints.

A country's international trade specialization profile is critical to its economic structure. The opportunity to develop sectors with high value added can mean higher wages and larger surpluses that make it possible for the public sector to implement income redistribution policies, with better health and education services. Accordingly, a thorough debate about recent trends in Argentina's specialization pattern is essential.

The country's exports have grown strongly since 2003. What accounts for this situation, which seems to have neutralized the external constraint, at least for now? To what extent can it be put down purely to favourable external conditions? What impact have these external conditions had on the overall specialization pattern of the

Argentine economy, and particularly on the behaviour of industrial manufactures? Is it possible to identify continuities and discontinuities within this pattern? The present study will seek to answer these questions.

It will begin with a brief exposition of the concept of the specialization pattern, its theoretical importance and its history (section II). It will then present the main changes in the macroeconomic context over the past decade (section III) before analysing the evolution of revealed comparative advantage for the country's different production categories and main trading partners, while also taking account of the role played by the improving terms of trade (section IV). Section V will analyse the behaviour of manufactures of industrial origin (MIO) by tracking the evolution of revealed comparative advantage, positing a situation of balance in industrial trade for this classification in order to ascertain the relative changes undergone by the different MIO sectors. It will then analyse international MIO trade results in terms of the sector's technology content and the gap separating it from the technical processes of the international frontier (section VI). Lastly, the conclusions of the study will be presented (section VII).

# II

## The specialization pattern and its theoretical importance

The international division of labour and the consolidation of capitalism as a social form of production around the globe opened up a theoretical debate about the specialization of the different nations within the nascent global market and the role played by this market in the levels of well-being enjoyed by individuals. This concept has been addressed by different schools of thought that have set out to study it either from an analytical perspective or with reference to the controversial policy implications that can be drawn from its analysis.

Departing from the neoclassical stance based on the Heckscher-Ohlin model (Appleyard and Field, 1997), a

variety of alternative theoretical approaches emerged, emphasizing new sources of comparative advantage and stressing the relevance of the specialization pattern for a nation's growth path.

New international trade theory, endogenous growth theory and different neo-Schumpeterian schools of thought have variously laid the stress on scale economy issues, the existence of reproducible factors with non-decreasing returns (essentially what they term human capital), spillover effects between industries and international differences in knowledge and technological capabilities (Bekerman and Sirlin, 1999).

On the basis of this conception of a country's international trade position, which ascribes a dynamic character to comparative advantage, there has arisen a more recent literature advancing different arguments that emphasize the importance of export diversification. In the first place, such diversification helps to reduce the volatility of export currency earnings, and thence of growth in the economy (Agosin, 2009). This is particularly important for developing countries, which tend to have little access to the international financial market when they need to cover temporary current-account deficits, and which usually depend heavily on imported capital goods and inputs.

At the same time, export diversification entails a productive diversification that enables local agents to "discover" unexplored comparative advantage in their economy, with export pioneers showing the way to those who come after them (Hausmann and Rodrik, 2003). Countries that have a high-quality export basket based on more sophisticated items enjoy higher subsequent growth than countries that do not (Rodrik, 2005). In this context, it is very important for the migration of producers to new sectors not to be blocked by high

barriers to entry (patents, large efficient minimum scales, etc.). These productive diversification processes generate a range of externalities (rising productivity because of agents' productive specialization, increasing workforce skills, etc.) that positively impact growth. This has led some authors to defend the role of the State in "guiding the market" towards the discovery of new capabilities (Wade, 1989).

To sum up, there is a broad consensus that a country's specialization pattern is crucial to its economic structure and thence to the sustainability and level of long-term growth in the economy. Within this context, the different sectors will have different levels of technological spillovers and differing potential to capture exceptional earnings by differentiating processes or products and thence accumulate capital and generate subsequent increases in productivity. This divergent evolution of productivity will influence their scope to raise real wages and generate larger surpluses that enable the public sector to implement income redistribution policies.

The following sections will analyse the macroeconomic context and the evolution of specialization patterns in the Argentine economy in the last decade.

### III

## The macroeconomic context

The collapse of the convertibility system, which entailed devaluation of the real exchange rate, led to a crucial transformation in the macroeconomic policy of Argentina. The initial period of uncertainty and shrinking domestic demand was followed, once the 2001-2002 crisis was over, by a process of economic recovery that made it possible to inaugurate a stage of steady growth without undermining the trade balance.

This was because the recovery process was based not only on reviving domestic demand but also on a strong expansion of exports and a process of import substitution. Thus, what may perhaps be considered a very striking macroeconomic feature of the post-convertibility period is the lifting of the external constraint on growth. The economy grew at high rates for eight years running (with a single interruption in 2009) even as a substantial trade surplus was maintained (see figure 1).

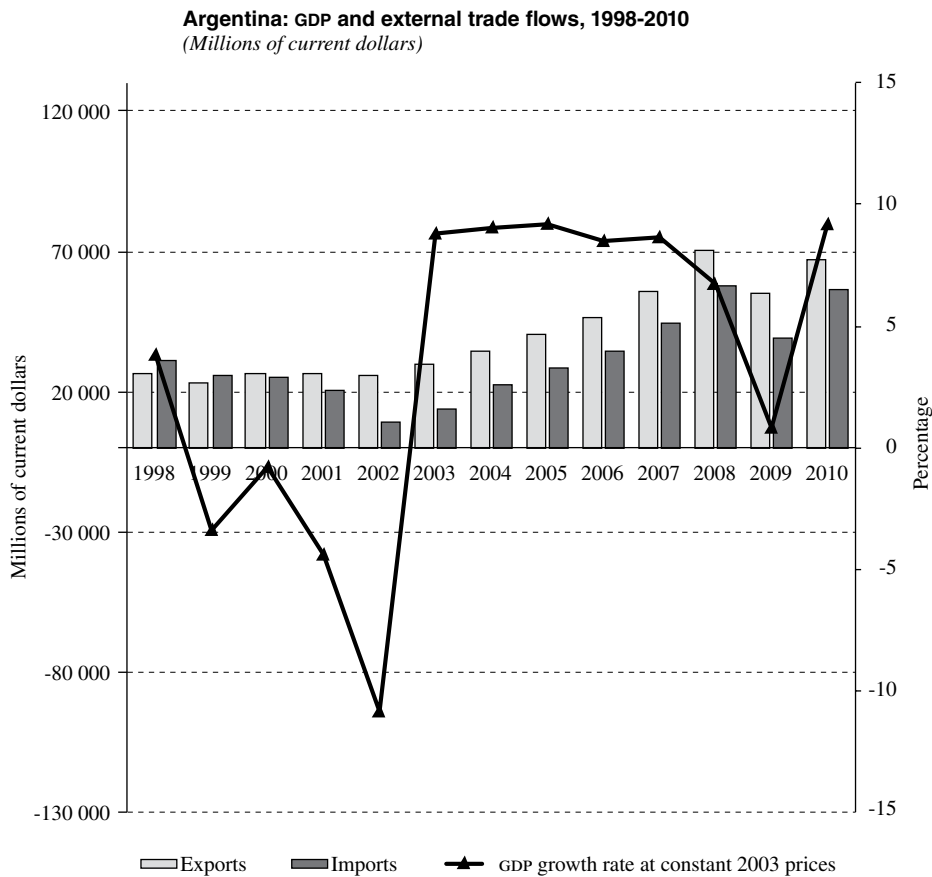
From 2001 there was a structural shift in the composition of final demand, with the shares of exports

and investment increasing at the expense of public- and private-sector consumption. External sales rose from the equivalent of 9.3% of aggregate demand during 1995-1997 to 21.7% between 2003 and 2005, a share that then drifted back down as public-sector consumption, and especially investment, recovered.<sup>1</sup>

Katz and Bernat explain that changes in macroeconomic regimes initiated during downturns, as happened in Argentina in late 2001, give rise to these shifts in the composition of aggregate demand because they affect the various sectors differently, depending on how far they lag the technical processes of the production frontier. Those closest to the international technical frontier can direct their surpluses to the external market when domestic consumption falls. Conversely, less productive sectors

<sup>1</sup> Investment represented 10.4% of aggregate demand in 2002 and now represents 19%.

FIGURE 1



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC) and United Nations Commodity Trade Statistics Database (COMTRADE).

GDP: gross domestic product.

cannot compete internationally and are more affected by the recession, with greater exit by firms (Katz and Bernat, 2011). One result of this process should be an increase in export potential, and this helps to explain why Argentina's external trade position came to play a much more important role as a driver of aggregate demand than in the previous decade. It also indicates, however, that these circumstances

did not affect all industrial sectors alike. Their responses were influenced by different factors, especially the levels of competitiveness they presented before the crisis. It is thus important to observe what transformations occurred in the international trade position of the major production categories and industry sectors, something that will be dealt with in the following sections.

## IV

### The external trade position by major production categories and main trading partners

#### 1. Methodological issues

##### (a) *The revealed comparative advantage (RCA) index*<sup>2</sup>

To determine an economy's specialization pattern, exports and imports must be studied simultaneously, and the sectoral trade balance is accordingly taken as a variable of analysis. However, trade balances must be normalized to discount the effect of temporary factors (especially macroeconomic ones) that result in overall trade surpluses or deficits.

In view of this, the RCA indicator has been used to analyse the overall specialization pattern, so that:

$$RCA_i = [(X_i - M_i) - (X - M) * (X_i + M_i) / (X + M)] * 1000 / (X + M)$$

where  $(X_i - M_i)$  is the trade balance observed in sector  $i$ , and  $(X - M) * (X_i + M_i) / (X + M)$  is a notional value representing the sectoral component of  $i$  in the overall surplus or deficit.

Revealed comparative advantages thus represent normalized sectoral trade balances, corresponding to a hypothetical situation of balanced trade. Accordingly, they are an indicator of the nation's comparative advantages.

As can be appreciated from the indicator, the way the observed sectoral balances are "normalized" is by deducting from them a notional sectoral component estimated from the sector's share of total trade (exports plus imports).

This method entails some simplifying assumptions, such as that temporary imbalances originating in macroeconomic variables affect all sectors alike (or, more precisely, affect them strictly in proportion to their share of total trade). Evolving activity levels can influence the evolution of the RCA indicator by their dissimilar impact on the behaviour of imports and exports.<sup>3</sup>

Although the RCA indicator is suitable for analysing the specialization pattern overall, it can create large biases for trade by destination. The greater the differences in the ratios between the trade balance and total trade for each destination, on the one hand, and for the whole world, on the other, the larger these biases will be. Theoretically, an analysis of trading activity that assumes balanced trade should be much more relevant to worldwide trade than to bilateral trade situations, where there may be no economic forces pushing trade back towards balance, at least in the short run. Ultimately, analysing trade by destination brings in a new issue, trade triangulation, which cannot be captured by the RCA indicator.

##### (b) *The trade performance (TP) index*

In view of these problems, a slightly different indicator has been used to study bilateral trade with Argentina's various partners. We have called this the normalized trade performance index, or simply the trade performance (TP) index:

$$TP_{ij} = [(X_{ij} - M_{ij}) - (X_{ij} + M_{ij}) * (X - M) / (X + M)] * 1000 / (X + M)_j$$

where subscript  $i$  represents each of the sectors and subscript  $j$  each trading partner, while no subscript means that total exports and imports are meant.

The difference from the RCA indicator (used to analyse the overall specialization pattern) is that in this case the overall trade balance is still used to normalize the sectoral trade balance (calculate the notional value), whereas bilateral trade variables are used for the rest of the indicator. In other words, these are trade situations corresponding to a state in which overall (and not bilateral) trade is balanced. This means that the sum total of the values for all sectors (which we shall call the total trade performance) of this indicator for each destination will no longer be zero. A negative (positive) sign will indicate that there is a larger (smaller) trade deficit or a smaller (larger) trade surplus with a particular country (relative to its total trade share) than with the remaining countries. A negative figure which increases over a period could be the consequence of a deterioration in particular sectors that is not offset by the behaviour of others.

<sup>2</sup> This index is based on the one developed by Miotti, Quenan and Winograd (1998).

<sup>3</sup> A higher level of activity may create greater import pressure from sectors with higher levels of import elasticity relative to output. Conversely, a recessionary situation will produce the opposite effect, as can be seen in the evolution of the index by major production categories for 1999-2002.

The trade performance indicator thus presents differences from the RCA indicator. The essence of the comparative advantage concept is the interrelationship between sectors, which means that the advantages of some are matched by the disadvantages of others. In this case, trade with a particular country may evince a positive or negative performance for all sectors. Total bilateral trade is taken as the final denominator for this indicator to avoid the effects arising from the differing shares of the various countries in Argentina's total trade and to make the values for trade with different trading partners and for worldwide trade comparable.

(c) *The MIO revealed comparative advantage (RCA<sub>MIO</sub>) index*

The fact that Argentina specializes heavily in primary products and manufactures of agricultural origin (MAO) means that RCA levels are strongly negative for sectors producing manufactures of industrial origin (MIO) and makes variations in them insignificant. Accordingly, a revealed comparative advantage index has been prepared for the different MIO sectors, relating them to the average for the universe of this category used in section V. The RCA<sub>MIO</sub> index is calculated as follows:

$$RCA_{MIOi} = [(X_i - M_i) - (X_{MIO} - M_{MIO}) * (X_i + M_i) / (X_{MIO} + M_{MIO})] * 1000 / (X_{MIO} + M_{MIO})$$

where  $(X_i - M_i)$  is the trade balance in sector  $i$  (which must be an MIO sector) and  $(X_{MIO} - M_{MIO}) * (X_i + M_i) / (X_{MIO} + M_{MIO})$  is a notional value representing the sectoral component of  $i$  in the MIO surplus or deficit.

Structurally, this index is analogous to the RCA index, except that the overall surplus or deficit is replaced by the MIO surplus or deficit. Consequently, it represents a normalization of the trade balance in the different MIO sectors, assuming total MIO trade to be in balance. It is important to note that there are no economic tendencies in Argentina towards balance in MIO trade, as there are in the case of overall trade. However, the index does serve to express the performance of a sector in relation to the overall behaviour of the MIO category. To do this, it compares the actual trade balance with the notional trade balance for the sector concerned. The latter is prepared by taking the sector's share of MIO trade (both imports and exports) and of the total trade balance of this category. A positive (negative) RCA<sub>MIO</sub> index value implies that the actual balance of the sector is larger (smaller) than the notional balance, and so the actual trade surplus is larger (smaller) than the notional surplus (when MIO are in surplus overall) or the trade deficit is smaller (larger)

than the notional one (when MIO are in deficit overall). Consequently, the sum of all MIO sectors of the index is nil.

## 2. The behaviour of RCA in the last decade. Analysis by major categories

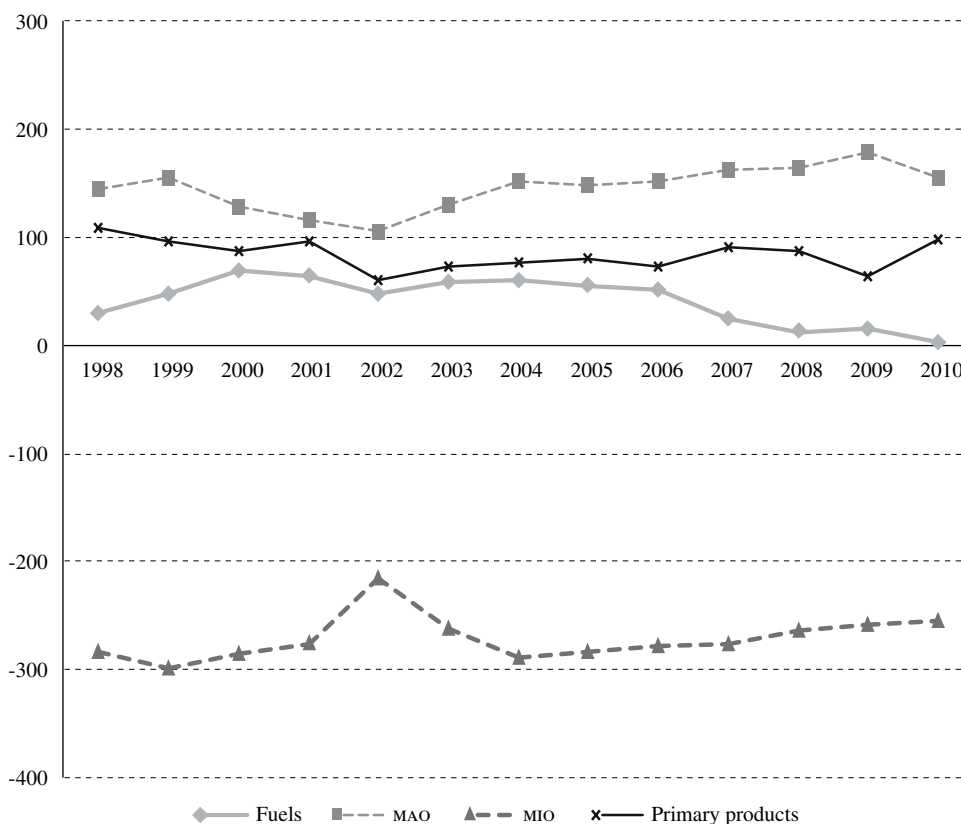
Historically, the Argentine economy has had a dual pattern of specialization. Its sources of comparative advantage lie in the production of primary products and MAO, while it presents strong comparative disadvantage in MIO. Under convertibility, this pattern of specialization was accentuated by the growing appreciation of the real exchange rate. During that period, the comparative advantage of primary products increased because of the performance of cereals and oilseeds and, to a lesser extent, unprocessed fish and seafood (Bekerman and Cerdeiro, 2007). Within the MAO category, animal feed, oils and fats were the best-performing sector, followed by hides and meat. It might be said that the food and beverages sector consolidated its external competitive hegemony and its position within the Argentine industrial structure, and its lesser elasticity relative to domestic activity meant that it was less affected than other industry sectors during the 1998-2002 crisis.

When the behaviour of MIO during the convertibility period is analysed, sectors can be divided into two groups. In the industrial commodities category, the privatization of public-sector enterprises resulted in consolidation of certain private-sector business groups that increased their market power and were able to move towards technological convergence with the international frontier. The clearest example of this is the production of seamless tubes for oil extraction. Conversely, the machinery, electronic appliances and transport equipment sectors had a large competitiveness deficit, and this widened in the late 1990s in the face of world technological progress and failure to bring on local innovation activities (Bekerman and Sirlin, 1999).

The evolution of the RCA index during the first decade of this century can be seen in figure 2. In the aggregate, Argentina's overall pattern of international specialization has not changed substantially. It retains a clear competitive advantage in primary products and has been increasing this advantage in MAO. In the case of primary products, this advantage progressively consolidated as technical processes from the international frontier, such as the use of genetically modified (GM) and no-till crops, were introduced into the country. In the case of MAO, growth is being seen in sectors that benefit from the differential in export duties between their input (grains or oilseeds) and their final output (oils and milling by-products). These windfall earnings come on top of those attributable to leading-edge technical processes and rely on the ability

FIGURE 2

**Argentina: RCA index by major production categories, 1998-2010**  
(Absolute value index)\*



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC) and United Nations Commodity Trade Statistics Database (COMTRADE).

\* Figures calculated from the equations described in section IV of this article.

RCA: revealed comparative advantage.

MAO: manufactures of agricultural origin.

MIO: manufactures of industrial origin.

of the primary sector to transfer some of the yields from land via the export duties system implemented after the currency was devalued in 2001-2002.

In the case of fuels, conversely, there has been a downward trend in recent years. This is explained by the strong growth of oil imports (from US\$ 198 million in 2003 to US\$ 2.567 billion in 2010), which led to a drop of 59% in net exports (US\$ 1.608 billion in 2010). Driven by economic expansion, domestic demand grew by substantially more than output, and this negatively affected the trade position of the sector.

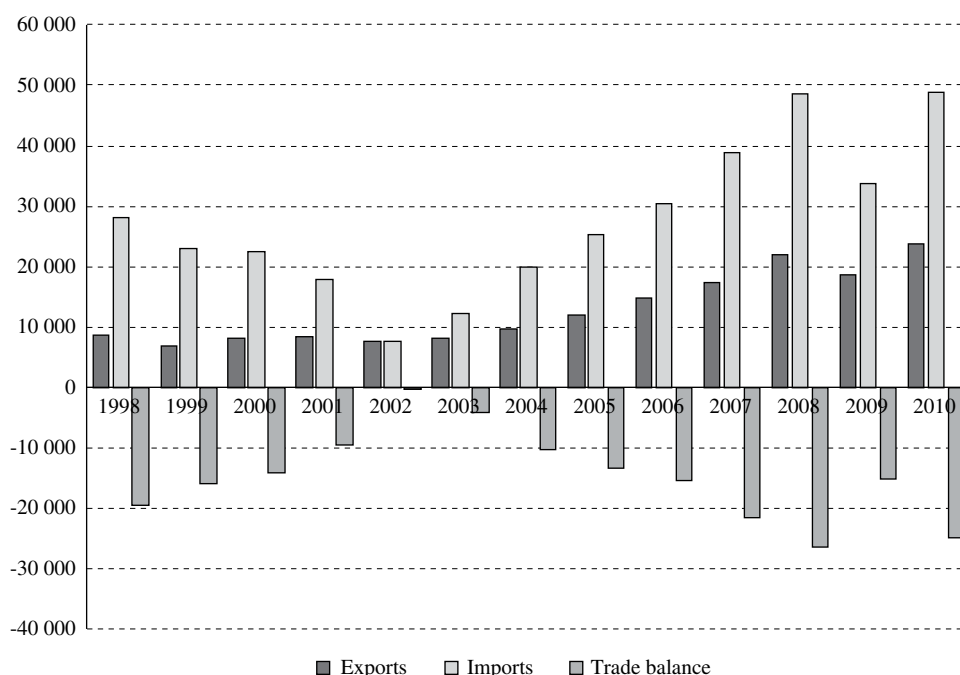
MIO continue to be affected by strong comparative disadvantages, but these have tended to ease slightly in recent years.

The obvious correlation between the MIO deficit and the activity level is due to the large share of MIO manufactures accounted for by certain categories associated with the workings of the economy, such as capital goods, inputs and parts and components.<sup>4</sup> This meant that the deficit rose during the economic recovery period and fell in 2009 owing to the impact of the international crisis on the domestic activity level (see figure 3).

<sup>4</sup> These categories account for 80% of mio imports, a structural share that was constant throughout the decade.

FIGURE 3

**Argentina: external trade in MIO, 1998-2010**  
(Millions of current dollars)



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC) and United Nations Commodity Trade Statistics Database (COMTRADE).

MIO: manufactures of industrial origin.

### 3. The impact of the terms of trade

The substantial MIO trade deficit has been more than offset during the last five years by a large surplus in primary products and MAO, with an overall trade surplus the result. A key factor behind this surplus has been the improvement in the terms of trade driven by the sharp rise in demand for food products, particularly in Asian markets.

What would have happened to the Argentine trade balance if international prices had held steady at 2003 levels? If the effect of changes in these prices is discounted<sup>5</sup> (by taking constant 2003 prices), it can be seen that there would still be a trade surplus, but of only US\$ 2.5 billion, i.e., it would be much smaller than those recorded in recent years (about US\$ 13 billion). This is because the hypothetical surpluses for primary products and MAO would be much lower than

those actually achieved at current prices (see figure 4). Consequently, today's large trade surplus is heavily dependent on relative price movements, something that reveals a certain fragility in the country's international trade pattern should the international crisis worsen. In addition, the trade balance is the main provider of currency for the current account, as the country has a structural deficit in the services category, albeit one that has been declining in recent years.

