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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.

Portrait of the economist as a young man: Raúl Prebisch's evolving views on the business cycle and money, 1919-1949

Esteban Pérez Caldentey and Matías Vernengo

ABSTRACT

This paper analyses Raúl Prebisch's lesser-known contributions to economic theory, related to the business cycle and heavily informed by the Argentine experience. His views of the cycle emphasize the common nature of the cycle in the centre and the periphery as one unified phenomenon. While his rejection of orthodoxy is less than complete, some elements of what would become a more Keynesian position are developed. In particular, there is a preoccupation with the management of the balance of payments and the need for capital controls as a macroeconomic management tool, well before Keynes and White's plans led to the Bretton Woods agreement. In the process it is clear that Prebisch developed several ideas that are still relevant for understanding cyclical fluctuations in the periphery and that he became more concerned with the ability to take advantage of cyclical booms to maintain sustained economic growth.

KEYWORDS Raúl Prebisch, economics, business cycles, <money, monetary policy, economic growth, Argentina

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AUTHORS Esteban Pérez Caldentey, Economic Affairs Officer, Financing for Development Division (ECLAC). esteban.perez@eclac.org
Matías Vernengo, Chief Research Officer, Central Bank of Argentina. vernengo@economics.utah.edu

I
Introduction

Raúl Prebisch (1901-1986) is mostly known for his extensive analysis and diagnosis of the development problem of Latin America, which he set out in full in *The Economic Development of Latin America and its Principal Problems* (1950), also known as the Prebisch manifesto, and in *Growth, Disequilibrium and Disparities: Interpretation of the Process of Economic Development* (1949). Another major concern, expressed in previous writings and more particularly during the period 1919-1949, was business cycle fluctuations and their relationship to money and finance. To a great extent, this concern was a direct result of his experience with the management of the Argentine economy.

Prebisch's interest in the business cycle was inspired by the frequent and severe fluctuations experienced by the Argentine economy in both the nineteenth and the twentieth centuries. While the episodes he analyses are very specific to their particular historical context, he argued that they were, for the most part, examples of a more generic type of cycle, a "boom and bust cycle." According to Prebisch, cycles were "natural," "recurrent" and inevitable facts of economic life. Moreover, he argued that the cycle phases were related (the sharpness of the contractionary phase was directly related to the excesses of the expansionary phase).

Initially, Prebisch held a monetary view of the business cycle, where financial flows played a crucial role as a triggering factor. In his analysis of the cycle he highlighted the role of expectations and speculation in ways that are reminiscent of the modern analyses of financial crises that were typical of the Cambridge and Scandinavian schools of the time.[1] Eventually, under the influence of the Great Depression he assigned a more prominent place to exports and external demand. This led him to introduce an antecedent to the Prebisch-Singer declining terms-of-trade hypothesis. At the same time, notwithstanding his disagreement with Keynes's savings-investment process in *The General Theory of Employment, Investment and Money* (1936), he provided an early development of Harrod's foreign trade multiplier, which highlighted the balance-of-payments constraint to economic growth in developing countries.[2]

A key component of his analysis of the cycle was to devise a policy to smooth out "booms" and "busts." Prebisch thought that the creation of a central bank could indeed perform this task. These views not only led him to play an instrumental role in the creation of the Central Bank of Argentina but also to introduce and recommend countercyclical economic policy actions including the undertaking of public works and infrastructure, the financing of industry, and the introduction of foreign exchange and capital controls, a discussion that preceded Keynes and White's defense of capital controls at Bretton Woods. As part of his policy recommendations and in consonance with current-day views, Prebisch also favoured international reserve accumulation as a precautionary measure to weather downturns.

Eventually, after having concentrated mainly on devising policies for mitigating economic contractions in Argentina, Prebisch's attention turned, during and following the Second World War, towards taking advantage of cycle upswings to achieve improved and sustained rates of growth. This led him to focus on the problem of economic growth in general, as he termed it, highlighting and underscoring the need to capture the domestic policy

☐ The authors are an Economic Affairs Officer at the Economic Commission for Latin America and the Caribbean (ECLAC) in Santiago, and the Chief Research Officer at the Central Bank of Argentina. The opinions here expressed are the authors' own and do not necessarily coincide with those of the institutions with which they are affiliated. The authors wish to express their gratitude to Ricardo Bielschowsky, Noemí Brenta, Benjamin Hopenhayn, Emiliano Libman, Julio López, Juan Carlos Moreno-Brid, Mario Rapoport, Osvaldo Sunkel and Anthony P. Thirlwall for their valuable comments on an earlier version. A preliminary version was presented at the Center of Economics and Finance for the Development of Argentina (CEFID-AR). All the English translations of sources in French and in Spanish, including Prebisch's works (Prebisch, 1991 and 1993) are by the authors of this paper. Throughout the text Prebisch's works are cited with the respective volume and page numbers.

[1] Hawtrey and other Cambridge economists, like Keynes, emphasized monetary shocks, in contrast to Wicksell and Schumpeter, who emphasized the role of real shocks as central for the trade cycle. Hawtrey worked at the United Kingdom Treasury but was educated at Cambridge and was seen as a peripheral member of the same school of thought. On Cambridge monetary ideas at that time, see Bridel (1987). On the role of the Scandinavian, or Swedish, school, in particular its preoccupation with expectations and macroeconomic dynamics, see Leijonhufvud (1981).

[2] This suggests, in fact, that Toye and Toye's (2003) suggestion that Singer first formulated the thought in his anonymous United Nations study in 1949 and that it was then used and quoted by Prebisch when the latter wrote his development manifesto the following year is incorrect.

space and autonomy required to isolate, as much as possible, the national economy from the fluctuations of developed countries. Central to this viewpoint was the substitution of domestic production for foreign production through the promotion of local industry.

These ideas, jointly with the recognition that the observed economic cycle was part of a single global process rather than a country-specific phenomenon, whose impulses triggered by the cyclical centre (first the United Kingdom and then the United States) were transmitted to the countries of the periphery (including Latin America), paved the way for the development of his later conceptual framework set out in the development manifesto and in *Growth, Disequilibrium and Disparities*.[3]

This paper traces, analyses and critically interprets Prebisch's evolving views on the cycle and on money and highlights their current relevance in the face of changing economic circumstances. Most of the focus is placed on the cycles prior to the Second World War. The article shows how Prebisch, starting with a very orthodox economic theory, was led by the force of events to change his ideas and adopt alternative views. It is clear that he did incorporate and develop elements of what would be Keynesian theory, adapted to the context of peripheral countries.

The paper is structured as follows. Section II presents Prebisch's categorization of the Argentine cycle and examines his thinking about the initiating factors of the cycle, the change from boom (expansionary phase) to bust (contractionary phase) conditions and the transmission mechanism in both phases. Section III centres on Prebisch's views on the foreign trade multiplier and its role in the business cycle, emphasizing the importance of monetary factors in the functioning of the multiplier. Sections IV and V analyse Prebisch's changing views on monetary policy during the cycle and, in particular, those pertaining to policy autonomy, which led to the development of his dynamic growth theory (unfinished) and the policy advice that made him famous worldwide.

[3] *The Economic Development of Latin America and its Principal Problems*, or the Prebisch manifesto, was published in 1949 as an introduction to the *1948 Economic Survey of Latin America* and also appeared in the same year in *Revista Brasileira de Economia*, No. 3, pp. 47-109 and in *El Trimestre Económico* 16(63); 347-431, July-September and in 1950, in *Revista de Ciencias Económicas*, Buenos Aires, year 38, Series III, No. 22, March-April. In 1962 it appeared in the *Boletín Económico de la América Latina*, vol. 3, No. 1, February 1962. "*Growth, Disequilibrium and Disparities: Interpretation of the Economic Development Process*" constituted the first part of the *1949 Economic Survey of Latin America*.

II

Prebisch's views on the Argentine business cycle

According to Prebisch, boom and bust cycles were a pervasive feature of Argentina's economic history. In the writings examined in this paper, covering the period from 1820 to 1944, he identified and analysed, albeit not with the same depth and detail, eight business cycles, the majority of which took place under a convertibility regime.[4] As did other economists at the time, Prebisch perceived cycles as recurrent and inevitable facts of economic life, or more precisely as "natural" economic phenomena. Cycles were by definition generic, with symmetrical and necessarily continuing upward and downward phases and independent of historical time and space. Moreover, the intensity of the bust (downward phase) was dependent on the excesses of the boom (upward phase).[5]

The regularity of their occurrence and movement, and their lack of specificity and historical contingency, held sway in Prebisch's thinking even until the start of the Great Depression (Prebisch, 1991, vol. 1, p. 618).

[4] See Cortés Conde (2001), Gurrieri (2001), Mallorquín (2006; 2007) and O'Connell (2001) for different analyses of Prebisch's thinking on business cycles and monetary issues. According to our analysis, Prebisch's cycles include 1820 to 1826; 1867 to 1880; 1881 to 1885; 1886 to 1891; 1899 (1903) to 1914; 1927 to 1933; 1935 to 1937; and 1939-1944. See Pérez Caldentey and Vernengo (2011) for a fuller treatment.

[5] This view is made explicit in Pareto (1896-1897), with which Prebisch was familiar (Fernández López, 2002). Pareto (1896-1897) also believed that the term "crisis" should apply to both the boom and the bust (expansion and contraction), that is to the complete cycle; Prebisch was in agreement (1991, vol. 1, p. 118, note 54).

Cycles, their phases and their turning points were mainly driven by external factors including the conditions in international liquidity and financial markets. While throughout his writings he presents examples of the effects of internal monetary expansion on the economy, he did not believe that the cycle was generated by domestic factors. As he put it (Prebisch, 1991, vol. 3): "I have not observed, neither in the cycles I have seen closely nor in those that I have studied in our history, the existence of domestic elements with the sufficient force to promote, by itself, our wave motion."

Up until the time of the Great Depression, Prebisch gave predominance to "changes in the flow of money" as the main cause of business cycle fluctuations. At first he placed the emphasis on financial flows, determined on the demand side by Argentina's financing needs and on the supply side by the liquidity stance of developed countries (the United Kingdom and the United States), as the triggering factor leading to a subsequent expansion of liquidity, prices and the improvement in business outlook and conditions. In so doing, he underscored what he termed to be the "subjective factors" of the cycle, such as speculation, business expectations, euphoria and contagion, as important factors in maintaining the momentum of the boom (expansionary phase) very much in line with a Kindleberger and Aliber (1991) type explanation "*avant la lettre*."[6]

During this time, Prebisch tenaciously held on to a monetary theory of the trade cycle throughout his writings, conceptually articulated around the quantity theory of money and the circulation velocity of money. These concepts were, in fact, also used to explain the cycle in the more developed countries. In this regard, besides the influence of Argentine figures such as Norberto Piñero and Juan B. Justo, or Luis Roque Gondra, Prebisch's cycle analysis bore the visible and obvious stamp of Irving Fisher, Ralph Hawtrey, Frank Taussig, Vilfredo Pareto and Clément Juglar.[7]

Prebisch came to the realization that, besides monetary and financial flows, changes in the conditions that affected export performance could also act as initiating factors of the economic cycle. But he introduced export performance as a triggering cause of economic fluctuations in the cycle as he became aware that agricultural prices had been trending down since the middle of the 1920s and that the Great Depression sharply aggravated this contraction.

Available data presented by Prebisch for 1900-1933 shows that the agricultural price trend rose between 1900 and 1925 (5% yearly average) and thereafter declined (falling by 7% on average between 1925 and 1933). The decline was steeper following the start of the Great Depression. In fact, Prebisch argued that the contraction was so sharp that around 1933 the agricultural price index reached levels that it had not witnessed since the nineteenth century. The comparison with the situation in industrialized countries whose manufacturing export prices had not decreased and in some cases had actually risen inevitably led to terms-of-trade considerations (Prebisch, 1991, vol. 2, pp. 188-191), most likely providing an antecedent to the Prebisch-Singer hypothesis more concerned with the cyclical terms-of-trade downturns than with the secular trend.[8]

Thus by the early 1930s the fluctuations in the economic cycle were seen as dependent on both the conditions in international monetary markets and export performance, as well as specific structural features. Prebisch explains it in the following way in an article entitled "The Economic State" (1930) (Prebisch, 1991, vol. 1, p. 634): "Recently, we referred to the predominating influence on our monetary cycle of the events in the international money market in New York, as used to happen before the war with that of London. It is now helpful to point out the consequences… for variations in foreign purchasing power."[9]

[6] Also note that at the time Prebisch distinguished between the objective and subjective elements of the cycle. Expectations were part and parcel of the explanation of the trade cycle in Cambridge (England). One year after Prebisch wrote his *Annotations of our own circulating medium* (1921), Lavington published the first edition of his trade cycle, where confidence, anticipations and contagion played an essential role.

[7] By 1921, when he wrote his *Annotations of our own circulating medium*, Prebisch was well acquainted with the North American and European economic literature on the cycle.

[8] Prebisch (1991, vol. 2, p. 191) quotes from the League of Nations (1932-1933) *World Economic Survey* and illustrates how structural features affect the export and internal performance of countries by making the point that in those years the purchasing power (terms of trade) of agricultural countries declined while that of industrialized countries increased due to a relatively greater fall in the latter's import prices compared with their export prices. Data presented for five industrialized countries (France, Germany, Switzerland, United Kingdom and United States) show that all managed to improve their terms of trade between 1929 and 1933 (by 16%, 45%, 12%, 20% and 33% respectively). By contrast, data for five agricultural countries (Argentina, Australia, Canada, Denmark and New Zealand) for 1929-1931 show a worsening of the terms of trade (by 32%, 35%, 10%, 16%, and 38%, respectively). The Prebisch-Singer hypothesis refers to a secular decline in developing countries' terms of trade with industrialized countries. The hypothesis was put forward by Prebisch and Singer independently in 1950. See Prebisch (1993, vol. 4), Singer (1950 and 1987), Palma (1987).

[9] Prebisch similarly argues (ibid. p. 201): "It is a well known fact that that the movements of our external trade constitute the decisive factor in the great changes of the Argentine economic situation. We are linked in a very straight manner with the international economy and exposed to all of its changes. When the world market increases its absorption

For Prebisch, the boom (expansionary phase) was "naturally" and unavoidably followed by a bust (downward phase). And in this sense the point of inflection from boom (expansion) to bust (contraction) was bound to occur. Moreover, the depth of the latter maintained a direct relationship with the intensity of the former. The greater the excesses of the boom (expansion) the more drastic would be the bust (contraction). At the same time, the bust (contraction) was not only unavoidable but in fact necessary to prepare the stage for the next upward phase.

Coherently with this view, until Prebisch became convinced that a central monetary authority possessed the tools to attenuate the cycle phases (see section IV on "Money, the cycle and economic policy"), he thought that attempts to avoid the contractionary phase of the cycle (and more specifically a bust) could only have temporary effects and were in fact ultimately useless in a process that was necessary to restore external equilibrium–a *sine qua non* condition for internal equilibrium. Moreover, by postponing what is viewed as a natural process, these measures are ultimately seen as artifices that tend to aggravate the required correcting forces.

For Prebisch, the turning point and triggering factor of the bust (contraction) is the same for all cycles considered, namely an unsustainable external position and, more precisely, an unsustainable current account deficit. This position is brought about by a combination of three factors or the presence of one of them: rising imports, higher debt service obligations and lower financial flows. The weight attributed to each of these factors depends on the specific cycle under consideration.

As with his analysis of the initiating factors of the cycle, Prebisch was aware of and understood the importance of external conditions in influencing the change from boom (expansion) to bust (contraction), and in particular that of international financial markets, which tended to behave procyclically.[10] After recognizing how economic structure shapes external and domestic performance, Prebisch gave paramount importance to external conditions and argued in 1944 that the Argentine cycle is a mirror of the international monetary cycle (Prebisch, 1991, vol. 3, pp. 321-322). Nonetheless, until that time he argued that the appropriate management of internal conditions, especially prudence in the conduct of economic policy during the boom (expansion), could substantially attenuate the impact of external "shocks" on domestic activity.[11]

In consonance with his understanding that the boom (expansion) and bust (contraction) are symmetric phases of the same process, Prebisch argued that the same forces pushing economic activity in the boom (expansion) would act in the opposite direction in the bust (contraction).

Initially he labelled the effects of the bust (contraction) as natural and healthy and as a cleansing of the bad elements as did some of the prominent economists of the time, such as Schumpeter (see, for example, Prebisch, 1991, vol. 2, p. 601 and footnote 13 below). As he put it in the early 1920s with regard to one of the cycles he analysed (Prebisch, 1991, vol. 1, p. 171): "With the beginning of the first outflows of metallic currency and consequently of the rarefaction of money [bills] in circulation, lack of confidence abounds and banks restrain their credit. The more imprudent the previous policy is the more intense the restriction will be". This monetary reaction is particularly harsh on speculators and those that have abused the easiness of credit conditions. Furthermore, while it affected "true and sound" businesses, these managed to weather the storm and remain in business. All in all, this was, according to Prebisch, the logical reverse, a natural and healthy reaction to a previous false and artificial prosperity.

However, by the end of the 1920s he eventually came to recognize the painful and protracted effects of adjustment and deflation on economic activity.[12]

of our products…the purchasing power of the population increases immediately; first in rural production … propagating throughout our domestic economy and translating into a more active demand for merchandises, both foreign and domestically made."

[10] Curiously enough, while Prebisch recognized the importance of external conditions in the initiation of the cycle he did not always attribute the same significance to their role in the bust. As an example, when analysing the factors that led to the bust (contraction) in the 1867-1876 cycle he states (Prebisch, 1991, vol. 1, pp.199-120): "A goodly part of the gold had been exported in payment of public debts, dividends of firms with foreign capital… etc.; in other words, the liabilities of the loan balance grew. It also not unsafe to say that the asset side of this balance declined due to the tension in the European monetary markets in 1873 resulting from the continental panic that began in Vienna; this tension must have made it difficult to recruit new loans in the European financial markets."

[11] In this regard he writes (Prebisch, 1991, vol. 1, p. 554): "If we had administered the increase in metallic reserves prudently, the export of gold provoked by high foreign interest rates would have caused only a mild dip in the prosperity of our commerce. But if it were employed generously in the expansion of money and credit without forestalling speculative excesses, the outflows of gold would have set off a more or less severe crisis."

[12] The negative effects of deflation were also highlighted by Silvio Gesell (1862-1930), a German economist who resided in Argentina from 1886 to 1900. Referring to the specific period of the end of the nineteenth century in Argentina, Gesell stated: "The increase in the value of money is the common cause for all the country's economic troubles" (Gesell, 1898). Keynes, in his *Tract on Monetary Reform* (1923) also pointed out the negative effects of deflation. Finally, it is to be noted that these were highlighted by the early Chicago School

This resulted to a great extent from the existence of imperfections and, in particular, contracts fixed in money terms, rigid and fixed costs such as wages and, in general, production costs. Deflation as well swelled the debt burden (Prebisch, 1991, vol. 1, pp. 59-60, also p. 135). These arguments formed the basis on which to question the benefits of "liquidation" during the downward phase of the cycle.[13]

The relationship between liquidity and prices, and economic expansion and imports in the boom (upward phase) and the bust (downward phase), was mediated not only by the capacity of the banking system to expand and contract its credit base but also by the behaviour of the circulation velocity of money and the propensity to import. The circulation velocity of money was partly driven by expectations encapsulated in what Prebisch termed "the subjective factors."

These included, in the case of the boom (expansionary phase): "The appreciation of the opportunities offered by Argentina and of the probabilities of rapid enrichment… stimulated the governing class…to contract European money…It's something subjective, the confidence that…permits and accelerates the development of an ascending phase; thanks to it [confidence], businesses expand on the basis of credit and financial fantasy takes flight" (Prebisch, 1991, vol. 1, p. 161). In the bust (downward phase) during which the contraction in credit produces the collapse of economic activity, "the resulting insecurity, depression and mistrust keep businesses stagnant until the remembrance of tragic epochs becomes blurred and reborn confidence opens the way for a new cycle" (Prebisch, 1991, vol. 1, p. 162).[14]

As Prebisch became more concerned with the balance of trade and, more precisely, exports as an initiating factor of the cycle, the analysis of the transmission mechanism focused in more detail on the linkage and pass-through between economic performance and exports and imports. He argued that exports and imports "vary correlatively," that is, a persistent upwards/downward movement in either imports (exports) tends to be accompanied by a movement in the same direction of exports (imports). Credit conditions, the circulation velocity of money and the propensity to import determined the pass-through (Prebisch, 1991, vol. 3, pp. 336-343).

of Economics in terms similar to those of Prebisch at this stage of his thinking (that is in terms of nominal price and wage rigidities) and became the basis for recommending reflationary policies (e.g. Simons, 1934).

[13] See also "Scholastic Inflation and Argentinean Currency" (Prebisch, 1991, vols. 2 and 3, pp. 336-350). "Liquidation" was one the phases of the cycle identified by Juglar (1860) that became associated with the Austrian business cycle theory (see, for example, Schumpeter, 1989; Hayek, 1933) and with passive policies adopted by the Federal Reserve and the Herbert Hoover administration that deepened the Great Depression (see White, 2010 for a contrary opinion). Eichengreen (1999) defines it as "liquidationism, according to which business cycle downturns served the Darwinian function of weeding out the weak enterprises least well adapted to a dynamic economy." As can be seen, Prebisch understood liquidation and its effect in a very modern sense.

[14] Again it is to be noted that Prebisch's depiction bears resemblance to Kindleberger's (1978) cycle of manias and panics that is triggered by "procyclical changes in the supply of credit" leading to a boom (expansion) and a process of euphoria, overtrading, and speculation (manias). Eventually, there follows a period of financial distress, revulsion, panic and crash. Both Prebisch and Kindleberger emphasize the recurring character of manias and panics.

III

The coefficient of expansion and the foreign trade multiplier

Prebisch developed his analysis of the pass-through between export receipts, domestic activity and imports by introducing a concept (*circa* 1935) termed the "coefficient of expansion" (Prebisch, 1991, vol. 3, pp. 249-298; 301-310; 335-342; 349-370) or, in better known terms, as the foreign trade multiplier.[15] According to Prebisch, the coefficient of expansion measured the intensity with which an increment in incomes, resulting from a given increase in exports or financial flows, produces an expansion of greater amplitude in domestic economic activity. His analysis of the foreign trade multiplier was a static one, an explanation of a change from one position of equilibrium to another.

Beginning with a position of full equilibrium, he explains the workings of a one-time increase in exports in the following way (Prebisch, vol. 3, p. 250):

> "If for example, the volume of Argentine exports increases–either due to an increase in exports or to a rise in prices–the agricultural sector will receive correlatively higher incomes allowing it to increase its demand for goods and services produced by other sectors and also for imported goods. There will be higher demand for industrial goods, more commerce activity and in transportation, greater utilization of professional services and greater imports. At the same time, these sectors, which will have received more income, will increase their demand for goods and services produced within the same sector and in other sectors; in this way the influence or effect of the initial growth in agricultural sector income thanks to rising exports will successively expand."

Eventually the system will return to equilibrium when the rise in domestic incomes brought about by the expansion in exports leaks out through a greater volume of imports and other payments to the rest of the world.