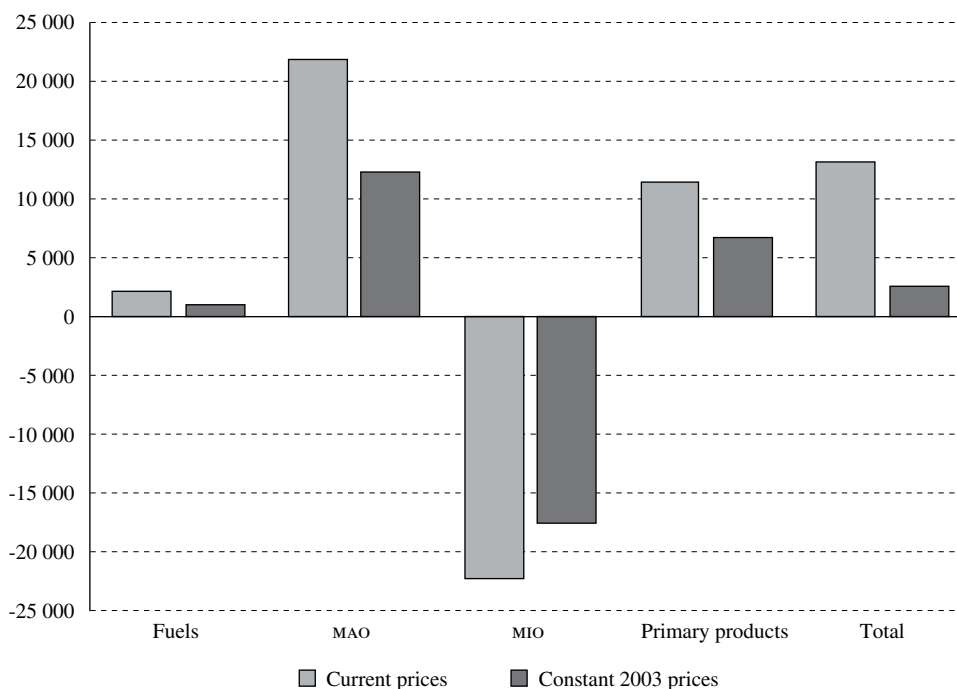
Nonetheless, it is important to stress that the Argentine trade balance would have been in surplus in what was a period of strong growth, even after discounting the favourable evolution of international relative prices since 2003, and this represents a change from the past.<sup>6</sup>

<sup>5</sup> See point 1 of annex II for methodological details of the conversion to constant 2003 prices.

<sup>6</sup> It is important to note that other general equilibrium effects on this evolution of the trade balance (investment, impact of the activity level on imports, etc.) are not considered, and only the price effect is analysed (although this was very significant for the period). To consider all effects in combination within a general equilibrium model would require a special analysis that is beyond the scope of this study.

FIGURE 4

**Argentina: average net exports by major categories, 2008-2010**  
(In millions of dollars at current prices and constant 2003 prices)



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

MAO: manufactures of agricultural origin.  
MIO: manufactures of industrial origin.

#### 4. Bilateral trade by major production categories and main trading partners

Argentina's trade with its different trading partners has undergone profound shifts in recent years. Accordingly, this subsection will analyse that trade by major production category for the four most important trading areas: Brazil, China, the 27 member States of the European Union and the United States.

Primary products offer a clear example of the very marked shift in trade destinations away from more traditional markets such as Brazil and the European Union towards China. The evolution of the country's trade with each of these destinations is shown in figure 5.

It can be seen that there was a decisive shift away from Europe as a destination for soybean exports, and

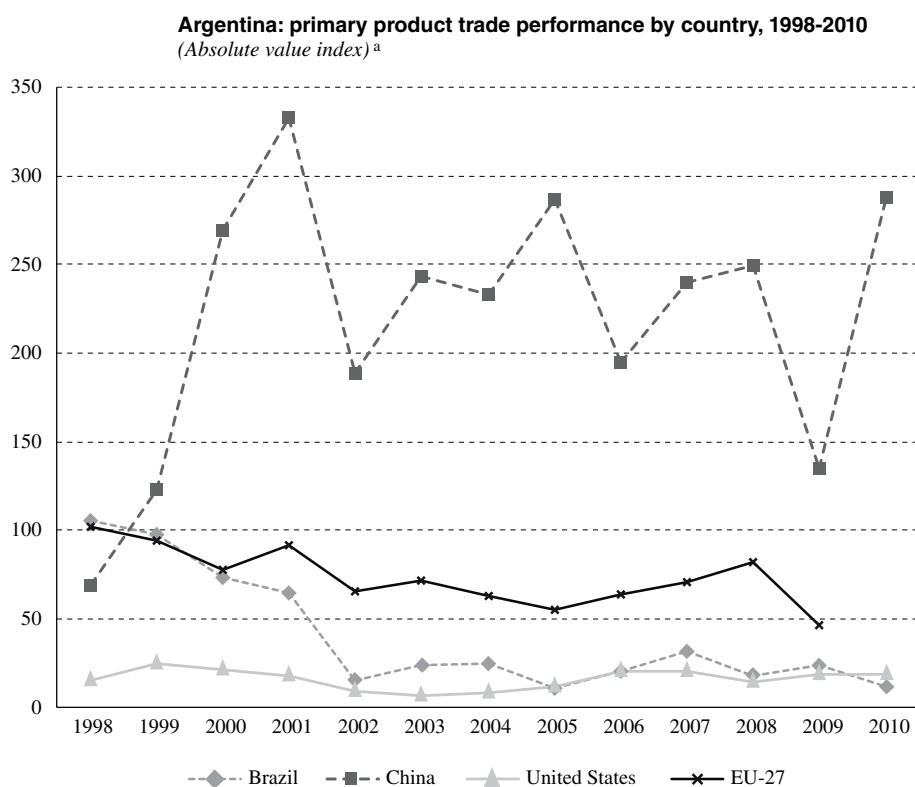
towards China.<sup>7</sup> However, Argentina's trade in primary products with the European Union has remained at high levels because of strong growth in exports of fish (45% of primary product exports by value) and maize (25%). Meanwhile, there has been a marked slowdown in wheat exports to Brazil, which grew at an average annual rate of 2% during 1998-2009.

The situation is different in the case of MAO, where the main development has clearly been the growth of trade with the European Union, which still far outstrips that with the other selected partners (see figure 6). This performance is due to large exports of soybean milling by-products (soy pellets) used for animal feed, as these accounted for 54% of MAO exports to the European Union in 2007-2009.

<sup>7</sup> During 1998-2009, exports of this type to China grew by a remarkable 29.5% a year, while exports to the European Union fell by 19%.



FIGURE 5



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

<sup>a</sup> Figures calculated from the equations described in section IV.

Meanwhile, MAO trade with China also grew, although it was more unstable and largely confined to a single product of the soy chain: exports of soy oil grew by an average of 31% a year over the whole decade (despite a sharp drop in 2010) and represented 81% of MAO exports to that destination in 2007-2009.<sup>8</sup> The large share of the soy complex in MAO exports and the dependence on the European Union and Chinese markets explain why the MAO trade balance was so concentrated.

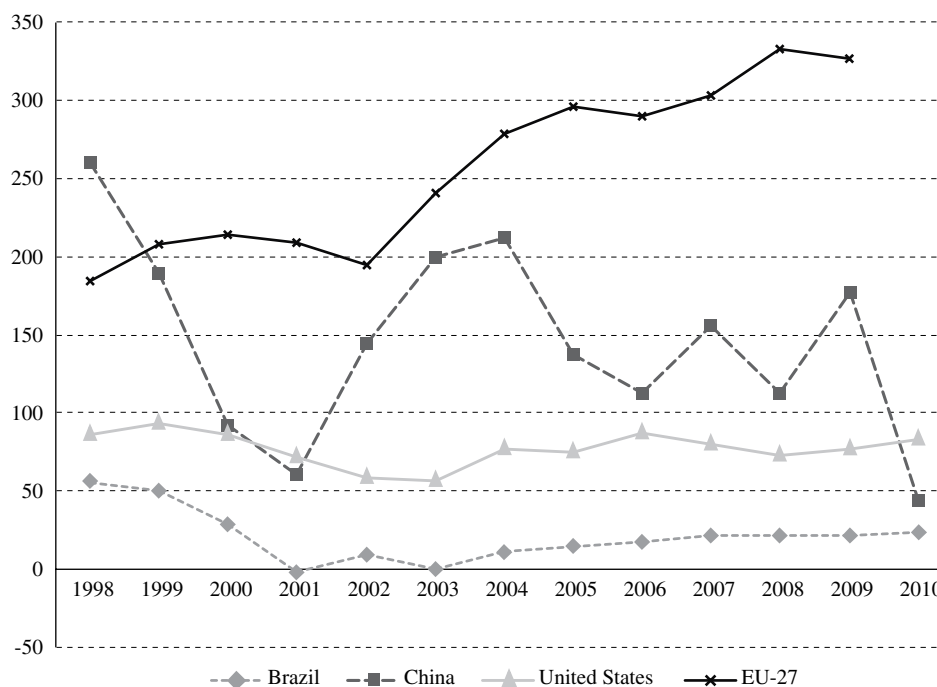
As for the relationship with Brazil, MAO exports were never large, owing to that country's strategy of developing a strong food industry of its own. They fell sharply around 2003, owing to a large drop in powdered milk exports, before recovering on the back of wheat flour and malt exports, although without regaining the levels of the previous decade.

In the case of MIO, the country's relationships with its different trading partners altered substantially in the context of a quite negative trade performance. Trade with Brazil deteriorated sharply until the mid-2000s before beginning to recover, although without approaching earlier levels. Imports were dominated by automobiles and tractors (24% of imports), vehicle parts (10%) and fixed-line and mobile telephones and other data transmission devices (6%), a category in which imports from Brazil grew strongly once economic recovery began in Argentina. On the export side, automotive exports grew strongly in the last five years (55% a year on average), with the result that their share of MIO exports to Brazil tripled, a development that largely explains the improvement in MIO trade to that destination noted earlier. However, this export growth was offset by a declining trade performance in the vehicle parts subsector, so that the net sectoral result is still a deficit for Argentina.

<sup>8</sup> Soybeans outweigh oil in exports to China, however, which explains why commodities performed better than MAO in exports to that destination.

FIGURE 6

**Argentina: MAO trade performance by country, 1998-2010**  
(Absolute value index)\*



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

\* Figures calculated from the equations described in section IV.  
MAO: manufactures of agricultural origin.

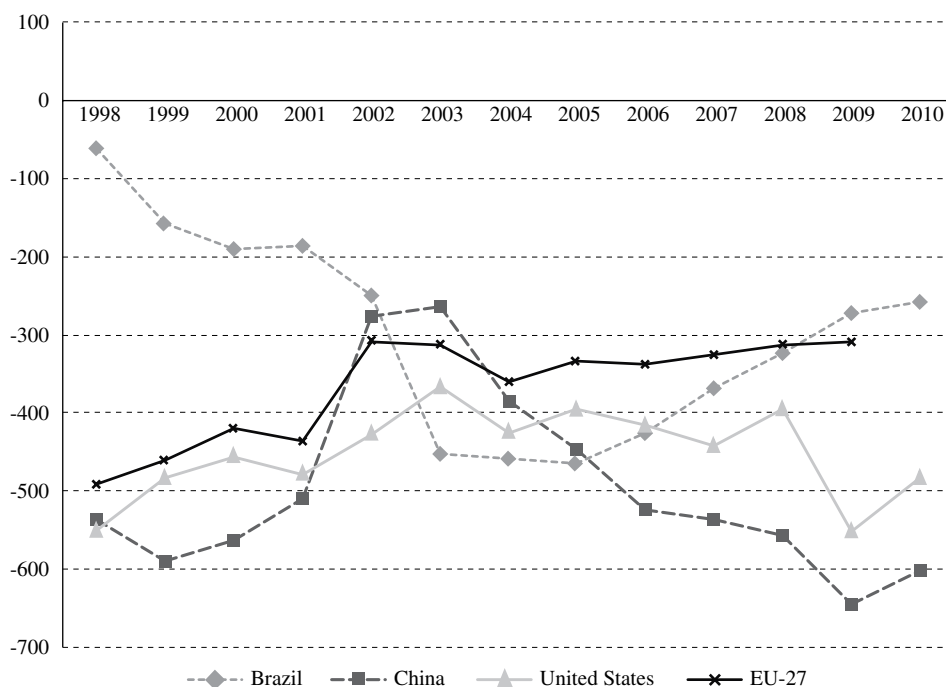
The basic chemicals and special-purpose machinery sectors have also experienced a clear improvement in their trade with Brazil. However, special-purpose machinery remains an important component of the MIO deficit with Brazil, accounting for 9% of it, which is practically the same share as in the late 1990s.

Since 2003 there has been a sharp deterioration in the MIO trade balance with China, owing to rising imports of capital goods, machinery and electrical products and

of inorganic chemical products, which account between them for some 60% of imports from that country by value. At the same time, there were improvements in the performance of the country's trade with the United States and the European Union (see figure 7), economies that have been displaced as suppliers of some industrial goods by China (capital goods and machinery and electrical appliances) and by Brazil (fixed-line and mobile telephones and vehicle parts).

FIGURE 7

**Argentina: MIO trade performance by country, 1998-2010**  
(Absolute value index)\*



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

\* Figures calculated from the equations described in section IV.  
MIO: manufactures of industrial origin.

## V

### Analysis of revealed comparative advantage (RCA) within the MIO category

The performance of the main MIO sectors has been taking on a fundamental role in Argentina's foreign trade in relation to the overall average. Technological dependency remains high, as shown by the close link between activity levels and industrial imports of intermediate and capital goods. Although MIO exports grew strongly over the decade, the MIO trade deficit also increased as imports rose by even more, whence the importance of assessing developments in the main sectors in order to identify

the principal changes undergone by these within the overall MIO category.

To do this, an MIO revealed comparative advantage index (RCAMIO) has been prepared for this study. It is an index of RCA within the MIO category, so that the evolution of each sector can be considered in relation to the average for this universe (see subsection 1(c) of section IV). This reworking of the data makes it possible to grasp changes within the MIO category and

abstract these from the powerful influence of the primary products and MAO sectors on the levels and evolution of the RCA of MIO.

Using this methodology, the present section will analyse 16 sectors chosen for their large foreign trade shares or for their dynamism. These sectors account for 89% of MIO exports and 76% of imports, in contrast to their 45% share of the category's gross value added (GVA), which shows how strongly they interact with foreign trade by comparison with their share of local production. The following categorization is used to analyse this sectoral behaviour:

- Sectors with revealed comparative advantage (RCA) within the universe of manufactures of industrial origin (MIO).

- Sectors with weak revealed comparative disadvantage (RCD) within the MIO universe.
- Sectors with strong RCD within the MIO universe.

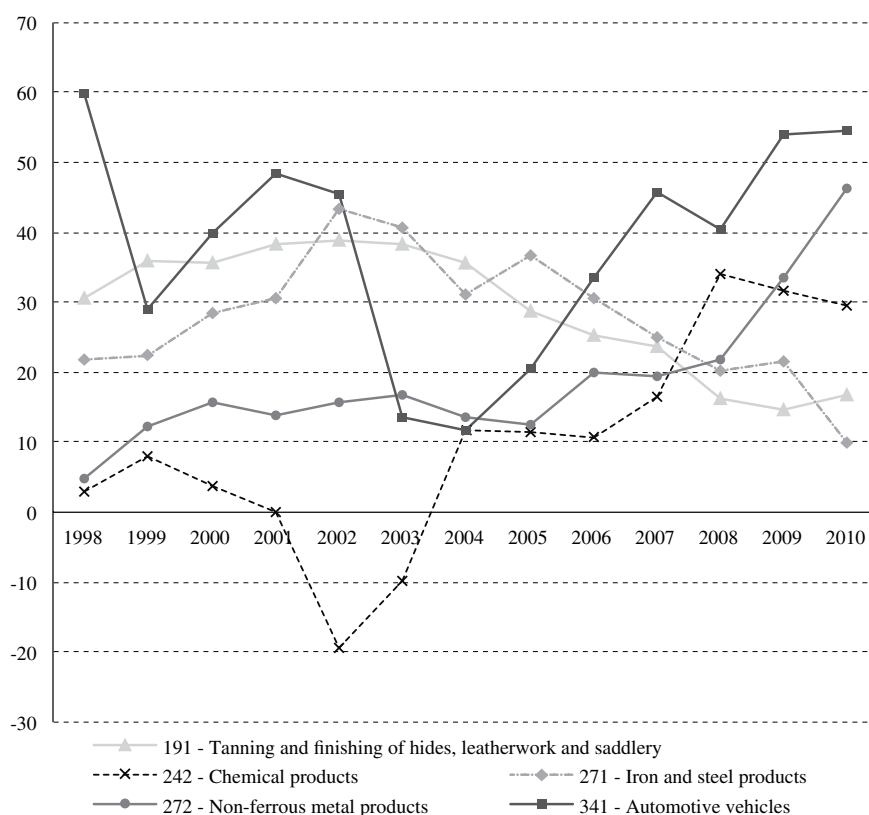
### 1. Sectors with RCA within the MIO universe

These sectors are the best positioned as contributors to the trade balance in the MIO category, as reflected in their  $RCA_{MIO}$  index values in excess of zero<sup>9</sup> (see figure 8). On the whole, they do not present very significant levels of

<sup>9</sup> Although some sectors present negative trade balances (automobiles and chemicals), their trade performance is clearly better than the MIO average, and this is reflected in positive  $RCA_{MIO}$  index values within that universe.

FIGURE 8

**Argentina: evolution of  $RCA_{MIO}$  in sectors with comparative advantage relative to the MIO universe, 1998-2010**  
(Absolute value index)\*



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

\* Figures calculated from the equations described in section IV.

MIO: manufactures of industrial origin.

$RCA_{MIO}$ : index of revealed comparative advantage for MIO.

import penetration in the local market (below 40%, except in the case of automobiles), and their trade balances have improved (see table A.1 of annex I).

The automotive sector showed a striking jump in exports in the last five-year period (average annual growth of 21.8%), bringing its trade into virtual balance. When vehicle components are added in, however, the trade of the sector as a whole remains in deficit (see section V, subsection 2). It is important to note that the market for both spares and finished vehicles depends heavily on the globalizing strategies of multinational firms,<sup>10</sup> which include a regional division of labour for inputs and products. Brazil is thus a very important destination, currently accounting for 81% of automotive vehicle sales.

The non-ferrous metals products sector is bound up with the performance of mining and its strong growth in the last five years, particularly for gold and aluminium. Unprocessed gold currently represents 89% of the trade surplus in this category and accounts for the sector's shift from deficit in the late 1990s to a surplus of US\$ 2.247 billion now. Primary aluminium is associated with the packaging industry, transport and construction, and behaved very dynamically, gaining comparative advantage and market share in a growing international market.

Within the chemical products sector, two subsectors clearly dominate. Biodiesel is a product that has benefited from the export tax differential with soy oil (its main input).<sup>11</sup> External market conditions also turned favourable for this product when minimum biofuel thresholds were set in the European Union and the subsidy for the mixture of diesel and biodiesel was established in the United States in 2005.

The pharmaceutical sector has held its position as the country's best-developed high-technology sector, accounting for about 4.5% of total industrial gross output value (GVA). A particular feature of the sector in Argentina as compared to other Latin American countries is the predominance of locally-owned companies as suppliers to the domestic market. During the post-convertibility period, the sector performed very dynamically both domestically and abroad, with exports growing by 15% a year in the last five-year period. However, local

production did not rise quickly enough to cover domestic demand growth, so that import penetration in apparent consumption and the sector's trade deficit increased. Its main competitive weakness lies in the production of active ingredients, which are almost entirely bought in from abroad and account for a third of its imports. Subsidiaries of multinationals have a strong tendency to import, as locally-owned firms, by contrast, have a trade surplus (see CILFA, 2008). Here it should be pointed out that a group of smaller local firms have grown significantly in recent years by investing in technology and scaling up, which has enabled them to introduce their products into the wider Latin American market (CEP, 2009).

The strong external competitiveness of iron and steel products is mainly accounted for by the subsector of seamless tubes for oil and gas pipelines, whose share of the sector's exports by value rose from 33% to 51% in the past decade. It is interesting to note that the sector's export competitiveness, so heavily dominated by these seamless tubes for oil and gas extraction, is due to a single firm, Siderca, which has positioned itself as the world's leading supplier of seamless tubes and exported almost 70% of its output in the last five-year period. As a result, Argentina is now positioned as a major global supplier of seamless tubes, ranking fourth in international trade in 2005-2009 with 6.5% of this market, after China (20% of the market), Japan (15.5%) and Italy (6.9%), which places it above even countries with a strong tradition in the iron and steel sector such as Germany (6.4%) and the United States (5.7%).<sup>12</sup>

## 2. Sectors with weak revealed comparative disadvantage within the MIO universe

This group includes sectors with very diverse behaviour and, in some cases, higher levels of volatility than the earlier groups. This volatility is particular in evidence in two sectors: parts and accessories for the automotive industry, and manufactured fibres (see figure 9).

Parts and accessories for the automotive industry represent 10% of the MIO deficit and 90% of that of the automotive chain. Although exports increased rapidly over the decade (by 9.6% annually), comparative advantage was eroded, with imports rising strongly (an annual average of 17.3% in the last five-year period). At the same time, both the parts and accessories sector and the final vehicles sector have seen strong growth in imports over apparent consumption (see table A.1 in annex I), something that reflects growing production

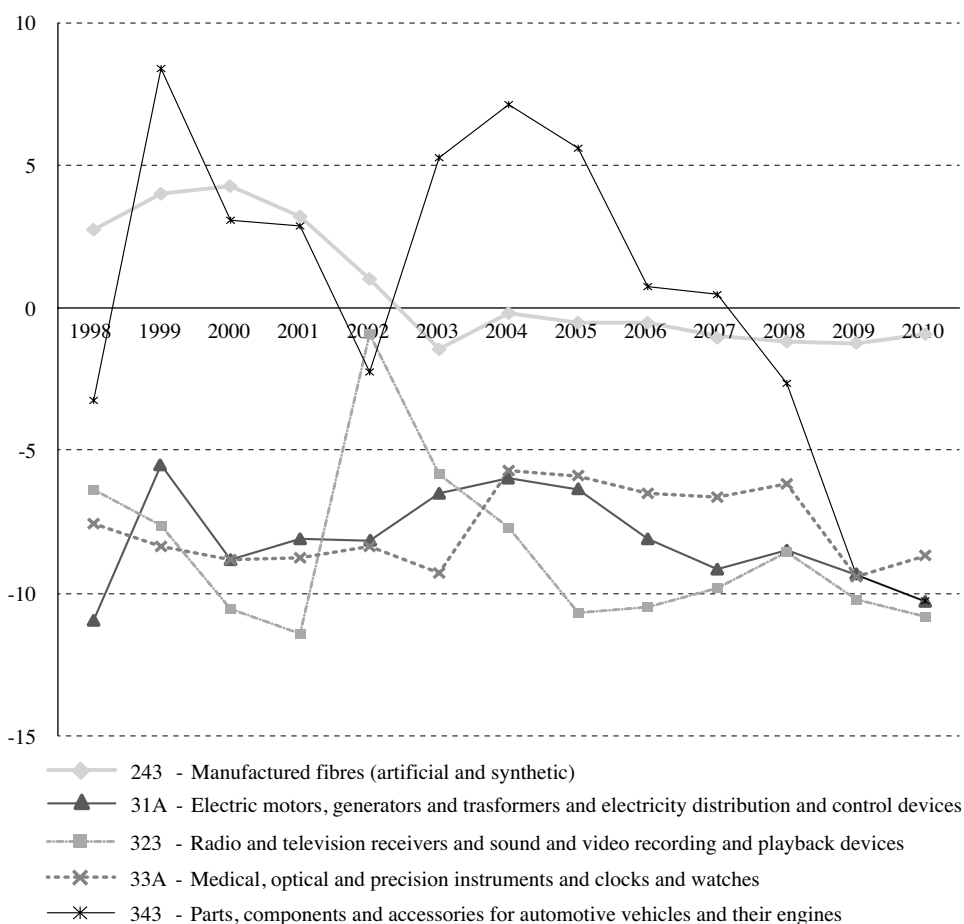
<sup>10</sup> In fact, a study by the National Institute of Industrial Technology (INTI) (Queipo, 2008) argues that the country has the potential for growth in the supply of vehicle spares and electronic components, but this is restricted by the globalizing strategies referred to, implemented by original equipment makers to supply themselves from abroad.

<sup>11</sup> Effective protection for the production of biodiesel from soy oil averaged 57.4% in 2008-2010. See Bekerman and Dulcich (2012) for further details.

<sup>12</sup> United Nations Commodity Trade Statistics Database (COMTRADE).

FIGURE 9

**Argentina: evolution of  $RCA_{MIO}$  in sectors with weak RCD relative to the MIO universe, 1998-2010**  
(Absolute value index)\*



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

\* Figures calculated from the equations described in section IV.

$RCA_{MIO}$ : index of revealed comparative advantage for MIO.

RCD: revealed comparative disadvantage.

complementarity at the regional level as a result of the strategies of the multinationals present in Brazil and Argentina. As has already been pointed out, the trade deficit in the final vehicles sector did not fall by enough to offset the rising negative balance for parts and components.