In the examples provided by Prebisch, incomes are fully spent domestically or externally through imports. As a result, the marginal propensity to save (s) is ultimately equal to zero and the effect of a change of exports (X) on expenditure (Y) is reduced to the inverse of the marginal propensity to import (m) or to the foreign trade multiplier. Hence, the increase in income is thus determined by the rise in exports times the foreign trade multiplier. Formally,

$$k = 1/(1-c+m) \Leftrightarrow k = 1/(s+m) \text{ with } s = 1-c; \quad \text{given } s = 0 \Rightarrow k = 1/m \tag{1}$$

Where,

k = multiplier.
c = marginal propensity to consume.

The use of equation (1) to determine the increase in income brought about by an autonomous change in exports yields,

$$\Delta Y = 1/m\ \Delta X \Leftrightarrow (\Delta Y/\Delta X) = 1/m \tag{2}$$

Besides the import propensity to consume, Prebisch identified the circulation velocity of money ("the number of times money changes hands") as the other limiting factor to the potency of the "coefficient of expansion." This led him to distinguish his "coefficient of expansion" from Keynes's "multiplier" as set out in Keynes's General Theory.[16]

Prebisch saw the multiplier effect as being explained by Keynes only for a closed economy with marginal references to the import propensity, with no reference to the circulation velocity of money, and limited mainly in its effects by the savings propensity, "which constrains the expansion of economic activity and conspires against the full employment of resources" (Prebisch, 1991, vol. 3, p. 359). Moreover, Prebisch also criticized the multiplier and the associated savings-investment process on the basis of their being a timeless representation of capitalist economies (Prebisch, 1993, vol. 4, p. 277) with little relevance for developing economies.[17]

[15] See also Fernández-López (1996).

[16] John Maurice Clark also emphasized the importance of monetary circulation for the working of the multiplier process (Fiorito and Vernengo, 2009).

[17] Throughout 1949 Prebisch still maintained that savings determined investment and that one of the major problems of developing economies such as Argentina was the lack of savings. See Prebisch, 1991, vol. 3, pp. 361 and 367.

In the General Theory, Keynes was mainly concerned with an entrepreneur economy and with the process of decision-making under uncertainty. In this sense the multiplier analysis appears in fact in a superficial and perhaps incomplete form (e.g. Kahn, 1984; Chick, 1997). Nonetheless, he was well aware of the effects of the propensity to import on the multiplier as illustrated by the reasoning underlying his estimate of the United Kingdom's multiplier and the comparison with that of the United States (Keynes, 1936).[18]

This follows from the fact that the propensity to import was part of the framework and, indeed, logic with which the multiplier was conceived (Kahn, 1972). Imports along with savings and "the non-transfer portion of the income of the unemployed," was considered a leakage, and leakages ensured that the multiplier could be expressed as an infinite but converging geometrical series. Accordingly, Keynes's *The Means to Prosperity* (1933), published three years prior to the General Theory, which deals with an open economy, fully incorporates the propensity to import as part of the multiplier analysis presented. Moreover, treatments of the foreign trade multiplier could be found in several authors of the time including Giblin (1930), Warming (1932), Kalecki (1933) and Harrod (1933). By 1941, roughly three years prior to Prebisch's full treatment of the export expansion coefficient, the foreign trade multiplier was a well-established concept in the literature (Haberler, 1945).

As mentioned above, besides the propensity to import, Prebisch identified the circulation velocity of money as the other key variable absent from Keynes's General Theory multiplier analysis, allowing him to draw a distinction between his approach and that of Keynes. Prior to the publication of the General Theory, J.M. Clark (1935) had made the distinction between "two approaches, one via successive cycles of income and spending by ultimate recipients of income, the other via the volume of money and its velocity of circulation. The first has been…developed by…Kahn…and J.M. Keynes; the second has, so far as I am aware, not found its way into print."

Following upon J.M. Clark's distinction, some authors have argued that the logic of the multiplier implicitly includes assumptions regarding the behaviour of the circulation velocity of money and that the analysis is incomplete without its explicit incorporation into the analysis. Haberler (1945) pointed out that to determine the secondary effects of new public expenditure, information was needed about the marginal propensity to consume and the circulation velocity of money. Machlup (1939) argued that the time element is "of great importance" to the theory of the multiplier and introduced period analysis to work out the primary and secondary effects of public works spending, where periods are seen as reciprocals of the circulation velocity of money. Prebisch seems to hold a similar view as he argues (Prebisch, 1991, vol. 3, p. 359) that following an increase in income, primary employment will expand but that this will not produce an expansion in secondary employment unless there is another round of new expenditure or unless the circulation velocity of money increases.

[18] Keynes's writings denote an important concern with the external sector; in fact, in the General Theory he argued that the lack of concern with the external position of a country was a by-product of *laissez-faire*. As he put it (Keynes, 1936, p. 339): "The weight of my criticism is directed against the inadequacy of the *theoretical* foundations of the *laissez-faire* doctrine upon which I was brought up... against the notion that the rate of interest and the volume of investment are self-adjusting at the optimum level, so that preoccupation with the balance of trade is a waste of time" (Keynes, 1936).

IV

Money, the cycle and economic policy

For the most part until 1931, the action of the government and the monetary and financial system during the upswings and downswings of the Argentine economic cycle had been procyclical. This stance was easily justifiable since the business cycle was a "natural," recurrent and predictable phenomenon with inevitable symmetrical upward and downward phases. Moreover as emphasized in an earlier section, avoiding downturns through "artificial policy measures" simply made the adjustment harsher.

The first policy reactions to the Great Depression did not constitute an exception. On the monetary front, the prevailing ideas, including those of Prebisch at the time, argued in favor of undertaking severe stabilization and adjustment measures to put the country, in spite of its contractionary effects in the short run, on a ready stand to take advantage of the inevitable upcoming recovery. On the fiscal front, a similar logic dictated the reduction of public salaries and State expenditures and the paralysis of public works (Prebisch, 1993, vol. 4, pp. 116-117).[19]

Since the cycle was bound to occur, the role of policy was limited and could at most ensure the orderly occurrence of its phases. On the one hand, policy could avoid the excesses of the boom (upward phase), including the characteristic processes of speculation and over-indebtedness, since the greater the excesses of the boom (in the upward phase) the harsher the following inevitable contraction would be. On the other hand, it could mitigate the effects of the downward phase on business conditions and real activity.[20]

A necessary condition to allow policy to play this role was the abandonment of the gold standard, which tended to aggravate the amplitude of the phases of the cycle, making it more unstable. Prebisch identified three key weaknesses of the gold standard. First, its workings required the unnecessary contraction of imports at the same time as that of internal activities. Second, the natural trend for banks was to increase their lending in the ascending phase of the cycle, helping heighten the amplitude of the boom (expansionary) phase and the contraction in the downward phase. Third, the stability of the exchange rates under a gold standard regime helped stimulate rapid silver capital inflows, aggravating the phases of the economic cycle (Prebisch, 1991, vol. 3, pp. 233-242; vol. 2, pp. 565-575; vol. 4, p.141). Linked to these criticisms was the argument that metallic currency regimes such as the Caisse de Conversion were "fair weather boards", giving an appearance of smooth functioning in good times as capital flowed in, yet requiring violent deflations in bad times when capital flowed out (Prebisch, 1991, vol. 3, p.4 and vol. 1).

The abandonment of the gold standard in Argentina in 1929 introduced the possibility of tinkering with discretionary policy measures to smooth out the fluctuations of the economic cycle. However, these measures did not have their intended consequences as they increased the instability and flimsy foundations of the current conditions. It would become obvious that managing, to the extent possible, the fluctuations of the economic cycle required a strong, central and independent monetary authority.

At first, to avoid depreciation of the currency, the government decided to export significant quantities of gold, reducing its supply and thus raising the foreign exchange price of the currency. The effect of the reduction of domestic gold supply on money supply, credit and, in general, liquidity conditions forced the introduction of the rediscount (Prebisch, 1991, vol. 3, pp. 4 and 89; 1993, vol. 4. p. 138).

The idea of using the rediscount was actually devised but not implemented in 1914 (Prebisch, 1991, vol. 1, p. 173). In April 1931 Prebisch suggested its use with the aim of restoring banks' liquidity to pursue their day-to-day operations and meet their immediate obligations, avoiding recourse to a brisk credit contraction and avoiding a financial crash. The rediscount was not created to be used to stimulate new business or expand existing ones and certainly not to spur or facilitate long-term investment (Prebisch, 1991, vol. 2, p. 2., vol. 3, p. 89 and 1993, vol. 4, pp. 118-119).

The use of the rediscount was followed by the imposition of exchange controls to allay fears of further exchange rate depreciation due to the United Kingdom's departure from the gold standard regime in October 1931(Prebisch, 1991, vol. 2, pp. 4-6). The imposition of

[19] As Under-Secretary of Finance, Prebisch implemented what he himself termed "brutal budget adjustments" including a 15% reduction in government wages. See Pollock, Kerner and Love (2002).

[20] These types of measures should be distinguished from those aimed at unnecessarily prolonging the boom (expansion). See Prebisch, 1991, vol. 1, p.123.

exchange controls lasted from October 1931 until late 1933 and fixed the value of the peso at an artificially high value. The consequences were to prolong the external imbalance and the decline in agriculture and industrial prices thus aggravating the effects of the Great Depression, including growing unemployment and expanding debt. The measures also provided the incentives for the creation of a foreign exchange black market (Prebisch, 1991, vol. 3, pp. 16-17).

Eventually, the pernicious unintended effects of these measures led to a change in the monetary stance in 1933, consisting of exchange rate devaluation coupled with the establishment of a dual exchange rate system comprising an official, market-based exchange rate (affecting the export of traditional products) and the imposition of import permits.[21]

Prebisch would later sustain that foreign exchange and import controls had been successful in helping to restore the external equilibrium in 1933. He passed a similar judgment on similar measures applied in 1937 and in the period running from 1938 to 1940, also stating that these measures provided a way to stimulate domestic industry (Prebisch, 1993, vol. 4, p. 194). This experience, coupled with the analysis of the foreign trade multiplier (see equation (2) above) probably constituted important steps leading towards his proposal of reducing the "import coefficient" as one of key pillars of his later policy proposal to achieve "general economic growth" (Prebisch, 1993, vol. 4, pp. 207-215).

Prebisch argued that the use of discretionary measures such as the rediscount (notwithstanding its lack of success) and exchange controls paved the way for the creation of the central bank, although he claims that he had seen the need to create a central monetary authority before the First World War. As he puts it (Prebisch, 1991, vol. 1, p. 7):

> "When I was at the Banco de la Nación as Director of Economic Research, I realized that the Caisse de Conversion did not work, that it worked when gold flowed into the country and ceased to work when gold flowed out of the country, and that a fundamental reform was necessary. This was before the great crisis. I began to consider the idea of creating an Argentine central bank. When the crisis came it was necessary to take emergency measures, and that convinced me even more that a central bank was necessary; that the rediscount could not be applied without first having an organization; that it was necessary to combine it with a series of other instruments; and that was the central bank."

The Central Bank of Argentina was created in 1935. The project for the bank was drafted by Prebisch himself in 1934 at the request of Minister of Finance Federico Pinedo.[22] It was conceived as an institution independent of the government ("It is not conceivable that a central bank be managed by governments")[23] permitting a more rational distribution of monetary functions and more efficient management of reserves, whose main objective was monetary stability, along conventional lines.

Prebisch thought that the central bank had a role to play in cushioning the effects of economic cycles, although he it found illusory to think that it could offset the movements of the cycle. As he put it: (Prebisch, 1991, vol. 2, p. 64) "To expect that fluctuations in the country's economic activity can be offset by the excellence of a monetary system would be to fall into the same illusion harboured by many economists in the United States with respect to the Federal Reserve, prior…to the… collapse. But it cannot be doubted that the amplitude of those movements could be cushioned by an efficiently run central bank."[24]

It is important to understand that the reason for cushioning business cycle fluctuations was not to maintain domestic output stability but rather to maintain price and currency stability. It is in this sense that the lean-against-the-wind monetary policy was, in essence, of an orthodox nature (see Prebisch, 1991, vol. 3, p. 90).

[21] From Prebisch's point of view, during this period Argentina undertook the first attempts, albeit tepid and temporary, at countercyclical policy. These consisted of sustaining the price of agricultural goods through government purchases, and the undertaking of public works. No doubt the influence of J.M. Keynes's *The Means to Prosperity*, which Prebisch had read in 1933, was paramount in the design of these measures (Prebisch, 1991, vol. 2, p. 146). In his interview with Prebisch in 1983, Julio González del Solar (Mallorquin, 2006) terms the use of the rediscount and the creation of the Commission for Foreign Exchange Control in 1931 as the first two heterodox steps in Prebisch's thinking. However, as explained above, the rediscount was an old idea and Prebisch himself considered it an orthodox instrument. He viewed exchange controls as somewhat of a departure from the mainstream doctrine (Prebisch, 1991, vol. 3, p. 89). See also, Prebisch (1984). Curiously, later on (in 1946), he claimed to be in disagreement and "abominate"' restrictions, including exchange rate controls, but justified their use on the grounds that developing countries did not possess alternative instruments to confront and mitigate the effects of the business cycle (see Prebisch, 1993, vol. 4, p. 226).

[22] He had been commended with the same task earlier (in 1931) by the then minister of finance Enrique Uriburu. See Prebisch, 1991, vol. 2, pp. 7 and 351.

[23] The independence of the central banks was seen by Prebisch as a protection against the temptation to inflate the currency due to fiscal imbalances (Prebisch, 1991,vol. 2, p. 363).

[24] See also Prebisch, 1991, p.358 for a similar statement and pp. 664-665.

This lean-against-the-wind monetary policy was reflected in one of the key objectives of the central bank as set out in Prebisch's 1934 project: to ensure an adequate level of reserve accumulation as a precautionary motive of building buffer stocks to confront export shocks and sudden capital stops. As he put it (Prebisch, 1991, vol. 2, pp. 610-111): "The ascending movements are, in general, of a limited duration. The opportunity to repair the consequences of past wrongs and accumulate reserves for difficult times, whose return it is prudent to expect, should then not be wasted."

The first article of the draft proposal for the creation of a central bank in Argentina dealing with its functions stated: "The Bank will have as an objective: (a) The concentration of sufficient reserves to moderate the consequences of fluctuations in exports and foreign capital investments on money, credit and commercial activities, in order to maintain the value of money" (Prebisch, 1991, vol. 2, p. 383).[25]

Following the creation of the central bank, the Argentine economy experienced an expansion in economic activity lasting until 1937. During this time the central bank, in line with the orthodox spirit of its creation, used open-market operations, interventions in the foreign exchange market and moral suasion to avoid an over-expansion and overheating of the economy (see Prebisch, 1991, pp. 64 and 359, and pp. 610-622; and vol. 3, pp. 88-119).

However, the force of events prompted by the beginning of the downward phase of the cycle in 1937 led the bank to progressively evolve into a less orthodox institution whose goal became more ambitious than just "cushioning" the phases of the business cycle to ensure their orderly occurrence and maintain the stability of money. The central bank became aware that it had a double objective (real and nominal price and output stability) and that the balance of payments was central for both.

Initially, in 1937 "the central bank…was predisposed to consider this contraction of domestic economic activity as a logical and natural event, indispensable to reduce imports and establish balance of payments equilibrium" (Prebisch, 1991, vol. 3, pp. 101-102). Yet, as the contractionary effects wreaked havoc, the central bank decided to change and stabilize domestic activity. According to the 1938 Central Bank Report (Prebisch, 1991, vol. 3, p. 104):

> "… monetary policy can propose two objectives in the face of the economic cycle. The first consists of keeping the expansion of credit from heightening the intensity of the waves… The second objective goes further. It is not limited to avoiding the heightening of these fluctuations, but it also seeks to limit their amplitude and reduce the intensity of the variation of purchasing power during the cycle, in order to attenuate the consequences of such variations on the volume of domestic economic activity."

The need for countercyclical action resurfaced soon after the start of the Second World War, as Argentina was faced with a growing external imbalance and the "perception of decline in business activity and, in particular, in the construction sector" leading to a fear of general economic prostration (Prebisch, 1993, vol. 4, pp. 156-157). The plan for countercyclical action (the Plan for National Reactivation) contemplated an expansionary monetary policy coupled with exchange rate controls. More specifically, the plan sought to purchase agricultural surpluses to avoid price declines, increase construction activity and promote the financing of industrial development.

Within the logic of the plan, fiscal policy played mainly a supporting role by creating the required conditions, incentives and space for private activity to flourish. The details of the plan, which also argue for the necessity of circumscribing the intervention of the State, are reminiscent of the "crowding-out" argument highlighting how attached the Argentine authorities remained to orthodox economic thinking.

The Plan for National Reactivation was never approved. The force of political and external events, in particular the United States war effort that led to an increase in domestic demand and imports, superseded it. As put by Prebisch (Prebisch, 1993, vol. 4. p. 160): "The United States, which in 1940 had been virtually absent from the market for certain Argentine products, starts to purchase very actively. This soothes our balance-of-payments concerns, allows a more flexible distribution of foreign exchange, increases domestic purchasing power and rapidly changes the context of the situation."

The change in external conditions led to the suppression of import permits and the flexibilization of the exchange rate regime, even though a dual exchange rate remained in place. It is also important to note that in 1943 the central bank imposed capital controls to deter

[25] In his *International Currency Experience: Lessons of the Inter-war Period* (Nurske, 1944), Nurske thought highly successful the policy of neutralization, mainly international reserve accumulation, pursued by the Argentine central bank under Prebisch's direction. Triffin also entertained a similar opinion and praised non-orthodox instruments such as foreign exchange controls. Following a similar line of thought, in 1945, Prebisch helped to draft the legislation for the newly created Central Bank of Paraguay and the reform of the existing system of foreign exchange controls. See Helleiner (2009).

the inflow of short-term capital and avoid its destabilizing effects, and to stimulate foreign direct investment. While this countercyclical measure was in force for only three months, it is worthwhile to quote Prebisch at length due to its current relevance (Prebisch, 1993, vol. 4, p. 183):

> "This capital [short-term capital] went to further inflate the categories of goods or assets that were already inflated and did not translate, except on very rare occasions, into a real increase in the country's output… the measures adopted by the government allow the central bank to make an exception, to allow the inflow of this capital if it is shown that it will be used for a real increase in output".[26]

[26] In Latin America, and elsewhere, proponents of capital controls base their case precisely on the argument put forward by Prebisch, that is, the change in the composition of financial inflows from short-term to long-term investment.

V

The quest for national policy autonomy and the global economic cycle

Prebisch viewed the change in external conditions after the start of the Second World War and its effects on Argentina as a validation of his business cycle approach. The business cycle and its phases was a recurrent and natural phenomenon. The phases were related, and the more exaggerated the boom (expansionary) phase the sharper the contraction would be. The change from boom (expansionary) to bust (contractionary) conditions occurred rapidly and unpredictably, requiring flexibility in economic policy and, more important, moderation and prudence and an active policy of neutralization.[27]

While he did recommend avoiding excessive fiscal spending and lax monetary policies, and increased savings during the boom (expansion) to face and weather the inevitable contraction to follow, he argued that a country like Argentina should not be forced to forego higher growth and improved material well-being during the upward phase of the cycle, only to face the consequences of a downturn.

He ultimately recommended shielding the domestic economy from ups and downs by substituting domestic industry and production for foreign imports. This was a basis for arguing for the promotion and development of domestic industry and the expansion of internal activity.

These ideas were already embedded in his book proposal *Money and Economic Activity* on which he began working in 1943, the year in which as a result of a military coup marking the eventual ascendancy of Peronism, Prebisch lost his post in the administration, including his central bank appointment, that had been essential for the development of his ideas since the early 1930s.[28]

In *Money and Economic Activity*, Prebisch argued that monetary and financial policy should have three main aims: (i) attenuate the impact of abrupt changes in harvest conditions, fluctuations and external contingencies; (ii) create the monetary conditions that stimulate the development and maintenance of full employment of the workforce; (iii) foster and support the highest possible rate of growth of economic activity.[29]

[27] As he explains: "We are exposed, in our country, to rapid and unpredictable changes in the economic situation. We skip from gloomy pessimism, as in 1940, to the opposite …It suffices to reflect on what would have happened if the plan for construction [under the National Plan for Reactivation] had been launched and if the resulting purchasing power had been coupled with new purchasing power derived from the increase in exports: circulation would have expanded excessively, with the pernicious consequences that always follow" (1993, vol. 4, p. 160).

[28] Following his resignation from the central bank in 1943 and until his appointment to the Economic Commission for Latin America (ECLA), he remained committed to teaching and was also an international consultant. According to him, at this time he began rethinking his past experiences and developing his periphery-centre and development theories. See Pollock, Kerner and Love (2002).

[29] As explained above, Prebisch had conceived maintaining stability in the value of money as one of the main functions of the central bank. Prebisch was aware that inflation and disinflation had important economic and social costs. The fact that a low and stable rate of inflation is not included as part of the aims of monetary policy in his 1943 draft responds to the belief that the central bank should expand its objectives and also aim at full employment. Nonetheless, maintaining full employment and the highest possible rate of growth of output does inevitably lead to situations of inflation and output trade-offs. Throughout the period covered in this article, Prebisch never abandoned the orthodox belief that inflation is the product of fiscal deficits. See, for example, Prebisch, 1993, vol. 4, p. 229.

The success of these policies required an import policy and fiscal reform. The import policy consisted of "the rational modification of their composition to serve certain objectives" rather than their "systematic restrictions". Prebisch thought that a policy of autarky was as absurd as a policy of free trade and agreed that Argentina should participate to the extent possible in the international economy but avoid a "constant subordination of the national economy to external movements and contingencies." Accordingly, the country needed to "develop inwardly, strengthening its internal structure, and achieve an autonomous functioning of its economy."[30]

Prebisch's defense of national policy autonomy eventually took on a regional tone, as he became convinced that the Argentine cycle and its features were not specific to Argentina but that they were rather the manifestations and characteristics of the workings of a global process, a universal cycle. In this sense Prebisch argued, as mentioned above, that the Argentine cycle was a mirror, a reflection, of the international monetary cycle.

The global or universal cycle was triggered by developed countries and more specifically by what Prebisch termed to be the cyclical centre. The cyclical centre referred to the country (perhaps group of countries) whose repercussions due to its economic importance were transmitted to the rest of the world. In the nineteenth century and up until the First World War, the United Kingdom held the cyclical centre title, which was taken by the United States thereafter. The countries subject to the influence of the impulses of the centre–periphery included all those in Latin America. As Prebisch put it (Prebisch, 1993, vol. 4, p. 224):

> "The United States… actively fulfills the role of the main cyclical centre, not only within the continent but also throughout the world; the Latin American countries are in the periphery of the economic system….Why do I call the United States the cyclical centre? Because the magnitude and economic characteristics of this country are such that it is the source of the expansionary and contractionary impulses of the economic life of the world, particularly in the Latin American periphery, whose countries are under the influence of those impulses just as they had been before, when the United Kingdom was the main cyclical centre." [31]

The universal or global cycle was thus divided into two phases with different characteristics, one affecting the centre and the other the periphery, that is, Latin American countries.[32] The cycles in the centre and periphery were different due to their structural characteristics.[33] Moreover, since the periphery faced a binding external constraint while the centre did not, they faced markedly different restrictions in their use of domestic policy space.