The radios, stereos, televisions and recording devices sector also experienced a very substantial jump in imports over apparent consumption, to over 70% (see table A.1 in annex I), as well as a decline in exports. The electronics complex recorded considerable growth

in physical output during the post-convertibility period, aided by exchange-rate protection and the Tierra del Fuego industrial promotion regime. However, it was not able to keep pace with rising demand or generate “backwards” productive linkages in the chain, a failing that was particularly acute in more technologically sophisticated segments. Consumer electronics, and the manufacture of radio and television receivers in particular, displayed great dynamism in terms of sales but a low degree of national integration based on imported components. Thus, the sector’s recovery and growth in the post-convertibility

period was accompanied by an even larger rise in its trade deficit (see table A.1 in annex I).<sup>13</sup>

The medical, optical and precision instruments and clocks and watches sector was practically dismantled during the convertibility period, suffering a steep drop in production between 1991 and 2002. Nonetheless, it has shown great dynamism in the domestic market during the post-convertibility period, increasing its share of industrial employment and showing signs of import substitution. However, its  $RCA_{MIO}$  has been very volatile, perhaps because exports to new destinations (such as the Bolivarian Republic of Venezuela) have been sporadic, while Brazil has continued to be the main import partner. In any event, its ratio of imports to apparent consumption has remained high at over 70%, while its trade deficit grew over the last five-year period (see table A.1 in annex I).

### 3. Sectors with the greatest revealed comparative disadvantage within the MIO universe

The sectors evincing the greatest revealed comparative disadvantage in relation to the MIO universe are shown in figure 10. They are in the areas of capital goods (general-purpose and special-purpose machinery and office and computing machinery) and industrial inputs (basic chemicals). Also in this category is the tubes, valves and radio and television transmitters and telephony devices sector, which comprises both inputs and final consumption goods, especially mobile telephones, which are very important in the sector's trade.

A more thorough examination of the specific sectors in this category shows that the level of import penetration for machinery is over 50%, rising to as much as 90% in the case of computing machinery. Likewise, all sectors present growing trade deficits that reveal a continuing heavy dependence on foreign suppliers to provide the inputs and capital goods domestic economic activity requires (see table A.1 in annex I).

The machinery category includes sectors that require continuous innovation because they are subject to rapid obsolescence. Imports of general-purpose machinery (accounting for 10% of the MIO trade deficit) are highly diversified. Within the different subsectors, the largest net imports between 2008 and 2010 were of pumps and

air compressors, followed by air conditioning equipment and centrifuges. Meanwhile, water turbines were the only sector with a positive trade balance. Two of the most dynamic subsectors are machines for treating substances by means of temperature changes (heaters, pasteurizers, dryers, sterilizers, coolers and so on) and lifting, loading, unloading and handling machines (lifts, conveyors, escalators and so on); net imports in these subsectors dropped by 40% over the decade, and between them they currently account for 10% of sectoral exports by value.

Special-purpose machinery, although also under a strong comparative disadvantage (see figure 10), has recovered somewhat since 2007. This situation was driven by two agricultural machinery subsectors: harvesters (with 30% average annual export growth in the last five-year period) and seed drills and ploughs (31.4%). The combination of a competitive exchange rate and the primary products price boom created new supply and demand conditions favourable to these subsectors during the post-convertibility period. In the agricultural tractors segment, on the other hand, the loss of production capacity during the convertibility crisis prevented local producers from responding to demand from farmers, and this was covered by imports, particularly from Brazil.

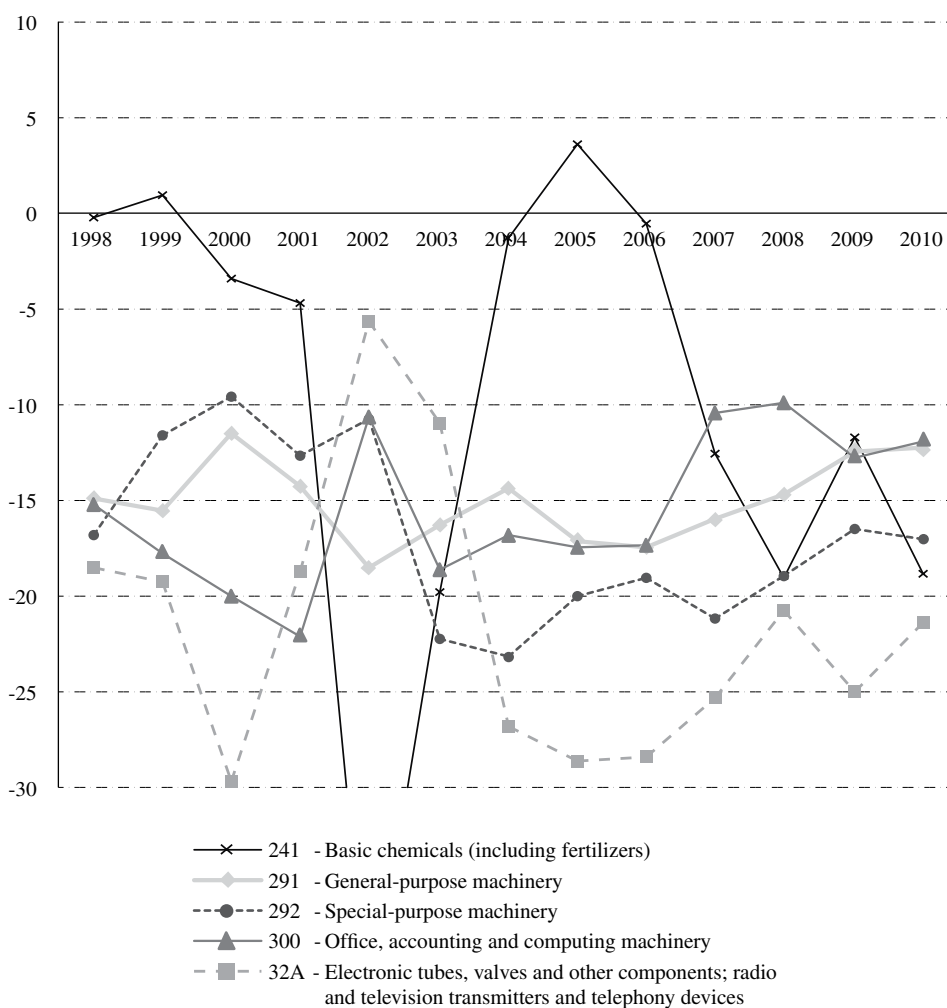
The structural disadvantage of computing and data processing machinery eased slightly from 2008. Although this is a sector in which import penetration is almost complete (90% of apparent consumption), the size of its trade deficit within the group of MIO products has fallen from 12% in the aftermath of the crisis to 5% now. However, a sectoral study by the National Institute of Industrial Technology (INTI) reports that Argentina is unlikely to be able to increase its value added in this industry in the medium run or penetrate the more dynamic segments of the international market, such as computer hardware and telecommunications (Queipo, 2008).

Basic chemicals are one of the sectors showing the greatest fluctuations over the period. In the late 2000s, there was a sharp rise in imports associated with growth in agriculture, as it was driven particularly by fertilizers and by various organic chemical products (which now account between them for 78% of the sector's deficit). In the last five-year period, exports from these two subsectors fell by an average of 10% a year, while import growth averaged 8% a year. However, there has been no substantial rise in imports as a share of apparent consumption, something that reveals a growing role for domestic producers in supplying the local market (see table A.1 of annex I).

<sup>13</sup> The best-positioned subsector in terms of exports is the car stereo industry, which accounts for 79% of the sector's modest exports, while televisions and monitors accounted for 33% of imports between 2008 and 2010.

FIGURE 10

**Argentina: evolution of  $RCA_{MIO}$  in sectors with strong RCD relative to the MIO universe, 1998-2010**  
(Absolute value index)\*



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

\* Figures calculated from the equations described in section IV.

$RCA_{MIO}$ : index of revealed comparative advantage for MIO.

RCD: revealed comparative disadvantage.

The electronic tubes, valves and other components and telephony devices sector shows the effects of the lack of historic continuity in technological development policies. Until the mid-1970s, a considerable variety of electronic parts and components, principally for televisions and audio equipment, were manufactured in Argentina to meet local demand. However, subsequent changes in tariff policy and the technological shift towards

more and more complex components, combined with a lack of continuity in semiconductor manufacturing efforts in both the public sector (National Institute of Industrial Technology (INTI) and Armed Forces Institute for Scientific and Technical Research (CITEFA)) and the private sector (the electronics division of FATE) meant that local production almost ceased. The situation worsened during the 1990s, with import penetration in



the domestic market rising from 38% in 1993 to 84% in 2001. This is now the sector with the greatest comparative disadvantage relative to MIO trade as a whole. Imports are heavily dominated by mobile phones, with domestic

demand being almost completely met from abroad (see table A.1 of annex I). The sector's exports are virtually negligible, so that its growing trade deficit represents 10% of the MIO trade deficit.

## VI

### Technology content, productivity and export performance in the different MIO sectors

The evolution of RCA in the Argentine economy by technology content can be seen in figure 11.<sup>14</sup> It can be clearly appreciated that comparative advantage is heavily concentrated in primary products (albeit decreasingly so in recent years), followed by agro-industrial products (which have offset this decline). This is because of the development, discussed above, of the earliest processing

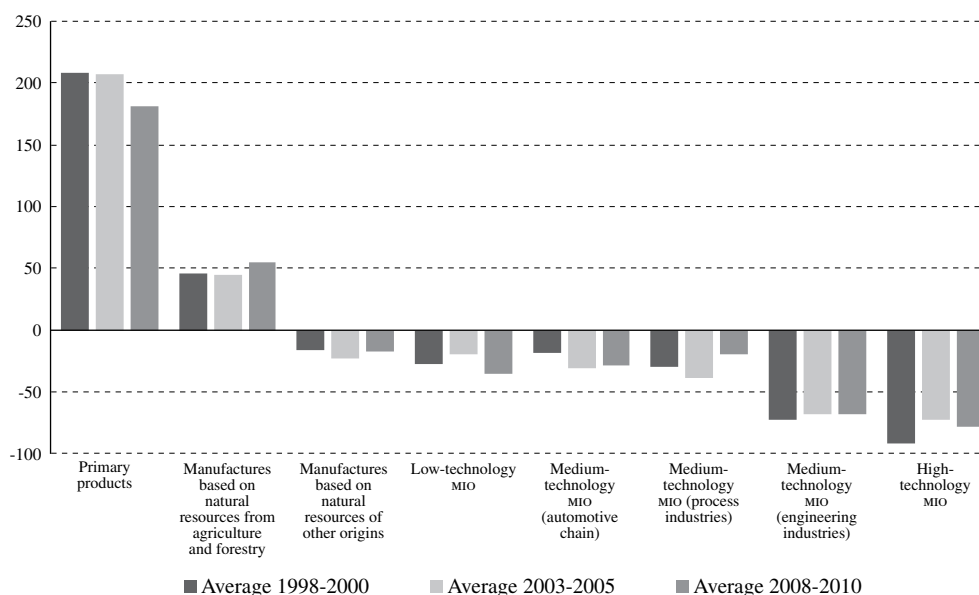
stages in the agrifood chain, such as the pressing of grains and oilseeds to produce oils, meals and animal feeds.

By contrast, all manufacturing sectors present comparative disadvantages, and these become more pronounced in high-technology manufactures. Where medium-technology links are concerned, comparative disadvantage is clearly greater in engineering-intensive industries than in process industries, which could reveal the continuing specialization bias of industry towards so-called industrial commodities.

<sup>14</sup> The technology content of trade is classified in accordance with the correlation matrix of the National Foreign Trade Commission (CNCE).

FIGURE 11

**Argentina: revealed comparative advantage (RCA) by technology content**  
(Absolute value index)\*



Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

\* Figures calculated from the equations described in section IV.

To classify the technology content of the main MIO sectors in accordance with the three categories given in section V, table 1 presents national and international sectoral technology characterizations based on the classifications of the Production Research Centre (CEP)<sup>15</sup>

<sup>15</sup> The CEP classification includes four subgroups for local research and development (R&D) intensity. It is based on 2004 spending on local R&D as a proportion of turnover in the different sectors relative to the national average (see CEP, 2008). This sectoral expenditure may

and the Organisation for Economic Cooperation and Development (OECD),<sup>16</sup> respectively.

differ from average worldwide expenditure, however, and thus this classification may not pick up cases where a sector uses leading-edge technology from abroad, as may happen when it is dominated by multinational firms that invest in R&D in developed countries and then transfer this knowledge to developing countries.

<sup>16</sup> The sectoral technology content categorization is based on Hatzichronoglou (1997), as updated by OECD (2005) and Loschky (2008).

TABLE 1

**Argentina: analysis of industrial RCA by technology content, 1998-2010**

RCA <sub>MIO</sub> category	Sector	GVA / GOV 2003 (percentages)	CEP technology classification	Argentine R&D intensity (percentages)	OECD classification <sup>a</sup>	Relationship Argentina-abroad (CEP vs. OECD)
Revealed comparative advantage (RCA)	191 - Tanning and finishing of hides, leatherwork and saddlery	19.8	LLT	0.06	LT	Same
	242 - Chemical products	35.6	HLT	0.84	HT <sup>b</sup>	Same
	271 - Iron and steel products	41.8	MLLT	0.11	MLT	Same
	272 - Non-ferrous metal products	31.7	MLLT	0.24	MLT	Same
	341 - Automotive vehicles	16.5	LLT	0.08	MHT	Different
Weak revealed comparative disadvantage	243 - Manufactured fibres (artificial and synthetic)	35.0	LLT	0.00	MHT	Different
	31A - Electric motors, generators and transformers and electricity distribution and control devices	42.7	MLLT <sup>c</sup>	0.22	MHT	Different
	323 - Radio and television receivers and sound and video recording and playback devices	38.0	MLLT	0.19	HT	Different
	33A - Medical, optical and precision instruments and clocks and watches	46.9	HLT <sup>d</sup>	0.79	HT	Same
	343 - Parts, components and accessories for automotive vehicles and their engines	34.8	HLT	0.97	MHT	Different
Strong revealed comparative disadvantage	241A - Basic chemicals (excluding fertilizers)	31.1	LLT	0.08	MHT	Different
	241B - Fertilizers and other agricultural chemical products	60.8	LLT	0.08	MHT	Different
	291 - General-purpose machinery	40.9	MHLT	0.36	MHT	Same
	292 - Special-purpose machinery	41.0	MHLT	0.44	MHT	Same
	300 - Office, accounting and computing machinery	40.0	HLT	1.79	HT	Same
	32A - Electronic tubes, valves and other components, radio and television transmitters and telephony devices	32.1	HLT <sup>e</sup>	0.59	HT	Same
Average for manufactures of industrial origin (MIO)		34.2				

Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC) and Production Research Centre (CEP).

Note: gross value added (GVA) / gross output value (GOV) of 243, constructed as an average of 241 and 242 (prepared by the authors on the basis of the sources indicated).

Nomenclature as per Production Research Centre (CEP) classification: LLT = low local technology, MLLT = medium-low local technology, MHLT = medium-high local technology, HLT = high local technology.

Nomenclature as per the Organisation for Economic Co-operation and Development (OECD) classification: LT = low technology, MLT = medium-low technology, MHT = medium-high technology, HT = high technology.

RCA: revealed comparative advantage.

RCA<sub>MIO</sub>: revealed comparative advantage of MIO.

<sup>a</sup> According to Loschky (2008).

<sup>b</sup> R&D intensity for chemicals (242) as given by the OECD covers pharmaceuticals (subsector 2423, part of 242). Source: Production Research Centre (CEP).

<sup>c</sup> Classified by the average Argentine R&D intensity of sectors 311 and 312, which make up sector 31A; and using the CEP methodology (own calculations).

<sup>d</sup> Classified by the average Argentine R&D intensity of sectors 331 and 332, which make up sector 33A; and using the CEP methodology (own calculations).

<sup>e</sup> Classified by the average Argentine R&D intensity of sectors 321 and 322, which make up sector 32A; and using the CEP methodology (own calculations).

It can be seen from table 1 that within the first category, showing the sectors that are best placed within the MIO group, just one, chemicals, is counted as a high-technology sector in both classifications. In other words, sectors with positive  $RCA_{MIO}$  are usually medium- or low-technology ones.

The automotive vehicles sector is classed differently by the OECD and CEP technology classifications. This may be because this sector is dominated by multinationals, whose operating methods may mean that they do not develop technology locally in certain production hubs. This may be associated with the fact that the ratio between added value and gross output value (GOV) is substantially lower than in the other sectors, owing to the large share of parts that are imported, as already discussed.

These differences in technology classification come up again in other sectors where multinational firms are heavily involved, or where imported technology is used. This situation is found in all sectors that have low levels of comparative disadvantage within the MIO universe, with the exception of medical instruments.

Machinery and electronic tubes, valves and other components, which, as already pointed out, are at a strong comparative disadvantage within the MIO universe and plainly import-dependent, are placed by both classifications in the medium- and high-technology categories.

Where variations in productivity are concerned, table 2 reveals that the sectors with the strongest  $RCA_{MIO}$  include those where productivity rose by least during the decade (with the exception of non-ferrous metal

TABLE 2

**Argentina: analysis of industrial RCA by evolution of productivity, and productivity level relative to the United States, 2005**

$RCA_{MIO}$ category	Sector	Change in productivity (1998-2000 and 2008-2010)		Labour productivity relative to the United States in 2005 <sup>a</sup> (percentages)
		Per worker employed (percentages)	Per hour worked (percentages)	
Revealed comparative advantage (RCA)	191 - Tanning and finishing of hides, leatherwork and saddlery	12.8	18.1	124.6
	242 - Chemical products	16.4	19.1	71.9 <sup>b</sup>
	271 - Iron and steel products	39.8	32.1	80.7
	272 - Non-ferrous metal products	105.4	109.7	41.6
	341 - Automotive vehicles	44.0	31.9	61.0 <sup>c</sup>
Weak revealed comparative disadvantage	243 - Manufactured fibres (artificial and synthetic)	-24.1	-15.1	40.9 <sup>d</sup>
	31A - Electric motors, generators and transformers and electricity distribution and control devices	52.4	61.2	3.8 <sup>e</sup>
	323 - Radio and television receivers and sound and video recording and playback devices	78.8	74.2	14.3
	33A - Medical, optical and precision instruments and clocks and watches	52.4	55.8	9.0
	343 - Parts, components and accessories for automotive vehicles and their engines	13.1	21.3	61.0 <sup>c</sup>
Strong revealed comparative disadvantage	241A - Basic chemicals (excluding fertilizers)	33.7	33.1	71.9 <sup>b</sup>
	241B - Fertilizers and other agricultural chemicals	87.7	89.7	71.9 <sup>b</sup>
	291 - General-purpose machinery	56.3	61.6	20.5 <sup>f</sup>
	292 - Special-purpose machinery	40.3	46.7	20.5 <sup>f</sup>
	300 - Office, accounting and computing machinery	-48.1	-45.5	20.5 <sup>f</sup>
	32A - Electronic tubes, valves and other components, radio and television transmitters and telephony devices	-45.0	-43.0	3.8 <sup>e</sup>
Average for selected sectors		32.2	34.4	44.9
Industry average (includes manufactures of both agricultural and industrial origin)		35.8	41.1	36.9

Source: prepared by the authors on the basis of Production Research Centre (CEP) and J. Katz and G. Bernat, "Creación de empresas, crecimiento en la productividad y cambio estructural como respuesta a una modificación en la política macroeconómica. Evidencia para la Argentina", *Revista de Economía Política de Buenos Aires*, year 5, vols. 9 and 10, Buenos Aires, University of Buenos Aires, 2011.

<sup>a</sup> As percentage of average output per worker employed (at 1985 prices).

<sup>b</sup> Corresponds to the aggregate sector "Chemicals".

<sup>c</sup> Corresponds to the aggregate sector "Transport equipment".

<sup>d</sup> Weighted average of the "Textiles" sector (66.7%) and the "Plastic products" sector (33.3%).

<sup>e</sup> Corresponds to the aggregate sector "Electronic equipment".

<sup>f</sup> Corresponds to the aggregate sector "Machinery and equipment".

products), in contrast to the strong growth seen in MIO sectors with revealed comparative disadvantage, such as electric motors and generators, radio and television receivers, fertilizers and general-purpose machinery. However, sectors with  $RCA_{MIO}$  are very close to the international frontier in terms of technical process, as their productivity differential with the United States is much smaller than the overall differential for industry, which is about 37%. This suggests that these advantages are to be ascribed more to the small differential with

the international frontier than to international demand growth, as might be the case with certain primary products and their derivatives. This proximity to the international frontier may help to explain why productivity growth has been lower there than in sectors with comparative disadvantage. The latter often present very low levels of productivity per worker employed by comparison with their United States counterparts, suggesting that these disadvantages may be due to the large productivity gap with the international frontier.

## VII

### Summary and conclusions

The pattern of international specialization in the Argentine economy has not changed greatly in the past decade as far as the major production categories are concerned. Primary products and MAO account for much of the country's external competitiveness and trade surplus. Within this context, however, there have been significant changes in the composition of primary products and MAO and in trade flows by origin and destination, as well as a sharp decline in the comparative advantage of fuels.

These shifts have largely been the result of strong growth in the relative prices of commodities, owing to rising demand from Asian countries. Without embarking upon a general equilibrium analysis, however, it can be said that the country has a trade surplus even when the favourable evolution of external relative prices is discounted, even though the past few years have been a time of strong growth in the Argentine economy.

MIO are still in a situation of comparative disadvantage, however, with a growing structural deficit, as the Argentine economy has not yet been able to weaken the strong link between activity levels and imports of certain types of machinery, inputs and parts and components. Nor has it been able to find satisfactory substitutes for imports in the face of strong demand for certain final goods, especially high-technology ones such as televisions and mobile phones.

Again, the composition of MIO exports displays strong growth in items that have benefited from favourable regimes, such as primary gold and aluminium and biodiesel. Also worthy of note is the automotive industry, which has benefited from a special regime under the rules of the Southern Common Market (MERCOSUR).

These sectors, along with seamless tubes for oil and gas, have provided the main underpinning for growth in MIO exports since the end of the convertibility regime.

Thus, the pattern of trade specialization in Argentina is still heavily concentrated in sectors associated with primary products and standardized industrial processes (this being true of both MAO and MIO), usually with limited differentiation of products and processes and often plainly dependent on foreign capital goods and components. It should be noted, however, that some high-technology industrial sectors, such as certain agricultural machinery subsectors, are beginning to develop external competitiveness.

Where destinations are concerned, changes in the origins of MIO imports and shifts in the export destinations for primary products and MAO have been essentially due to the emergence of China as a major player in the global economy. The growth of China as a buyer of commodities and foodstuffs and as a supplier of industrial goods is tending to push emerging economies towards specialization in the primary product sector. This may be accentuated over time, in view of the goals set in the country's latest five-year plan, which include the development of more technologically sophisticated industrial segments. It is important to note that the more prominent role of China and Brazil as new trading partners has displaced traditional partners, so that the long-standing concentration of Argentina's external trade in a few countries has persisted.

In the light of the theoretical considerations set out, it can be said that both the sustainability and the level of long-run growth may be affected if this trading

pattern is maintained in the future and industry remains heavily dependent on imported capital goods and inputs. Likewise, the slower growth in the overall productivity of the economy implied by specialization in standardized sectors means a lesser potential for real wages to rise without affecting capital development and accumulation, something that may worsen distributive strains. Again, the heavy sectoral and regional concentration of the Argentine economy's external trade means that it is reliant on a few markets.

This context is creating major challenges, especially given the changes that are occurring in the production structure around the world. There is a need to promote export diversification based on the expansion of value added in existing industries and of strategic sectors that can play a leadership role, taking the MERCOSUR market as a first step in the fulfilment of this strategy. To meet these objectives it is necessary, first, to carry out macroeconomic management in a way that ensures the real exchange rate is conducive to productive development. Second, it is necessary to implement specific policies that alter the vector of free market prices determining "static efficiency"

and thereby tend to favour export diversification. This requires a process of strategic collaboration between the public and private sectors to generate the information needed for the successful design and implementation of industrial policies. It also requires strong political authority to administer the conflicts of interests between different groups that may be created by the implementation of such policies. A supplementary challenge is to impose a system of reciprocity or rewards and punishments that encourages investment in non-traditional sectors but, as discussed by Rodrik (2005), that can also detect failing investments and generate the conditions for a system to capture revenues.