Faced with a contraction of economic activity and price declines, the cyclical centre could always resort to the use of monetary instruments such as the money supply or interest rates without regard for exchange rate parity or international reserve adequacy conditions.[34] Contrarily, the periphery, bereft of the use of this privilege by the binding character of its external constraint, had to turn to the use of exchange rate variations or quantitative restrictions and controls (Prebisch, 1993, vol. 4. pp. 225-226).

Prebisch also contemplated a policy of reserve accumulation by the countries of the periphery. In fact he argued, very much in line with his earlier views, that the countries of the periphery had "the responsibility" to generate the financial resources during the upward phase of the cycle (including international reserves) so as to face and weather contractions (Prebisch, 1993, vol. 4. p. 232).

Prebisch also thought that the White and Keynes plans for a new international order had great merit in their proposal of a credit system allowing temporary alleviations of balance-of-payments imbalances. However, according to him, they failed to address the

[30] See Prebisch (1943, p. 7; and 1993, vol. 4, pp. 209-214). In line with the balance-of-payments approach he argued that a country like Argentina needed to import in order to export. Had Prebisch been aware that in his framework, formalized in part by equation (2) above, exports (X) can equal the propensity to export times the level of external demand (or income), as in McCombie and Thirlwall (1994), he could have been a step away from realizing that a policy for general economic growth could be based in part, on the reduction in the import coefficient, on an increase in the export coefficient or on a combination of both. The reduction in the import coefficient may well be conceived alternatively as in an increase in the productivity of imports. In many respects the simple numerical example presented in section III on "The coefficient of expansion and the foreign trade multiplier" prefigures the literature on the balance-of-payments constraint to growth.

[31] The centre-periphery cycle dichotomy was a historical and evolutionary concept. Not all developed countries belonged to the centre. Indeed, Prebisch asked himself whether Canada should be part of the periphery or of the centre. Also, besides a main cyclical centre, Prebisch introduced the notion of second cyclical centre–a role he attributed to the United Kingdom. See Prebisch, 1991, vol. 4, pp. 224-231.

[32] Prebisch did not develop the different phase characteristics of centre and periphery.

[33] See also Prebisch, 1991, vol. 3, pp. 319-329.

[34] This is remindful of the debate surrounding the policy of quantitative easing pursued since 2008 by the Federal Reserve Bank of the United States.

more fundamental problem of creating a balanced and equitable trading system.[35]

As he progressed in his thinking about cycles, Prebisch continued to underscore the relevance of a general cycle theory but argued that a cycle theory must converge towards a more general "dynamic theory." Prebisch understood that the growth process of a capitalist economy was that of a growth cycle and that this process encompassed the entire spectrum of economic activity. In his own words (Prebisch, 1993, vol. 4, p. 414):

> "I am more and more convinced that the cycle is the way through which a capitalist economy grows. A capitalist economy expands only in wave motion, and any disruption…can only give rise to a wave motion movement. …If the cycle is the way to grow…and if the economy moves incessantly in this manner, it would seem that all the events of the economy together, not only those of production and employment, but also those of distribution, must be integrated into a general dynamic theory."

Prebisch outlined his dynamic economic theory in 1949, but it remained at the level of a series of lecture and conference notes. Nonetheless, it included (albeit at a rough stage, apart from the centre-periphery dichotomy and the idea that the main constraint to economic expansion in the periphery was the balance of payments) the workings of technological progress in both development poles, as well as other notions and concepts that were key to justify State-led industrialization and also regional integration. These are central tenets of his manifesto *The Economic Development of Latin America and its Main Problems* and of ECLA —and later ECLAC— development thinking.

(Original: English)

[35] As he put it (Prebisch, 1943, pp. 8-9): "In spite of their great merits they [the Keynes and White plans] do not resolve the fundamental problem that depends essentially on the restoration of international trade. If the United States does not buy as much from the rest of the world as the world buys from the United States, there is no monetary system that will resist in the long run."

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Care: the missing link in economic analysis?

Corina Rodríguez Enríquez

ABSTRACT

This article sets out to synthesize the contribution of feminist economics to economic analysis by expounding, explaining and highlighting the functional role of domestic and care work. It notes the inadequacy of the treatment given to this subject over the years by the different schools of economics, before going on to set out just why this dimension is essential to an understanding of system functioning. It also deals with the conceptual, methodological and economic policy implications of incorporating this dimension of analysis, and with its relevance to the effort to carry forward an agenda that addresses the economic dimensions of gender inequity.

KEYWORDS

Economics, feminism, economic analysis, incorporation of the gender perspective, women, family welfare, unpaid work

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AUTHOR

Corina Rodríguez E., Researcher with the National Council of Scientific and Technical Research (CONICET) – Argentina, Consultant with the Gender Affairs Division of ECLAC. crodriguezenriquez@ciepp.org.ar

I
Introduction

For decades, economics has sought to explain how (in economic terms) the world works. In order that everyone might understand it, the world has been represented in stylized and simplified forms. Capitalist societies are thus understood as a system of relationships between households, firms and the State. These institutions interact to produce and distribute the goods and services people require to satisfy their needs and desires, making the best possible (or, as we economists put it, optimal) use of the resources —scarce by definition— that the planet provides.

In its zeal for constructing models, the dominant approach in economics (based mainly on elaborations of neoclassical economic theory) has tended to play down the importance of political, social and cultural dimensions in this analysis, as these are difficult to formalize with mathematical instruments, the preferred tool for conventional analysis. This risks opening up a more or less substantial gap between the representation of reality and reality itself. Economics could thus progressively lose its explanatory power and thence its relevance as a social science that is necessary for the generation of knowledge of use not only in understanding the world, but also (and perhaps most importantly) in changing it.

This situation has been identified and criticized in a variety of heterodox approaches within the discipline of economics and an effort made to produce knowledge from alternative perspectives. An example of this is feminist economics,[1] a school of thought that emphasizes the need to factor in gender relations, as an important variable in the functioning of the economy, and the different positions of men and women as economic agents and subjects of economic policies.[2]

One of the central arguments of feminist economics is that it is necessary and important for economic analysis to bring out the fundamental role played by the work that must be done to produce and reproduce people, broadly known as care work.

Why is this important? Firstly, because without care work there would be no labour force, and consequently no way of generating economic value and reproducing the economic and social system. Secondly, because, by failing to recognize this dimension, economic analysis has become lopsided and not only provides an incomplete diagnosis of system functioning, but is subject to a high likelihood of error when the real repercussions of economic policies are evaluated. Thirdly, because the way care is organized in society, i.e., the way care responsibilities are distributed between State, market and households, on the one hand, and between men and women, on the other, accounts for a substantial proportion of the inequalities that currently exist. At least two things need to be highlighted here. First, the presumption that the sexual division of care work is at the root of gender inequalities, which are manifested in this and other areas (particularly the labour market). Second, that the options for organizing care activities differ by social class, and this results in different opportunities of access to and enjoyment of welfare.

Consequently, appreciating the systemic functional role of care work supplies an essential missing link in economic analysis. Again, understanding and casting light on the social organization of care can lead to the creation of tools for the design of actions to reduce or remove inequalities, and thus to progress towards a fairer society.

The purpose of this study is to present the essential contributions made by feminist economics

[1] For a seminal work from the perspective of feminist economics, see Ferber and Nelson (1993) and its updated version, Ferber and Nelson (2003). For a survey of work done in this field from a Latin American perspective, see Esquivel (2011a). Also consult www.iaffe.org and www.gemlac.org.

[2] The concept of gender as a social category of analysis is one of the most significant theoretical contributions of contemporary feminism. It arose to explain the inequalities between men and women and the way the idea of the female and the male had developed on the basis of a mutual cultural and historical relationship. Gender is a cross-disciplinary category that refers to the psychological and sociocultural characteristics and functions attributed to each of the sexes at each point in history and in each society. Historically constructed gender relations are systems of power, with hegemonic discourses. The "problematization" of gender relationships was able to dispel the idea that they were natural. The term "gender perspective", when used to refer to the theoretical frameworks adopted to research or develop policies or programmes, means: (i) recognizing the power relationships that arise between the genders, these being generally favourable to men as a social group and discriminatory for women; (ii) acknowledging that these relationships have been socially and historically constituted and are constitutive of persons; and (iii) appreciating that they pervade the whole fabric of society and interact with other social relationships, such as those of class, ethnic origin, age, sexual preference and religion (Gamba, 2007).

as regards the inclusion of care in economic analysis. To this end, section II provides an overview of the way economics deals with the issue of care. Section III presents a proposal for including the care dimension in economic analysis. Section IV reviews the theoretical, methodological and public policy implications that arise when the issue of care and its organization in society is addressed.

II

How economics deals with care[3]

Economic theorizing about the concept of work (for the market) and its relationship with care work, essentially meaning domestic work, began with the classical economists. They identified the importance of workforce reproduction, but concentrated on the matter of the "wage goods" consumed by households, without exploring the role of domestic work in this process. This was because their interest centred on the relationship between the value of labour (its natural price) and the price of labour (wages) as set in the market. David Ricardo considered that the "natural price" of labour was given by the value of the subsistence goods consumed by workers, without which they could not participate in production processes and thus create wealth. Its level was based on the historical costs of reproduction for workers and their families, which set a minimum threshold below which wages could not fall without inducing a drop in birth rates. In developing this argument, David Ricardo ignored the contribution of domestic work to workers' and their families' reproduction process, concentrating instead on the potential conflict between the rate of return and the cost of reproduction of the workforce, as determined by the value of wage goods.

In the context of this discussion, the classical economists accepted as natural the hierarchical model of marriage and the family.[4] Thus, Adam Smith considered that the self-interest which drove people's actions in the marketplace was diluted within households, where altruism prevailed instead. He considered that society needed a sphere of social relations that was guided by moral criteria and not by criteria of efficiency. It was the household, and particularly the role of women within it, that provided the necessary counterweight to the individualism and materialism of the market. From this perspective, unpaid care work would be seen as an expression of this altruism and these moral sentiments.

When Marx developed his theory of labour value, on the other hand, he recognized as labour both that which was productive in capitalist terms (work producing commodities, i.e., goods and services, with an exchange value) and that which was socially productive (work producing goods and services with a social value).[5] However, the emphasis of Marx's analysis was on capitalist production relationships, and he therefore dealt only marginally with domestic work. In a sense, Marx took up a position similar to Ricardo's, circumventing the problem of domestic work by assuming that capitalists provided everything necessary to the reproduction of the workforce and that only consumption of commodities took place within the home (and not production or processing of these by means of domestic work and unpaid care).

Engels, on the other hand, did go quite thoroughly into the role of the family in the capitalist system. Thus, he further developed the idea, put forward in his early writings with Marx, that the main objective of the institution of the family was to ensure the transmission of private wealth down the generations.[6] In his observation, Engels argued that, within the context of the patriarchal family, the organization of households and the care given to their members (mostly by women) became a private service that did not form part of social production. Engels even went so far as to identify the strain created in this context by the growing need of capitalism to incorporate women into the workforce. What was never

[3] Here I mainly follow the reading of Gardiner (1997) found in Rodríguez Enríquez (2001).

[4] The exceptions are John Stuart Mill and Harriet Taylor, who recognized the importance of women participating in the employment market as an essential element in the democratic distribution of decision-making and responsibilities within the home.

[5] Gardiner (1997) argues that the development of Marxist theory in relation to the issue of domestic work can be traced back mainly to the first three volumes of Marx's *Capital* and to his *Theories of Surplus-Value* and to Engels' contributions in *The Condition of the Working Class in England* and *The Origin of the Family, Private Property and the State*.

[6] In this context, patriarchal control of women by men implies husbands controlling their wives' sexuality and fertility as a way of ensuring indisputable heirs (Gardiner, 1997).

questioned from this original Marxist standpoint was the sexual division of labour, nor was consideration given to the possibility of redistributing the burden of care between men and women. Indeed, the view was taken that women could only free themselves from this burden and achieve equality with men once domestic and care work had become socialized.

With the subsequent development of the marginalist school, this aspect disappeared completely from view.[7] By considering labour exclusively as a factor of production that individuals traded in the marketplace, it divorced the price of this (the wage) from any social or historical process. Because economic value was tied to the ability and desire to make this trade, any unpaid work (or work for which there was no market) ceased to be treated as an object of analysis. Also omitted was any consideration of the factors leading individuals to offer or withhold their labour in the labour market.[8]

While not considering it an object of economic study, however, Marshall recognized the importance of the domestic work done by women in the home. Thus, he argued for the importance of reinforcing the necessary altruism of women, to which end he advocated a family wage for all male workers and considered that the minimum wage required for the reproduction of the workforce should also be sufficient to support wives. His stance against the incorporation of women into the labour market is consistent with this. Pigou took much the same line in his "welfare economics", where he argued that poor women, and mothers in particular, ought to receive financial assistance from the State so that they could perform their domestic work properly without having to look for a job.

Subsequent developments in this school of thought, now consolidated as neoclassical theory and the dominant outlook in economics, sought to explain the seeming paradox of a rising labour force participation rate among married women at a time when wages (and thus household incomes) were increasing. Progress was also made in adapting market concepts to the analysis of activities within the home. The so-called new home economics synthesized this theoretical approach.[9]

From this perspective, households are deemed to be harmonious, rational and ahistorical units. In them, people make rational decisions about the distribution of their time between activities for the market (paid production work), activities for the home (unpaid domestic and care work)[10] and leisure.[11] Becker, who went closely into this aspect, considered that households acted as a unit following the rational choice model[12] and maximizing the shared utility of their members, who were subject to time and income constraints. The traditional gender division of labour within the home is considered to be a rational economic response by the household to the value the market places on the time of each of its members, something that in turn is taken to reflect individuals' productivity in the marketplace.[13]

The meeting of economics and feminism in the study of care[14]

In the realm of feminist theory, the "domestic labour debate" turned back to Marxist theory. The main point of discussion was the relationship between domestic work and capital accumulation. Two basic positions were taken. One was that domestic work subsidized capitalist production through its role in the reproduction of the labour force, thus directly increasing capitalist profits. The other refuted the idea of a subsidy, instead treating domestic work as essential to the reproduction of the labour force in societies of this type.

The first position redefined the value of the labour force as the total working time necessary for its reproduction, i.e., the time spent on care work in the home, plus the abstract time incorporated into the commodities

[7] *Principles of Economics*, published in 1890 by Alfred Marshall, is the text that is most representative of the early development of this school of thought.

[8] From this perspective, and on the assumption that all individuals are rational economic agents, the decision to offer or withhold labour in the marketplace is in fact seen as being driven by the quest for an optimal personal situation, and thus as the best possible decision (and the only one in equilibrium).

[9] Mincer (1962) and Becker (1965) wrote the founding texts of this school.

[10] This perspective revives the classical idea of self-interested and competitive behaviour in the marketplace coexisting with altruistic behaviour in the home (which is thus the preferred setting for certain types of work requiring altruism, such as care).

[11] Implicit in this theory is that men choose between work (in the marketplace) and leisure, while women choose between work in the home (and leisure) and work in the marketplace.

[12] In this connection, see in particular his text *The Economic Approach to Human Behaviour*.

[13] Thus, gender differences in employment patterns are explained as resulting from the cumulative effects of the individual and household decisions of men and women, who respond rationally to the signals given out by the market regarding their comparative advantages in the different spheres of production. Empirically, this means, for example, that if young men and women start by being equally productive in both spheres of production, gender discrimination in the labour market (which reduces women's wages below their market productivity) will mean that women take on a larger share of domestic work and men a larger share of remunerated work in the market (Gardiner, 1997).

[14] This draws on some ideas set forth in Marco Navarro and Rodríguez Enríquez (2010).

consumed. Thus, surplus value is appropriated by the capitalists, who pay male workers a wage that is less than the value of their labour.

Accordingly, the contribution made by domestic work to the production of surplus value is to keep the value of the labour force below its cost of reproduction. The mechanism for this is the retention within the home of those aspects of reproduction and maintenance of the labour force that are not profitable either for capitalist production or for the State, in the event that the latter were to take on responsibilities in this area. The future configuration of domestic work would thus appear to depend on the relationship between labour force reproduction costs, the capital accumulation process and the demand for remunerated female labour.

The perspective that treats domestic work as an indispensable element in the survival of the capitalist mode of production views it as production in itself, not of commodities this time, but of use value. Its ultimate purpose is to provide labour that can be sold. From this perspective, the main reason domestic labour survives is that capitalism requires workers who are free individuals offering their labour in the market.

The "domestic labour debate" did not explore the problem of gender relations or ask whether men might be benefiting from domestic work as well as (or rather than) capitalists. Likewise, little attention was paid to the fact that it was the combination of domestic work and paid work, rather than domestic work alone, that characterized the experience of women under capitalism. Some of these things were discussed in the "patriarchy debate".

Three perspectives can be distinguished within this line of thinking.[15] The first uses a strict definition of the patriarchal family, identifying it with households containing a head, an economically dependent female spouse, and children. Men thus have a common interest in having a woman available to serve them within the home. As women gain access to the labour market and secure other measures of social equity, men's authority within the family declines and gender segregation in jobs becomes the main way of perpetuating the economic dependence of women in the patriarchal family. In today's industrial societies, accordingly, a new agreement has arisen between patriarchy and capitalism whereby married women are wage workers and domestic workers, an agreement based on wage differentials and occupational segregation, perpetuating the economic dependency of women (Hartmann, 1981).

A second perspective in this debate argues that the term patriarchy is more appropriately reserved for situations where society is organized upon identifiably patriarchal models and where physical violence and ideology combine with economic mechanisms to produce a systematic subordination of women. Consequently, patriarchy is based on the social relationships of human reproduction, i.e., on control over women (and children) by men, and especially on control over their sexuality and fertility.[16]

The third approach is one that places the debate within a global and environmental perspective. Mies (1986), the main exponent of this approach, contends that capitalist patriarchy is a global system that subjects women. In this system, domestic work (the production of life and values in use to meet human needs) is essential for capital accumulation because it is vital to the existence of wage-paying work. The role of women as spouses is necessary both to reproduce the labour force and to reduce competition with male workers in the labour market, in addition to the fact that they become consumers.

More recently, feminist economics has made large contributions to the study of unpaid work, highlighting its gender aspects, its invisibility and its key contribution to social reproduction and the functioning of the economy. Studying the realm of what was labelled the "care economy", it has demonstrated the invalidity of many of the assumptions of conventional microeconomic models. Thus, it has argued that "instead of challenging the traditional division of labour whereby men 'specialize' in remunerated work and women in domestic work or other unpaid activities, these models take a number of (static) gender characteristics for granted —i.e., women are better cooks than men and better at childcare, while men do better in the labour market— with the aim of explaining and justifying the traditional division of labour and the inequities associated with it inside and outside the home" (Benería, 2003b, p. 41).

As noted by Esquivel (2011a, p. 2), the concept of the care economy "has the advantage of tying together the different signifiers of 'economy' —the realm of the market, money and production, where income is generated and the living conditions of the population are determined— with 'care', the private, everyday realm of feeling and affection […] the care economy

[15] There is a fourth perspective, which is the one developed by black women, mainly in the United Kingdom and the United States.

[16] The main exponents of this approach are Mackintosh (1977) and Folbre (1994). They note that it is not only men who benefit from domestic work but also future generations and society as a whole.

shifts the focus from the old emphasis on the costs of those giving care (women) to the new emphasis on the contributions made to the welfare of those receiving it (Benería, 2003b, p. 169). Since recipients of care are essentially taken to be groups of dependents (small children, older adults, the sick and disabled), the care economy overlaps with debates about social protection, which is also organized around the idea of the 'risks' to which certain population groups are subject." Thus, the care economy "emphasizes the relationship between the care given to children and older adults in the domestic realm and the characteristics and availability of both State and private-sector care services (Folbre, 2006; Himmelweit, 2007; Razavi, 2007)."

This extension of the sphere of analysis with regard to care reveals how the "feminization" of care reaches beyond the home, with the naturalization of female overrepresentation in certain remunerated care activities (in the health-care sector, education and domestic service).[17] Care thus takes on the characteristics of a public policy problem that goes beyond the strict realm of private life and its naturalization as a female concern.

In sum, the care economy, as conceptually and analytically conceived by feminist economics, seeks not only to gauge, measure and give prominence to care and incorporate the sectors providing it (including households) into economic analysis, but to articulate a position that questions the functioning of the economic system and the way this is interpreted. As pointed out by Nelson (1993 and 1996), it advocates a movement in the central focus of economic analysis away from trade and choice to provisioning, i.e., to the goods and processes necessary for human survival.

[17] Empirical analyses have shown how those working in these feminized sectors are penalized with lower wages and poorer working conditions.

III

Incorporating care into economic analysis: the expanded circular flow of income

One way of understanding how gender relations permeate the workings of the economic system is to employ the conceptualization of conventional economics and extend it to incorporate the missing dimensions. This is what is done by Picchio (2001 and 2005), who is concerned to define the process of social reproduction of the population and situate it within the dynamic of the economic system.

This concern ties in with one of the basic elements in the feminist argument, which is the need to give visibility to the gender dimensions that are manifested in the relationship between production and reproduction, whose structuring perpetuates the economic subordination of women by limiting their autonomy.

Picchio (2005) argues that the tension between producing commodities and reproducing people derives from the nature of the labour market, which represents a particular historical way of trading work for the means of subsistence, a central aspect of capitalist organization.[18] The key point here is that for the necessary endowment of the labour factor to be available, another endowment of labour is needed to carry out the social reproduction of people, and this is not taken into account in conventional economic analysis.

As already mentioned, the main contention of feminist economics in this regard is that the "sexual division of labour" —which encompasses the distribution of productive and reproductive work[19] between households, the market and the State, on the one hand, and between men and women, on the other— entails the economic subordination of women, as manifested in lower participation in paid work (and greater participation in unpaid work), a worse position in the labour market (in terms of pay and working conditions), less access

[18] Following the social theory tradition of classical economics, Picchio (1992) uses the term subsistence to mean a state of sustainable living standards. In the case of paid work, the indicator used to identify this condition is a set of commodities conventionally considered necessary for the reproduction of workers and of the working population as a "species".

[19] The idea of reproductive work employed here is equivalent to the domestic and care work mentioned earlier.

to economic resources and, in consequence of all this, a lower degree of economic autonomy.[20]

To grasp the social character of reproductive work, it is important to appreciate the historical link between the production and reproduction processes. A separation has arisen between the two in the capitalist system, and this has led to the creation of separate spheres, institutions, social organizations, norms and even cultures that distinguish paid work from unpaid reproductive work. This separation has been instrumental in concealing the links between the different types of work and the different processes (Picchio, 1992 and 1999).

To succeed in altering the analytical approach and centring it on the social reproduction process, Picchio (2005) considers it necessary to "situate the process of social reproduction of the working population in relation to the process of resource production, a central issue in the dynamic analysis of the classical economists" (Picchio, 2005, p. 23).

For this, Picchio (2001) suggests expanding the "traditional schema of the circular flow of income" by incorporating an economic space which might be termed the space of reproduction,[21] in which three economic functions undertaken within the private realm of households are distinguished. These functions, whose position in the expanded circular flow of income can be seen in figure 1, are as follows:

(i) expansion or extension of monetary income (real wages) in the form of expanded living standards (actual consumption), i.e., cooked food, clean clothes, etc.; in other words, commodities purchased with the monetary wage are included, as is the transformation of these goods and services into actual consumption through the mediation of unpaid domestic and care work;

(ii) an extension of expanded living standards (consumption) in the form of an effective welfare condition;[22] this consists in the enjoyment of specific and conventionally appropriate levels of education, health care and social life, made possible by the mediation of unpaid care work (consisting, for example, in ensuring children attend school, monitoring their health, ensuring they have recreation and stimulation, etc.);

(iii) reduction or selection of population segments and individual capabilities to be used as a factor in the commodities and services production process in the market economy. In this case, unpaid work done in the domestic realm plays a supporting role in the selection (carried out in the labour market) of the people and individual capabilities actually employed in production processes, materially and psychologically facilitating adaptation to these and absorbing the strains they generate.

The expanded circular flow of income (see figure 1) brings the mass of unpaid care work to light and relates it to economic agents and the system of production, and to the effective welfare of individuals.[23]

How should figure 1 be interpreted? The upper section reproduces the traditional circular flow of income, which discriminates the monetary and real flow of production and distribution in the commercial sphere. As can be seen, this representation does not encompass what happens within households, which includes both the transformation of goods and services into effective welfare that allows people to reproduce, and the administration of the workforce that determines what labour is available for the market.

This is what is added in the lower section of figure 1, where the market sphere is joined by the reproductive one. The first thing that can be noted there is the inclusion of unpaid work. This encompasses all activities carried out by households to ensure the reproduction of their members, including the specific work of care (of dependents, including children and the elderly and infirm, but also people capable of looking after themselves, such as spouses) and domestic work (home maintenance, cleaning, administration of the home, repair of installations, etc.).

Once households have acquired the goods and services they require to satisfy their needs and desires in the commercial marketplace, they need to turn them into effective consumption. Thus, adding unpaid work

[20] Evidence from time-use surveys reveals that: "(i) the amount of unpaid social reproduction work (domestic and care work and others) is greater than the total amount of paid work done by men and women, and (ii) the gender distribution of work (paid and unpaid) presents very marked disparities in all countries" (Picchio, 2005, p. 25).

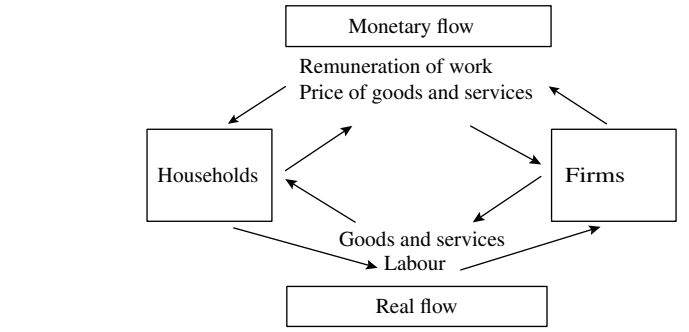
[21] Picchio (2001) terms it the space of human development, but this could be confused with the concept associated with the Human Development Index calculated each year by the United Nations Development Programme (UNDP), or with the concept of human capital, which conversely refers to an instrumental use of people as production inputs requiring ongoing training and proper application to increase their productivity.

[22] Picchio (2005), following Sen (1985) and Nussbaum (2000), understands welfare as a set of human capabilities and effective functionings in the social realm.

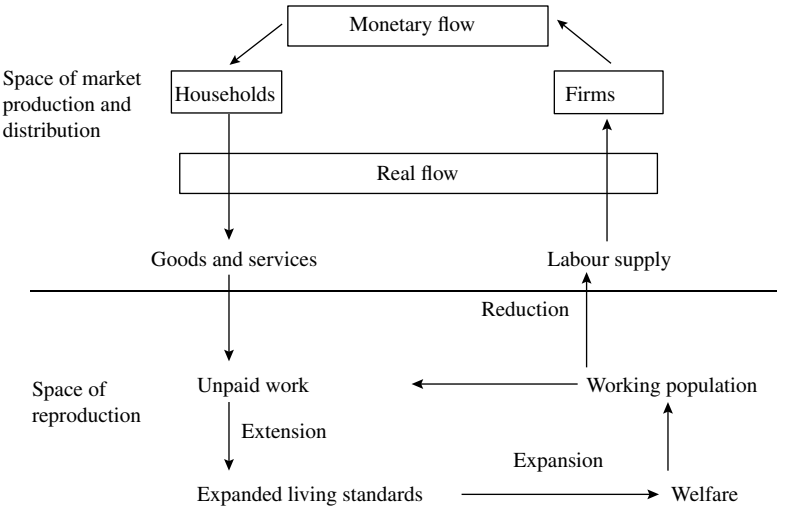
[23] It should be pointed out that this framework of analysis excludes public policies, which operate both in regulating production and the wage fund and in expanding people's welfare. Links to the external sector are also excluded, given that the objective is to situate the reproduction process in relation to that of production and not to carry out a complex analysis of the workings of the economic system.

FIGURE 1

Circular flow of income



EXPANDED CIRCULAR FLOW OF INCOME



Source: prepared by the author on the basis of A. Picchio, "Un enfoque macroeconómico ampliado de las condiciones de vida", paper presented at the inaugural conference of the "Tiempos, trabajos y género" congress, Barcelona, University of Barcelona, 2001.

to goods and services results in this consumption being extended into expanded living standards.

It is also people's unpaid care work that turns these living standards into welfare, through activities related to health care, education, leisure, etc. It is precisely the recognition of needs, capabilities and aspirations that characterizes what in this context is defined as "the income expansion process, termed welfare" (Picchio, 2001, p. 15).

By contrast with the conceptualization of households adopted for the traditional circular flow,[24] with the expanded flow households are not treated as harmonious institutions. On the contrary, the inclusion of unpaid work in the analysis gives greater complexity to households, whose members must now explicitly negotiate and decide how labour is to be divided up between them.[25] This is the process whereby only a portion of the available workforce is made available in the marketplace. Thus, households make possible the reduction of the supply of labour required in the market through the relationship between their own requirements for unpaid labour and the conditions prevailing in the labour market. To put it

[24] This conceptualization derives from the same body of theory and matches that of the new home economics, touched upon in the previous section.

[25] The idea of households as inharmonious units, riven by conflicting interests and asymmetrical power relationships, ties in more closely with the notion of cooperative conflicts developed by Sen (1990).

another way, the supply of paid labour is regulated by the negotiations carried out within households to distribute unpaid labour to reproductive tasks.

In figure 1, this process is manifested in the fact that not all of the working population forms part of the labour supply. Or, more strictly, not all of the endowment of labour at people's disposal is actually made available in the market. This is because there are people who remain completely outside it, as they are employed full-time on care and domestic activities, or because they implement strategies combining part-time work for the market with their everyday employment on unpaid work.[26]

The process of distributing labour within households is part of the sexual division of labour, which is determined by both cultural norms and economic rationality. The existence of discrimination in the labour market is thus seconded by the traditional division of domestic and care responsibilities, accounting for the persistence of a sexual division of labour that places most of the responsibility for reproducing people upon women.

The pressure on unpaid labour is unremitting, as it is this that has to cover the gap between available income and social consumption norms and, most particularly, between the conditions of remunerated work and living conditions. The expansion of income through unpaid work is a real process that serves to reduce the discrepancy between the resources distributed and actual family consumption (Picchio, 2001).

At the same time, unpaid work is not infinitely elastic either. Its potential for arbitrage between the labour market and living conditions declines when new opportunities arise for some segments of the labour force (including women). The problem of the growing tensions between the conditions of the social reproduction process and the conditions of commodity production cannot be resolved by symbolically enhancing women's capabilities without also going into the internal contradictions of the system as regards the formation of social capital, the norms of social living and the appropriateness of the remuneration for labour.

When unpaid care work is integrated in this way into the analysis of capitalist production relationships, it can be appreciated that a transfer takes place from the domestic sphere to the accumulation of capital. Briefly, it might be said that the unpaid care work done in households (mostly by women) constitutes a subsidy to the rate of return and capital accumulation.

Picchio (1999) formalizes this relationship by including unpaid work in the macroeconomic aggregates from a classical standpoint. Thus, she establishes that commodity production incorporates not only paid production work, but also unpaid reproduction work (which is incorporated into the remunerated labour force). Consequently, some of the analytical implications of this approach can be conjectured.[27]

It is possible to define a simple relationship where product *P* is a function of wage labour (*Lw*) and domestic and care labour (*Ld*).

$$P = f\,(Lw + Ld) \qquad (1)$$

The product is distributed between labour (wage and domestic) and profit (*R*), so that:

$$P = Lw\,W + R + Ld\,0 \qquad (2)$$

The share of *P* corresponding to domestic labour is nil, as its wage is nil. It might be said that part of the product ends up in the hands of those carrying out the care work because of a rule of distribution of *W* within households, but this is indeterminate (and would exceed the specific component of the family wage). In fact, the relationship between domestic labour and the other variables (*Lw*, *P*, *W*, *R*) would need to be specified.

Domestic labour influences the amount and quality of wage labour (*Lw*). Its effect on the quality of *Lw* is related to the values transmitted through education within households and to the health care carried out there. Domestic labour also influences the number of hours of wage labour available, as it releases this from care responsibilities.

The role of domestic labour in relation to *W* is very important, as there is a degree of substitution between domestic labour and wage commodities, and living standards do not depend exclusively on commodities because non-commercial goods and services are important too.

Likewise, insofar as *W* is inversely related to *R*, the share of *W* corresponding to intra-household resource transfers will also depend on the degree of exploitation of capital over wages, or the proportion of *W* and *R* in relation to product *P*. If we consider (given the historical evidence) that profit is most likely to relegate wages to the status of a remainder,[28] then we can understand how

[26] Obviously, and increasingly, there are also people who combine full-time working days for the market with their unpaid working days.

[27] This draws on the arguments advanced in Rodríguez Enríquez (2007) and Marco Navarro and Rodríguez Enríquez (2010).

[28] Profit is determined first, and the remainder (of the economic value produced) goes to wages.

hard domestic labour is. Reproduction is caught between a given wage and people's needs and wants. "This is at the same time a problem of class and gender power relations, since the inverse relationship between wages and profit becomes a direct relationship between unpaid domestic labour and profit" (Picchio, 1999, p. 220).

The discrepancy between the burden of care work, its high social productivity and the scantiness of the resources allocated in the distribution to the reproduction of the working population in general reveal the extent to which the relationship between this work and the distribution of income is social and not objective. For this reason, the political demand for greater visibility for domestic and care work seeks not only to make explicit the relationship between reproductive work and social output, but also to open a debate on distribution norms, modes of production and the quality of the relationship between production and reproduction.

IV

The implications of understanding and displaying the social organization and economic functionality of care

Once the importance of incorporating the care dimension into economic analysis is accepted, numerous conceptual, methodological, political and public policy implications ensue.

Conceptually, the thrust of current developments is to delimit and clarify the substance of the ideas of care economics and social organization of care.[29] Some research has concentrated on the specific study of unpaid care work, exploring its characteristics, distribution and implications. Other developments have involved a more comprehensive approach whereby the provision of care by unpaid labour in households is linked to that provided by the market (care services in the areas of education, health, personal services and, very importantly, remunerated domestic service), the State (via policies and programmes in the areas of education, health, social services and labour market regulation policies) and community and social organizations.[30]

In methodological terms, a central challenge, and one deemed crucial when it comes to measuring and giving visibility to care, is to estimate the unpaid care work people do and its economic value. Two fields of study should be highlighted here: first, time-use surveys, which are the main tool for capturing situated information on the time people spend on unpaid care work;[31] and second, the exercises carried out in an attempt to turn this time into some measurable economic value.

A very telling way of conveying the scale of care work in relation to the economic value societies generate is the work being done on the construction of household extensions or satellite accounts within the framework of systems of national accounts.[32] Incorporating unpaid work into the "language" of national accounts means choosing a method for expressing it in monetary units. The one suggested is the input cost method, which in the case of unpaid work involves the imputation of a particular wage. Some measure of the market wage is generally taken as the benchmark. Three possible criteria come up here: (i) the global substitution method, in which the average wage for every kind of domestic activity is taken as a benchmark; (ii) the specialized substitution method, where the benchmark taken is the wage for the specific domestic activity; (iii) opportunity cost, whose benchmark is the wage that might be received by the person carrying out the domestic activity if they participated in the labour market. In this last case, the

[29] See Esquivel (2011a and b) for a state of the art on this subject.

[30] Here, mention should be made of: (i) the studies by the ECLAC Gender Affairs Division surveying the organization of childcare in different countries of Latin America (see Rodríguez Enríquez, 2007; Marco Navarro, 2007); (ii) the United Nations Research Institute for Social Development (UNRISD) project "Political and Social Economy of Care" which, as well as systematizing a conceptual framework for addressing the issue, is analysing a number of national cases around the world (see Razavi, 2007); (iii) the "Building Networks: Latin American women in the global care chains" project, which is studying the relationship between paid domestic service and migration dynamics (Pérez Orozco, 2009) in the creation of global care chains.

[31] See Esquivel and others (2008) for a synthesis of the state of the art in this field.

[32] Gómez Luna (2003) presents a good synthesis of the underpinnings for these advances, as well as of concrete empirical experiences.

benchmark is the wage of an employed person with similar characteristics (principally in terms of age, sex and educational level) (Benería, 2003a).

Each of these methods has its advantages and drawbacks, as well as posing a dilemma. Is it valid to equate these activities, when they are carried out under very different conditions and norms? Can productivity concepts and measures be treated as comparable in each case? Can similar parameters be used to evaluate products obtained in the market and domestic realms? The debate remains open.

Also debatable are the political consequences that flow from estimating and highlighting the scale of unpaid care work and the profiles and circumstances of those doing it. Once all this is known, should these activities be remunerated? Who should meet the economic cost of a monetary transfer rewarding unpaid care work? What form should these transfers take? Is it liberating for women for monetary recognition of this type to be implemented, or is it actually a way of entrenching their role as carers? Here again, the debate is open.

Lastly, highlighting, exposing and measuring unpaid care work and the inequitable consequences of its current organization creates a challenge for public policies. Mention may be made here of at least three implications.

The first implication relates to monetary recognition for unpaid domestic and care work. From the earliest proposal to institute a family wage to the extreme of calling for the implementation of a "housewife's wage", the debate is wide-ranging, controversial and ongoing. Recently, as a consequence of the momentum the subject has been building up in the public policy debate, some countries have incorporated components into social security reforms that seek, not necessarily to remunerate unpaid care work, but to compensate women for the income they forfeit over the life cycle by taking on these responsibilities. Examples are the application of the "child bonus" as part of the Chilean social security reform[33] and the inclusion of a reckoning of contribution years for each child in the Uruguayan social security system.

The second implication is the incorporation of the gender perspective, and particularly the care dimension, into the diagnosis, design, monitoring and evaluation of all economic policies. Each and every public policy adopted operates in a field that is permeated by gender relations. Each of these also has more or less direct implications for the organization of care. Recognizing these links and making them explicit is a necessary step in the effort both to enhance the impact of policies and to correct the negative biases they may have in respect of the position of women and gender equality.[34] A good example in this field is gender analysis of conditional cash transfer programmes, whose controversial implications come out precisely in relation to the symbolic and practical field of care.[35]

The third implication concerns public policy approaches that should specifically address the issue of care and be oriented towards seeking a better distribution of these responsibilities, while at the same time opening the way to greater distributive justice. Two fields of action can once again be identified here. First, there are those initiatives that seek to facilitate reconciliation between people's work and family lives (and in fact these are called reconciliation actions or policies). These encompass State regulations in the world of paid work dealing with issues such as maternity and paternity leave, the provision of care at production units, regulation of working time and the technical organization of labour, and actions by firms themselves in these areas.[36]

Again, there is a field of very substantial challenges for public policies in the region, which is the need to create an extensive and accessible network of public care services provision. The vital importance of this issue can be seen when it is understood that a different way of organizing care in society is essential to progress towards equality goals. Progress has also been made in this sphere within the region, an example being the current discussion about a comprehensive national system of care in Uruguay.[37]

The excessive restrictions that care responsibilities impose upon poor women's access to and control of economic resources are obvious. Their situation is contributed to by: (i) greater care responsibilities (because they are usually part of large households, with more children); (ii) fewer resources to purchase care services in the market; and (iii) fewer and worse opportunities in the labour market (considering that such opportunities would give them access to resources to purchase care services in the market). Consequently, the development of an extensive network of public care services would simultaneously improve these women's

[33] On this point, see Yáñez (2010).

[34] Rodríguez Enríquez (2005) presents a synthesis of the basic links that can be identified between different dimensions of economic policy and the organization of care.

[35] See Rodríguez Enríquez (2011).

[36] ILO/UNDP (2009) presents a good systematization of the state of the debate and policies in this field in Latin America.

[37] See Rico (2011).

(and their families') economic opportunities and ensure better conditions of care for children.

Consideration of care as a central dimension of social protection systems is a debate that is beginning to take place in the region, alongside consideration of care as a matter of rights.[38] This inevitably leads on to discussion of fiscal constraints. Here, there needs to be discussion of the costs of implementing care services as compared to the (economic and social) costs of not doing so.[39]

Throughout this debate, it is as well to be clear about the political goal that drives it. From a feminist viewpoint, the political objective of introducing the issue of care into economic analysis is to transform its current social organization, which is considered to reproduce social and gender inequalities. Without overlooking the slow but steady progress that has been made with women's economic participation, it must be emphasized that the redistribution of care remains one of the greatest unmet challenges.

A fairer and more egalitarian society needs to be underpinned by a more equitable distribution of total work (production work and care work) and by the implementation of social and collective responsibility in the reproduction of people.

(Original: Spanish)

[38] See Pautassi (2007).
[39] See Rodríguez Enríquez and others (2010).

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Inflation targeting works well in Latin America

José García-Solanes and Fernando Torrejón-Flores

ABSTRACT

This paper analyses the macroeconomic effects of inflation targeting (it) in five Latin American countries during the period 2000-2007. We perform three types of econometric tests, which coincide in showing that it regimes have contributed to decreasing the level and variability of both the rate of inflation and the short-term interest rate, compared with a group of non-it Latin American countries. Moreover, our empirical analysis clearly reveals that it has led to lower variability in gdp growth, but the net effects on the level of economic growth remain unclear. The main technical innovation of this paper is the estimation of a treatment effects model to solve the endogeneity problem of adopting it, which is inherently present in most of the econometric tests applied so far in this field.

KEYWORDS

Inflation, monetary policy, macroeconomics, econometric models, economic growth, economic indicators, Latin America, Brazil, Chile, Colombia, Mexico, Peru

JEL CLASSIFICATION

E52, F21, F33

AUTHORS

José García-Solanes, Faculty of Economics and Business Studies, University of Murcia, Spain. solanes@um.es

Fernando Torrejón-Flores, Faculty of Law and Business Studies, San Antonio Catholic University of Murcia, Spain. ftorrejon@pdi.ucam.edu

I
Introduction

Many empirical studies prove that the emerging market economies (EMEs) with inflation targeting (IT) regimes have succeeded in lowering their inflation rates. Calderón and Schmidt-Hebbel (2003a, 2003b) showed that the IT countries (ITers) in Latin America and the Caribbean have been able to systematically reduce both inflation rates and inflation-target misses after adopting this monetary regime. Lin and Ye (2009) obtained a similar result using a variety of propensity score matching methods in 13 developing countries. Corbo, Landerrechte and Schmidt-Hebbel (2002) and Gonçalves and Salles (2008) discovered that, compared with non-targeters (NITers), developing countries adopting the IT framework experienced greater drops not only in inflation but also in output growth volatility. Valdés (2007) found similar results in Chile. Batini and Laxton (2007) and the International Monetary Fund (IMF) (2005 and 2006) report even larger macroeconomic benefits in terms of lower and less volatile inflation, as well as lower volatility of interest rates, exchange rates, international reserves and output growth, when compared with countries that have not adopted IT. Finally, Brito and Bystedt (2010) also find that IT reduces inflation, inflation volatility and output growth volatility in EMEs, although the effects are less strong and significant than noted in previous literature.

The final results of IT hinge for the most part upon the capability of IT to strengthen credibility and to decrease inflation expectations in developing countries.[1] Proponents of IT offer an optimistic view on the grounds that the pote ntial of credibility gains is high since developing countries generally start implementing this regime with very weak institutions. Svensson (1997), Mishkin (1999), King (2005), IMF (2006) and Blejer and others (2001) advised the adoption of IT regimes in EMEs during IMF structural adjustment programmes. Other distrustful authors claim that some kind of "original sin" in institutions and structural drawbacks in policy implementation preclude the central banks of these economies from reducing inflation expectations consistently (Calvo and Mishkin, 2003; Sims, 2005; Blanchard, 2005).

The empirical analysis of the macroeconomic impact of IT requires solving the endogeneity bias created by the adoption of an IT regime. To our knowledge, Brito and Bystedt (2010) is the only work to address this problem explicitly and seriously in the context of emerging market economies. For the period 1980-2006, these authors analysed the impact of IT on inflation and output growth in 13 IT developing countries, using as benchmarks several control groups from a sample of 33 non-IT emerging economies. They applied the two-step S-GMM panel estimator, which controls for the time-varying bias problem and for the endogeneity of the IT regime. Their findings indicate that the EMEs with IT strategies have been successful with disinflation, but at the cost of hindering output growth.

In this paper, we tackle and solve the endogeneity problem by estimating (after the application of two conventional regression tests) a treatment effects model, following the procedure suggested by Heckman (1979), Maddala (1983) and Greene (2003). This method is particularly suited for evaluating the impact of qualitative variables, such as the adoption of IT, on other variables that are easily quantified. It consists of estimating a probit relationship aimed at assessing the extent to which some variables picked out from theory and from the empirical literature affect the probability of adopting an IT regime, and outcome equations that relate some macroeconomic variables with their main determinants, among which the adoption of IT is a key variable.

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[1] A similar debate exists in the literature concerning the suitability of IT regimes in transition economies. On the one hand, Jonás and Mishkin (2005) and Hrncir and Smidkova (2003), for instance, believe that, although inflation-targeting central banks face particular difficulties in these countries (such as predicting inflation under increased uncertainty and suffering more frequent shocks), such regimes could still deliver important benefits in terms of increased control over expectations and short-term flexibility of monetary policy. On the other hand, Kvasnicka (2000) considers that IT regimes are not advisable for transition economies because such economies are strongly affected by uncertainties and instability in the monetary policy transmission mechanism. In the framework of eight developed countries, Yigit (2010) showed IT effectiveness in reducing inertia in inflation expectations.

Our analysis focuses on five Latin American countries that adopted an IT regime by the end of 2007, taking another set of 10 non-IT Latin American economies as a benchmark for the years 1980-2007. For several reasons, Latin America does indeed provide an interesting case study for assessing the effects of IT on emerging market economies. First, the five Latin American targeters have been the forerunners of IT in the worldwide group of emerging market economies. Second, choosing a panel composed of only Latin American countries allows for minimizing economic and institutional differences between the members of the panel; this helps to better isolate the effects of adopting IT. In fact, we work with a group of economies that are more homogeneous than those usually considered in the literature.