Some fundamental changes of course have been observable in recent years, and these should not be underestimated, but the main challenge now facing Argentina is much the same as it was two decades ago: "the need to develop a production structure that can improve its trade performance and generate more productive employment by reducing structural heterogeneity so that income distribution is improved and extreme poverty reduced" (Rosales, 1989).

## ANNEX I

TABLE A.1

**Argentina: import penetration and trade balance in the MIO sectors considered**

Sector	Imports/apparent consumption (percentages)			Trade balance (millions of dollars)		
	Average 1998-2000	Average 2008-2010	Linear change	Average 1998-2000	Average 2008-2010	Linear change
191 - Tanning and finishing of hides, leatherwork and saddlery	8.4	11.8	3.4	723	755	33
241A - Basic chemicals (excluding fertilizers)	43.9	45.7	1.8	-1 378	-2 626	-1 248
241B - Fertilizers and other agricultural chemicals	27.6	28.8	1.2	-248	-832	-585
242 - Chemical products	16.9	26.7	9.8	-1 258	-97	1 161
243 - Manufactured fibres (artificial and synthetic)	26.9	51.7	24.8	15	-147	-162
271 - Iron and steel products	17.4	17.5	0.2	144	45	-99
272 - Non-ferrous metal products	31.7	40.8	9.1	22	1 384	1 363
291 - General-purpose machinery	53.9	53.1	-0.8	-1 577	-2 124	-547
292 - Special-purpose machinery	48.8	52.4	3.6	-1 121	-2 151	-1 030
300 - Office, accounting and computing machinery	93.0	97.1	4.1	-1 167	-1 135	32
323 - Radio and television receivers and sound and video recording and playback devices	41.4	70.6	29.2	-553	-1 007	-454
341 - Automotive vehicles	37.7	55.9	18.2	-465	-200	265
343 - Parts, components and accessories for automotive vehicles and their engines	40.7	53.8	13.1	-849	-1 874	-1 025
31A - Electric motors, generators and transformers and electricity distribution and control devices	60.8	64.2	3.4	-693	-1 113	-420
33A - Medical, optical and precision instruments and clocks and watches	67.1	71.4	4.3	-659	-967	-308
32A - Electronic tubes, valves and other components and radio and television transmitters and telephony devices	79.2	97.8	18.6	-1 444	-2 184	-740

Source: prepared by the authors on the basis of National Institute of Statistics and Censuses (INDEC), United Nations Commodity Trade Statistics Database (COMTRADE) and National Foreign Trade Commission (CNCE).

MIO: manufactures of industrial origin.

## ANNEX II

## Methodological aspects

## 1. Databases and information sources

The sectoral categorization and the information on exports as a share of sectoral gross output value and imports as a share of sectoral apparent consumption are taken from the 2010 sectoral records of the Production Research Centre (CEP).<sup>17</sup>

The external trade database covers Argentine external trade in 1998-2009 as per the six-digit MERCOSUR Common Nomenclature (NCM), 2002 harmonized system (*Source*: INDEC and COMTRADE).

This database was converted to the nomenclature of the International Standard Industrial Classification of All Economic Activities (ISIC), Revision 3.1, produced by the United Nations; and to the major categories, economic use and technology content using the correlation matrix of the National Foreign Trade Commission (CNCE) from June 2003.

<sup>17</sup> Available at [online] [http://www.cep.gov.ar/descargas\\_new/estadisticas/sectores/fichas\\_sectoriales\\_2010.xls](http://www.cep.gov.ar/descargas_new/estadisticas/sectores/fichas_sectoriales_2010.xls).

The conversion of current external trade flows to constant 2003 prices was carried out using the index of import prices by economic use, base 1993 = 100, and the index of export prices by major categories, base 1993 = 100 (*Source*: INDEC in both cases). These indices were weighted by the share of the economic use or major category in each year, employing the CNCE trade databases and correlation matrix already referred to. The macroeconomic data for GDP and composition of aggregate demand are also from INDEC.

## 2. Sectoral categorization

The MIO categorization took 32 sectors from the SITC Rev. 3.1 three-digit classification and 10 MIO sectors aggregated by categories by CEP for its sectoral records. Sixteen of these sectors were chosen for the analysis, 11 from the SITC Rev 3.1 classification and 5 of those prepared by CEP, in view of their preponderance in the level or evolution of trade and industrial production.

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# Determinants of ownership concentration in the Chilean stock market

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## ABSTRACT

This paper analyses econometrically the determinants of ownership concentration in the Chilean stock market, paying particular attention to the effects of the Public Tender Offer Act (*Ley de Ofertas Públicas de Adquisición de Acciones*). Although the Public Tender Offer Act achieves its central purpose, the tender offer mechanism increases the concentration of ownership, mainly because of the “residual tender offer” obligation for which the Act provides. In addition, the study has found significant opposite responses between the controlling shareholder and the next two largest shareholders, which should sound a warning for international comparisons based on a common measure of ownership concentration that do not take account of the ownership structures characterizing Latin American markets. These aspects must be considered if the regulatory goals aimed at by minority shareholder protection bills are to be achieved.

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## KEYWORDS

Shares, markets, economic concentration, laws and regulations, econometric models, Chile

## JEL CLASSIFICATION

G32, G34, G23

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# I

## Introduction

Many studies have analysed the determinants of ownership concentration. Thus, Demsetz and Lehn (1985) argued that the structure of corporate ownership was explained by firm size, the instability of profits, whether or not the firm concerned was a regulated utility or financial institution, and whether or not it was in the mass media or sports industry. They also found that large publicly traded corporations were frequently characterized by highly diffuse ownership structures that effectively separated ownership of residual claims from control of corporate decision-making. On the basis of these findings, Weiss and Richter (2010) have recently studied the relative importance of firm-, industry- and country-level factors as determinants of the level of company ownership concentration. They have found that firm- and country-level factors, especially the institutional context, influence ownership concentration significantly, rather than industry-level factors.

In a similar context, the law and finance literature has extensively analysed the relationship between ownership concentration and legal protection for minority shareholders. At the empirical level, statistical evidence indicates that ownership is more concentrated on average in countries where legal protection is weaker. Following La Porta and others (1998) and La Porta, López-de-Silanes and Shleifer (1999), when legal protection is weak, ownership concentration provides a substitute for investors, given that large shareholders have a greater likelihood of achieving a positive return on their investments. Conversely, investors appear to be willing to take minority positions and to finance firms in countries where legal rules exist and are effectively enforced.

However, the concept of weak or strong legal protection is not always a clear one. The papers cited above also suggest that better accounting standards reduce ownership concentration, while mandatory dividend payments increase it. In the same area, Faccio and others (2001) analyse dividend policies in several countries of Asia and Europe, finding that concentration

is higher in European countries even though firms there pay proportionally larger dividends than firms in Asian countries. If we consider that higher dividends are associated with better legal protection, then there will not be an inverse relationship between concentration and legal protection for shareholders as the empirical evidence suggests.

This contradiction could be solved by the arguments presented by Burkart and Panunzi (2006). That paper looks beyond the popular idea that legal protection reduces the likelihood of managers diverting resources from the firm and considers the relationship between the quality of legislation and the incentives for shareholders to monitor managers. Thus, when legislation offers a substitute for monitoring, legal protection for shareholders could increase ownership concentration rather than reducing it as, on average, the empirical evidence suggests. On the other hand, ownership concentration appears to depend on a trade-off between manager initiative and shareholder monitoring that is directly associated with the legislation. Again, there is more monitoring in countries with strong legal protection, and ownership concentration is not required to protect shareholders. Hence, while some rules or laws are complementary to monitoring, others are substitutes, giving rise to this direct relationship between legal protection and ownership concentration that contradicts the average empirical evidence.

Musacchio (2007) analyses the historical evolution of ownership concentration and legal protection for minority shareholders in Brazil. His work mainly focuses on the effects of voting systems limiting power to larger shareholders, on regulations ensuring the payment of dividends and on ownership concentration for firms where ownership is dispersed. Although the results are not statistically conclusive, there is some evidence to support policies limiting voting rights for larger shareholders and providing legal protection for minority shareholders, with the objective of reducing ownership concentration.

From the perspective of corporate governance in Europe, Kim and others (2008) demonstrate the hypothesis that shareholder protection rights and board independence are positively related. The results show that countries with stronger shareholder protections have firms with more independent directors. These are thus complementary

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governance mechanisms, so ownership concentration and board independence are negatively related.

From the point of view of the relationship between corporate ownership and initial public offerings (IPOs), Foley and Greenwood (2010) analyse panel data on corporate ownership in 34 countries between 1995 and 2006 to test the relationship between ownership concentration and weak investor protection. Their results reveal that newly public firms tend to have concentrated ownership regardless of the level of investor protection. They also show that, after listing, firms in countries with strong investor protection are more likely to experience decreases in ownership concentration in response to growth opportunities.

This paper analyses econometrically the determinants of ownership concentration in the Chilean stock market, paying particular attention to the effects of the Public

Tender Offer Act (*Ley de Ofertas Públicas de Adquisición de Acciones*). Section II begins with a description of the main variables commonly cited in the literature as determinants of ownership concentration. Section III presents a discussion on pyramidal ownership structures as alternative control schemes to the one considered in this study. Section IV looks at the role of institutional investors in corporate governance in terms of monitoring managers and the main shareholders. Section V outlines the basic features of the Public Tender Offer Act, considering how it protects the interests of minority shareholders when control of a firm changes hands. Section VI presents the econometric analysis, including a description of the dataset and the results of the estimation. Lastly, section VII presents the conclusions derived from the empirical evidence and discusses the research agenda for future work.

## II

### Determinants of ownership concentration

Besides the existence and quality of laws dealing with corporate governance and protection for minority shareholders, firm-specific factors (size, financial ratios, etc.) and aggregate variables (market capitalization and liquidity, per capita income, etc.) should also be treated as potential determinants of ownership concentration in the market.

Although empirical analysis of these determinants should be based on the specification of a function derived from first principles (first-order conditions from a utility maximization problem solved for shareholders and their interaction), most of the statistical evidence comes from cross-sectional studies for several countries that include variables which might affect ownership concentration, but without any consistent model-building approach.

Among the firm-specific variables usually treated as determinants of ownership concentration are size, leverage and dividend policy.

A first argument says that the larger the firm, the greater the number of shareholders required to create the stock of capital, and the more dispersed ownership must be. In most countries (the exceptions being the United States, the United Kingdom and Japan), however, firms are usually controlled by families or even individuals and there is no significant deviation from the “one share, one

vote” rule (i.e., voting rights are proportional to ownership stakes), the implication being that control is obtained mainly through ownership concentration, with any equity increase coming from larger shareholders rather than from a greater participation by minority shareholders, so that ownership concentration is increased.

Second, a higher level of debt (measured by financial leverage) indicates better access to bank and bond financing, reducing the need for a larger number of minority shareholders when it comes to financing new investment projects. Thus, greater leverage may be directly related to ownership concentration.

In addition, dividend policy is considered to be a protection mechanism for minority shareholders, given the potential for expropriation by controlling shareholders. In fact, policies providing for minimum dividend payout percentages could be seen as substitutes for specific legal protection for small shareholders. The larger the dividend payment percentage (above the legal minimum, where one exists), the larger the number of minority shareholders willing to involve themselves with the company. Thus, ownership concentration should be inversely related to dividends. However, as discussed in the Introduction, the relationship could be a direct one if the dividend payout policy results in less monitoring by shareholders.

Pension funds are minority shareholders by definition because of regulatory limits on their investments. However, given that these institutional investors have teams of well-trained financial analysts, while it is possible for several funds to vote as a block to secure a seat on the board, they are in a position to monitor managers and perhaps to improve the corporate governance of the firms they invest in. All these actions may induce greater dispersal of ownership by reducing the control premium for large shareholders or giving minority shareholders greater confidence to participate. The role of pension funds could be particularly important in the Chilean case because of the large volume of funds accumulated since the start of the private pension system in the early 1980s.

In terms of aggregate variables (common to all firms), a stock market that is deep and wide (as measured by market capitalization to GDP) should make it easier for minority shareholders to invest in firms, helping to reduce ownership concentration. Similarly, per capita GDP (as a proxy for average income) should have a direct relationship with the number of minority shareholders, helping to reduce concentration.

Along with the above, a number of factors must be taken into account in efforts to reduce ownership concentration, as they can generate unexpected negative effects if they are not considered. In this regard, the first consideration is that corporate governance at an appropriate management level is essential to control associated agency costs.

The importance of the corporate governance issue has been debated worldwide for over a decade, and particularly since 2007 and the financial crisis, which only served to expose a series of failures in the governance of financial institutions.

This led to the 2010 review by the Basel Committee on Banking Supervision of the so-called principles for enhancing corporate governance,<sup>1</sup> which took into consideration the recommendations previously made by the Organisation for Economic Cooperation and Development (OECD, 2004). In particular, corporate governance is defined as one of the key elements for improving economic efficiency and growth and for promoting confidence among market participants.

Also dealing with financial regulation and consumer protection, and published in the same year in the United States, was the Dodd-Frank Wall Street Reform and Consumer Protection Act, aimed at promoting financial stability in the country, the transparency and accountability

of its financial system and protection of taxpayers and consumers from potential abuse. The key points of this new reform include strengthened corporate governance and the management of conflicts of interest, and it establishes the important role played by the board of directors in monitoring each company.

Meanwhile, as discussed below, Chile introduced the topic of corporate governance in its so-called Public Tender Offer Act in 2000 and later, in 2009, with the passing of Law No. 20382, which “introduces improvements to the rules governing the corporate governance of companies”. This statute enacted amendments to Law No. 18045 and Law No. 18046 with a view to protecting the rights of shareholders in corporations, encouraging transparency and information provision and establishing the important role the board plays in achieving this. It added a new section on related party transactions, defining what is meant by such operations, the requirements for carrying them out and the reporting obligations for them to be approved by the board of directors, in accordance with certain stipulations.<sup>2</sup> This change was made to facilitate the identification of potential conflicts of interest that may arise when such operations are conducted.

Furthermore, given the characteristics of ownership concentration in Chile, with most directors being people who have ties to the controlling group of the company, the law requires the appointment of at least one independent director. This plays an important role in improving the management of companies and could ultimately increase their value (Lefort and Urzúa, 2008).

In relation to insider dealing, the law establishes that company employees who are aware of insider information may not buy or sell stocks until the information is released. This is what is known as a blackout period. The law also makes a distinction between the presumption of possession of insider information, which applies to those who work within the company management, and the presumption of access to information, which applies to those who interact with the management without being part of it. These improvements are very important given the ownership structure of Chilean companies, as there may be greater potential for misuse of insider information in this case.

<sup>1</sup> See [online] <http://www.bis.org/publ/bcbs176.pdf>.

<sup>2</sup> According to article 147 of Law 18046, the requirements and procedures laid down may be waived for some related party transactions, such as those not involving substantial sums, those deemed to be a routine part of the company's business and those carried out between legal entities when the company owns at least 95% of the counterparty, either directly or indirectly.

In summary, the establishment of an appropriate governance system creates the right incentives for both the management and the board of directors to run the company properly and for effective monitoring and

timely protection of stakeholders. Nevertheless, there is a further factor that can potentially affect ownership concentration for companies: their structure. In the next section, we analyse the implications for Chilean firms.

### III

## Pyramidal structures

This study analyses ownership structure purely on the basis of the percentage of companies owned by their controlling shareholders. In other words, it assumes that company control is exercised through “one share, one vote”, implying that voting rights are proportional to share ownership. In fact, many public-sector enterprises in developing countries that form part of business groups are characterized by the separation of voting rights from cash flow rights through the use of cross-shareholdings, stock pyramids and multiple-class equity, allowing owners to gain effective control of their firms with limited cash flow rights.

In a pyramidal structure, the controlling family achieves control through a chain of ownership relationships: the family directly controls a company, which in turn controls another company, which may control another company, and so on. For example, a family at the top of a pyramid may own 50% of a company that in turn owns 50% of another firm, which owns 50% of a third firm, thereby achieving control of all firms in the pyramid with an increasingly small investment in each firm down the line. In this way, the ultimate shareholder maintains control of the companies without being entitled to the cash flows they generate, so that pyramids are a distortion of the principle of “one share, one vote”.

This distortion could affect our analysis, since we are considering only the ownership percentage of the controlling shareholders in a firm. In other words, we may not obtain the results expected if pyramidal structures prove to be very important in the Chilean market. This section will therefore discuss the operation of pyramidal structures and their presence in the Chilean market.

La Porta, López-de-Silanes and Shleifer (1999) define the ownership structure of a company as a pyramid if it has an ultimate owner and there is at least one publicly traded company between it and the ultimate owner

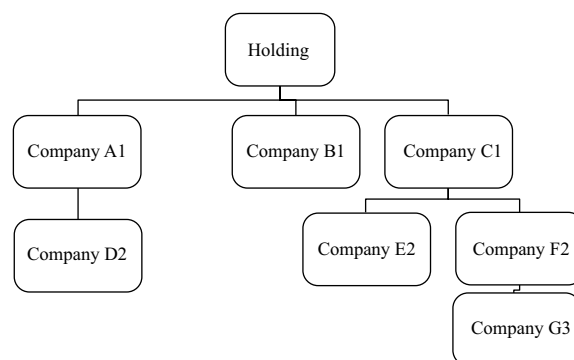
in the chain of 20% voting rights. Thus, if a publicly traded firm B has 45% of the votes in a firm A, and an individual C has 30% of the votes in firm B, we would say that C controls A, and that the ownership structure is a pyramid.

Figure 1 shows how ownership is separated from control by using pyramidal structures in a business group. The holding company has effective control of all the firms in the pyramid, while actually owning an ever-smaller portion of each firm. For example, while the holding company receives 100% of dividends paid by companies A1 and B1 and 70% of those paid by company C1, it receives only 34.3% of the dividends paid by company G3.

La Porta, López-de-Silanes and Shleifer (1999) examined the ownership structures of large corporations in 27 developed economies around the world and found

FIGURE 1

#### An example of pyramidal ownership



Source: F. Lefort, “Hacia un mejor gobierno corporativo en Chile”, *Temas de la agenda pública*, year 3, No. 23, Santiago, Chile, Catholic University of Chile, 2008.

that 26% of firms were controlled through pyramids; also, this structure appeared to be the most important mechanism used by controlling shareholders to separate ownership of cash flows and control rights. Claessens and others (2000) examined companies in nine Asian countries and found that the use of pyramidal structures was quite common there. Faccio and Lang (2002) reported that the use of dual-class shares and pyramids to enhance the control of the largest shareholders was common in Western Europe, and Khanna and Yafeh (2007) found that these structures were more often present in emerging markets.

Like other Latin American countries, Chile has a high concentration of ownership and a corporate structure dominated by clusters. In Chile, corporate groups seek control basically through pyramidal structures, mainly because cross-shareholdings are prohibited under Chilean law. Sometimes these pyramids have several layers of investment companies before the level of operational

firms is reached. The latter may also control several individual companies, sometimes in unrelated sectors of the economy.<sup>3</sup> Lefort and Walker (2000 and 2007) have shown that approximately 70% of non-financial companies listed in Chile belong to one of 50 clusters, which together control 91% of the assets of non-financial corporations in the country. They suggest that the most common way of separating control from cash flow rights in Chilean conglomerates is through simple pyramidal schemes, with only a third of the affiliated companies listed on the second and third levels of the pyramid structure. They also show that the controlling shareholders of Chilean conglomerates have more shares than are necessary to maintain control, with 57% of consolidated capital being directly or indirectly owned by them in 1998.

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<sup>3</sup> See Agosin and Pastén (2003).

## IV

### Institutional investors and corporate governance

Another aspect that has gained in importance recently is the role that institutional investors, and particularly pension fund administrators (AFPs), might have in improving and promoting good corporate governance practices in the companies they invest in. According to the Organisation for Economic Cooperation and Development (OECD), despite the limitations on investment opportunities in Latin America, institutional investors are playing a leading role in stock market growth as the largest and most influential minority shareholders in many listed companies, so that “pension fund governance and accountability...remains an important public policy priority for the region” (OECD, 2010).

The interest of institutional investors in promoting corporate governance is further underscored in markets with a high concentration of ownership. Investors of this type act as a counterbalance to the controlling shareholders and protect minority shareholders against the interests of the company board or management, other than those that serve the interests of the company and its shareholders

as a whole. In the case of pension funds, the social role and vigilance exercised to protect the future benefits of retirees should be correspondingly stronger.

Pension system reforms, starting with Chile in 1981 and continuing in the 1990s with many other Latin American countries, have made a large contribution to growth in domestic pools of investment funding. The half-yearly statistics for pension funds in Latin America show that such funding in Chile amounts to 60% of GDP.

As was pointed out in the previous section, the Chilean market is characterized by the existence of financial conglomerates and pyramidal structures,<sup>4</sup> while regulations prevent pension funds from controlling firms. They are the main minority shareholders in Chilean companies, investing a large share of their resources

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<sup>4</sup> As Lefort and Walker (2000) showed, pyramidal schemes are the most common way of achieving control in Chilean conglomerates, since cross-shareholdings are forbidden by law and dual-class shares are relatively rare.

in local shares. In fact, according to Agosin and Pastén (2003), “a specific feature of Chilean capital markets is the existence of well-developed institutional investors, specifically the private pension managers that arose from the pension reform of 1981 where in spite of the limitations imposed upon the AFPS in the kinds of investments they can make, they have been responsible for a significant deepening of the stock market”. This indicates the importance of investors of this type, given their potential influence over corporate governance and corporate ownership structures, as well as over the regulation and depth of capital markets.

Accordingly, Iglesias-Palau (2000) studied the influence of Chilean pension fund administrators (AFPS) on corporate governance. He established that AFPS involvement in the stock market had had positive effects on corporate governance in several respects, including: an increase in the number of independent board members; a decrease in monitoring costs as a result of improved public information quality; enhanced supervision of companies that pension funds had invested in; and improved bondholder protection. More recently, Lefort (2007), analysing the channels through which the AFPS may be having an effect, directly or indirectly, on the quality of corporate governance at Chilean companies, has concluded that this effect is positive, particularly in relation to three issues: (i) the emergence of reform in the legal system and the improvement of the oversight under which firms operate, which have influenced the quality of the external mechanisms regulating corporate governance; (ii) the emergence of greater capital market liquidity with growing funding and trading volumes; and (iii) the professionalization of financial intermediaries and the adoption of more advanced and cost-efficient transaction methods. After analysing various interventions by the AFPS to improve the corporate governance practices of corporations in which they have invested their resources, the author emphatically concludes that direct monitoring and intervention by AFPS exercising their rights as minority shareholders, bondholders or both has helped to improve firms’ internal corporate governance mechanisms.

Starks (2000) and Gillian and Starks (2003) examine the relationship between corporate governance and ownership structures, focusing on the role of institutional investors. They examine cross-country differences

in ownership structures and the implications of these differences for institutional investor involvement in corporate governance. They conclude that despite these differences across markets, institutional investors have the potential to play an important role. On balance, they expect an increase in the liquidity, volatility and price informativeness of the markets in which institutional investors invest and, consequently, the increased information provided by institutional trading should result in better monitoring of corporations and in better corporate governance structures. Regarding the influence of international institutional investors on governance, Aggarwal and others (2009) examine whether institutional investors affect corporate governance by analysing institutional holdings in companies from 23 countries for the 2003-2008 period. Their finding is that firm-level governance is positively associated with international institutional investment. They also establish that the origin of the institution matters, as institutions domiciled in countries with strong shareholder protection are more effective at promoting good governance than institutions from countries with weak shareholder protection.

From another point of view, Davis (2002) separated the discussion of the growing dominance of equity holdings by institutional investors into two groups: the Anglo-Saxon countries (the United Kingdom, the United States and Canada) and continental Europe and Japan (Germany, France, Italy and Japan). He found that the former countries were showing an increase in the direct influence of institutions in place of the previous reliance on the takeover mechanism to discipline managers, and thence improved corporate performance, while the second group of countries remained more firmly within the bank relationship-based governance paradigm. On this subject, though, Rojo and Garrido (2002) have argued that these types of differences in the structure of corporate governance systems lead to differences in the nature of the problems and in the solutions available to them. According to these authors, institutional investors can provide a solution to the problem of dispersed share ownership, but this solution needs to be accompanied by a host of regulatory changes, while regulatory changes are even more necessary in the case of continental systems of corporate governance, because otherwise institutional investors will tend to aggravate the corporate governance problem.