Our panel treatment methodology is not distorted by time-varying bias because all countries of the group started applying full-fledged IT around 2000, which is also the year in which our analysis of the treatment effects begins. Small differences in dates of IT adoption cannot bias the results significantly. Furthermore, there is no evidence that the Latin American countries in our sample have been affected by different time trends since 2000. There are also reasons to believe that our methodology correctly addresses the self-selection problem because the variables that led each country to adopt the IT framework are determined endogenously in our model. We can assert, then, that the econometric treatment effects methodology contributes to improving the inference of the causal effect of IT on the selected macroeconomic variables, compared with other methodologies that do not correctly deal with the time-varying bias and the self-selection problem.

The paper is structured in four sections. After this introduction, in section II we perform a descriptive analysis using all three of the candidate variables (rate of inflation, short-term interest rate and economic growth) for the two groups of countries, in order to intuitively grasp the impact of IT on them. In section III we apply three different econometric tests to rigorously investigate the impact of IT on the level and variability of those three variables. Finally, section IV summarizes the main empirical findings.

The results that we derive from the empirical analysis may be summarized as follows. The regression and treatment effects tests coincide to show that IT has decisively contributed to reducing both average levels and variability of domestic inflation and short-term interest rates and to decreasing variability of GDP growth compared with alternative monetary regimes during the period under study. Although the final effect on the level of GDP growth cannot be clearly discerned —which is not surprising given the relatively short length of the observed period— our results point out that the IT regime has improved macroeconomic results compared with other policy regimes that are not equipped with an explicit inflation expectations anchor.

II
Descriptive Analysis

In this section we apply descriptive statistics to get a first impression of the likely macroeconomic effects of the adoption of IT in five Latin American countries: Brazil, Chile, Colombia, Mexico and Peru. The general methodology is as follows: (i) for each ITer, we compare the results relating to some relevant macroeconomic variables during the pre-IT era with those of the post-IT period of the same country, and (ii) we compare the results (for the same set of variables) that each group of countries (ITers and NITers) obtained during the post-IT period of the first group. The group of NITers selected as a benchmark comprises 10 countries: Argentina, the Bolivarian Republic of Venezuela, Costa Rica, Dominican Republic, Ecuador, El Salvador, Panama, Paraguay, the Plurinational State of Bolivia and Uruguay. Both groups of countries are in Latin America because this enables us to compare areas that share not only an analogous geographical context but also similar degrees of economic and institutional development.

As a prior step, it is useful to describe the exchange-rate regimes in force in the countries of the sample over the entire period of analysis. The 15 selected countries offer not only a variety of different exchange-rate regimes but also a number of very different monetary arrangements. Table 1 shows the exchange-rate regimes declared by these countries to the IMF in three different years: 1985, 2002 and 2007. As can be seen, the general tendency is a switch from intermediate regimes towards corner solutions: while in 1985 12 of the 15 countries had exchange-rate regimes that represented intermediate

TABLE 1

Latin America: exchange-rate regimes, 1985, 2002 and 2007

ITers countries	1985	2002	2007
	Exchange-rate regimes		
Brazil	Intermediate	Flotation	Flotation (IF)*
Chile	Intermediate	Flotation	Flotation (IF)*
Colombia	Intermediate	Flotation	Flotation (MF)*
Mexico	Intermediate	Flotation	Flotation (IF)*
Peru	Intermediate	Flotation	Flotation (MF)*
NITer countries		Exchange-rate regimes	
Argentina	Intermediate	Flotation	Flotation (MF)
Bolivia (Plurinational State of)	Flotation	Intermediate	Intermediate (CP)
Costa Rica	Intermediate	Intermediate	Intermediate (CP)
Dominican Republic	Intermediate	Intermediate	Flotation (MF)
Ecuador	Intermediate	Rigid peg	Rigid peg (NS)
El Salvador	Intermediate	Rigid peg	Rigid peg (NS)
Panama	Rigid peg	Rigid peg	Rigid peg (NS)
Paraguay	Intermediate	Flotation	Flotation (MF)
Uruguay	Flotation	Flotation	Flotation (MF)
Venezuela (Bolivarian Republic of)	Intermediate	Flotation	Rigid peg (CF)

Source: A. Berg, E. Borensztein and P. Mauro, "An evaluation of monetary regime options for Latin America", IMF Working Paper, N° 02/211, Washington, D.C., International Monetary Fund, 2002; and Berg, Borensztein and Mauro (2002, p.25) and International Monetary Fund (IMF), ("De Facto Classification of Exchange Rate Regimes and Monetary Policy Frameworks", April 2008). [online] http://www.imf.org/external/np/mfd/er/2008/eng/0408.htm.
Note: CP, crawling peg; IF, independently floating; MF, managed float with no pre-announced exchange-rate path; NS, no separate legal tender; CF, conventional fixed peg.

arrangements, by 2007 the share had fallen to 2 out of 15. According to the empirical study by Calderón and Schmidt-Hebbel (2003b), the structural break took place in 1998, immediately after the Asian crisis.

Among the nine countries with floating currency regimes in 2007, three operate independent and free exchange-rate flexibility and the other six exhibit managed floats with no pre-announced exchange-rate path. The three central banks with independent floating regimes belong to the IT group, and they do not use systematic interventions to dampen fluctuations of their exchange rate.

1. Inflation targeting in Latin America

To date, five Latin American countries have adopted inflation targeting strategies with more or less intensity. Mishkin and Savastano (2002) present a detailed analysis of the characteristics of these regimes up to 2001. Table 2 updates, for the five countries, the main features of the IT regimes adopted. The starting dates within parentheses indicate when the central bank began to publish inflation reports.

Chile is the first country (January 1991) that gave independence to its central bank and announced price stability as one of its primary objectives. As a result, the domestic inflation rate decreased gradually. However, it was not until 1999 that the central bank explicitly announced a multi-year target for inflation. In May 2000 the central bank began to issue inflation reports in which it published its baseline inflation forecasts. Healthy public finances and a sound financial system are two key features of the Chilean economy that have supported a full-fledged inflation targeting regime in this country.

In 1999 Brazil started a monetary policy regime with all the key ingredients of an IT regime. The central bank immediately published a comprehensive inflation report. Since then the independence of the central bank of Brazil has been enhanced and increased in order to ensure the success of the IT scheme. Moreover, fiscal deficits must be brought back to levels that remove any possibility of fiscal dominance.

In 1991 the central bank of Colombia started to announce explicit numerical targets for the one-year rate

TABLE 2

Latin America (five countries): inflation-targeting regimes of individual countries

Country	Starting date and main features
Brazil	Starting date: June 1999 (September 1999). Inflation targets: 8% ± 2% (1999), 6% ± 2% (2000), 4% ± 2% (2006-2007). Inflation report and announcement of multi-year inflation targets. Weak fiscal position and relatively sound financial system.
Chile	Starting date: January 1991 (May 2000). Inflation targets: 15%-20% (1991), 3.5% (2000), 2%-4% (2001-2007). Inflation report and announcement of multi-year targets. Strong fiscal position and relatively sound financial system.
Colombia	Starting date: January 1991 (January 1999). Inflation targets: 22% (1991), 10% (2000), 4.5% ± 0.5% (2006), 4% ± 0.5% (2007). Inflation report and announcement of multi-year targets. Strong fiscal position and relatively sound financial system.
Mexico	Starting date: January 1996 (April 2000). Inflation targets: 20.5% (1996), <10% (2000), 3% ± 1% (2003-2007). Inflation report and announcement of multi-year targets. Strong fiscal position and relatively sound financial system at today.
Peru	Starting date: January 1994 (June 2002). Inflation targets: 15%-20% (1994), 3.5%-4% (2000), 2.5% ± 1% (2002-2006), 2% ± 1% (2007). Inflation report and announcement of multi-year targets. Weak fiscal position, but relatively sound financial system.

Source: The authors, on the basis of economic reports from the respective central banks.
Note: The dates in parentheses correspond to when the central banks published their first inflation reports.

of inflation. This anti-inflationary strategy failed until 1999 because the central bank continued to give priority to other objectives, especially output stabilization and external competitiveness, whenever these goals were threatened by the inflation target. Furthermore, the budget deficit was not sufficiently controlled until that year. The strategy changed positively in January 1999 when the central bank of Colombia began to publish inflation reports. Moreover, in September 1999 the exchange rate began to float freely. The announcement of multi-year inflation targets since October 2000 has also contributed to the success of the new regime in the past few years.

The central bank of Mexico waited until it acquired sufficient anti-inflationary credibility to put in place a full-fledged IT regime. This occurred in January 1999, when the annual rate of inflation (12.3%) was below the 13% target. In April 2000 the Mexican central bank started to publish its monthly report on inflation.

The announcement of IT in 1994 initiated a period of anti-inflationary success in Peru. The inflation rate fell from levels over 20% in 1994 to 3% in 2001. However, Peru's monetary authorities did not gain sufficient credibility during that period because their monetary framework lacked many of the crucial features of an IT regime. Some of these features were the announcement of multi-year inflation targets, publication of inflation reports and mechanisms for making the central bank accountable. By June 2002 these drawbacks were almost completely corrected, and monetary policy started to fulfil the key requirements of a true IT regime.

2. Macroeconomic results

In order to get a first insight as to the extent to which an IT regime may have contributed to improving macroeconomic results in the five incumbent Latin American countries, we investigate the results in terms of inflation, bank deposit interest rates and GDP growth. We apply descriptive calculus for both time series and cross-section variables of the two groups of countries.

(a) *Descriptive analysis of time series variables*

We assembled a database of monthly data for the relatively long period from January 1981 to December 2007 and computed annualized rates for three relevant variables: inflation, short-term interest rate (bank deposits maturing in one year) and GDP growth. For reasons of data availability, the rates of GDP growth were calculated

using quarterly observations. The sample is split in two periods in each country, taking into account the starting date of the IT regime. The starting IT date is the moment at which the central bank first published an inflation report. The five ITers started a complete IT regime between January 1999 and June 2002 (see table 3).[2]

The details concerning the length of each subsample are presented in table 3. Sample 1, corresponding to the period preceding IT, excludes the years of hyperinflation in each country. Sample 2 encompasses the period after the adoption of IT. We consider hyperinflation to be rates of inflation over the 95th percentile in the inflation distribution of the entire sample of Latin American countries.

[2] Other authors argue that it took several attempts for full-fledged IT regimes to be introduced. The suggested starting dates are not coincident between authors but are relatively close. Thus, according to Mishkin and Schmidt-Hebbel (2007), the stationary target period started at some moment between January 2001 and January 2003, whereas Batini and Laxton (2007) consider that the date was between the second quarter of 1999 and the first quarter of 2002.

Table 4 shows the average and standard deviation of the monthly rates of inflation computed over twelve months (annual basis) for each subsample and country. As far as level values are concerned, it is clearly apparent that the inflation rate decreased sharply between the first and the second subperiods in each country. Brazil reaped the best results, even without taking into account the huge inflation numbers of its hyperinflation years. On average, in the second period the inflation rate fell to 9% of the value recorded during the first sample period.

As regards inflation rate variability, the third and fourth columns of table 4 illustrate reductions of a similar order as the average in each country. The fall in variability is especially pronounced in the countries with highest initial inflation levels. To sum up, the improvement in inflation is quite remarkable in all countries and has taken place in both levels and variability.

Table 5 provides information that is similar to that set out in the preceding table, but referring to the annualized nominal interest rate on bank deposits. As can be seen, both the average levels and the standard deviations also decrease substantially in each country. For

TABLE 3

Latin America (five countries): subsamples for each country

Country	Sample 1: before IT	Hyperinflation period	IT start	Sample 2: after IT
Brazil	Jan. 1981-Aug. 1999	Feb. 1987-Mar. 1995	Sept. 1999	Sept. 1999-Dec. 2007
Chile	Jan. 1981-Apr. 2000		May 2000	May 2000-Dec. 2007
Colombia	Jan. 1981-Dec. 1998		Jan. 1999	Jan. 1999-Dec. 2007
Mexico	Jan. 1981-Mar. 2000		Apr. 2000	Apr. 2000-Dec. 2007
Peru	Jan. 1981-May 2002	July 1988-July 1991	June 2002	June 2002-Dec. 2007

Source: The authors, on the basis of economic reports from the respective central banks.
Note: Sample 1 comprises the years before the adoption of IT. Sample 2 comprises the years after the adoption of IT. Sample 1 excludes the years of hyperinflation. Hyperinflation includes the rates of monthly inflation within the 5% group of observations with the highest rates of inflation.

TABLE 4

Latin America (five countries): inflation by country
(Annualized monthly observations, percentages)

Country	Average level of inflation on annual basis		Standard deviation	
	Before IT	After IT	Before IT	After IT
Brazil	97.00	7.32	81.40	3.35
Chile	15.43	3.07	8.42	1.39
Colombia	23.32	6.93	4.34	2.26
Mexico	45.73	5.05	39.89	1.67
Peru	36.96	2.11	63.18	1.13
Average	*47.85*	*4.29*	*38.08*	*1.53*

Source: Authors' calculations on the basis of International Monetary Fund, International Financial Statistics.

the countries that we include in the empirical analysis, IT clearly contributes to easing the task of monetary policy and to reducing tensions in domestic money and credit markets. Consequently, it is not surprising that IT creates a favourable environment for investment decisions, which in turn should contribute to increasing economic growth in the medium and long term.

Table 6 reports the same information for annualized economic growth, computed with quarterly observations of real GDP. It seems that the adoption of an IT regime comes with a clear reduction in the dispersion of growth outcomes, but its effects on the level of growth are ambiguous: the positive effects are observed only in Brazil and Peru.

(b) *Descriptive analysis of cross-section variables*

In order to gain a more comprehensive understanding of the results derived from the adoption of the IT regime, it is useful to compare the macroeconomic performance of two groups of Latin American economies: countries with IT, and countries without IT. In the first group we include the five countries considered in the preceding section; the second group is composed of ten countries: Argentina, the Bolivarian Republic of Venezuela, Costa Rica, Dominican Republic, Ecuador, El Salvador, Panama, Paraguay, the Plurinational State of Bolivia and Uruguay. We compute cross-sectional monthly values for the inflation and interest rates and quarterly rates of change for GDP growth for the period January 2000 to December 2007 for the two groups of countries.

Figure 1 presents the results for the three variables for the two groups of countries. As can be seen, the results support the conclusions of the preceding analysis based on time series variables: compared with countries that did not adopt IT regimes during the sample period, those that engineered IT obtained (i) a lower and less volatile rate of inflation; (ii) lower variability in GDP growth; and (iii) much lower levels and variability in short-term interest rates. The net effects on average GDP growth are unclear.

TABLE 5

Latin America (five countries): annualized interest rate on bank deposits
(Annualized monthly observations, percentages)

Country	Average rate of interest		Standard deviation	
	Before IT	After IT	Before IT	After IT
Brazil	132.47	16.80	133.56	3.54
Chile	23.02	4.57	13.87	2.06
Colombia	31.16	10.19	4.35	4.82
Mexico	36.78	4.10	24.85	1.83
Peru	17.21	2.96	26.76	0.40
Average	*86.81*	*10.36*	*40.22*	*3.40*

Source: Authors' calculations on the basis of International Monetary Fund, International Financial Statistics.

TABLE 6

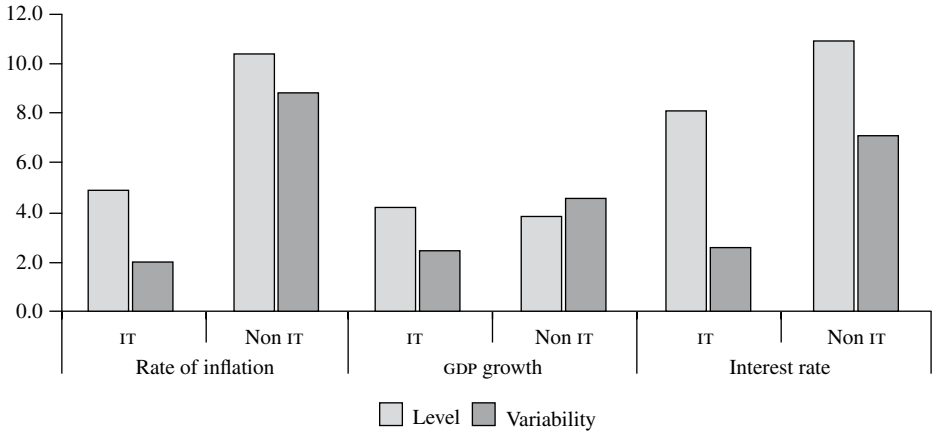
Latin America (five countries): gdp growth
(Annualized quarterly observations, percentages)

Country	Average rate of GDP growth		Standard deviation	
	Before IT	After IT	Before IT	After IT
Brazil	2.02	3.18	2.45	1.64
Chile	6.28	4.31	3.66	1.26
Colombia	3.09	2.93	1.34	3.35
Mexico	3.36	2.74	3.59	2.16
Peru	3.99	6.08	4.21	1.69
Average	*3.75*	*3.85*	*3.05*	*2.02*

Source: Authors' calculations on the basis of statistical data from the website of the Economic Commission for Latin America and the Caribbean (ECLAC).
Note: Numbers are annual rates of GDP growth on the basis of quarterly observations. Sample: first quarter of 1992 to fourth quarter of 2007.

FIGURE 1

Average and variability of inflation, economic growth and interest rates in it and non-it countries
(Jan. 2000 - Dec. 2007)



Source: Authors' calculations based on statistical data from the website of the Economic Commission for Latin America and the Caribbean (ECLAC) and International Monetary Fund, International Financial Statistics.

III
Time Series and Panel Analysis

1. Time series regressions

In this section we perform regressions with dummy variables, following the Ball and Sheridan (2005) methodology, to assess whether the levels and variability of three variables (the rate of inflation, the short-run interest rate, and GDP growth) have significantly changed between the pre-IT and post-IT periods of the ITers.

For this purpose, we estimate the following equation:

$$x_{i,t} = \alpha_i + \delta_i F_{i,t} + \gamma_i x_{LAT,t} + \theta_i GB_{i,t} + \varepsilon_{i,t} \qquad (1)$$

Where $x_{i,t}$ is the variable under analysis of country i corresponding to period t, and $F_{i,t}$ is a dummy that takes value 1 during the periods where country i applies IT and value 0 during the rest of the sample. Parameter δ_i measures the effect of IT on the variable $x_{i,t}$.

Equation (1) includes two control variables in order to isolate the pure effect of IT. The first one, $x_{LAT,t}$, stands for the average of $x_{i,t}$ of a large group of Latin American countries. It is included to avoid the biased estimations of parameter δ_i that arise when the variable $x_{i,t}$ converges towards a common mean in the sample of countries. For instance, if $x_{i,t}$ is the inflation rate in Chile, the observed reduction in the value of this variable between the pre- and post-IT periods could, in fact, be created by a general trend in the entire group of countries and not by the implementation of IT. The second control variable, $GB_{i,t}$, captures the strength of the public budget and is measured by the ratio of proceeds over expenditures of the central government.

Ball and Sheridan (2005) used a similar methodology to analyse the effects of IT in a group of industrialized countries, but without conducting separate estimations for each country.

We first estimate equation (1) for the level and standard deviation of the rate of inflation. Inflation is measured by the annual rate of variation in the consumer price index, and its variability is approximated by its standard deviation. In order to more accurately determine the incidence of IT on these variables, we perform regressions for three period samples that differ in the starting date of the pre-IT period. The first one starts in January 1981, the second begins in January 1992, and the third starts in January 1996. If the implementation of IT significantly changes the evolution of the variables (in a

TABLE 7

Latin America (five countries): inflation rate for three periods

Country	Inflation rate					
	Jan. 1981 - Dec. 2007		Jan. 1992 - Dec. 2007		Jan. 1996 - Dec. 2007	
	Level	Standard Deviation	Level	Standard Deviation	Level	Standard Deviation
Brazil	-23.81	-73.05	12.36	-3.18	5.57	-3.92
	(-5.26)*	(-2.61)*	(4.44)*	(-1.97)**	(7.99)*	(-2.57)*
	0.81	0.04	0.44	0.99	0.54	0.53
	219	208	153	153	144	144
			8.15	–	–	–
			*(2.61)**	–	–	–
Chile	-6.83	-1.36	-3.11	-0.02	-1.10	0.10
	(-8.19)*	(-6.14)*	(-8.17)*	(-0.34)	(-3.63)*	(2.19)**
	0.51	0.29	0.68	0.36	0.47	0.05
	278	267	188	188	144	144
			-3.31	–	*-1.15*	–
			*(-8.76)**	–	*(3.60)**	–
Colombia	-14.80	-0.56	-13.26	-0.27	-9.57	-0.20
	(-27.95)*	(-5.41)*	(-31.86)*	(-2.36)**	(-20.78)*	(-1.42)
	0.82	0.20	0.90	0.03	0.91	0.09
	278	267	188	188	144	144
			–	–	*-10.08*	*-0.17*
			–	–	*(-22.81)**	*(-1.25)*
Mexico	-38.79	-7.58	-18.93	-2.86	-9.29	-2.80
	(-7.49)*	(-9.06)*	(-16.35)*	(-6.91)*	(-10.96)*	(-10.29)*
	0.27	0.24	0.59	0.25	0.85	0.50
	278	267	188	188	144	144
			–	–	*-9.52*	*-2.49*
			–	–	*(-11.37)**	*(-10.68)**
Peru	-25.97	-39.45	-7.32	21.38	-0.81	-0.06
	(-4.32)*	(-0.68)	(-2.81)*	(0.75)	(-2.57)*	(-0.99)
	0.40	0.14	0.44	0.32	0.77	0.04
	270	259	188	188	144	144
			-4.20	–	*-2.05*	–
			*(-7.41)**	–	*(-8.14)**	–

Source: International Monetary Fund, International Financial Statistics.
Note: Monthly data. For each country:
- The first row shows the estimated value of δ_i.
- The second row shows the *t*-statistics under the null hypothesis H_0: $\delta_i = 0$. The significance levels are 1%(*) and 5%(**), respectively.
- The third and fourth rows show the $\overline{R}^2$ statistics and the number of observations, respectively.
- Cells in rows five and six containing numbers in italics correspond to the cases where the government budget is statistically significant. Row five shows the estimated value of δ_i and row six shows its *t*-statistics. Where no results are given for this estimation the government budget is not statistically significant.

similar way as a structural change), we would expect that the effects of IT will be stronger and more statistically significant for longer pre-IT subperiods.

Table 7 shows the regression results for the inflation rate of each IT country. The first two columns offer the estimation of δ_i for the level and the standard deviation of inflation, corresponding to the longest period sample, January 1981 to December 2007. The control variable $GB_{i,t}$ is not included due to the lack of monthly data for many observations prior to 1992. According to the estimated values of these parameters and of their *t* statistics, IT has been very effective in reducing both inflation and its variability in each country. For instance, in the case of Chile, the values δ_{Chile} = -6.83 and δ_{Chile} = -1.36 mean that the inflation rate and its variability declined by 6.83 percentage points and 1.36 percentage points on average, respectively, in the post-IT period compared with the pre-IT period. The *t* statistics (-8.19 and -6.14) allow us to clearly reject the null hypothesis of non-significance in each of these estimations.