## V

### The Public Tender Offer Act

The Public Tender Offer Act, published in Chile in December 2000, regulates changes in corporate control via a tender offer mechanism, identifying situations in which an offer must be made, the information to be disclosed to shareholders, the period of time for which the offer must remain open and the pro rata conditions that apply whenever a tender offer generates a surplus supply of shares. In addition, the law establishes the conditions under which a tender offer is not mandatory and provides for a three-year transition period during which control may change hands without recourse to the tender offer mechanism.

The tender offer mechanism gives all shareholders the same price and the same opportunity to sell their shares to the new controlling shareholder, who notifies the percentage being sought and the time period during which the offer will be open. In addition, the buyer must indicate the pro rata conditions for share allocation when supply exceeds demand, to ensure that all shareholders have similar opportunities to sell shares to the controlling shareholder.

When analysing ownership concentration, it is interesting to highlight the role of “residual tender offers”

whenever the controlling shareholder obtains two thirds of voting rights (shares representing that percentage), irrespective of whether they have been obtained by a tender offer or any other acquisition mechanism. The consideration underlying this residual tender offer obligation is that, with two thirds of voting rights, the controlling shareholder can govern the company unopposed, even in the case of actions requiring a qualified quorum. The obligation could also be justified by considering the reduced liquidity faced by minority shareholders once just a third of the company is traded on the market, and the corresponding liquidity premium affecting prices. In this latter situation, however, the law includes a right for minority shareholders to withdraw by selling their shares to the firm at the average market value for the previous two months.

Overall, the main feature introduced by the Public Tender Offer Act for the protection of minority shareholders is the inability of large shareholders to receive a “control premium” when selling their stakes, as the mechanism makes the same conditions available to all shareholders, whatever percentage of the company they may own.

## VI

### Econometric analysis

#### 1. Data description

The dataset includes 67 firms listed on the Santiago Stock Exchange during the 1990-2007 period. Although the total number of listed firms was larger, we excluded companies in which the State held a significant stake, firms with low or zero trading volumes and firms with incomplete or unreliable data.

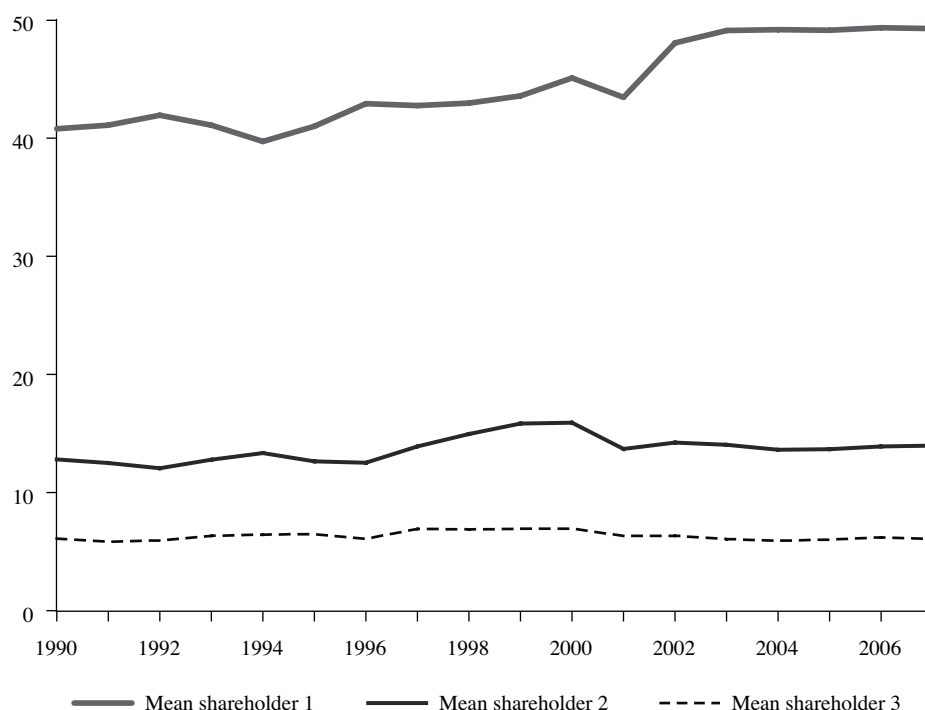
To measure ownership concentration, the international literature usually takes the sum of the three largest shareholders, considering that companies in countries like the United States, the United Kingdom and Japan

are widely held. In Chile, however, the main shareholder owns almost half the company on average, with the second-largest shareholder owning one seventh and the third-largest one sixteenth. Taking the sum of the three largest shareholders assumes some homogeneity of behaviour between them, but in fact they could show totally different responses to the variables determining ownership concentration.

As regards independent variables, corporate equity is measured in millions of Chilean pesos at constant 2003 prices, while financial leverage is calculated as total debt divided by equity as of December each year.

FIGURE 2

Mean ownership shares of shareholders, 1990-2006



Source: prepared by the authors on the basis of data from the Office of the Superintendent of Securities (SVS).

Given the mandatory dividend payout of 30% of the previous year's earnings, this variable indicates the payout in excess of that minimum.

The pension funds variable measures the overall share of the group of AFPs, provided they are among the top 10 shareholders in the firm. Aggregate variables such as market capitalization to GDP and per capita GDP are all measured at constant 2003 prices.

Figure 3 looks at the size (equity) of companies and shows that the distribution is less skewed towards small companies by the end of the sample. The average size in 1998 and 2007 is between US\$ 100 million and US\$ 500 million.

## 2. Panel estimation

The following specification is estimated by fixed-effects panel methods, taking four alternative shareholder shares as the dependent variable:

$$\begin{aligned}
 SHARE_{j,t} = & f(C, \overset{+-}{DIV}_{j,t-1}, \overset{+-}{\ln EQ}_{j,t}, \overset{+-}{\ln LEV}_{j,t}, \\
 & \overset{-}{\ln GDP\_PC}_{j,t}, \overset{-}{MC\_GDP}_{j,t}, \overset{-}{PF}_{j,t}, \overset{+-}{PTO}_{j,t}, \\
 & \overset{+-}{TRANS}_{j,t}, \overset{+-}{SHARE}_{j,t-1})
 \end{aligned}$$

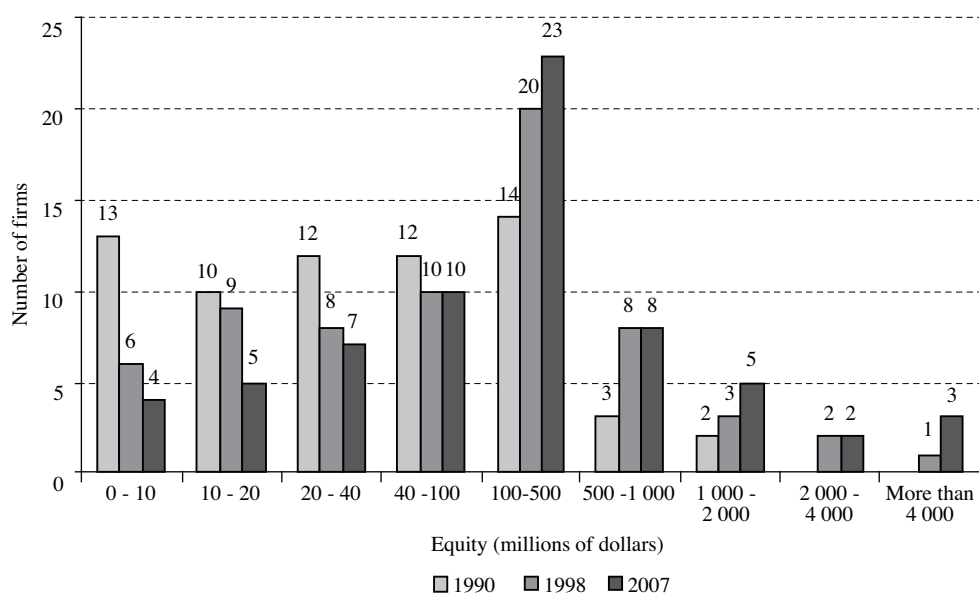
Dividends are lagged one period to avoid potential endogeneity, since payout policy may depend on ownership concentration.

The effect of the Public Tender Offer Act is represented by a dummy variable taking a value of 1 for the year 2001 onward and 0 otherwise. The transition period is represented by a second dummy variable equal to 1 for the year 2001 and 0 for the rest of the sample. In this latter case, it only made sense to relinquish control outside of the tender offer mechanism during the first year, since a larger premium would have to



FIGURE 3

## Size distribution of companies, 1990, 1998 and 2007



Source: prepared by the authors on the basis of data from the Office of the Superintendent of Securities (SVS).

be paid for doing this later in the transition period (the reputational cost in the eyes of domestic and foreign institutional investors was assumed to rise over the transition period).

The lagged dependent variable is included to take account of autocorrelation in the error term. The resulting dynamic panel model is consistently estimated by a fixed-effects method, since the bias in the autoregressive coefficients falls towards zero (0) as the time series observations tend towards infinity. Meanwhile, the rest of the parameters are unbiased provided the independent variables are strictly exogenous.

### 3. Estimation results

The following table presents the econometric results for each of the four dependent variables used as measures of ownership concentration. The first column contains the regression model for the popular definition taking the top three shareholders. The next three models consider the first, second and third shareholder in order to check if the inference from the popular analysis is appropriate for the Chilean case.

Although some of the independent variables in the model present potentially non-stationary behaviour

(if only in the form of a deterministic trend in the long run), the shareholder share is a stationary variable in any definition we choose. There was thus no risk of any spurious correlation in our estimation that might invalidate the analysis from the results obtained. Moreover, not controlling for potential trends in some of the exogenous variables makes the present econometric analysis more demanding on our model specification.

As can be seen from the estimation results above, dividend policy reduces ownership concentration for the first shareholder (and for the top three) while increasing it for the second (for the third, the coefficient is no different from zero (0)). There is a similar contradiction in the level of equity, with a direct relationship for the first and top three shareholders but a negative one for the second and third. Similarly, AFP ownership reduces concentration if the top three shareholders are taken, but this is really explained by a lower concentration of ownership for the first one alone (the coefficient for the second and third shareholders is positive but no different from zero (0)).

Per capita GDP seems to increase concentration, even though it has no statistical effect on the first shareholder's share. On the other hand, a deeper market reduces overall concentration.

TABLE 1

**Ownership concentration**  
(Fixed-effects panel estimation)

Independent variable	Dependent variable: shareholder share			
	Top three	First	Second	Third
Constant	-0.7180 (0.01)	0.0855 (0.75)	-0.6157 (0.00)	-0.2234 (0.02)
Dividend payout (-1)	-0.0099 (0.04)	-0.0214 (0.00)	0.0127 (0.00)	-0.0007 (0.69)
Log (equity)	0.0076 (0.10)	0.0173 (0.00)	-0.0053 (0.09)	-0.0038 (0.03)
Log (leverage)	0.0009 (0.57)	0.0005 (0.78)	-0.0005 (0.67)	0.0005 (0.39)
Log (per capita GDP)	0.0529 (0.01)	-0.0167 (0.45)	0.0509 (0.00)	0.0210 (0.01)
Market capitalization/GDP	-0.0431 (0.00)	-0.0350 (0.00)	-0.0085 (0.12)	-0.0011 (0.73)
AFP share	-0.2069 (0.00)	-0.2311 (0.00)	0.0167 (0.56)	0.0121 (0.46)
Public Tender Offer Act dummy	0.0066 (0.24)	0.0185 (0.00)	-0.0087 (0.02)	-0.0047 (0.03)
2001 transition dummy	-0.0637 (0.00)	-0.0432 (0.00)	-0.0157 (0.00)	-0.0024 (0.43)
Lagged dependent variable	0.7784 (0.00)	0.7934 (0.00)	0.7055 (0.00)	0.6977 (0.00)
Adjusted R <sup>2</sup>	0.9385	0.9383	0.8482	0.7988
Number of observations	1 139	1 139	1 139	1 139

Source: prepared by the authors.

Note: *P*-value in parentheses.

The Public Tender Offer Act produces an increase in concentration for the first shareholder, but reduces the share of the second and third, making the ownership of companies even more concentrated after its implementation. The transition period seems to induce a lower concentration of ownership, despite the coefficient not being statistically significant for the third shareholder.

In the annex at the end of this paper, we check the robustness of the models estimated above.

First, we estimate a static model for the top three shareholders, not including the lagged dependent variable, to see if the rest of the independent variables are still statistically significant in explaining shareholder shares. As can be seen in table A.1, none of the independent variables has a coefficient that becomes statistically equal to zero (0) in the static model. Moreover, some of

them, such as leverage and the Public Tender Offer Act dummy, become significant while retaining the same sign as before. On the other hand, per capita GDP and AFP share increase their effect on the dependent variable.

Next, given the relatively high correlation observed in table A.2 between the shares of the first, second and third shareholders, we use an instrumental variable method to estimate the shareholder share models, including the other two shareholders' shares for each equation. The results in table A.3, from the panel two-stage least squares estimation, are basically the same for all three shareholders' shares. In the cases of the first and second shareholders, furthermore, the effects from the other two shares are not statistically different from zero (0). In the case of the third shareholder, while the coefficients are statistically significant, they have opposite signs with similar levels.

## VII

### Conclusions

The effect of dividend payout policy has been to reduce ownership concentration, which could be evidence for its playing a role complementary to that of legal protection and monitoring. It is interesting to note that the reduction in the first shareholder's share more than offsets the increase in the second shareholder's, which in turn highlights the opposing responses of the controlling and following shareholders.

The direct relationship between equity and concentration for the controlling shareholder and the negative effect for the second and third shareholders imply greater concentration at larger companies, with capital increases coming more from the main shareholder than from the inclusion of minority shareholders.

The sign of per capita GDP is positive for the top three shareholders as a group, and for the second and third individually, but is statistically equal to zero (0) for the controlling shareholder, which means that more minority shareholders are coming into the stock market as average income in the country increases.

The positive sign for market capitalization to GDP appears to indicate that a deeper stock market works against concentration.

The role played by pension funds in monitoring and enhancing corporate governance is statistically

significant in reducing ownership concentration. This issue is particularly relevant for Latin American countries, given the scale of pensions funds' presence in the region's stock markets.

Although the Public Tender Offer Act achieves its central purpose, the tender offer mechanism increases the concentration of ownership, mainly because of the "residual tender offer" obligation the Act provides for. This assertion does not follow in any way from the econometric analysis above, but in the authors' opinion it does offer a potentially sound explanation for the observed increase in Chilean shareholder concentration since the implementation of the Public Tender Offer Act.

The empirical evidence for statistically significant opposite responses by the controlling shareholder and the next two largest shareholders should sound a note of warning for international comparisons based on a common measure of ownership concentration, when made between stock markets with totally different ownership structures. This issue should be a reminder of the specific characteristics of Latin American stock markets and ownership structures, which need to be taken into account when designing and promoting minority shareholder protection bills, since otherwise the final results may run counter to the original regulatory goals.

#### ANNEX

TABLE A.1

**Ownership concentration: static model**  
(Fixed-effects panel estimation)

Independent variable	Dependent variable: shares of top three shareholders			
	Coefficient	Standard deviation	t-statistic	Probability
Constant	-1.7509	0.4147	-4.2218	0.0000
Dividend payout (-1)	-0.0222	0.0080	-2.7676	0.0057
Log (equity)	0.0124	0.0076	1.6398	0.1014
Log (leverage)	0.0071	0.0027	2.6648	0.0078
Log (per capita GDP)	0.1513	0.0332	4.5522	0.0000
Market capitalization/GDP	-0.0331	0.0135	-2.4509	0.0144
AFP share	-0.9088	0.0711	-12.7735	0.0000
Public Tender Offer Act dummy	0.0176	0.0091	1.9272	0.0542
2001 transition dummy	-0.0505	0.0131	-3.8681	0.0001
Adjusted R <sup>2</sup>	0.832033			
Number of observations	1 137			

Source: prepared by the authors.

TABLE A.2

**Correlation matrix for shareholder shares**

	First	Second	Third
First	1.0000		
Second	-0.2356 (0.00)	1.0000	
Third	-0.5347 (0.00)	0.3614 (0.00)	1.0000

Source: prepared by the authors.

Note: *P*-value in parentheses.

TABLE A.3

**Ownership concentration**

(Instrumental variable estimation: 2S-OLS panel)

Independent variable	Dependent variable: shareholder shares		
	First	Second	Third
Constant	0.1298 (0.65)	-0.5814 (0.00)	-0.2247 (0.02)
Dividend payout (-1)	-0.0222 (0.00)	0.0129 (0.00)	-0.0021 (0.23)
Log (equity)	0.0170 (0.00)	-0.0051 (0.10)	-0.0032 (0.06)
Log (leverage)	0.0006 (0.73)	-0.0006 (0.60)	0.0009 (0.14)
Log (per capita GDP)	-0.0199 (0.39)	0.0477 (0.00)	0.0215 (0.00)
Market capitalization/GDP	-0.0342 (0.00)	-0.0080 (0.15)	-0.0014 (0.65)
AFP share	-0.2266 (0.00)	0.0251 (0.44)	-0.0188 (0.28)
Public Tender Offer Act dummy	0.0188 (0.00)	-0.0083 (0.03)	-0.0032 (0.11)
2001 transition dummy	-0.0429 (0.00)	-0.0153 (0.00)	-0.0038 (0.19)
Lagged dependent variable	0.7952 (0.00)	0.6998 (0.00)	0.6367 (0.00)
First shareholder share		0.0101 (0.55)	-0.0356 (0.00)
Second shareholder share	0.0789 (0.14)		0.0309 (0.08)
Third shareholder share	-0.0781 (0.49)	0.0873 (0.21)	
Adjusted R <sup>2</sup>	0.93682	0.847551	0.8271
Number of observations	1 137	1 137	1 137

Source: prepared by the authors.

Note: *P*-value in parentheses.

2S-OLS: two-stage ordinary least squares.

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## Chile: subsidies, credit and housing deficit

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### ABSTRACT

This article has two objectives: to analyse the effects of the housing subsidy on access to credit and on real-estate investment; and to study the influence of those relations in the Chilean experience. Following a review of the financing and subsidy systems in Chile, a theoretical model is put forward to analyse the effect of subsidies on housing credit and on the equilibrium of the real-estate market. The model offers new perspectives on the role played by subsidies policy and the structure on which the empirical research is based. The econometric analysis corroborates the two main theoretical proposals, namely: access to the subsidy increases a family's chances of obtaining credit and reduces the number of families living in a housing-deficit situation. The econometric results also help to interpret the trend of the housing deficit in Chile.

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### KEYWORDS

Housing, housing needs, housing subsidies, credit, econometric models, statistical data, housing finance, Chile

### JEL CLASSIFICATION

R21, R28, H53

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# I

## Introduction

In the mid-1970s, a far-reaching reform of the real-estate financing system was undertaken in Chile, with the explicit aim of boosting investments in homes and overcoming the housing deficit. Innovative mechanisms combining credits and subsidies were created, and these had an immediate effect on the market.

Apart from representing a satisfactory experience of real-estate financing and serving as a benchmark for other Latin American countries, the Chilean case provides a good empirical basis for an analysis of how a subsidies policy can affect economic agents' decisions and the volume of real-estate investments —partly because it is a policy that has now been applied for many years, so its long-term effects can be observed. Moreover, the wide variety of home-purchase modalities available allow for a more effective evaluation of the relations that exist between subsidy, credit and income. Housing can be financed through subsidies, credit, self-financing without subsidies and, lastly, through a combination of credit and subsidies.

This article is organized in five sections following this introduction. Section II describes the Chilean financing model and the main subsidy programmes; section III sets forth a theoretical model to analyse how subsidies influence housing credit and affect equilibrium in the real-estate market. That model offers new perspectives on the role played by subsidies policy and provides the structure on which the empirical research reported in the following sections is based. Section IV performs an econometric analysis to measure the influence of the subsidies on a family's chances of obtaining housing credit, which, in addition to helping to interpret the Chilean experience, provides empirical elements that corroborate the proposed theoretical model. Section V describes the methodology for estimating the housing deficit in Chile, and provides details of the calculations, based on data obtained from the National Socioeconomic Survey (CASEN). The section also reports other econometric research inspired in the relations that exist between the variables that determine real-estate investment. The article concludes with a section offering final thoughts.

# II

## Summary of housing policy in Chile

Chilean housing policy has three dimensions: (i) the financing system; (ii) the subsidies policy; and (iii) the regulations governing construction and urban development. Each of those dimensions has evolved at a different rate over the last 50 years, displaying well-defined phases. This section reviews the housing-finance models, the subsidy policy and its interaction with credit —issues that provide the central focus of this article.<sup>1</sup>

### 1. Financing system

The history of housing finance in Chile in the twentieth century can be divided into three periods, identified by the financial intermediation instruments used to channel

savings into real-estate investment: (i) up to 1959; (ii) from 1959 to 1976; and (iii) after 1976.

According to Morandé (1993), mortgage finance played a key part in Chilean financial intermediation policy in the first period. In the 1930s, mortgage bonds —instruments issued in pesos with nominal interest rates— grew to represent 50% of total bank lending. In the wake of the upsurge in inflation from 1940 onwards, however, the corresponding interest rates fell below the rate at which prices were rising and came to represent income transfers from investors to mortgage borrowers. The market was unable to resist, and the supply of credit in the system decreased sharply.

In 1959, the government solved the problem by creating tax incentives for both supply and demand, defined in Decree with Force of Law No. 2 of 1959 (DFL2). The innovation contained in the decree consisted of instituting a monetary-correction scheme for long-term

<sup>1</sup> For a broader historical view of Chilean housing policy, see Castillo and Hidalgo (2007); MINVU (2007), and Brain, Cubillos and Sabatini (2007).

operations, thereby making it possible for investment and saving to coexist with high inflation rates.

In the same year, the National Saving and Loan System (SINAP) was created. This played an important role in capturing saving through saving and loan associations; and it also revitalized housing activity and validated the system of readjustment indices, which formed the basis for the subsequent success of the new housing finance systems established from the 1970s onwards. The indexation of saving deposits and mortgage loans, which remains in force today, played a crucial role in eliminating inflationary risk and guaranteeing the supply of credit at lower cost.

In the 1960s and early 1970s, the government introduced a wide-ranging subsidies policy to help low-income sectors purchase homes. Between 1960 and 1969, nearly 68,000 families received a subsidy to buy their own home, and the number grew to almost 150,000 between 1970 and 1979 (see figure 1). In just three years of that period, from 1970 to 1972, over 72,500 families received the subsidy.

The SINAP lost momentum in the 1970s, however; and between 1974 and 1976, the number of housing units

financed per year (16,100) fell by 28% compared to the previous four years (22,400).<sup>2</sup> That occurred because savings dwindled in the wake of the recession, and this was compounded by a loss of purchasing power among the population and political instability in the country. There was also a mismatch between investment and savings maturity periods, a problem previously encountered in the North American system.

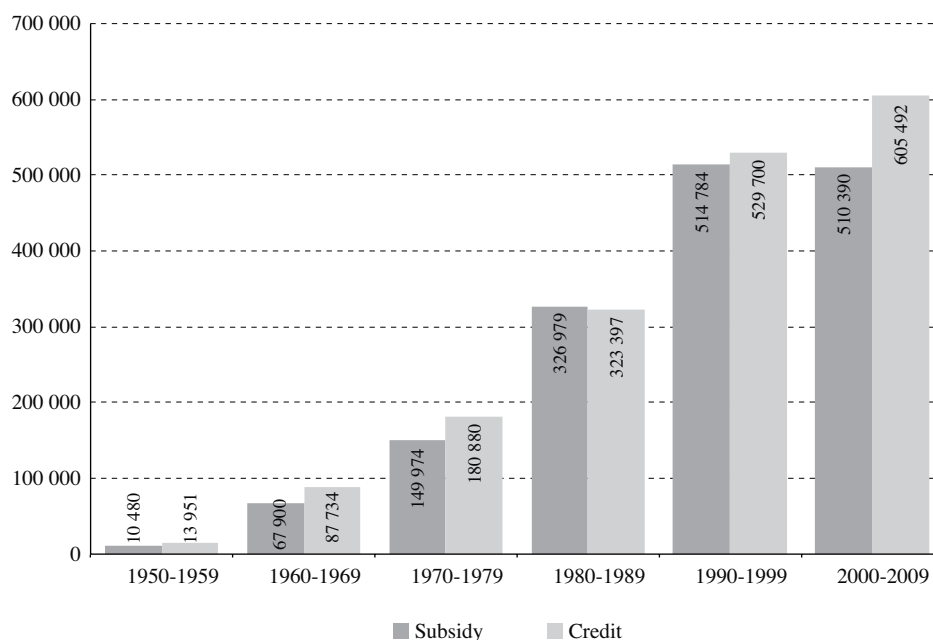
In 1976, a new institutional framework was introduced through structural reforms to liberalize the economy, accompanied by economic stabilization measures. This resulted in a far-reaching reorganization of the capital market, which in turn had repercussions on financial intermediation and housing credit.