Columns three to six of table 7 report the results for two shorter periods including the variable $GB_{i,t}$ in

the regressions. When $GB_{i,t}$ is statistically significant, the estimated value of δ_i and its *t*-statistics are reported in italic numbers in rows five and six, respectively, for the corresponding countries. For comparison purposes, in those cases we also performed the same regressions excluding $GB_{i,t}$, with the results that appear in the first and second rows for each country. As can be seen, except for the two shorter periods in Brazil, δ_i is always negative and statistically significant in regressions with the level of inflation and also in most regressions with inflation variability. Moreover, the inclusion of $GB_{i,t}$ generally improves the statistical significance of parameter δ_i.

To sum up, the regression results indicate that both the level and variability of inflation have been negatively affected by the adoption of the IT regime.

Table 8 shows the results of the regressions for the annualized rate of interest of bank deposits calculated with monthly observations. For reasons of data availability, the estimations are restricted to the shorter periods, from January 1992 to December 2007 and from January 1996 to December 2007.

We observe that the adoption of IT led to a significant reduction in both the level and variability of the nominal interest rate, except for interest rate variability in Brazil

TABLE 8

Latin America (five countries): interest rate

Country	Interest rate			
	Jan. 1992 - Dec. 2007		Jan. 1996 - Dec. 2007	
	Level	Standard Deviation	Level	Standard Deviation
Brazil	-3.00	4.06	-4.81	-4.10
	(-1.86)***	(1.93)***	(-4.33)*	(-9.61)*
	0.64	0.99	0.60	0.47
	153	153	144	144
	-6.90	–	*-6.19*	–
	*(-4.69)**	–	*(-5.46)**	–
Chile	-8.50	-3.52	-5.88	-2.37
	(-13.44)*	(-13.85)*	(-8.62)*	(-15.37)*
	0.59	0.56	0.65	0.66
	188	188	144	144
	–	*-3.35*	*-5.15*	*-2.39*
	–	*(-13.24)**	*(-7.85)**	*(-17.85)*
Colombia	-19.62	-1.29	-12.38	-0.94
	(-26.75)*	(-4.76)*	(-12.01)*	(-3.06)*
	0.81	0.13	0.84	0.23
	188	188	144	144
	–	–	–	*-0.92*
	–	–	–	*(-3.06)**
Mexico	-16.52	-3.22	-8.11	-2.67
	(-15.34)*	(-8.31)*	(-9.30)*	(-10.90)*
	0.56	0.32	0.78	0.51
	188	188	144	144
	–	–	*-7.16*	*-2.36*
	–	–	*(-9.62)*	*(-10.33)*
Peru	-7.94	-5.54	-5.78	-0.33
	(-7.96)*	(-2.53)**	(-15.76)*	(-5.19)*
	0.36	0.05	0.83	0.27
	188	188	144	144
	-7.21	*-0.13*	*-6.24*	*-0.12*
	*(-24.26)**	*(-1.88)****	*(-17.60)**	*(-1.88)****

Source: International Monetary Fund, International Financial Statistics.
Note: Monthly data. For each country:
- The first row shows the estimated value of δ_i.
- The second row shows the t-statistics under the null hypothesis H_0: $\delta_i = 0$.
- The significance levels are 1%(*), 5%(**) and 10%(***), respectively.
- The third and fourth rows show the $\bar{R}^2$ statistics and the number of observations, respectively.
- Cells in rows five and six containing numbers in italics correspond to the cases where the government budget is statistically significant.
- Row five shows the estimated value of δ_i and row six shows its *t*-statistics. Where no results are given for this estimation the government budget is not statistically significant.

during the first period. As in the preceding table, the results with the inclusion of $GB_{i,t}$ (with numbers in italics) are reported only when the government budget is statistically significant. In those cases, $GB_{i,t}$ clearly improves the statistical quality of the results.

Table 9 reports the results of the regression for GDP growth on a quarterly basis. Estimations are limited to the two shorter samples for reasons of data availability. Since the inclusion of $GB_{i,t}$ delivered non-statistically significant estimations, the corresponding results are not reported in the table. As can be seen, in the majority of cases IT significantly reduces the variability of GDP growth. However, results concerning average growth are less conclusive. In some cases, the impact is positive (Brazil and Peru during the period 1996-2007), but in most cases it is non-significant or even negative (Chile, 1992-2007, and Mexico, 1996-2007).

2. Panel regressions

In this section we perform panel regressions that include one dummy deemed to capture the differences in the macroeconomic results between ITers and NITers.

Consider the following equation:

$$x_{i,t} = \alpha + \delta F_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where $x_{i,t}$ stands for the interest variable, and $F_{i,t}$ is a dummy variable that takes the value 1 for the observed data from IT countries and the value 0 for data from NIT economies. The parameter δ measures the difference (on average) between the $x_{i,t}$ values of the two groups of countries.

We run regressions for the three variables of interest —the rate of inflation, the bank deposit interest rate and GDP growth— using monthly and quarterly data over the period from January 2000 to December 2007. The variables are defined and measured in the same way as in section II.2(a).

Table 10 shows the results for all the regressions. As can be seen, the estimated values of δ always have the appropriate sign and are statistically significant (at the 1% level) except for the level of GDP growth. The results referring to the rate of inflation (presented in the first two columns) indicate that the IT group obtained an average rate of inflation 4.95 percentage points lower

TABLE 9

Latin America (five countries): gdp growth

Country	GDP growth			
	1992:QI - 2007:QIV		1996:QI - 2007:QIV	
	Level	Standard Deviation	Level	Standard Deviation
Brazil	0.59	-0.27**	1.51*	-0.25
	(1.37)	(-2.02)	(4.26)	(-1.57)
	0.34	0.05	0.59	0.04
	61	58	48	48
Chile	-1.86*	-0.46*	-0.98	-0.39**
	(-3.23)	(-3.10)	(-1.55)	(-2.14)
	0.39	0.25	0.33	0.25
	61	58	48	48
Colombia	0.45	0.04	0.67	0.04
	(0.73)	(0.18)	(1.05)	(0.18)
	0.58	0.22	0.59	0.22
	52	49	48	46
Mexico	-0.55	-0.62**	-1.93**	-0.81*
	(-0.78)	(-2.59)	(-2.67)	(-3.17)
	0.14	0.08	0.30	0.15
	61	58	48	48
Peru	1.01	-1.09*	2.45*	-1.03*
	(1.17)	(-7.12)	(3.88)	(-6.15)
	0.27	0.46	0.55	0.44
	61	58	48	48

Source: Statistical data from the website of the Economic Commission for Latin America and the Caribbean (ECLAC).
Note: Quarterly data. The first row shows the estimated value of δ_i.
The second row presents the *t*-statistics under the null hypothesis H_0: $\delta_i = 0$. The significance levels are: 1%(*) and 5%(**), respectively.
The third and fourth rows show the $\overline{R}^2$ statistics and the number of observations, respectively.

TABLE 10

Cross-section regressions

	Jan. 2000 - Dec. 2007		Jan. 2000 - Dec. 2007		2000:QI – 2007:QIV	
	Inflation rate (Monthly data)		Interest rate (Monthly data)		GDP growth (Quarterly data)	
	Level	Standard Deviation	Level	Standard Deviation	Level	Standard Deviation
IT	-4.95	-1.71	-2.60	-1.20	0.12	-0.37
	(-7.63)*	(-8.93)*	(-5.14)*	(-6.39)*	(0.30)	(-3.19)*
	1 440	1 440	1 440	1 440	480	480
	0.04	0.05	0.02	0.03	-0.02	0.02

Source: Statistical data from the website of the Economic Commission for Latin America and the Caribbean (ECLAC) and International Monetary Fund, International Financial Statistics.
Note: The first row shows the estimated value of δ.The numbers in parentheses show the *t*-statistics under the null hypothesis H_0: δ = 0. The significance level is 1%(*). Rows three and four show the number of panel observations and the $\overline{R}^2$ statistics, respectively. The IT countries include Brazil, Chile, Colombia, Mexico and Peru. The group of NIT countries is made up of Argentina, Bolivarian Republic of Venezuela, Costa Rica, Dominican Republic, Ecuador, El Salvador, Panama, Paraguay, Plurinational State of Bolivia and Uruguay.

than that of the NIT group. The IT group also improved the results concerning the variability of the inflation rate: the standard deviation decreased by 1.71 percentage points with respect to the NITers. As regards the nominal interest rate (third and fourth columns), the improvements afforded by the IT regime are also evident in terms of both lower levels and decreased variability.

The results referring to GDP growth deserve additional comments. First, they are obtained using quarterly data (480 observations). Second, although the impact parameter has the correct sign, the estimated value is very small and not statistically significant: t-statistics equal to 0.30. Third, IT clearly decreases GDP growth variability, since the impact variable has a negative sign and is statistically significant at the 1% level. IT contributed to reducing growth rate variability by an average of 0.37 percentage points in ITers compared with NITers. These results fully confirm our findings in the time regression analysis of GDP growth effects, where the advantage of ITers compared with NITers was detected in variability but not in levels.

3. Treatment effects

The way that the econometric tests applied so far assess the influence of qualitative variables, such as the adoption of IT, may suffer from endogeneity problems. To overcome this difficulty, in this section we estimate a model of treatment effects that is especially designed to investigate the impact of non-observable variables on quantitative ones and to solve the self-selection bias. We apply the model suggested by Heckman (1979), Maddala (1983) and Greene (2003) to estimate the effects of IT on the mean and variability of the three interest variables. The method consists of two sequential estimations. We first estimate a *probit* equation, which aims at assessing the extent to which some variables proposed in the empirical literature affect the probability of adopting an IT regime, and then three *outcome* equations that relate each interest variable with its main determinants, including the adoption of IT. The model is as follows:

$$y_{it} = \beta' x_{it} + \delta IT_{it} + u_{it} \quad (3)$$

$$IT_{it} = \begin{cases} 1 & if\ IT^*_{it} > 0 \\ 0 & otherwise \end{cases} \quad (4)$$

$$IT^*_{it} = \gamma' w_{it} + \zeta_{it} \quad (5)$$

Equation (3) is the outcome equation valid for each interest variable y_{it}. It shows that y_{it} (the value of y in country i during quarter t) has two main determinants: vector x_{it}, which includes a set of observable variables liable to affect y_{it}, and a dichotomy variable, IT_{it}, which takes the value *1* if country i in period t is an ITer, and the value *0* otherwise, as indicated by the expression (4). Regarding the components of vector x_{it}, we have selected four variables included in standard macroeconomic models, i.e. gross formation of fixed capital ($gffk_{it}$), international openness ($open_{it}$), the growth rate of the money supply (m_1) and the public deficit as a percentage of GDP (def_{it}). The parameter δ measures the effect of adopting IT on variable y_{it}.

Columns two to four of table 11 describe the hypothesized signs of the effects of the exogenous

TABLE 11

Hypothesized signs in the treatment effects equations

	Output equation			Probit equation
Control variable	Inflation rate	Short-run interest rate	GDP growth	
$gffk_{it}$			+	
$open_{it}$	–	–	+	–
IT_{it}	–	–	+/-	
m_1	+	–		
def_{it}	+/-	+/-		+/-
dep_{it}				+
ca_{it}				–
$extdebt_{it}$				–

Source: The authors, on the basis of conventional macroeconomic models.

variables on the levels of the three endogenous ones in the outcome equations. As far as the nominal variables (inflation and interest rates) are concerned, it seems clear that openness should result in a drop in both nominal levels. Moreover, the rate of money growth is deemed to increase inflation and reduce short-run interest rates. However, there are no conclusive reasons for the sign of the fiscal deficit. If fiscal deficits are predominantly debt-financed, they should push up interest rates and lower inflation. But if they cause money expansions, effects in the opposite direction must be expected. As regards the effects on economic growth, the first two variables of vector x_{it} are expected to impact positively. The favourable impact of $gffk_{it}$ on growth is extensively documented in the traditional models of economic growth, and the positive contribution of international openness to economic growth is empirically demonstrated by proponents of the export-led growth hypothesis (see, for instance, Feder, 1983; Helpman and Krugman, 1985; and Krugman 1987) and by the endogenous growth theory (Romer, 1986; Grossmann and Helpmann, 1995; and Alesina and Rodrick, 1999). Empirical evidence of the positive effects of international trade on economic growth for some groups of EMEs is provided by Hassan (2005) and Ekanayake, Vogel and Veeramachenemi (2003).

Equation (5) is the probit equation, establishing that the probability of adopting IT is represented by a non-observed variable IT^*_{it}, which in turn depends on a set of factors included in vector w_{it}. After looking at the potential determinants of IT that have been most frequently suggested in the literature —see, for instance, Gerlach (1999), Hu (2006), Batini and Laxton (2007) and Leyva (2008)— we have selected the following variables: (i) fiscal deficit, (ii) economic openness, (iii) the strength of financial development, (iv) vulnerability to external shocks, and (v) the amount of external liabilities denoted in foreign currency.

Let us now explain how the variables included in the probit equation are measured, and the sign of their expected influence on the probability of adopting an IT regime (see column four of table 12). The fiscal deficit is measured as a percentage of GDP and, as in the case of the outcome equation, there are no definitive arguments to clearly hypothesize the sign of this variable. On the one hand, central bank independence (an important ingredient of IT regimes) forces governments to adopt more austere fiscal policies but, on the other hand, the adoption of IT might be endogenously decided as a remedy for weak public budgetary practices. Consequently, either of the two signs may be expected. Economic openness is measured with the amount of imports plus exports as a share of GDP. Since openness increases the rate of pass-through from exchange-rate variations to domestic prices, it interferes with the control of inflation and discourages the central bank from adopting IT. This is especially true in emerging market economies because their pass-through coefficients are higher than those of the industrialized countries (García-Solanes and Torrejón-Flores, 2010). Moreover, as emphasized by Mishkin (2001), Eichengreen (2002) and Willet (2002), increasing trade and financial openness under exchange-rate flexibility may cause financial instability in EMEs with IT. Thus, it is reasonable to expect a negative relationship between openness and the probability of adopting IT.

The soundness, health and development of a financial system may be proxied by the total amount of bank deposits as a share of GDP. Given that this variable

is a key element —if not a prerequisite— of IT strategy, we may assume that it contributes to the adoption of IT. Then, the sign of its effects on the adoption of IT must be positive. We measure vulnerability to external shocks with the current account deficit. High external imbalances make the central bank less inclined to adopt IT, which indicates that the sign of this variable should be negative. Finally, the amount of external liabilities in foreign currencies is measured with the stock of external debt denoted in foreign currency. It is easy to understand that, since high levels of this variable hinder the operation of flexible exchange rates, external liabilities reduce the probability of adopting IT.[3] Consequently, the minus sign is our guess.

To estimate the system (3) to (5), we may apply either the maximum likelihood method, or the two-step procedure suggested by Heckman (1979), which has been well explained by Maddala (1983) and Greene (2003) and used by Edwards (2004). Given that we have chosen the two-step methodology, a brief explanation of it is in order. In the first step, we apply the *probit* method to estimate the parameter γ, which is then used in equation (5) to estimate the variable IT^*_{it}. The result is applied in equation (4) to derive the dichotomy variable IT_{it}. In the second step, we estimate the output equations. However, in order to obtain a consistent and non-overestimated value of the parameter δ in equation (3) we must incorporate in that equation the variable $\hat{\lambda}_{it}$, which is defined as the ratio between the density function and the accumulated distribution of IT^*_{it} : $\hat{\lambda}_{it} = f\left(I\hat{T}^*_{it}\right) / F\left(I\hat{T}^*_{it}\right)$ (see Greene, 2003, chap. 22). Consequently, we estimate the enlarged equation, $y_{it} = \beta' x_{it} + \delta IT_{it} + \beta_{\hat{\lambda}}\hat{\lambda}_{it} + \xi_{it}$, to obtain the values of the parameters β, $\beta_{\hat{\lambda}}$ and δ.

Table 12 reports the estimation results of the system (3)-(5) for the three interest variables. As far as the probit equation is concerned, all the variables selected as determinants of the probability of adopting IT have the hypothesized sign and are statistically significant at the 1% level, which means that the probability of adopting the IT regime is very well captured by the selected variables and is favoured by the occurrence of the following factors: (i) fiscal imbalances, (ii) limited economic openness, (iii) strength of the domestic financial system, (iv) low current account deficits, and (v) low levels of external debt.

As regards the outcome equations, all estimations exhibit very good statistical quality. However, there are important differences between them. Thus, the level and variability of both inflation and short interest rates are very well explained by openness, money supply growth, public deficit and IT. All these determinants exhibit the hypothesized signs presented in table 11. Interestingly, money supply growth significantly affects the interest rate level but not its volatility. The most relevant finding is that IT has a clear negative and significant incidence in both the level and volatility of inflation and interest rates, confirming the results of the former sections. Turning now to the growth equation, the results presented in columns 5 and 6 of table 12 indicate that economic growth is favoured by gross formation of fixed capital and by international openness. Adoption of the IT regime contributes significantly to lowering variability growth, but it does not significantly impact the level of GDP growth, confirming, once again, our previous findings in this paper. This result is unsurprising since the effects of IT on growth should appear over time horizons longer that those of our samples.

[3] Although debt dollarization is a clear obstacle to IT implementation, it does not per se preclude the use of IT as an effective policy regime. The case of the shighly dollarized Peru is a good example, as shown by Leiderman, Maino and Parrado (2006).

TABLE 12

Treatment effects: the impact of inflation targeting
(2000:QI - 2007:QIV)

Treatment variable: application of the inflation-target strategy (IT^{*}_{it}). Probit equation.	
Variable	IT
c	5.468* (8.769)
def_{it}	0.142* (4.305)
$open_{it}$	-0.064* (-9.631)
dep_{it}	0.089* (8.070)
ca_{it}	-0.214* (-7.051)
$extdebt_{it}$	-0.100* (-8.810)

	Outcome variable					
Variable	Inflation	Inflation standard deviation	Interest rate	Interest rate standard deviation	GDP growth	GDP growth standard deviation
c	5.045*** (1.656)	0.570 (0.655)	22.869* (9.916)	2.100** (2.517)	0.149 (0.148)	1.178* (4.117)
$gffk_{it}$					0.159* (3.681)	-0.014 (-1.012)
$open_{it}$	-0.102* (-6.285)	-0.022* (-4.840)	-0.078* (-6.306)	-0.027* (-5.970)	0.010*** (1.681)	-0.013* (-5.641)
IT_{it}	-3.362** (-1.966)	-1.118** (-2.289)	-7.290* (-5.633)	-1.177** (-2.514)	0.062 (0.329)	-0.236** (-1.923)
$\hat{\lambda}_{it}$	17.188* (3.527)	4.110* (2.951)	-6.964*** (-1.888)	1.918 (1.437)	-0.037 (-0.139)	1.709* (3.635)
m_1	0.088** (2.257)	0.049* (4.383)	-0.083* (-2.821)	0.017 (1.570)		
def_{it}	0.297*** (1.613)	0.152* (2.882)	-0.325** (-2.330)	-0.102** (-2.023)		
Observations	480	480	480	480	480	480
σ					0.291	
ρ					0.126	

Source: Statistical data from the website of the Economic Commission for Latin America and the Caribbean (ECLAC) and International Monetary Fund, International Financial Statistics.
Note: Level of significance: 1% (*); 5% (**) and 10% (***). Values within parentheses are the quartiles of the typical normal distribution (in the probit estimation) and the values of the *t*-statistics (in outcome estimations).

IV
Concluding Remarks

In this paper we have analysed the extent to which inflation targeting has improved macroeconomic performance in a group of five Latin American countries during their post-IT period. To evaluate the results in relative terms, we have taken as a benchmark 10 Latin American countries that share many institutional features with the five ITers, except for the adoption of an IT regime. We expect that geographical and institutional homogeneity serves to extract more clearly the specific effects of IT.

In order to get a first impression of the likely results of IT on both the average levels and the variability of some domestic variables, in the second section we performed a descriptive analysis and statistical tests with data for the fifteen Latin American countries. In the third section, we applied three different econometric tests to more accurately assess the impact of IT. In the first two econometric tests, based on time series and panel regressions, we used dummy variables to indirectly evaluate the effects of IT on some macroeconomic variables. Since the results of these conventional tests may be affected by endogeneity and self-selection problems, in order to overcome those shortcomings we estimated a treatment effects model especially suited to evaluating the impact of qualitative variables (such as the adoption of IT) on other variables that are easily quantified (such as inflation, interest rates and GDP growth). This is the main and original technical contribution of this paper, compared with the available literature in this field. The results from the three econometric tests confirm the descriptive impressions, signalling IT as responsible for lower levels and variability of both inflation and short-run interest rates and decreased growth variability in the countries that adopted this regime. However, none of the three econometric tests was able to clarify the effects of IT on average GDP growth. In sum, we provide evidence that adoption of IT in the five Latin American ITers of our sample improved economic performance during the investigated period, probably by anchoring and lowering inflation expectations in those countries.

(Original: English)

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The performance of Chinese and Brazilian exports to Latin America, 1994-2009

Marcos Tadeu Caputi Lélis, André Moreira Cunha and Manuela Gomes de Lima

ABSTRACT This article analyses the structure of Brazilian and Chinese exports to Latin American markets, for the purpose of evaluating the repercussions of China's emergence as a global power and major trading partner of the countries of the region. An estimation of several international trade and competitiveness indicators shows that Chinese exports, particularly manufactured goods, are displacing Brazilian products on the regional market; and this poses a potential threat to Brazil.

KEYWORDS Exports, Brazil, China, Latin America, measurement, evaluation, trade statistics, economic indicators, competitiveness

JEL CLASSIFICATION F14, O57, O54

AUTHORS Marcos Tadeu Caputi Lélis, Professor at Universidade do Vale do Rio dos Sinos (UNISINOS) and Coordinator of the Business Intelligence Unit of the Brazilian Trade Promotion Agency (Apex-Brasil). mcaputi@uol.com.br

André Moreira Cunha, Professor at the Department of Economic Sciences of the Federal University of Rio Grande do Sul (UFRGS) and Research Fellow at the National Council for Scientific and Technological Development (CNPq). andre.cunha@ufrgs.br

Manuela Gomes de Lima, Analyst at the Business Intelligence Unit of the Brazilian Trade Promotion Agency (Apex-Brasil). manuela.lima@apexbrasil.com.br

I
Introduction

In the first decade of the twenty-first century, China consolidated its position as a global economic power and the projection of its very wide-ranging influence. The six-monthly reports produced by the International Monetary Fund (IMF) and other multilateral agencies and research centres were already showing that Chinese growth, in conjunction with the expansion of the United States economy, accounted over half of the rate of growth of world income in the 2003-2008 cycle.[1] The current crisis has not altered this situation. On the contrary, the vigorous performance of the Chinese economy was reaffirmed in 2009, when its gross domestic product (GDP) grew by 8.7%;[2] and with its economy projected to grow at rates of 9% - and 10% over the next few years, while the world's mature economies remain difficulty, China will continue to climb the international ranking.[3]

Against this backdrop, various studies are being undertaken to evaluate the repercussions on Latin America of China's rise to world power status.[4] This article forms part of that line of research, with an analysis that focuses on the period subsequent to the world financial crisis. A number of indicators are constructed of the performance of Brazilian and Chinese exports in the region. The analysis starts from a Brazilian perspective in which the Latin American market, particularly South America, has been vital for absorbing Brazil's manufactured exports. It can clearly be seen that Chinese exports are advancing into the spaces previously occupied by Brazilian suppliers. The article's main hypothesis is that China will seek to maintain diversified destination markets, while gradually reducing its reliance on the industrialized countries, which have been hit harder by the global financial crisis. In the framework of a "new normality", emerging country markets, including Latin American ones, are likely to be more vigorously contested (Gross, 2009; Spence, 2009), and this could displace Brazilian manufactured exports still further. It is argued that exports are the key to keeping China's internationalization strategy active, and thus guarantee stability in the country's modernization path.[5]

Following this brief introduction, the article is divided into three sections. Section II reviews the performance of Chinese exports worldwide in recent years, while section III compares the performance of Chinese and Brazilian exports in Latin America and identifies potential sectors in which Chinese exports could render Brazil less competitive. Final comments are made in section IV.