The social security reform implemented in late 1980 was another important factor which promoted the secondary securities market and channelled large amounts of long-term savings into real-estate financing. According to the Pensions Supervisor, the number of funded pension accounts grew rapidly following the

<sup>2</sup> CASEN Survey 2009.

FIGURE 1

**Chile: total number of families with access to credit and the subsidy,<sup>a</sup> 1950-2009**



Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey.

<sup>a</sup> Includes social rental programmes.



reform, from around 500,000 in mid-1981 to 5,014,000 in December 1994. Pension fund assets grew from US\$ 305 million in 1981 to US\$ 21,145 million in 1994 —growth that proved crucial in expanding the overall supply of funds in the 1980s and 1990s, when real-estate credit expanded rapidly.<sup>3</sup>

Savings banks, which had a total of almost 14 million accounts holding assets of over US\$ 130 billion in late 2010, provided some of resources used for housing credit.<sup>4</sup> The funds held in those saving accounts represented an asset for Chilean families that could be drawn on when purchasing a property, thereby reducing the need for credit. Moreover, while those funds remain in the financial system, a portion is used to make real-estate loans.

Under the new system, housing came to be financed through various combinations of public and private funds. The system is based on granting long-term credit (from eight to 30 years) in two modalities: (i) mortgage-backed bearer bonds (*letras de crédito hipotecarias*); or (ii) negotiable mortgage loans (*mutuos hipotecarios endosables*). Both instruments are denominated in an inflation-linked unit of account, known as the *Unidad de Fomento* (UF), which is adjusted on a daily basis according to the variation in the consumer price index (CPI), thereby ensuring that the real values of the credits are maintained. The resources underlying mortgage bonds and loans come from pension funds, life insurance companies and private investors.

In addition to mortgage finance, the new housing-finance system is based on two other sources of funds: subsidies and prior saving. Explicit subsidies represent a social wealth-transfer mechanism, which uses tax revenue to overcome the shortage of homes and reduce the need for credit.

While prior saving also reduces families' need for credit when purchasing properties, as the corresponding funds are built up they used to grant loans, thereby increasing the supply of credit. According to figures published by the Superintendency of Banks and Financial Institutions (SBIF) of Chile, in December 2010 there were 3.36 million prior saving accounts<sup>5</sup> earmarked for home purchase, holding paid-in balances of UF 19,642 million

out of a contracted amount of UF 170,859 million.<sup>6</sup> The sheer volume of funds captured by the system reveals the importance of prior saving in the formation of funds for lending.

This home-financing model has remained virtually unchanged until the present day. Following the end of the military regime in 1992, the subsequent democratic governments have maintained the general design of the system while increasing the resources available for subsidies. In the 1980s, subsidies were paid to 330,000 families, and the number rose to 515,000 in the following decade (see figure 1). As a result of this and the economic growth of the 1990s, the volume of credit also grew.

## 2. Subsidies policy

The housing subsidies policy created in Chile in the 1970s has remained essentially unchanged to the present day (Simian, 2010). The policy reflects the principles of equity and progressivity: access is universal, and the subsidies are proportionately larger for the lower-income population. In general, the system is based on granting subsidies for demand or the construction and donation of homes. In the first modality, the government issues a voucher to be used to pay for part of the value of the home, thereby reducing the need for prior saving and credit. The house-building and transfer policy is applied to the lowest-income sectors of society, who are unable either to accumulate prior saving or to obtain credit.

From the mid-1970s until today, Chilean housing policy has coexisted with numerous subsidy programmes that differ in terms of their area of action (rural or urban), the target public and type of home. The main programmes in that period have been: (i) the Basic Housing Programme; (ii) the Unified General Subsidy (SGU); (iii) the Rural Subsidy Programme; (iv) the Economy of Labour Programme (PET), and (v) the Progressive Housing Programme. According to data from the 2006 CASEN survey, those five programmes accounted for over 75% of the subsidies granted between 1976 and 2006. The other subsidy programmes relate mainly to social renting, leasing, and the purchase of urbanized lots.

The Basic Housing Programme was created in 1975 and operated until the decade of 2000. It targeted families in the first and second quintiles of the income distribution, without their own homes, living in marginal

<sup>3</sup> The number of accounts in Chilean pension funds had grown to 8,957,000 in December 2001, with assets totalling US\$ 145.6 billion.

<sup>4</sup> Figures published by the Superintendency of Banks and Financial Institutions (SBIF).

<sup>5</sup> Dedicated savings for home purchases is one of the ways in which the Chilean system captures savings. The number of saving accounts totalled 13.8 million in late 2010, with a deposit balance of UF 2,852 million.

<sup>6</sup> The fact that the UF was worth 21,454.91 pesos or US\$ 45.81 in December 2010 means that a total of US\$ 889.75 million had by then been deposited for the purchase of an owner-occupied home, out of a total of US\$ 7,827 million contractually agreed upon for that purpose.

housing in urban and rural zones. The programme defined guidelines for home financing for low-income persons in Chile through a combination of prior saving, subsidy and credit. The average subsidy amounted to 70% of the price of the home.<sup>7</sup>

The General Unified Subsidy, created in 1978, targets medium-low-income families, who are not home-owners but have sufficient payment capacity to obtain bank credit. The family has to demonstrate a willingness to pay for the home, through prior saving deposited in an earmarked bank account (housing savings account). This system makes it possible to purchase a new or used home on a definitive basis in an urban or rural area.

The Rural Subsidy Programme started to operate in 1980 and targeted families living in marginal housing in the rural area, but who owned a piece of land in the rural zone, or had rights on it. The programme required the contribution of the land (another form of prior saving), while the rest was financed through a bank loan.

The Economy of Labour Programme (PET) was created in 1985 to serve families without a home of their own who belonged to organized social groups, preferably linked to professional categories or workers' associations. Like the Basic Housing Programme, the PET assisted families from urban and rural areas under the prior saving-subsidy-credit triad.

The Progressive Housing Programme started to operate in 1990 to meet the needs of families without homes who were cohabiting with other families or living in marginal housing. Priority was given to families in the first quintile of the income distribution. The homes in this programme were envisaged as being built in stages; the first stage involved a 13 m<sup>2</sup> dwelling on a land plot of 100 m<sup>2</sup>; the land plot needed to be fully urbanized and the house had to have sanitary infrastructure and one room. After that initial stage, the family could complete the house using their own resources or apply for government support for the following stage. Access to the programme required the existence of prior saving, and the rest of the financing was provided through the state subsidy and mortgage credit granted by the Housing and Urban Development Service (SERVIU).

These programmes were revised and replaced by new ones as from the decade of 2000. As noted by Simian (2010), the main changes consisted of a revision of the benchmark values and abolition of the modality

of house-building for donation. The two main subsidy programmes established in that period were the Housing Solidarity Fund of 2001 and the Housing Subsidy of 2004. Nonetheless, those new programmes maintained the financing model that involves prior saving, subsidy and credit.

The subsidies policy and its interaction with financing mechanisms were fundamental for increasing housing investments in Chile, because:

"The housing subsidy is a demand subsidy mechanism designed to overcome the problem of information asymmetry, reducing the need for credit and thereby avoiding excessive risk for financial institutions, which would not lend without an intervening subsidy" (Simian, 2010, p. 288).

The subsidy thus reduced the need for credit and minimized the risks of lending to low-income sectors, by increasing the supply of credit. Moreover, the housing subsidy is granted with the backing of prior saving.<sup>8</sup> According to Domínguez Vial and Nieto de los Ríos (1993), this subsidy also represents a way of measuring the initial effort and capacity to generate saving, thereby reducing information asymmetry.

Data from the 2009 CASEN survey show the relation between credit and the subsidy in Chile. By 2009, a total of 1,633,000 Chilean families had obtained subsidies to purchase homes (see table 1), of whom 1,276,000 also obtained credit to finance the purchase (32% of Chilean families). While 358,000 families relied on the subsidy alone, another 527,000 families had access to credit, but did not receive a subsidy to purchase their home. Over 70% of the families that obtained credit (1.8 million) also received a subsidy; so, as noted by Simian (2010), the subsidy seems to increase the chances of obtaining credit. Nonetheless, about 62% of Chilean families (3.5 million) did not have access either to credit or to the subsidy.<sup>9</sup>

Table 2 shows the number of families that had access to credit or benefited from subsidy programmes in the

<sup>7</sup> For further details of this programme see MINVU (2007).

<sup>8</sup> Prior saving is a mandatory condition in the Chilean housing subsidy system, either as a monetary contribution or through ownership of the land. An exception to this requirement is made in the case of families living in situations of extreme poverty, and those receiving priority and direct care from the State. Simian (2010, p. 286) identifies the subsidy programmes and prior saving needed to obtain the subsidy in the period 1974-2008.

<sup>9</sup> This large number includes all heads of family, including those paying rent, living in properties made available to them by their employer, or sharing housing with other families. It also includes families that bought properties long before the reforms instituted under the current financing and subsidy systems.

period 1976-2009. In that time, over 3.1 Chilean families purchased a home, of whom half had access to credit and 35% obtained both credit and a subsidy. In contrast, 40% did not benefit from any type of programme for

purchasing their home, whereas 72% of families with access to credit also received a subsidy. These figures strengthen the aforementioned idea that access to credit seems to depend largely on receiving the subsidy.

TABLE 1

**Chile: families who received credit or a subsidy for home purchase, up to 2009**

		Subsidy		Total
		No	Yes	
Credit	No	3 490 215	357 661	3 847 876
	Yes	527 177	1 275 796	1 802 973
Total		4 017 392	1 633 457	5 650 849

Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey (CASEN).

TABLE 2

**Chile: families that obtained credit or received a subsidy for home purchase, 1976-2009**

		Subsidy		Total
		No	Yes	
Credit	No	1 263 972	323 676	1 587 648
	Yes	443 299	1 116 506	1 559 805
Total		1 707 271	1 440 182	3 147 453

Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey (CASEN).

### III

## Subsidies, credit and real-estate investment

The role of housing subsidies is generally viewed in terms of their permanent effect on the income flow and wealth of families.<sup>10</sup> Nonetheless, this article starts from a broader hypothesis: as the subsidy is an instantaneous transfer of resources to pay part of the value of the property, it affects general housing conditions and, hence, influences the decisions made by banks regarding the supply of credit.

#### 1. Housing subsidy and the return earned by banks

A home loan is a contract that involves five elements: the amount of the loan ( $B$ ); the rate of interest on the loan ( $r^*$ ); the subsidiary collateral ( $C$ ) consisting of the real asset used to guarantee the loan (mortgage); the amount subsidized ( $S$ ); and the amount of the down-payment ( $E$ ). The mortgage is foreclosed if the contract is not fulfilled. In terms of home financing, the value of

the collateral is equal to the value of the property. To simplify, we assume that the contract defines two periods of time: in time  $t$ , the borrowing takes place, and in  $t+1$  the borrower must pay back the principal and interest.

It is assumed that the amount of the loan taken out in the initial period corresponds partly to the collateral, less the amount of subsidy. This relation is established in equation (1), in which  $\lambda$  is the percentage of the value of the property being financed, having deducted the subsidy ( $-0 < \lambda \leq 1$ ). The remainder  $(1 - \lambda)$  is equivalent to the prior saving demanded by the bank for the financing—the contract down-payment ( $E$ ). It is assumed that  $0 \leq S \leq C$ .

$$C = B + E + S, \quad B = \lambda \cdot (C - S) \text{ and } E = (1 - \lambda) \cdot (C - S) \quad (1)$$

Fulfilment of the contract depends on a basic financial condition, equation (2), and on the probability distribution of fulfilment. The financial condition for the payment requires that the value of the debt plus interest shall not exceed the value of the collateral, for otherwise the borrower would be better-off defaulting on the debt and handing the subsidiary collateral over to the bank when the loan falls due.

$$B + B \cdot r^* < C \quad (2)$$

<sup>10</sup> According to the Ministry of Housing and Urban Affairs (MINVU), “The housing subsidy constitutes a large monetary transfer from the State to the selected households. By part-financing a durable asset such as housing, the subsidy generates an income equivalent to the portion of the cost of the home that it covers. This income represents a saving in respect of the monthly housing expense; so the state subsidy makes a permanent contribution to the income and quality of life of poor sectors, while the families in question make use of the subsidized home” (MINVU, 2007, p. 235).

Provided condition (2) is satisfied, the contract will be fulfilled or otherwise depending on the interest conditions and the resources available to the borrower. Let  $p$  be the probability of fulfilment of the financing contract: in period  $t + 1$  each contract has a probability  $p$  of being paid and  $(1 - p)$  of not being paid. The probability  $p$  depends on the resources of the families ( $w$ ) and the interest rate on the home financing, as shown in equation (3).

$$p = f(w, r^*), p \in [0, 1] \tag{3}$$

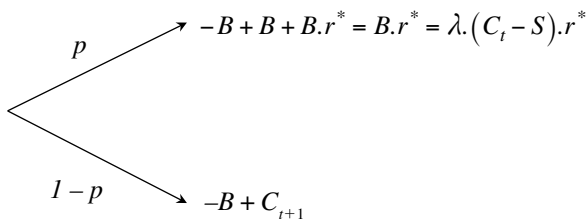
A rise in the interest rate on the home loan is assumed to reduce the probability of fulfilment of the contract, whereas an increase in the wealth of the families raises this.<sup>11</sup> The second derivatives are assumed positive.

$$\frac{\partial p}{\partial r^*} < 0, \frac{\partial p^2}{\partial^2 r^*} > 0 \quad \text{and} \quad \frac{\partial p}{\partial w} > 0 \quad \frac{\partial p^2}{\partial^2 w} > 0 \tag{4}$$

The return to the banks depends on the parameters of the contract and the probability of fulfilment. If the borrower respects the contract, the bank pays out the amount lent and receives the same amount back plus the loan interest. If the borrower does not respect the contract, the bank loses the amount lent but receives the subsidiary collateral. Figure 2 shows the return to the banks each case.

FIGURE 2

**Possible return from the real-estate loan**



Source: prepared by the authors.

To simplify, it is assumed that the value of the collateral in  $t + 1$  is equal to its value in  $t$ , in other

words, neither the increase in the value of the property through time, nor the depreciation rate ( $\delta$ ) in the period, are taken into account.

$$C_{t+1} = C_t = C \tag{5}$$

Considering the two possibilities, fulfilment or not fulfilment, the bank's expected return ( $\Pi$ ) is a function of the loan interest rate, the amount of the subsidy and the amount lent.

$$\Pi(r^*, S, B) = p.B.r^* + (1-p).(C-B) \tag{6}$$

The banks' expected rate of return is defined as the expected return divided by the amount lent:

$$\rho(r^*, S, B) = \Pi(r^*, S, B)/B = p.r^* + (1-p).(C/B - 1) \tag{7}$$

The banks are assumed to be profit-maximizers, so the interest rate on the loan will be that which maximizes the bank's expected return, as proposed by Stiglitz and Weiss (1981). Formulating the derivative of the banks' expected rate of return with respect to  $r^*$ , and taking account of equation (3), gives:

$$\frac{\partial \rho}{\partial r^*} = p'_r.r^* + p - p'_r.(C/B - 1)$$

This relation may be greater or less than zero (0) depending on the interest rate on the loan. Given that  $p > 0, p'_r < 0$ , as assumed in equation (4), and  $C \geq B$ , when the interest rate tends to zero (0) the derivative is positive. In contrast, when  $r^*$  tends to infinity, the derivative is negative.

$$\lim_{r^* \rightarrow 0} \partial \rho / \partial r^* > 0 \quad \text{and} \quad \lim_{r^* \rightarrow \infty} \partial \rho / \partial r^* < 0$$

Identifying the interest rate that maximizes the banks' rate of return requires setting the aforementioned derivative to zero (0). That condition assumes that:

$$p'_r.r^* = p'_r.(C/B - 1) - p \quad \text{or} \quad r^* = \frac{C}{B} - 1 - \frac{p}{p'_r} \tag{8}$$

Consequently, there is a maximum interest rate that is positive. If the interest rate is greater than  $r^*$ , the

<sup>11</sup> It should be remembered that, by definition,  $p$  is constrained to the interval between 0 and 1. When  $p$  attains the value 1, the derivative of  $p$  with respect to  $w$  becomes zero.

banks' rate of return is not at a maximum.<sup>12</sup> The amount of the subsidy granted to purchase a property affects the expected return to the banks. As the value of the subsidy rises, the amount lent by the bank declines, because part of the price of a property has been paid by the government. Substituting definition B of equation (1) into (7) gives:

$$\begin{aligned} \rho(r^*, S, B) &= p \cdot r^* + (1-p) \cdot (C/\lambda \cdot (C-S) - 1) \\ &= p \cdot r^* + (1-p) \cdot \left( \frac{C \cdot (1-\lambda) + \lambda \cdot S}{\lambda \cdot (C-S)} \right) \end{aligned}$$

The derivative of the banks' expected rate of return with respect to the subsidy is:

$$\frac{\partial \rho}{\partial S} = \frac{C \cdot \lambda \cdot (1-p)}{[\lambda \cdot (C-S)]^2} > 0$$

This means that the larger the subsidy, holding other variables constant, the greater will be the banks' expected rate of return. An analysis of the second derivative of the rate of return with respect to the subsidy shows that the rate of return rises at increasing rates as the amount of subsidy rises.

$$\frac{\partial^2 \rho}{\partial^2 S} = \frac{2 \cdot C \cdot \lambda^2 \cdot (1-p)}{[\lambda \cdot (C-S)]^3} > 0$$

Another important point is that the subsidy affects the loan interest rate  $r^*$  that maximizes the banks' return—equation (8). As  $B$  contains the value of the subsidy, a change in that value affects the equilibrium rate. Formulating the derivative of equation (8) with respect to  $S$ , gives:

$$\left. \frac{\partial r^*}{\partial S} \right|_{\rho \max} = \frac{C \cdot \lambda}{[\lambda \cdot (C-S)]^2} > 0$$

Thus, the larger the subsidy, the higher will be the loan interest rate, because the increase in the value of the subsidy shifts the banks' expected yield curve (see

figure 3). Like the interest rate, a larger subsidy also involves a higher return. Nonetheless, the increase in the subsidy means that the loan interest rate that maximizes the banks' return is greater.

## 2. Housing subsidy and credit market

As the subsidy has a positive effect on the return on bank loans for home financing, it also affects the supply of credit to purchase a home ( $L^S$ ). The influence of the subsidy can be better understood by considering the figure proposed by Stiglitz and Weiss (1981). Starting from the Cartesian coordinate ( $L^S, \Pi$ ) in figure 3, it can be seen that the interest rate that maximizes the banks' expected return defines the final point of the supply of credit by the banks. The amount of credit supplied by the banks also depends on the volume of funds that are available for lending in the economy, which is an exogenous variable designated by  $M$ . The first quadrant of the figure shows the relation between the supply of credit and the loan interest rate. Supply rises with the interest rate up to point  $r^*$ , after which it declines as the interest rate continues to rise.

In this system, the granting of the subsidy shifts the banks' expected yield curve (quadrant ( $\Pi, r$ )), which means an increase in the supply of credit (quadrant ( $\Pi, L^S$ )). These changes affect the relation between the interest rate on real-estate loans and the supply of credit: the credit supply curve shifts upwards in the ( $L, r$ ) quadrant. This means that, with the same interest rate ( $r^*$ ), an increase in the subsidy has a greater effect on credit supply; moreover the amount of credit supplied also increases in response to the rise in the home-loan interest rate from  $r^*$  to  $r^{**}$ .

When the funds available for financing real-estate investments increase, the supply of credit also grows. Nonetheless, that expansion does not affect the loan interest rate that maximizes the expected yield. Consequently, the effect should be seen as an upward shift in the credit supply curve.

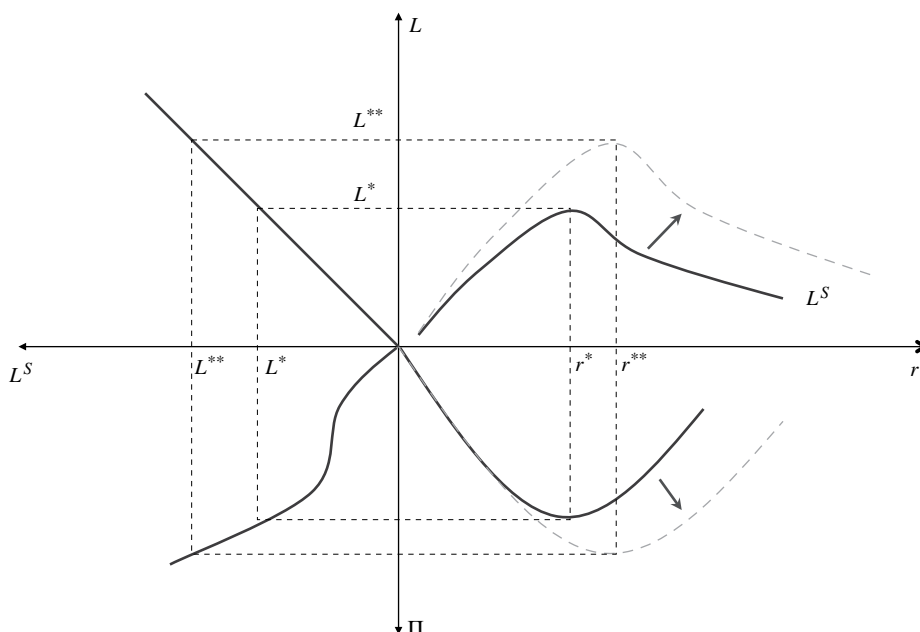
Lastly, it is necessary to analyse the effect of the subsidy and other parameters that define the real-estate financing contract, on families' decisions to take out loans to purchase their own homes. Based on the models used in Stiglitz and Weiss (1981), families are assumed to have a utility function  $U(w)$  that responds to the level of wealth. Marginal utility is positive and decreasing:  $U' > 0$ ,  $U'' < 0$ . The decision to borrow to purchase a property is based on the family's comparison of expected utilities obtained from: (i) the risk-free investment alternative; (ii) taking out a loan, or (iii) self-financing of the home.

<sup>12</sup> Confirmation  $r^*$  is a maximum, requires calculating the second derivative of the bank's rate of return with respect to the loan interest rate.

$$\frac{\partial^2 \rho}{\partial^2 r^*} = p \cdot r^* + 2 \cdot p \cdot r^* - p \cdot r^* \cdot \left( \frac{C}{B} - 1 \right) - 2 \cdot p \cdot r^* + p \cdot r^* \cdot \left( \frac{B(1+r^*) - C}{B} \right) < 0$$

FIGURE 3

Effect of the subsidy on the supply of credit



Source: prepared by the authors on the basis of Ana Lelia Magnabosco, “A política de subsídios habitacionais e sua influência na dinâmica de investimento imobiliário e no déficit de moradias do Brasil e do Chile”, São Paulo, Catholic University of São Paulo, 2011.

In the first case, the family does not purchase the property but rents their housing. All family resources are invested risk-free financial assets. The expected utility of alternative (i) is defined as the utility associated with the value of the family’s initial wealth ( $w_0$ ), capitalized by the rate of return on the safe investment ( $r$ ), less the rental payment.

$$U_a \equiv U(w_0 \cdot (1+r) - R) \tag{9}$$

If the family obtains a home loan (situation (ii)), the expected utility corresponds to equation (10), namely the probability-weighted sum of the utilities in the case of payment or non-payment of the debt. When the debt is paid, the family’s utility corresponds to the value of initial wealth less the down-payment made to purchase their own home, capitalized by the market interest rate, having deducted the principal and debt service on the home loan, plus the value of the property. If the loan is defaulted, the utility corresponds to the value of wealth less the down-payment for the purchase of the home,

capitalized by the market interest rate, less the value of the property which reverts to the bank.

$$U_b \equiv U((w_0 - E) \cdot (1+r) - B \cdot (1+r^*) + C) \cdot p + U((w_0 - E) \cdot (1+r) - C) \cdot (1-p) \tag{10}$$

If the family chooses to self-finance their house purchase (situation (iii)), the expected utility corresponds to expression (11). That value is virtually the same as in equation (9), except that the value of the property multiplied by  $r$  is deducted, instead of the rent.

$$U_c \equiv U((w_0 - C) \cdot (1+r) + C) = U(w_0 \cdot (1+r) - C \cdot r) \tag{11}$$

A direct comparison of equations (9) and (11) leads to the relation that defines the choice between the safe investment or self-financing of the property. The expected utility of self-financing is greater than that of the safe investment when the rental  $R$  exceeds the value of the property multiplied by the interest rate on the safe investment ( $C \cdot r$ ). The latter is the amount of financial

income that will be forgone because the money was invested in the property.<sup>13</sup>

The analysis of the decision to take out a loan entails comparing the expected utility functions (10) and (11). For that purpose, equation (10) is divided into two parts: the first indicates the value obtained when the loan is paid (subindex 1); and the second the value in the case of default (subindex 2). The first part of equation (10) can be written as follows:

$$U_{b1} \equiv U\left(w_0 \cdot (1+r) - C \cdot r + (B+S) \cdot (1+r) - B \cdot (1+r^*)\right)$$

Comparing the argument of this function with that of equation (11) shows that the expected utility of self-financing could be either greater or less than the expected utility of the loan (in the case of payment). When the following expression is positive, the expected utility of the loan (in the case of payment) is less than the expected utility of self-financing:

$$(B+S) \cdot (1+r) - B \cdot (1+r^*) > 0$$

This is so because the value of the subsidy, capitalized by the interest rate on the safe investment, is greater (in absolute terms) than the amount of the debt multiplied the difference between the interest rate on the safe investment and the rate on the real-estate loan. If there is no subsidy, clearly  $U_{b1} < U_c$ . As the value of the subsidy rises, the expected utility of the loan tends to be greater than the expected utility of self-financing. The same is true when the home-loan interest rate tends towards the safe-investment rate.

The second part of equation (10), related to subindex 2, can be written as follows:

$$U_{b2} \equiv U\left(w_0 \cdot (1+r) - C - E \cdot (1+r)\right)$$

A comparison of the argument of this function with that of equation (11) shows that the expected utility of self-financing can also be greater or less than the expected utility of the loan in the case of default. The condition is as follows:  $U_c$  is greater than  $U_{b2}$  when  $C + E \cdot (1+r)$  is greater than  $C \cdot r$ . This happens when the interest-rate  $r$  is less than the ratio between  $(C + E)$  and  $(C - E)$ , in other words, when the interest rate on the safe investment is

not very high. For example, if  $E$  were equal to zero (0), the limiting two-period interest rate would be 100%. If there is an interest rate greater than 100% between the two periods,<sup>14</sup> the expected utility of the loan tends to be greater than that of self-financing, as the value of the down-payment decreases.

In short, the expected utility of requesting a loan could be greater or less than the expected utility of self-financing. Nonetheless, loan contracts with a high subsidy and a small down-payment are known to increase the expected utility of choosing a loan. The same is true when the loan interest rate tends towards the rate on the safe investment. Moreover, low rental rates or high interest rates on the safe investment repress both self-financing and borrowing for the purchase of owner-occupied housing.

Family decisions are also affected by their level of wealth. In the case of very poor families with very little initial wealth  $w_0$ , the amount of the down-payment ( $E$ ) prevents them from entering the credit market. They are also unable to self-finance, because if their initial wealth is less than the value of the down-payment, it will also be less than the value of the property. Families in this situation put their sparse resources in the safe investment, and therefore rent their home.

In the case of families whose initial wealth is greater than the value of the property, it is assumed, on the basis of progressivity, that the homes they seek are not eligible for a state subsidy. In this case, as noted above, the utility of the loan is certainly less than that of self-financing if the debt is repaid ( $U_{b1} < U_c$ ). If the debt is not paid, for  $U_{b2}$  to be less than  $U_c$ , the value of the property demanded by the family needs to be greater than half of the value of the debt, capitalized by the interest rate on the safe investment. If this is the case, the family will choose to self-finance their home. But even if the latter condition does not hold, it should be remembered that the probability of default declines as family wealth grows (equation (4)). For this reason, the decision to self-finance owner-occupied housing becomes more advantageous as the initial wealth of the families increases. Borrowing to purchase their own home is, therefore, an alternative typical of the middle-class.

<sup>13</sup> This relation shows that markets with a repressed rental value, or a very high interest rate on safe investments, discourage families from self-financing their properties.

<sup>14</sup> This is a common level in real-estate financing plans. The two-period interest rate is the total value of interest paid in a financing operation divided by the value of the loan. In a financing plan with a constant instalment, for instance for a 30-year period and at an interest rate of 9% per year, the two-period interest rate would be 192%. If the annual interest rate were 6%, the two-period interest rate would be 118%.

A direct consequence of the above is that housing subsidies affect the demand for credit. When the subsidy value increases, the utility of loan financing rises and will exceed the utility of self-financing for some families. Moreover, the increase in the subsidy reduces the value of both the loan and the down-payment, and thus expands the set of families that apply for and are granted credit. Thus, the subsidies have a direct and positive effect on the demand for credit.

### 3. The housing subsidy and the dynamic of the real-estate market

The dynamic model of housing investment follows the formulation proposed by Garcia and Rebelo (2002), which is based on Muth (1960) and Tobin (1969). In this model, the economy consists of  $N_t$  families which grow at a constant rate of  $n$ . At time  $t$ , the demand for properties by the representative family,  $k_t^d$ , depends on wealth ( $w_t$ ) and the rental value ( $R_t$ ). The demand for properties is given by equation (12):

$$k_t^d = f(w_t) + g(R_t) \tag{12}$$

It is assumed that  $\partial k_t^d / \partial w_t > 0$  and  $\partial k_t^d / \partial R_t < 0$ ; in other words the variation in the demand for property with respect to wealth is positive and the variation with respect to the rental is negative. For convenience, it is assumed that  $g(R_t)$  is a linear function:  $g(R_t) = -\beta \cdot R_t$ ,  $\beta > 0$ . In the short run, the supply of properties is fixed, and given by equation (13).

$$k_t^s = k_t^0 = k_t \tag{13}$$

The rental value is determined by the equilibrium between demand and supply:

$$R_t = \frac{f(w_t) - k_t}{\beta}$$

To analyse investor behaviour, the profitability of real-estate enterprises is defined. Following Tobin (1969),  $q_t$  is defined as the ratio between the market price of the property ( $pm_t$ ) and the replacement cost of one unit of housing capital ( $c_t$ ). Assuming that the cost of construction is constant and equal to 1,  $q_t$  is equal to the market price of the properties, which varies according to the profitability net of depreciation provided by the rental income on the asset.

$$q_t = \frac{pm_t}{c_t} = pm_t \tag{14}$$

The yield of the real-estate asset between two periods has three components: the capital gain  $q_t$ , the rental income ( $R_t$ ) and the physical depreciation ( $\delta$ ) of the asset, which is a proportion of the property value  $q_t$ . The rate of return ( $r^K$ ) is defined as the ratio between the yield and the asset price.

$$r^K \equiv \frac{\dot{q}_t + R_t - \delta \cdot q_t}{q_t} \tag{15}$$

Rearranging expression (15) gives:

$$\dot{q}_t = (r^K + \delta) \cdot q_t - R_t \tag{16}$$

Substituting expressions (12) and (13) into equation (16), gives the dynamic equation  $q_t$ :

$$\dot{q}_t = (r^K + \delta) \cdot q_t - \frac{f(w_t) - k_t}{\beta} \tag{17}$$

The model is completed by observing the variation in the amount of housing capital through time. By definition, the amount of capital in  $t$  is equal to the capital in  $t - 1$ , less capital depreciation in  $t$ , plus investment:  $\dot{K}_t = I_t - \delta \cdot K_t$ . Dividing both sides of the equation by the number of families ( $N_t$ ), and considering that  $\dot{k}_t = \dot{K}_t / N_t - n \cdot k_t$  and  $i_t = I_t / N_t$ , gives:

$$\dot{k}_t = i_t - (n + \delta) \cdot k_t \tag{18}$$

Credit rationing is introduced into the general dynamic real-estate model through the families' investment function ( $i_t$ ). This function responds to the amount of credit offered by the banks and property prices, and is defined as the sum of the investment made by families classified in three classes according to their income level. Classes  $a$  and  $c$  encompass very wealthy and very poor families, respectively. Families of medium wealth belong to class  $b$ .

Very poor families, whose wealth is less than the down-payment on the property, do not have access to credit. In this case, their wealth is also less than the value of the property itself. Consequently, those families are not in a condition to self-finance and therefore rent their housing. Real-estate investment serving that sector of



the population is undertaken by third parties, in other words by investors seeking the rental income. For that group, the arbitrage condition proposed by Garcia and Rebelo (2002) applies, which means that the investment for class-*c* families depends on the ratio between the market price of a property and the replacement cost ( $q_t$ ), as expressed in equation (19). It is assumed that  $\theta_c > 0$ ; in other words the higher the market price of the properties for a given construction cost, the greater will be the amount of housing investment.

$$i_t^c \equiv i^c(q_t) = \theta_c \cdot q_t, \quad \theta_c > 0 \quad (19)$$

Very wealthy families do not participate in the credit market because it is more advantageous for them to self-finance their own home. For those families, investment also depends only on the ratio between the price of the property and the construction cost.

$$i_t^a \equiv i^a(q_t) = \theta_a \cdot q_t, \quad \theta_a > 0 \quad (20)$$

Investment by families in class *b* is defined by the sum of the value financed and the value of autonomous investment. The latter arises from (21), and loans per family are determined by equation (22). The total value of investment is obtained through equation (23):

$$i_t^b \equiv i^b(q_t) = \theta_b \cdot q_t, \quad \theta_b > 0 \quad (21)$$

$$l_t^* = l(s_t, m_t), \quad l'_s > 0 \quad \text{y} \quad l'_m > 0 \quad (22)$$

$$i_t^b \equiv l_t^* + i_t^b \equiv l(s_t, m_t) + \theta_b \cdot q_t \quad (23)$$

In these equations,  $m$  represents the amount of funds available in the economy for lending to families, and  $s$  is the amount of subsidy per family. The average investment per family is a weighted average of the investments made by families in each class. The weights correspond to the proportion of each class in society, defined as the number of families in each class divided by the total number of families. Defining the proportion of each class as  $\phi_a$ ,  $\phi_b$  and  $\phi_c$ , such that  $\phi_a + \phi_b + \phi_c = 1$ , gives equation (24).

$$i_t \equiv \phi_a \cdot (\theta_a \cdot q_t) + \phi_b \cdot (l_t^* + \theta_b \cdot q_t) + \phi_c \cdot (\theta_c \cdot q_t), \quad \text{or} \quad (24)$$

$$i_t \equiv \phi_b \cdot l_t^* + \theta \cdot q_t$$

where  $\phi_a \cdot \theta_a + \phi_b \cdot \theta_b + \phi_c \cdot \theta_c = \theta$ . By definition,  $\theta$  is positive; so substituting equation (22) in expression (24); and the result of that substitution in the housing capital accumulation equation, expression (18), gives:

$$\dot{k}_t = \phi_b \cdot l(s_t, m_t) + \theta \cdot (q_t) - (n + \delta) \cdot k_t \quad (25)$$

Equations (17) and (25) form the system of differential equations that define dynamic equilibrium in the real-estate market.<sup>15</sup> The equilibrium of the system is found in the steady state of variables  $q$  and  $k$ . Expressions (26) and (27) describe the equilibrium curves of the price and quantity of housing capital. While the curve described by equation (26) has a negative gradient, that described by equation (27) slopes upwards. System equilibrium is defined in the intersection of the two curves, and the equilibrium values are shown in expressions (28) and (29).

$$\dot{q}_t = 0 \Rightarrow q_t = \frac{f(w_t) - k_t}{\beta \cdot (r^k + \delta)} \quad (26)$$

$$\left. \frac{dq_t}{dk_t} \right|_{\dot{q}_t=0} = \frac{-1}{\beta \cdot (r^k + \delta)} < 0$$

$$\dot{k}_t = 0 \Rightarrow k_t = \frac{\phi_b \cdot l(s_t, m_t) + \theta \cdot (q_{t-1})}{(n + \delta)} \quad (27)$$

$$\left. \frac{dq_t}{dk_t} \right|_{\dot{k}_t=0} = \frac{n + \delta}{\theta} > 0$$

$$q^* = \frac{f(w_t) \cdot (n + \delta) - \phi_b \cdot l(s_t, m_t) + \theta}{\beta \cdot (r^k + \delta) \cdot (n + \delta) + \theta} \quad (28)$$

$$k^* = \frac{\beta \cdot (r^k + \delta) \cdot \phi_b \cdot l(s_t, m_t) + \theta \cdot [f(w_t) - \beta \cdot (r^k + \delta)]}{\beta \cdot (r^k + \delta) \cdot (n + \delta) + \theta} \quad (29)$$

<sup>15</sup> The system has saddle-point stability, because the jacobian determinant is negative:

$$|J| = \begin{vmatrix} r^k + \delta & 1/\beta \\ \theta & -(n + \delta) \end{vmatrix} = -(n + \delta) \cdot (r^k + \delta) - \frac{\theta}{\beta} < 0$$

Lastly, the effects on housing-market equilibrium of changes in the system's exogenous variables need to be evaluated, namely the amount of subsidy per family ( $s_t$ ), the value of funds available for lending per family ( $m_t$ ), average family wealth ( $w_t$ ) and the rate of growth of the number of families ( $n_t$ ). An increase in the amount of subsidy per family reduces the value of the property and increases the amount of capital. Those effects, described by the partial derivatives set out below, correspond to a downward shift in the curve  $\dot{k}_t = 0$  (see figure 4 (a)).<sup>16</sup>

$$\frac{\partial q^*}{\partial s} = \frac{-\phi_b \cdot l'_s}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} < 0 \text{ and}$$

$$\frac{\partial k^*}{\partial s} = \frac{\beta \cdot \phi_b \cdot l'_s \cdot (r^k + \delta)}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} > 0$$

If there is an increase in loanable funds in the economy, the price of the property will fall and the amount of capital should increase. This is because the curve  $\dot{k}_t = 0$  also shifts downwards (see figure 4(b)). These effects are described through the partial derivatives:

$$\frac{\partial q^*}{\partial m} = \frac{-\phi_b \cdot l'_m}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} < 0 \text{ and}$$

$$\frac{\partial k^*}{\partial m} = \frac{\beta \cdot \phi_b \cdot l'_m \cdot (r^k + \delta)}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} > 0$$

An increase in family wealth raises the market price of properties and increases the amount of housing capital. In this case, there is an upward shift in the curve  $\dot{q}_t = 0$  (see figure 4(c)). That the effect is described through the partial derivatives of  $q^*$  and  $k^*$  with respect to  $w_t$ . Faster population growth raises the market price of properties and reduces the amount of housing capital per family, as a result of an upward shift in the curve  $\dot{k}_t = 0$ .

$$\frac{\partial q^*}{\partial w} = \frac{(n + \delta) \cdot f'(w_t)}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} > 0 \text{ and}$$

$$\frac{\partial k^*}{\partial w} = \frac{f'(w_t) \cdot \theta}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} > 0$$

$$\frac{\partial q^*}{\partial n} = \frac{k_t}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} > 0 \text{ and}$$

$$\frac{\partial k^*}{\partial n} = \frac{-\beta \cdot k_t \cdot (r^k + \delta)}{\beta \cdot (n + \delta) \cdot (r^k + \delta) + \theta} > 0$$

<sup>16</sup> In this model, the effects of the subsidy on the price of the property and the equilibrium amount of housing capital tend to be greater in societies with a relatively larger middle class.

FIGURE 4

Changes in the steady-state equilibrium

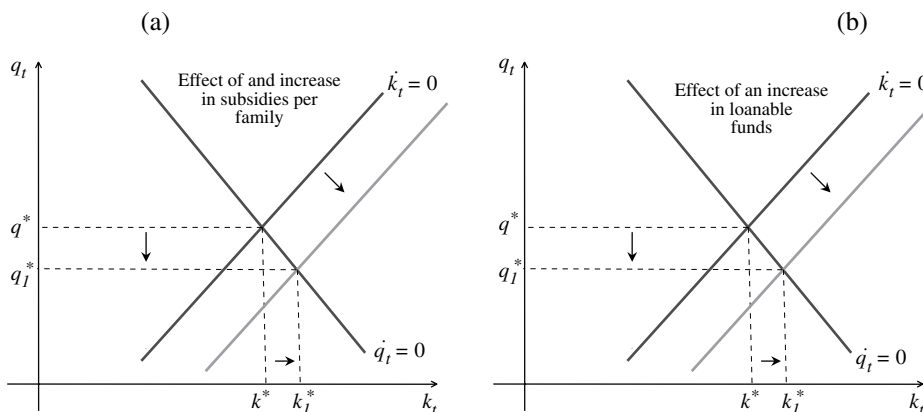
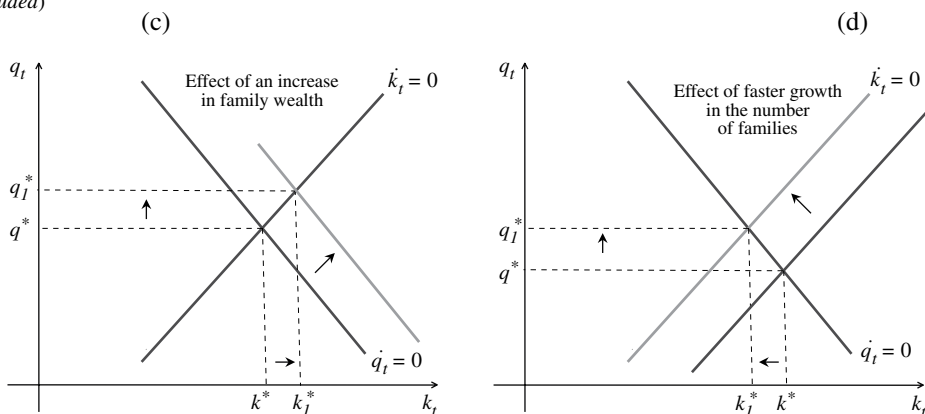


Figure 4 (concluded)



Source: prepared by the authors on the basis of Ana Lelia Magnabosco, “A política de subsídios habitacionais e sua influência na dinâmica de investimento imobiliário e no déficit de moradias do Brasil e do Chile”, São Paulo, Catholic University of São Paulo, 2011.

4. Subsidies and housing deficit

Garcia and Rebelo (2002) proposed a formula for relating housing investment to the housing deficit, based on the hypothesis that there is an arbitrary level of income,  $y_c$ , below which basic housing needs are not satisfied. In other words, below that level, the family is in a housing-deficit situation. This article adopts a similar approach, in which the critical variable is the amount of capital ( $k_c$ ).

The foregoing results show that family wealth and the amount of housing capital are positively related. Thus, for the critical level of capital  $k_c$ , there is a critical wealth level  $w_c$ . Families with a very low wealth level ( $w_l$ ) reach equilibrium with a small amount of steady-state capital; these are families in a deficit situation. Those that are not in deficit conditions have a higher level of wealth ( $w_h$ ). The steady-state price of properties (per  $m^2$ ) is also different for each class, which means that the property market is segmented.

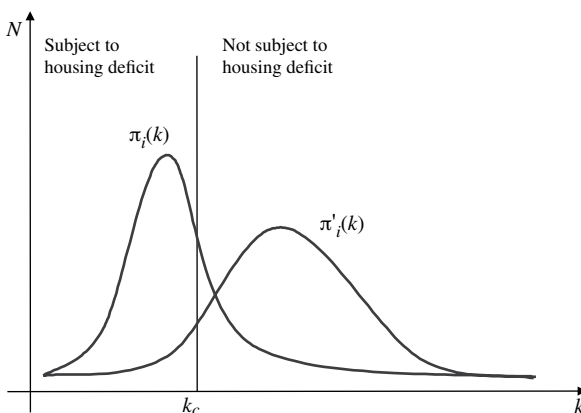
The absolute and relative housing deficit is given by:

$$D_i = \int_0^{k_c} \pi_i(k).dk \text{ and } d_i = \frac{\int_0^{k_c} \pi_i(k).dk}{\int_0^{\infty} \pi_i(k).dk} \quad (30)$$

where  $D_i$  is the absolute housing deficit in a given region  $i$ ;  $d_i$  is the relative deficit; and  $\pi_i(k)$  is the distribution of the

amount of housing capital. The integral of the numerator shows the number of families with a capital reserve of up to the critical level, and that of the denominator indicates the total number of families. This reasoning is illustrated in figure 5.

FIGURE 5 Distribution of families by amount of housing capital and deficit



Source: prepared by the authors on the basis of Fernando Garcia and André Rebelo, “Déficit habitacional e desigualdade da renda familiar no Brasil”, *Revista de Economia Aplicada*, vol. 6, No. 3, São Paulo.

As shown in figure 5, the subsidies policy has the effect of redistributing the amount of capital from  $\pi_i(k)$  to  $\pi'_i(k)$ , which expands the sector of the population

that is above the critical housing capital level, and thus reduces the absolute number of families living in a deficit situation. Similarly, an increase in investment funds ( $m$ ) or family wealth ( $w$ ) reduces the housing deficit in both

absolute and relative terms, whereas faster demographic growth increases it.

$$D_i = f(s_i, w_i, m_i, n_i), \quad f'_s < 0, f'_w < 0, f'_m < 0, f'_n > 0 \quad (31)$$

## IV

### Effect of the subsidy on housing credit

This section uses an econometric model to examine the determinants of credit in Chile and the role played by subsidies in that process. The empirical analysis is based on data from the 2009 CASEN survey, undertaken by the Ministry of Social Development (formerly the Ministry of Planning and Cooperation – MIDEPLAN). The survey interviewed 84,946 families. The monetary variables were standardized in dollars adjusted to purchasing power parity in Chile at 2009 prices.<sup>17</sup>

A logistic regression model was used to identify the factors that determine the probability of obtaining credit. Access to credit ( $c$ ) is a variable with a binary distribution, which indicates whether the family obtained the property using credit ( $c=1$ ) or not ( $c=0$ ). The estimated function is described through equation (32):

$$\begin{aligned} P(c = 1 | X) &= G(\beta_0 + \beta_1 x_1 + \dots + \beta_k x_k) \\ &= G(\beta_0 + X\beta) \end{aligned} \quad (32)$$

where  $G(z)$  is a logistic function that takes values between zero (0) and one (1) for all real numbers  $z$ , such that:

$$G(z) = \frac{\exp(z)}{1 + \exp(z)} = \Lambda(z) \quad 18$$

The set of variables that affect the probability of a family having access to credit ( $X$ ) includes: its access to subsidy programmes; its monthly family income; the number of family members; the age of the head of the family; his or her level of schooling; the location

of the home in rural or urban zones; regional units, and a dummy time variable (representing the financing regime) to distinguish homes acquired after 1976, the year in which the Chilean housing financing system was reformed.

The regression results are reported in detail in table 3.<sup>19</sup> The coefficients of income, access to subsidy, financing regime and schooling of the head of the household are all positive and significant; in other words as those variables increase, the probability of obtaining credit also rises. The coefficient on the subsidy variable is on the order of three, which means that if the family receives a subsidy, its chances of obtaining credit improve considerably. The financing regime variable displayed a positive and significant coefficient: after 1976, the chances of obtaining credit for own-home purchase are almost 20 percentage points higher than in the previous period. This reflects the effect of the policies promoted in that period, which restored the conditions of real-estate credit in Chile.

The empirical model described above corroborates the idea that access to the subsidy improves the chances of gaining access to credit. The subsidy thus supplements the income of poor families and reduces the banks' credit risk, allowing both the demand for and the supply of credit to expand. Nonetheless, the model's major shortcoming is the absence of other control variables for the supply of credit in the Chilean real-estate market. The CASEN survey that was analysed encompasses homes acquired between 1930 and 2009, in other words those purchased with and without credit under a very different macroeconomic conditions and credit regimes (see section II).

<sup>17</sup> The conversion factor was taken from *World Development Indicators* (online), World Bank.

<sup>18</sup> This is the cumulative distribution function of a standard logistic random variable.

<sup>19</sup> As the CASEN is a sample-based survey, each observation has a weight attributed to it by the sample selection process. The regression used the observations weighted by their respective sample weights.