☐ The opinions expressed in this article are the authors' exclusive responsibility and do not necessarily coincide with the official position of the institutions to which they are affiliated.

[1] See http://www.imf.org/external/ns/cs.aspx?id=29 (access in May 2010, "China Quarterly Update" published periodically by the World Bank (http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/CHINAEXTN/0,contentMDK:20652127~pagePK:141137~piPK:141127~theSitePK:318950,00.html, viewed in May 2010); The annual Trade and Development Report published by the United Nations Conference on Trade and Development (UNCTAD) and the Annual Report of the Bank for International Settlements (BIS), among other publications.

[2] In 1990, China's GDP represented 4.2% of the world total, measured in purchasing power parity (PPP) dollars. In 2009, the proportion had grown to 12.5%.

[3] On the rise of China, see, among others, Goldman Sachs (2007); Bijian (2006); Kang (2007); Naughton (2007); Kurlantzick (2007); National Intelligence Council (2008).

[4] Castro (2008); CAF (2006); Devlin, Estevadeordal and Rodríguez-Clare (2006); Lederman, Olarreaga and Perry (2008); ECLAC (2009).

[5] See Bijian (2006) and Kurlantzick (2007).

II

The performance of Chinese exports in world trade

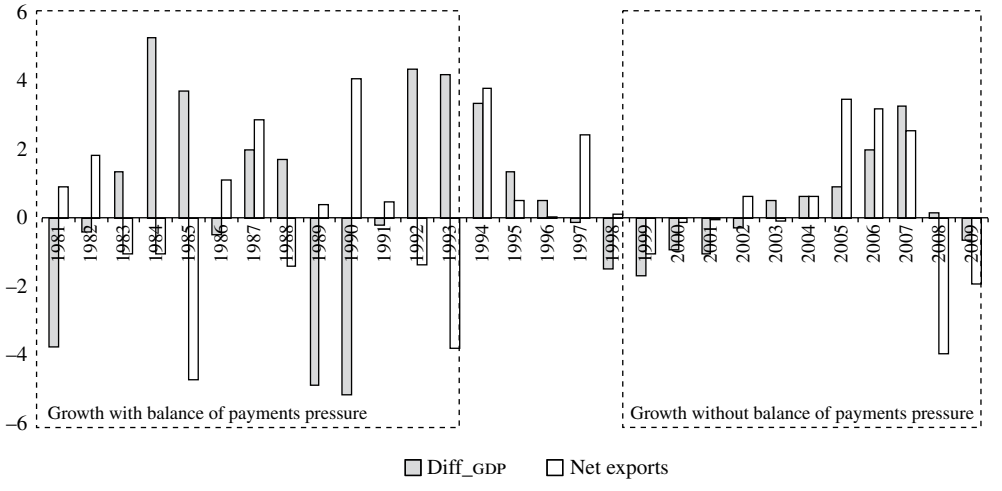
The first decade of the twenty-first century saw China become a member of the World Trade Organization (WTO) in 2001, as foreign trade and financial flows from that country increased sharply as a proportion of world totals (Naughton, 2007; Goldman Sachs, 2007; UNCTAD (2009; ECLAC, 2009; Sen, 2010). This section seeks to analyse a number of aspects of that involvement and recent changes. The analysis starts from two empirical findings relating to the period 1981-2009. Firstly, since mid-1999, Chinese GDP growth has surpassed the average for the reference period, without a deterioration in the contribution made by its net exports to GDP growth (see figure 1).[6] This stands in contrast to the pattern of previous years, when the acceleration in growth reduced the external sector's contribution to the country's overall economic performance. Secondly, as seen in figure 1, and particularly figure 2, since 2007 there has been a pronounced contraction in the contribution made by exports to income growth. Gross fixed capital formation (GFCF) now seems to be driving Chinese growth.[7]

[6] Net exports are defined as the balance between exports and imports of goods and non-factor services in local currency. The contribution made by net exports to GDP growth represents the percentage directly contributed by that aggregate to the rate of income growth. Thus, a negative value would indicate a negative contribution to the GDP growth rate, whereas a positive value would represent a positive contribution. The source of the raw data is Euromonitor International (www.eromonitor.com).

[7] On the debate over the factors driving Chinese growth, see, for example, Prasad and Rajan (2006); Naughton (2007); Sen (2010); Felipe and others (2010).

FIGURE 1

China: Difference between the average and annual rates of gdp growth and contribution of net exports to gdp growth, 1981-2009
(Percentages)

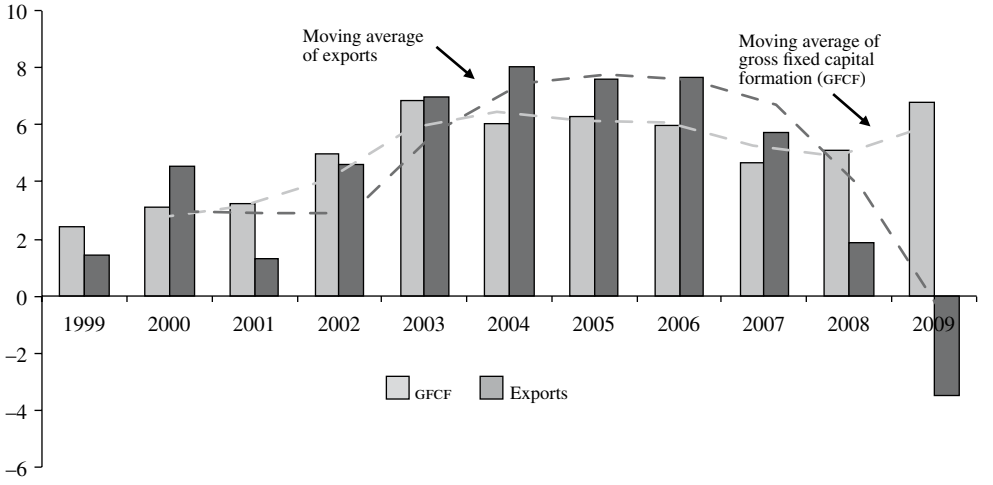


Source: Euromonitor International (www.eromonitor.com).
Note: Diff_GDP: Difference between average and annual GDP growth rates.

GDP: Gross domestic product.

FIGURE 2

China: Contribution of gfcf and exports to gdp growth and their respective two-year moving averages, 1999-2009
(Percentages)



Source: Euromonitor International (www.euromonitor.com).

Nonetheless, from strategic standpoint,[8] the external sector is a key factor in the dynamism of Chinese growth.[9] Job creation and the generation of income and investments linked to the export sector are cited as key elements of that country's modernization process (Rodrik, 2006; Bijian, 2006; Naughton, 2007; Sen, 2010; Felipe and others, 2010). Although its larger net creditor position — stemming from a substantial accumulation of assets denominated in foreign currencies during recent years — has mitigated balance-of-payments sustainability risks, the deterioration of the trade account is permanently monitored by Chinese economic policymakers. In the years before the period of economic expansion in the first decade of the twenty-first century, productive modernization depended on access to foreign currency, guaranteed by both exports and borrowing, together with access to foreign investment (Wu, 2005).

As noted in the introduction, this article sees the quest for new export markets as crucial to China's development strategy. Consequently, despite the downtrend in China's net exports, its traditional markets, particularly the United States and Europe, are expected to continue to face economic difficulties in the next few years. In that context, and given Latin America's economic growth prospects for the next few years, this region is becoming a target for the expansion of China's external sales. Based on these premises, it is interesting to note the spread of China's trade before and after the world financial crisis, for which various indicators are calculated of the performance of China's international trade.

The first of these is China's trade intensity index (TII) with specific regions: United States, Asia, excluding Hong Kong (Special Administrative Region of China), Macau and Taiwan Province of China, the euro zone,

[8] See Yufan Hao, Wei and Dittmer (2009).

[9] Export growth is assumed to provide two basic benefits to an economy's development process (McCombie and Thirlwall, 1993; Thirlwall, 2003). The first of these relate to the effects on the process of expanding material prosperity in society and can be subdivided into two aspects: (i) exports are directly related to higher income in society; and (ii) export growth can create a virtuous circle of economic expansion based on the link between the production growth and productivity increase. The second benefit concerns the capacity to increase the country's income without putting pressure on the balance of payments. In other words, a continuous export growth dynamic makes it possible to finance the region's internal demand for imported goods through its own external sales, thereby facilitating rapid economic development in the country and reducing reliance on financing through the capital and financial account. In the last few years, the external financial constraint has not posed a major problem for China (Bijian, 2006), among other things because positive net exports contribute to achieving a net creditor external position.

the United Kingdom of Great Britain and Northern Ireland,[10] Africa and Latin America, except for Brazil.[11] This indicator is defined using the following structure:

$$TII_{j,i} = \frac{m_{i,j} / M_{i,w}}{x_{j,w} / X_{w,w}}$$

Where: $m_{i,j}$ = Imports of country i from country j; $M_{i,w}$ = Imports of country i from the world; $x_{j,w}$ = Exports from country j to the world; $X_{w,w}$ = Total world exports.

This index shows the extent to which exports from region j to region i are greater (or less) than expected, given the relative importance of region j in international trade. A value above 1 indicates that the exports of j to i are greater than expected, given share of region j in international purchases.[12] Figure 3 shows the Chinese economy's TII with the regions mentioned between 1994 and 2008.[13] The vertical dotted lines represent the difference between the minimum and maximum values of trade intensity recorded each year.

In general, China's trade intensity has increased with regions that had lower index at the start of the reference period, and there is a movement en bloc. At the same time, there is a slight reduction in the Chinese economy's TII with regions displaying a high index at the outset, thereby reducing the TII differential between regions. As a counterpart, the TII with the euro zone remained virtually stable. Nonetheless, non-European

[10] The United Kingdom of Great Britain and Northern Ireland was included in the analysis because it does not belong to the euro zone, and because there has been a substantial movement in the trend of China's TII with that group.

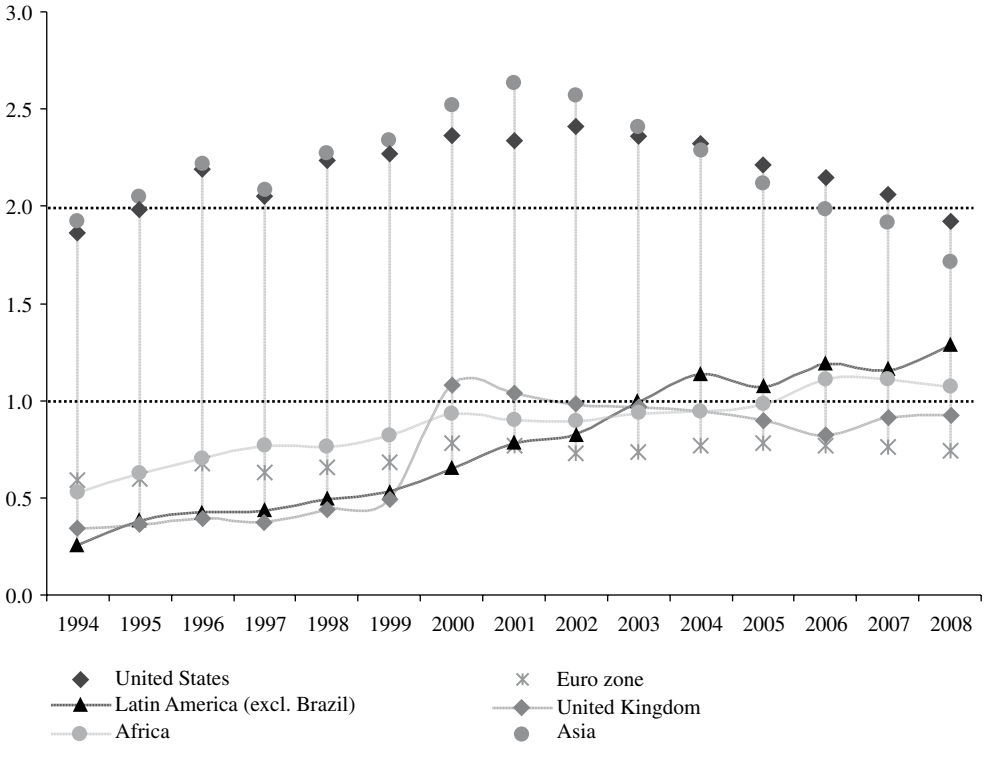
[11] In this article, Latin America, excluding Brazil, is defined as comprising the following countries: Argentina, Bolivia (Plurinational State of), Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela (Bolivarian Republic of).

[12] For further details see Hoekman, Mattoo and English (2002).

[13] Figure 3 uses data from the United Nations Commodity Trade Statistics Database (COMTRADE). As consolidated data for 2009 were not available, that year is excluded. This also applies to other information obtained from this source.

FIGURE 3

China: Trade intensity index (tii) with selected regions, 1994-2008



Source: United Nations Commodity Trade Database (COMTRADE).

Union countries face well-known difficulties in increasing their trade intensity with that bloc, since that indicator is a relative measure of the intensity of exports from one region to another. Consequently, given the trade intensity within the bloc and the dynamic of openness to new markets for Chinese exports, the index ultimately remains constant. Nonetheless, the proportion of imports from China in the euro zone's total global purchases grew in absolute terms from 1.9% in 1994 to 6.3% in 2008. Despite the increased share of Chinese products in the euro zone's external purchases, the equivalent proportion grew more strongly in other regions, specifically in the United Kingdom, Africa and Latin America. Accordingly, the movements of those three regions are highlighted in figure 3.

Table 1 shows details of the deconcentration dynamic of China's export destinations, which to some extent could be discerned in the TII and indicated in figure 3.[14] For that purpose the concentration ratio (CR) is used, which represents the share of the main trade partners in China's total exports. The value of CR(1) represents the share of China's exports sent to its main trading partner, while CR(2) represents the same indicator for the two leading partners, and so on.

The CR(15) index shows a sharp deconcentration in China's export destinations, with this trend intensifying after 1999, defined above as "Growth without balance of payments pressure". The deconcentration dynamic seems to have been provided mainly by the movement recorded within CR(2). Moreover, despite the increasing intensity of China's trade with the African continent and with Latin America, no country from those regions is included in the 15 main destinations for China's exports. This shows that the growth in China's trade intensity with Latin America and Africa occurred without causing major alterations in its preferential export destinations. In other words, China's external sales are consolidating in its main destinations, while gaining new positions in international trade at the same time.

This demonstrates the exceptional capacity of the Chinese economy to expand its export supply, given the size of its workforce and rate of growth of his productive base.[15] Figure 4 shows that these movements occurred without causing China's exports to become more sectorally concentrated. The index of the sectoral concentration of exports used is the Herfindahl-Hirschman index (HHI), which is defined as follows[16]:

$$HHI_j = \sum_{k=1}^{n} \left(\frac{x_{j,k}}{X_{j,w}} \times 100 \right)^2$$

Where: $x_{j,k}$ = Exports of sector k by country j; $X_{j,w}$ = Worldwide exports from country j.

On the scale of this indicator, a result below 1,000 means a low concentration, whereas an HHI between 1,000 and 1,800 reflects moderate concentration, and a

TABLE 1

China: Concentration index (CR) 1995, 1999, 2004, 2008 and 2009
(Percentages)

	China in the world				
	1995	1999	2004	2008	2009
CR(1)	25.2	26.5	25.4	20.4	21.3
CR(2)	47.1	47.0	40.3	29.8	30.7
CR(3)	53.1	52.0	46.0	35.7	35.9
CR(4)	58.1	56.9	50.8	40.5	40.7
CR(5)	61.2	60.3	54.5	44.2	44.2
CR(10)	72.8	72.5	66.8	57.1	57.1
CR(15)	79.9	79.1	75.1	66.5	66.4
	Main destinations – rank				
United States	2	1	1	1	1
Japan	1	2	2	2	2
Republic of Korea	3	3	3	3	3
Germany	4	4	4	4	4
Netherlands	6	5	5	5	5
England	8	6	6	6	6
Singapore	5	7	8	8	7
India	23	21	17	9	8
France	10	9	9	13	9
Australia	13	11	12	14	10
Taiwan Province of China	7	8	7	11	11
Italy	9	10	10	10	12
Malaysia	16	16	14	16	13
United Arab Emirates	17	18	15	12	14
Canada	14	12	13	15	15

Source: Global Trade Information Services (GTIS).

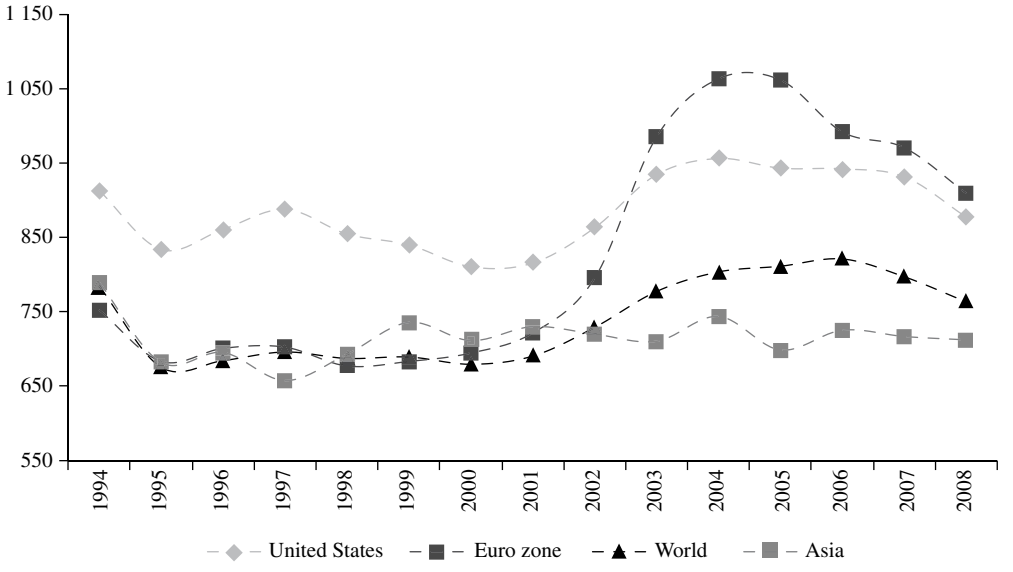
[14] The reader is reminded that China's trade with Hong Kong (Special Administrative Region of China), Macao and Taiwan Province of China is excluded.

[15] Deutsche Bank data estimate the average annual growth of China's investments at 12% between 1990 and 2009, and 14.5% per year between 2001 and 2009. Industrial production also grew by an average of 10% per year over the last 20 years (http://www.dbresearch.de, viewed in May 2010).

[16] The indicator was calculated on the basis of the sectors defined by the National Classification of Economic Activities (CNAE), at the two-digit level. In the 1990s, the CNAE was developed by the Brazilian Institute of Geography and Statistics (IBGE) in conjunction with administrative record-keeping agencies, for the purpose of standardizing Brazil's economic data. The reference used in preparing the CNAE was the International Standard Industrial Classification of all Economic Activities (ISIC), produced by the United Nations Statistics Division.

FIGURE 4

China: Herfindahl-Hirschman index of sectoral concentration of the export schedule, 1994-2008



Source: United Nations Commodity Trade Database (COMTRADE).

higher value indicates an export schedule concentrated in few sectors. For further details of the HHI see Resende and Boff (2002).

The concentration of China's total external sales vary between a minimum of 675 and a maximum of 820 in the reference period, reaching a level of 763 in 2008. This represents a low-concentration model. There was a significant change in the HHI of China's exports to the United States and the euro zone between 2002 and 2005.

Given the changes in the relative importance of the different sectors in the Chinese export basket, the composition of external sales in terms of technological intensity changed between 1996 and 2008,[17] as shown in table 2.

The proportion of labour-intensive products in China's export basket declined considerably between 1996 and 2008. At the same time there has been increase in manufactures produced by specialized suppliers, goods intensive in economies of scale and those intensive in research and development (R&D). The sectors indicated as manufactures produced by specialist suppliers relate to specially commissioned capital goods. Goods intensive in economies of scale include the automotive, iron and steel industries, along with consumer electronics (mainly video, audio, and white-line appliances). China's exports are dominated by the sectors manufacturing radio and television receivers and sound and video reproduction, recording or amplification, and the manufacture of electrical appliances. Sectors involving R&D-intensive products are fine chemicals, electronic components, telecommunications, and the aerospace industry. The sector manufacturing telephony and radio telephony apparatus and equipment, and television and radio transmitters, accounts for the largest share of China's external sales. This reflects another distinctive feature of China's performance in world trade: the capacity to add value to products in the export basket in a relatively short space of time.

[17] See the methodology described by Pavitt (1984), expanded by Holland and Xavier (2004).

TABLE 2

China: Exports and imports by technological intensity, 1996 and 2008
(Percentages)

Type	Exports		Imports	
	1996	2008	1996	2008
Commodities	8.7	2.8	9.3	24.6
Natural-resource-intensive products	10.4	8.2	17.9	14.7
Labour-intensive manufactures	44.9	26.9	21.0	8.5
Economies-of-scale-intensive manufactures	17.1	22.7	12.6	9.2
Manufactures produced by specialized suppliers	10.5	22.9	26.0	17.0
R&D-intensive manufactures	7.7	16.3	13.1	25.7
Unclassified	0.7	0.1	0.0	0.4
Total	*100*	*100*	*100*	*100*

Source: Global Trade Information Services (GTIS).

III

The performance of Chinese and Brazilian exports in Latin America

The previous section highlighted China's capacity to diversify its export markets and products and add greater value to its export basket. Given these characteristics, this section seeks to compare the recent path of Brazilian and Chinese exports in Latin America, to determine whether Brazilian exports risk being displaced in the region as a result of China's expansion. The initial analysis focuses on industrial exports. Figure 5 shows the estimated trend of the value of exports from sectors related industry in the Brazilian and Chinese economies to Latin American countries (in billions of dollars).[18] The periods in which there were changes in those trends are also indicated. It should be remembered that indicators showing the relation between the Chinese economy and Latin American countries do not include Brazil.