TABLE 3

## Chile: logistic regression of access to credit

	Coefficient	Standard deviation	z	P> z	Confidence interval (95%)	
					Lower	Upper
Monthly income of the family (ln)	0.3442	0.00144	239.86	0.0000	0.3414	0.3471
Access to the subsidy	2.8449	0.00311	915.50	0.0000	2.8389	2.8510
Financing regime	0.1966	0.00365	53.91	0.0000	0.1894	0.2037
Number of persons	-0.0538	0.00077	-69.50	0.0000	-0.0553	-0.0522
Age of head of family	-0.0016	0.00010	-15.74	0.0000	-0.0018	-0.0014
Schooling of head of family	0.0965	0.00038	254.18	0.0000	0.0958	0.0973
Urban area (0 or 1)	1.1454	0.00495	-231.24	0.0000	-1.1551	-1.1357
Region						
I Tarapacá	0.6749	0.01654	40.80	0.0000	0.6424	0.7073
II Antofagasta	0.2965	0.01640	18.08	0.0000	0.2643	0.3286
III Atacama	0.9405	0.01819	51.71	0.0000	0.9049	0.9762
IV Coquimbo	1.0538	0.01556	67.74	0.0000	1.0233	1.0843
V Valparaíso	0.8854	0.01476	59.97	0.0000	0.8565	0.9144
VI Libertador O'Higgins	0.9905	0.01546	64.08	0.0000	0.9602	1.0208
VII Maule	0.5674	0.01523	37.25	0.0000	0.5376	0.5973
VIII Bío Bío	0.7269	0.01470	49.44	0.0000	0.6981	0.7557
IX La Araucanía	0.5393	0.01541	35.00	0.0000	0.5091	0.5695
X Los Lagos	0.7141	0.01511	47.27	0.0000	0.6845	0.7437
XI Aysén	0.4735	0.02293	20.65	0.0000	0.4285	0.5184
XIII Metropolitan Region	1.2471	0.01433	87.03	0.0000	1.2190	1.2752
Constant	-6.4961	0.01945	-216.18	0.0000	-4.2434	-4.1671

Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey (CASEN).

Note: No. of weighted observations = 3,553,491.

Degree of fit: -2 log of maximum likelihood = 3,340,059.

Degree of fit (pseudo R<sup>2</sup>) = 32.04%.

As noted in the theoretical model, macroeconomic conditions affect the supply of funds for real-estate credit; and the value of the down-payment (related to prior saving) affects the relation between the size of the mortgage and the amount of the loan, with repercussions on the return to the banks and their willingness to lend. Owing to the restructuring of the credit system, reform of the pension system, and continuing expansion of banking services that occurred during the period under analysis, the supply of funds in the Chilean economy and prior family saving both grew considerably in those years. The proportion of families using credit to buy homes also increased. Figure 6 clearly shows the rising trend of that proportion and distinguishes three historical levels, which can be associated with the credit regimes described in section II of this article: up to 1959, between 1959 and 1976, and after 1976.

In this context, it is reasonable to ask whether the omission of those factors has a decisive effect on the estimation of the influence of access to the subsidy on access to credit. As there is no way of distinguishing

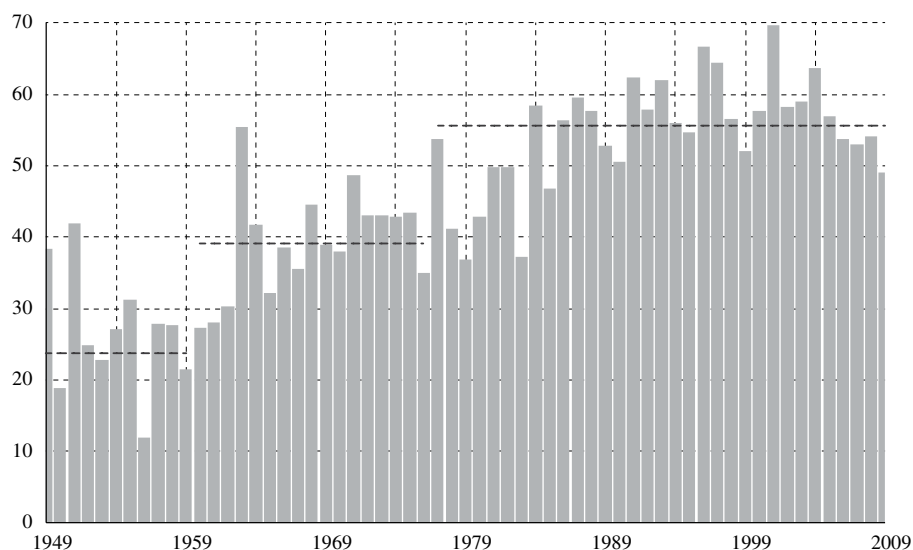
credit supply conditions between the individuals in the sample, they are assumed to vary very little through time. One way of capturing the influence of those conditions on the chances of access is to include dummy variables in the logistic regression to indicate the year in which the property was purchased. The set of dummy variables informs the conditions of credit supply, thereby balancing the model's set of explanatory variables.<sup>20</sup> The new calculations are shown in table 4.<sup>21</sup>

<sup>20</sup> This reasoning implies that macroeconomic conditions and the aggregate volume of prior family saving in a given year affects the chances of obtaining credit for all families that acquired their homes in that year, in the same way and with the same intensity.

<sup>21</sup> The set of dummy variables that express the year of purchase is significant according to the maximum likelihood test (LR). The calculated value of the LR statistic is 87,600, way above the critical value for any conventional significance level. Accordingly, the null hypothesis that the coefficients on the dummy variables representing the year of home purchase are not significant, is rejected. The value of the estimated coefficients captures the rising trend of the chances of obtaining credit, as illustrated in figure 6.

FIGURE 6

**Chile: proportion of homes acquired with credit, 1949-2009**  
(Percentages)



Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey (CASEN).

TABLE 4

**Chile: logistic regression of access to credit, with dummy variables  
for year of purchase**

	Coefficient	Standard deviation	z	P> z	Confidence interval (95%)	
					Lower	Upper
Monthly income of the family (ln)	0.3156	0.00143	221.20	0.0000	0.3128	0.3184
Access to the subsidy	2.8449	0.00311	915.50	0.0000	2.8389	2.8510
Number of persons	-0.0352	0.00077	-45.52	0.0000	-0.0367	-0.0337
Age of head of family	0.0016	0.00011	15.10	0.0000	0.0014	0.0018
Schooling of head of family	0.0968	0.00038	256.51	0.0000	0.0960	0.0975
Urban area (0 or 1)	1.1993	0.00496	241.57	0.0000	1.1895	1.2090
Region						
I Tarapacá	0.7667	0.01663	46.11	0.0000	0.7341	0.7992
II Antofagasta	0.4507	0.01652	27.28	0.0000	0.4183	0.4831
III Atacama	1.0398	0.01817	57.22	0.0000	1.0042	1.0755
IV Coquimbo	1.1121	0.01576	70.54	0.0000	1.0812	1.1430
V Valparaíso	0.9690	0.01498	64.67	0.0000	0.9396	0.9984
VI Libertador O'Higgins	1.1386	0.01564	72.78	0.0000	1.1080	1.1693
VII Maule	0.6774	0.01544	43.88	0.0000	0.6471	0.7077
VIII Bío Bío	0.8243	0.01491	55.28	0.0000	0.7951	0.8535
IX La Araucanía	0.6300	0.01559	40.41	0.0000	0.5994	0.6605
X Los Lagos	0.8000	0.01530	52.29	0.0000	0.7700	0.8300
XI Aysén	0.6129	0.02269	27.01	0.0000	0.5684	0.6574
XIII Metropolitan Region	1.3805	0.01455	94.85	0.0000	1.3520	1.4090
Constant	-5.7599	0.26354	-21.86	0.0000	-6.2764	-5.2434

Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey (CASEN).

Note: No. of weighted observations = 3,553,491.

Degree of fit: -2 log of maximum likelihood = 3,427,659.4.

Degree of fit (pseudo R<sup>2</sup>) = 33.43%.

The results shown in table 4 reinforce those reported in table 3, because the coefficient that relates access to the subsidy to access to credit has the same sign and magnitude. The same can be said of the coefficients on the other explanatory variables, except for that relating the age of the head of family to access to credit. This coefficient changes sign, from negative to positive, thereby suggesting that the older the head of the family, the greater the chances of obtaining credit, which makes

more economic sense. The correction of the coefficient reflects the fact that there is a naturally positive correlation between the year of purchase of the home and the age of the head of the family, which, if not controlled for, biases the coefficient on that variable. Consequently, the macroeconomic and institutional conditions that affect the supply of credit help not only to explain the chances of obtaining credit, but also to correct the model's calculations.

## V

### Subsidies, credit and housing deficit in Chile

This section analyses the housing deficit in Chile. After defining the methodology used in this article to measure the deficit and analysing its recent trend, the section investigates the factors that are decisive for the housing deficit, highlighting the role of the subsidies and real-estate credit.

#### 1. Housing deficit

The Chilean housing deficit can be measured in several different ways. Simian (2010) mentions the three main methodologies: that used by the Ministry of Housing and Urban Affairs (MINVU); the methodology used by the Chilean Chamber of Construction; and that used by the Libertad y Desarrollo think tank. These differ conceptually, and the numerical calculations vary considerably from one to another.

Arriagada (2005) analyses the methods used to measure the housing deficit in Latin American countries, and identifies two concepts that are present in nearly all methodologies: Homes made from precarious materials and squatter households, in which more than one family shares a home, are classified as housing-deficit situations; in other words there is a need for immediate relocation and an increase in the number of homes.

This article uses a methodology based on Szalachman (2000) to estimate the housing deficit in Chile. This methodology is less restrictive and brings together the elements that are common to most of studies in this field. While allowing for comparisons with other countries, this methodology does not use income criteria to select

deficit families, which makes it possible to use income in the explanatory models of the housing deficit. Box 1 sets out the concepts used to estimate the housing deficit in Chile, which is analysed in the dimensions "Precarious housing" and "Cohabitation".<sup>22</sup>

Table 5 shows the trend in the number of families in the two dimensions of housing deficit between 1996 and 2009. Firstly, the number of families living in precarious housing dropped sharply from 148,000 in 1996 to 67,000 in 2009, representing a 5.9% decrease per year between 1996 and 2009. The downward trend seems to be related to the systematic increase in housing subsidies and credit in the decades of 1990 and 2000.

Over the 13-year period, the number of families sharing a home with another family grew by 2.2% per year. In addition to displaying a trend that differs from that of precariousness, this sector represents between 16% and 19% of all Chilean families. This means that, over those years, family cohabitation continued to increase until 2006, despite the growth of subsidies and credit for families.

<sup>22</sup> The concept of precarious housing used in this article did not take account of conditions outside the home, such as the existence of sewerage services, access to water, garbage collection and urban infrastructure. Those characteristics were not included in the analysis because the investment to construct such networks and services is not a matter of individual decision or a decision by the real-estate credit market. These are public services for which installation and operation is subject to other types of credit constraint and other decision processes. Those issues, which are highly important for the housing and urban context, require different treatment to that used in this article.

BOX 1

**Concepts used to estimate the housing deficit**

Components	Specification
Precariousness	Families who live in homes included in at least one of the three following categories: <ul style="list-style-type: none"> <li>(i) Improvised housing                      Locations and properties not intended for residential use which serve as alternative housing (commercial properties, under bridges and viaducts, the shells of abandoned vehicles, boats, caves, among others)</li> <li>(ii) Rustic homes                              Those that do not have brick wall wooden walls</li> <li>(iii) Rented or donated homes              Correspond to housing in rented or donated homes</li> </ul>
Cohabitation	Families who live in another family's home

*Source:* prepared by the authors on the basis of Camilo Arriagada, "El déficit habitacional en Brasil y México y sus dos megaciudades globales: Estudio con los censos de 1990 y 2000", *Población y Desarrollo series*, No. 62 (LC/L.2433-P), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), 2005. United Nations publication, Sales No. S.05.II.G.179.

TABLE 5

**Chile: number of families in a housing-deficit situation, 1996 to 2009**

Year	Precarious housing	Family cohabitation	Total families	Relative deficit ( <i>percentages</i> )	
				Precarious housing	Family cohabitation
1996	147 915	711 172	4 334 620	3.41	16.41
1998	164 615	745 667	4 522 690	3.64	16.49
2000	166 608	822 220	4 723 832	3.53	17.41
2003	116 835	898 422	5 028 826	2.32	17.87
2006	78 717	975 828	5 312 894	1.48	18.37
2009	66 859	941 377	5 626 867	1.19	16.73
Variation ( <i>percentages</i> ) <sup>a</sup>	-5.90	2.20	2.00	-2.22	0.32

*Source:* prepared by the authors on the basis of the National Socioeconomic Survey (CASEN) (various years).

<sup>a</sup> In the case of the relative deficit, this is measured as the percentage-point difference between 1996 and 2009.

According to Housing Minister Patricia Poblete Bennett,<sup>23</sup> many Chilean families live with their relatives because they lack conditions to maintain a home of their own. Those families should not even be considered in the housing deficit, because the construction of a home would not resolve the problem. Data obtained by the 2009 CASEN confirm that phenomenon. Of the over 941,000 families living in the residency of other families, 577,000 (61.3%) cite economic reasons for cohabitation. On the other hand, about 20% of families in that situation cite

motives of family tradition or preference for shared housing. The same survey notes that a minority (42.2%) of cohabiting families had plans to build their own home in the next few years.<sup>24</sup>

## 2. Factors determining the deficit

The empirical analysis developed in this section also uses the database of the 2009 CASEN survey. As in the analysis of the relation between credit and subsidy, the

<sup>23</sup> The opinions of Patricia Poblete Bennett, Minister of Housing and Urban Affairs of Chile, in the administration of President Michelle Bachelet, were taken from Magnabosco (2011) – Annex 2.5.

<sup>24</sup> The methodology used to calculate the housing deficit in Brazil, which was developed by the João Pinheiro Foundation, does not count families that do not intend to build a home of their own.



family-income variable was standardized in dollars, adjusted for purchasing power parity in Chile, at 2009 prices.

The dependent variables of the logistic regression models used to identify the determinants of the deficit are membership of the group living in precarious housing (0 no; 1 yes), and membership of the group living in a situation of cohabitation (0 no; 1 yes). The estimated equations are specified in expression (32) of the previous section, and the distributions depend on the variables that indicate whether the families have access to the subsidy programmes and credit and, also, monthly family income. The set of control variables includes the number of family members, the age of the head of the family, his or her level of schooling, the location of the home in rural or urban zones, and regional units. Tables 6 and 7 report the results of the logistic regressions to determine the probability of being in a housing-deficit situation owing to precariousness and cohabitation.

The results shown in table 6 are highly significant. The coefficients on income, access to credit and access to the subsidy are negative. As family income rises, the likelihood of being subject to a housing deficit on the grounds of precariousness declines. Access to credit and the subsidy also considerably reduce the probability of a family living in precarious housing; as do the number of family members, and the age and schooling of family heads. The spatial variables indicate that housing deficit is less prevalent in urban areas and in the southern regions of the country. In contrast, the regions in which families are most likely to live in precarious housing are Antofagasta and Atacama.

The results reported in table 7 on the probability of belonging to the group of cohabiting families are even more significant. The coefficients on income and access to the subsidy are negative, which indicates that access to the subsidy and higher family income reduce the chances

TABLE 6

Chile: logistic regression of membership of the group living in precarious housing

	Coefficient	Standard deviation	z	P> z	Confidence interval (95%)	
					Lower	Upper
Monthly income of the family (ln)	-0.3553	0.00362	-98.03	0.0000	-0.3624	-0.3482
Access to credit	-2.2771	0.03476	-65.52	0.0000	-2.3453	-2.2090
Access to the subsidy	-1.5298	0.02546	-60.09	0.0000	-1.5797	-1.4799
Number of persons	-0.4027	0.00271	-148.68	0.0000	-0.4080	-0.3973
Age of head of family	-0.0396	0.00028	-141.53	0.0000	-0.0402	-0.0391
Schooling of head of family	-0.1146	0.00111	-102.94	0.0000	-0.1168	-0.1124
Urban area (0 or 1)	-0.3799	0.01095	34.68	0.0000	0.3584	0.4013
Region						
I Tarapacá	1.7048	0.30313	12.41	0.0000	3.1692	4.3574
II Antofagasta	3.0099	0.30207	16.78	0.0000	4.4764	5.6605
III Atacama	2.8765	0.30242	16.32	0.0000	4.3423	5.5278
IV Coquimbo	2.1969	0.30213	14.08	0.0000	3.6633	4.8476
V Valparaíso	1.9148	0.30190	13.16	0.0000	3.3816	4.5651
VI Libertador O'Higgins	2.1299	0.30200	13.87	0.0000	3.5965	4.7804
VII Maule	1.3610	0.30222	11.31	0.0000	2.8272	4.0119
VIII Bío Bío	1.7982	0.30185	12.78	0.0000	3.2651	4.4483
IX La Araucanía	1.4872	0.30218	11.73	0.0000	2.9534	4.1380
X Los Lagos	1.5587	0.30203	11.98	0.0000	3.0253	4.2092
XI Aysén	-2.0585	0.32746	6.29	0.0000	1.4167	2.7003
XIII Metropolitan Region	2.2047	0.30170	14.13	0.0000	3.6719	4.8546
Constant	0.8941	0.30328	-6.34	0.0000	-2.5185	-1.3297

Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey (CASEN).

Note: No. of weighted observations = 5,431,713.

Degree of fit: -2 log of maximum likelihood = 593,702.

Degree of fit (pseudo R<sup>2</sup>) = 15.89%.

of belonging to the cohabiting group. Access to credit, in contrast, increases the likelihood that a family shares housing with another family. The number of people in the family and the level of schooling of family heads have a positive effect on that probability, indicating that cohabitation is more frequent among larger families whose head has a higher education level. The age of the head of the family has a negative coefficient, indicating that cohabitation is more frequent in families headed by young people. The spatial variables show that housing deficit is more frequent in urban areas and in the country's most heavily populated regions: the Metropolitan Region of Santiago and the Libertador Bdo. O'Higgins region.

Special attention should be paid to the positive coefficient relating access to credit to the likelihood of cohabitation, since those two variables could be reflecting other aspects of the behaviour of Chilean families that are not considered in the theoretical model

of the real-estate market developed in this article. Apart from cohabitation for reasons of preference and family tradition, some families have an economic strategy of sharing durable consumer goods and increasing the wealth of the family group.

The strategy of sharing consumer durables can be inferred from CASEN survey data. Ownership of this type of good is much more frequent among principal families than secondary families. In 2009, for example, 91.6% of principal families had a refrigerator, compared to just to 6.9% of secondary families. This indicates reliance on the refrigerator owned by the principal family. The strategy to increase the wealth of the family group is reflected in the number of secondary families that have their own property or are paying a mortgage (287,500, or 30.5% of cohabiting families). The homes of those families are mostly rented, which increases the income flow of the family group.

TABLE 7

**Chile: logistic regression of membership of the group living in conditions of cohabitation**

	Coefficient	Standard deviation	z	P> z	Confidence interval (95%)	
					Lower	Upper
Monthly income of the family (ln)	-0.9295	0.00180	-517.23	0.0000	-0.9330	-0.9259
Access to credit	0.0751	0.00480	15.66	0.0000	0.0657	0.0845
Access to the subsidy	-0.0464	0.00480	-9.67	0.0000	-0.0558	-0.0370
Number of persons	0.6503	0.00096	680.00	0.0000	0.6484	0.6522
Age of head of family	-0.0732	0.00014	-527.73	0.0000	-0.0735	-0.0730
Schooling of head of family	0.1121	0.00053	212.57	0.0000	0.1111	0.1131
Urban area (0 or 1)	0.0954	0.00545	-17.53	0.0000	-0.1061	-0.0848
Region						
I Tarapacá	0.5279	0.02090	2.14	0.0320	0.0039	0.0858
II Antofagasta	0.7758	0.02052	14.26	0.0000	0.2525	0.3329
III Atacama	0.2476	0.02291	-10.28	0.0000	-0.2804	-0.1906
IV Coquimbo	0.4963	0.02053	0.64	0.5190	-0.0270	0.0535
V Valparaíso	0.5857	0.01951	5.26	0.0000	0.0644	0.1408
VI Libertador O'Higgins	0.8367	0.02011	17.59	0.0000	0.3142	0.3930
VII Maule	0.4005	0.02019	-4.09	0.0000	-0.1222	-0.0430
VIII Bío Bío	0.4868	0.01945	0.19	0.8490	-0.0344	0.0418
IX La Araucanía	-0.0545	0.02052	-26.20	0.0000	-0.5778	-0.4974
X Los Lagos	0.4856	0.01988	0.13	0.9000	-0.0365	0.0415
XI Aysén	0.4831	0.03284	-14.71	0.0000	-0.5474	-0.4187
XIII Metropolitan Region	0.8278	0.01905	18.10	0.0000	0.3074	0.3821
Constant	2.7273	0.02384	142.65	0.0000	3.3545	3.4480

Source: prepared by the authors on the basis of the 2009 National Socioeconomic Survey (CASEN).

Note: No. of weighted observations = 5,431,713.

Degree of fit: -2 log of maximum likelihood = 2,675,684.

Degree of fit (pseudo R<sup>2</sup>) = 40.85%.

# VI

## Final thoughts

This article has analysed housing policy in Chile, where far-reaching reforms were implemented in the housing finance system in the mid-1970s; and it highlights the strategy of combining credit with a subsidy in real-estate financing. That policy achieved positive results in combating the housing deficit, particularly in reducing the number of precarious homes, and it became a reference in this field for Latin America. Beyond individual government programmes, Chilean housing policy has gained the status of a state policy, maintained across several government administrations with different ideological tendencies.

Based on the financing system in Chile, in which the property is purchased using resources based on prior saving, credit and subsidy, a theoretical model was developed to analyse the influence of the housing subsidies policy on the credit market and on the real-estate market. The granting of subsidies for home purchase increases the return on bank loans and expands the supply of credit. The subsidy also boosts the demand for loans. An increase in subsidies and the expansion of the supply of credit change the equilibrium in the real-estate market, resulting in an increase in housing capital per family and a reduction in property prices, with repercussions on the housing deficit.

Those theoretical relations guided the econometric analyses undertaken in the following sections, the results of which results for Chile corroborate the theoretical proposals formulated in the article. The most important new theoretical results were not refuted by the data: (i) access to the subsidy has a decisive influence on the granting of credit, directly increasing a family's chances of obtaining credit; and (ii) an increase in the amount of the subsidy reduces the number of families with housing capital below the critical level, in other words those living in housing-deficit situations.

The econometric results also help in interpreting the trend of the housing deficit in Chile between 1996 and 2009. New subsidies were granted year by year, and

the percentage of families assisted by this policy grew. Whereas in 1996, 20.9% of Chilean families had received some type of housing subsidy, by 2009 the proportion had risen to 28.2%. Credit also flowed liberally: the proportion of families with access to real-estate credit rose from 22.3% in 1996 to 31.0% in 2009. The average income of Chilean families grew from US\$1,600, in purchasing-power-parity terms, to US\$ 2,100—equivalent to 27% growth in the period analysed.

That trend of credit and subsidies, together with the growth of family incomes, led to a gradual reduction in the deficit caused by precariousness, as predicted by the theoretical model and in the econometric analysis. The trend of those variables also explains the relative persistence of families living in situations of cohabitation. In the reference period, the proportion of families with access to credit grew, and Chile became more urbanized,<sup>25</sup> factors that ended up increasing the frequency of cohabitation. Increased access to the subsidy, higher average family income, and the lower average age of heads of family apparently prevented cohabitation from increasing by even more.<sup>26</sup>

The results show that Chile's housing subsidies policy has considerable effects on the deficit, reducing precariousness and reorganizing its dimensions, with a relative increase in family cohabitation. The tests undertaken add to knowledge of the effects of housing policy, which is useful not only for analysing the Chilean real-estate market, but also for research in other Latin American countries, such as Brazil and Mexico, which adopted policies similar to those of Chile in the decade of 2000.

<sup>25</sup> In absolute terms, between 1996 and 2009, 1,167,000 new families were formed in urban areas in Chile compared to just 83,000 new families in rural areas. The proportion of families living in urban areas rose from 85.7% to 87.4% in the same period.

<sup>26</sup> The average age of heads of family rose from 45.6 years in 1996 to 49.3 in 2009.

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