When estimating the behaviour of the trend in a given time series, components associated with irregularities, seasonality, and cycles are eliminated to obtain a more robust observation of the movement of the series. Both the trend of Brazilian manufactured exports to Latin America (Brazilian trend), and the trend of Chinese exports to the same destination (Chinese trend) moved sharply upward as from 2003, when the region started to grow more vigorously (ECLAC, 2009). Nonetheless, since the second quarter of 2007, the value of the trend of China's industrial exports to Latin America has surpassed the equivalent aggregate for the Brazilian economy. Figure 6 more clearly illustrates the dynamic of the difference between the two trends. The positive values indicate that the trend of Brazilian exports is above the trend of Chinese exports, whereas negative values indicate the reverse.

Figure 6 also shows that in 2009, when the global crisis had a major dampening effect on international trade, the difference between the Brazilian and Chinese trends was narrowing. The same conclusion arises from figure 5, which shows that the difference in the two trends widens in the initial recovery following the crisis.

Having evaluated the behaviour of industrial exports based on the respective trends, the analysis now focuses on the Chinese and Brazilian trade intensity indices with Latin America. The aggregate used to calculate this index is each country's' total exports to the Latin American region excluding Brazil. Table 3 shows China's and Brazil's TII with Latin American countries, and each country's share in Latin America's external purchases.

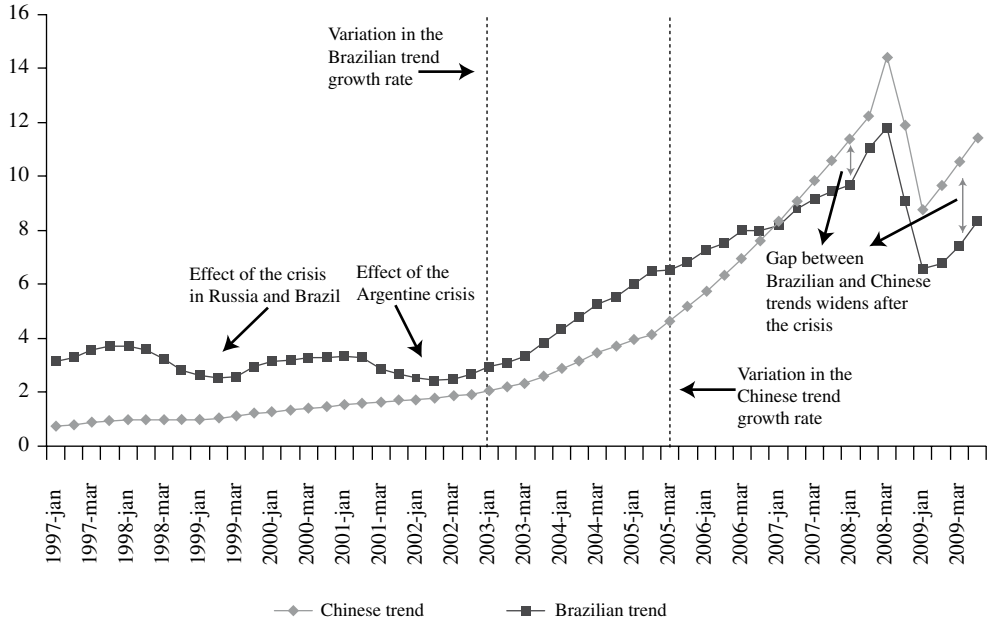
Although the Chinese trend outperformed Brazil's, China's trade intensity with Latin America is still less

[18] The statistical method used to estimate the trend is that applied in univariate structural time-series models. For further details see Harvey (1989); Commandeur and Koopman (2007).

FIGURE 5

Estimated trend of Brazilian and Chinese industrial exports to Latin America, quarterly data from 1997 to 2009

(Billions of dollars)

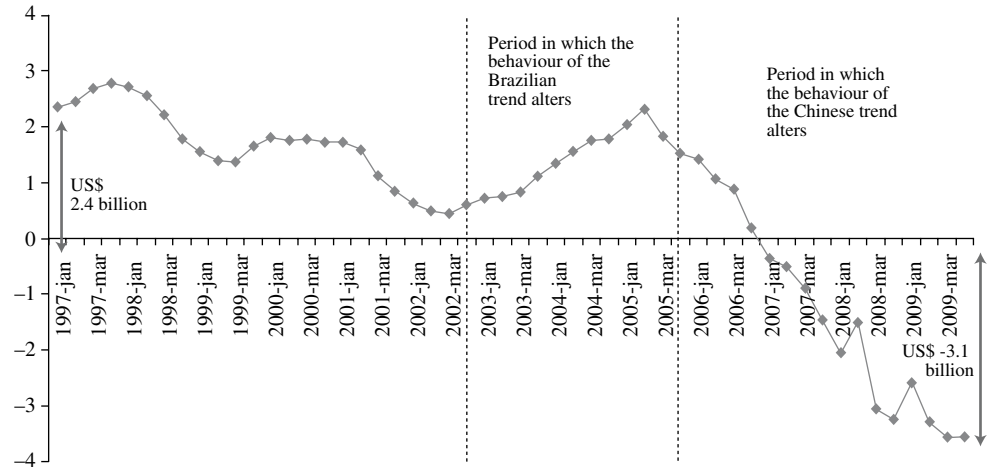


Source: Global Trade Information Services (GTIS).

FIGURE 6

Difference between the trends of Brazilian and Chinese exports to Latin America, quarterly data from 1997 to 2009

(Billions of dollars)



Source: Global Trade Information Services (GTIS).

TABLE 3

China's and Brazil's tii with Latin America and the proportion of imports from those two countries in the total imports of Latin American countries,[a] 1994-2008

Year	CHINA		BRAZIL	
	IIC	Share (%)	IIC	Share (%)
1994	0.25	0.8	5.22	6.1
1995	0.38	1.2	5.58	5.6
1996	0.42	1.3	5.84	5.6
1997	0.43	1.6	5.44	5.7
1998	0.49	1.7	5.29	5.3
1999	0.53	1.9	4.78	4.3
2000	0.58	2.4	4.96	4.5
2001	0.69	3.1	4.56	4.5
2002	0.74	3.8	4.16	4.0
2003	0.88	5.3	5.11	5.1
2004	1.00	6.7	5.81	6.4
2005	0.95	7.2	5.92	7.1
2006	1.06	8.8	5.77	6.9
2007	1.02	9.5	5.52	6.7
2008	1.13	11.0	5.11	6.9

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

[a] Excluding Brazil in both cases.
TII: Trade intensity index.

than Brazil's. The TII between Brazil and Latin American countries shows that trade between that region and the Brazilian economy is almost five times as large as Brazil's global trade ratio. That value does not increase steadily during the reference period, rising from 6.1% in 1994 to 6.9% in 2008. In contrast, the specific nature of China's TII with Latin America displays a substantial increase between 1994 and 2008, attaining a value of 1.13 in the latter year. In other words, the trade intensity between the Chinese economy and Latin American countries is similar to that registered between China and the world at large. Despite Brazil's greater trade intensity with Latin America compared to China's with the same region, China has the larger market share.

Table 4 shows the concentration index of China's export destinations to Latin America excluding Brazil. In 2009, 92% of China's exports were sent to 10 Latin American markets, with 67.2% being absorbed by the four leading economies. Those figures suggest extremely high concentration, which strengthened further between 1995 and 2009. Nonetheless, between 2004 and 2009, the share of the three leading destinations for Chinese exports (CR(3)) in Latin America (excluding Brazil) decreased by 6%. This suggests a slight deconcentration

TABLE 4

China: Export concentration ratio (cr) to Latin America, 1995, 1999, 2004, 2008 and 2009
(Percentages)

China: Exports to Latin America (Excluding Brazil)	1995	1999	2004	2008	2009
CR(1)	26.2	24.9	36.3	27.6	30.3
CR(2)	44.2	43.9	52.2	43.3	46.4
CR(3)	56.2	58.4	64.6	55.6	58.6
CR(4)	64.8	70.3	70.8	65.7	67.2
CR(5)	71.2	75.9	75.4	72.3	74.1
CR(6)	77.6	79.7	79.7	78.3	80.0
CR(7)	82.3	83.2	82.8	83.8	85.2
CR(8)	85.3	86.3	85.6	86.9	87.7
CR(9)	87.6	88.8	88.1	89.6	90.1
CR(10)	89.7	91.3	90.5	91.6	92.0
Main destinations - rank					
Mexico	4	2	1	1	1
Panama	1	1	2	2	2
Chile	2	3	3	3	3
Argentina	3	4	4	4	4
Venezuela (Bolivarian Rep. of)	8	6	6	5	5
Colombia	9	9	5	6	6
Peru	6	8	7	7	7
Ecuador	12	16	9	8	8
Cuba	5	5	10	9	9
Uruguay	10	7	13	10	10

Source: Global Trade Information Services (GTIS).

trend in destinations the of China's export to Latin American countries.

To compare the concentration ratio of Brazilian and Chinese export destinations in Latin America, table 5 shows the corresponding indicator for the Brazilian economy. As in the case of China, Brazilian export destinations in Latin American countries are becoming more concentrated, particularly in Argentina. Nonetheless, the path of CR(3) shows a smaller deconcentration trend than in the Chinese case. The deconcentration trend of Chinese exports in the three leading Latin American destinations is greater than that achieved by Brazil.

In addition, Brazilian exports to Latin America are mostly sent to South American countries, with nine of the 10 leading destinations for Brazil's external sales to Latin American countries in that region. Mexico, which is the only exception and was the second leading destination for Brazil's exports to Latin American countries in 1999 and 2004, was ranked fourth in 2008 and third in 2009 —the year in which the repercussions of international crisis were felt. The dynamic of China's exports to Latin American countries is more decentralized, with one country from each region among its three leading destinations: North America, Central America and South America.

Brazil's top two export markets in Latin America are also among China's three main destinations in South America (excluding Brazil). As can be seen in table 3, variations in the structure of China's exports in the South American region may have been one of the factors that prevented Brazil from increasing its share in the total external purchases of Latin American countries. Here it is worth noting the trend of the ranking of China and Brazil in the total imports of Argentina and the Bolivarian Republic of Venezuela. In the case of Argentina, imports from Brazil grew by an average of 9.2% per year between 2004 and 2009. In contrast, the same indicator for China reports 40.6% annual growth over the same period The share of Brazilian products in Argentina's total imports fell from 34.6% to 30.9%, whereas the proportion of imports from China increased from 4.1% to 13.0% between 2004 and 2009. Table 6 gives details of subsectors[19] in which the share of imports from Brazil declined substantially, as the

[19] The subsectors category used in this section corresponds to the three-digit breakdown of the National Classification of Economic Activities (CNAE), obtained from the International Standard Industrial Classification (ISIC) produced by the United Nations.

TABLE 5

Brazil: Concentration ratio (cr) of exports to Latin America, 1997,1999, 2004, 2008 and 2009
(Percentages)

Brazil: Exports to Latin America	1997	1999	2004	2008	2009
CR(1)	47.6	48.6	34.9	38.9	41.0
CR(2)	57.5	58.3	53.7	50.3	52.5
CR(3)	65.9	66.4	65.8	60.9	61.1
CR(4)	72.1	73.1	72.7	70.4	69.7
CR(5)	77.9	79.2	77.6	75.9	75.4
CR(6)	83.3	84.1	81.8	80.9	80.8
CR(7)	88.4	88.1	84.9	86.1	85.6
CR(8)	91.5	91.7	87.9	89.7	89.9
CR(9)	94.5	94.1	90.4	92.2	92.9
CR(10)	96.5	95.3	92.8	94.1	94.9
Main destinations - rank					
Argentina	1	1	1	1	1
Venezuela (Bolivarian Rep. of)	6	6	4	2	2
Mexico	5	2	2	4	3
Chile	3	3	3	3	4
Colombia	8	8	5	7	5
Paraguay	2	4	6	5	6
Peru	9	9	8	6	7
Uruguay	4	5	7	8	8
Bolivia (Plurinational State of)	7	7	9	9	9
Ecuador	11	11	10	10	10

Source: Global Trade Information Services (GTIS).

TABLE 6

Argentina: Share and variation in the share of imports from Brazil and China in total imports of selected subsectors, 2004 and 2009
(Percentages)

Subsectors	Brazil		China		Variation in share	
	2004	2009	2004	2009	Brazil	China
Fabrics - including yarn and fabric	47.7	32.6	3.5	33.8	-15.1	30.3
Textile articles	87.0	63.6	1.3	15.7	-23.4	14.4
Woollen fabrics and articles	38.7	9.9	1.0	61.7	-28.8	60.8
Clothing manufacture	37.0	8.6	4.8	43.7	-28.4	38.9
Footwear	74.4	55.4	10.2	27.7	-19.1	17.5
Pharmaceuticals	14.2	6.8	10.6	20.4	-7.4	9.8
Ceramics	42.0	30.3	8.5	26.0	-11.7	17.5
Electrical appliances	49.7	35.1	15.0	34.0	-14.5	19.0
Electrical generators, transformers and motors	21.0	12.2	5.8	12.8	-8.8	7.0
Insulated electrical wires, cables and conductors	53.8	29.1	3.6	22.4	-24.7	18.8
Lamps and lighting equipment	26.5	12.2	30.9	60.4	-14.3	29.5
Basic electronic material	13.0	3.7	8.4	27.1	-9.4	18.7
Radio, television, sound and video	14.6	5.8	13.9	53.0	-8.7	39.1
Optical, photographic and cinematographic apparatus	15.3	8.2	12.7	44.2	-7.1	31.5
Vehicle cabins, chassis and trailers	78.4	51.8	3.7	20.0	-26.6	16.4
Furniture items	50.9	39.6	8.8	20.2	-11.3	11.3

Source: Global Trade Information Services (GTIS).

share of imports from the Chinese economy grew in the total imports of the subsector by the Argentine market.

Increases in the share of imports from China compared to those from Brazil have occurred particularly in labour-intensive subsectors (manufacture of textile products, footwear and furniture items) and electro-electronics generally. From the Brazilian standpoint, the situation of exports to the Bolivarian Republic of Venezuela, its second ranked destination in Latin America, is more worrying than that of Argentina. Between 2004 and 2009, imports from Brazil grew at an average annual rate of 16.5%. In contrast, Chinese exports to the Bolivarian Republic of Venezuela grew by an average of over 54% per year. Thus, while the share of imports from Brazil decreased from 8.3% of Venezuela's total imports in 2003 to 7.4% in 2009, the share of imports from China grew from 2.9% to 10.6% in the same period. In 2009, the year in which the international economic crisis worsened, the share of imports from China in the Venezuelan market grew by 0.8%, whereas the share of imports from Brazil decreased by around 0.9%. Table 7 shows the main subsectors in which imports of Brazilian origin lost share and those from China gained, compared to the total external purchases by the subsector in question in the Bolivarian Republic of Venezuela.

These figures reveal two specific features of China's exports to Brazil's two leading markets in Latin America. The first relates to the capacity to gain positions with respect to Brazilian exports in an international crisis setting. This dynamic had been mentioned above when describing the trend of China's exports of industrial products in all Latin American countries, as shown in figure 5. The second specific feature concerns its expansion capacity in most industrial subsectors. This is even clearer when comparing the results shown in tables 6 and 7, which show a considerable number of non-coinciding subsectors in the economies of Argentina and the Bolivarian Republic of Venezuela. That situation had been noted in the previous section, dealing with the performance of China's exports worldwide. To demonstrate the sectoral deconcentration capacity of China's exports in Latin American countries, figure 7 shows the Herfindahl-Hirschman index of Chinese and Brazilian external sales to Latin American countries.

Brazilian exports to Latin American countries reveal a slight sectoral deconcentration trend. In 2009, 53.8% of those exports were concentrated in four sectors, namely manufacture and assembly of motor vehicles, trailers and chassis (22.6%); manufacture of chemical products (11.1%); machinery and equipment (10.7%); and basic metallurgy (9.4%). In terms of the dynamic of Chinese exports, there is a sector deconcentration movement associated with a change in composition, with higher value-added sectors gaining importance.

The accumulation of value in China's exports to Latin American countries is clear, since in the first year of the series, the main sectors were clothing manufacture and accessories (21.2%); manufacture

TABLE 7

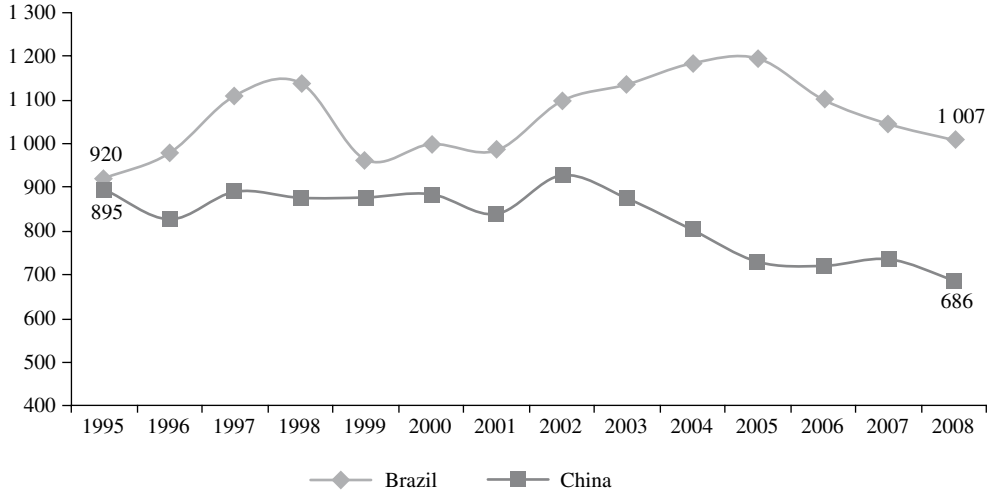
Bolivarian Republic of Venezuela: Share and a variation in the share of imports from Brazil and China in total imports by selected subsectors, 2004 and 2009
(Percentages)

Subsectors	Brazil		China		Variation of Share	
	2004	2009	2004	2009	Brazil	China
Fabrics, including yarn and fabric	9.1	4.2	22.1	29.3	-4.9	7.2
Footwear	11.1	8.6	4.9	25.7	-2.5	20.8
Wood products, cork and braided material , except furniture	37.8	27.3	7.0	18.4	-10.5	11.4
Continuous fibres, yarns, cables and filaments, artificial and synthetic	5.8	1.4	1.5	24.8	-4.4	23.3
Glass and products of glass	14.3	5.6	3.1	22.9	-8.7	19.8
Tanks, boilers and metallic deposits	9.2	1.8	4.4	13.0	-7.4	8.6
Machine-tools	12.8	7.1	4.4	16.4	-5.7	12.0
Machinery and equipment used for mineral extraction and construction	22.2	14.3	3.1	11.8	-7.9	8.7
Other machinery and equipment of specific use	15.9	9.5	2.6	9.9	-6.4	7.3
Electrical appliances	6.6	3.4	9.2	19.5	-3.2	10.3
Lamps and lighting equipment	8.7	1.5	21.9	44.8	-7.2	22.9
Other transport equipment	2.6	0.3	23.7	50.0	-2.3	26.3
Furniture items	8.3	7.2	8.4	26.2	-1.1	17.8

Source: Global Trade Information Services (GTIS).

FIGURE 7

Herfindahl-Hirschman index of sector concentration of Chinese and Brazilian exports to Latin America, 1995-2008



Source: United Nations Commodity Trade Database (COMTRADE).

of textile products (15.3%); preparation of leather and manufacture of leather articles, travel articles and footwear (7.9%); and machinery and equipment (7.1%). By 2008, in contrast, the four leading export sectors to Latin America were the manufacture of electronic material and communications apparatus and equipment (12.1%); machinery and equipment (10.8%); manufacture of chemical products (8.7%); and manufacture of textile products (8.2%). In other words, as the share of labour-intensive activities decreases, the importance of manufactures produced by specialized suppliers and R&D-intensive products increases.

To analyse these findings in greater depth, the trade complementarity index (TCI) was calculated for Chinese and Brazilian trade with Latin American countries, again remembering that indicators relating to that region do not include Brazil. The TCI between the two regions is obtained by comparing the export basket of country *i* to the world at large, with the total import basket of country *j*. For the purposes of this article, it is possible to verify the extent to which products exported by Brazil and China worldwide coincide with the products imported by Latin American countries. The TCI is calculated using the following formula, where the sector characterization used to calculate the share in total imports and exports is the CNAE version 1.0, at the three-digit level:

$$TCI_{i,j} = 100 - \sum_{k=1}^{n} \left[\frac{\left| m_{k,j} - x_{k,i} \right|}{2} \right]$$

Where: $m_{k,j}$ = Represents imports of sector k in the total imports of country j; $x_{k,i}$ = represents exports of sector k in the total exports of country i.

A TCI of zero means that there is no complementarity between the imports and exports of the regions analysed, whereas if the indicator has a value of a 100, it means that the schedules are perfectly complementary; i.e. the country in question exports precisely what the other country wants to import.[20] Figure 8 shows the dynamic of the TCI for China and Brazil with respect to Latin America.

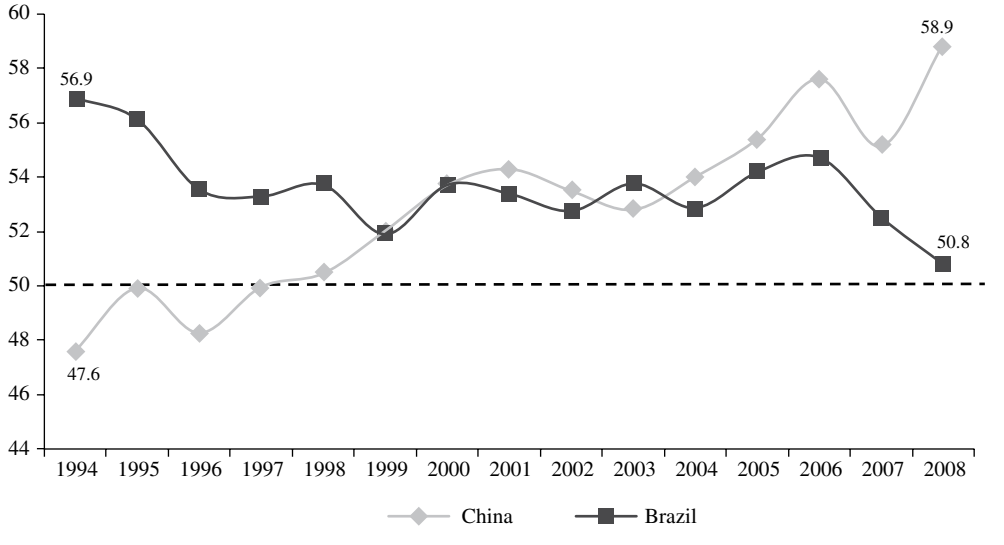
In the reference period, China's TCI with Latin American countries increased, while Brazil's TCI with those countries declined. Although a TCI value above 50 points indicates a high level of complementarity, in 2008 China's complementarity with Latin America was greater than Brazil's, because the indicators for the two countries in 1994 were 47.6 and 56.9 respectively. The subsectors recording an increase in the TCI of China's exports and Latin America's imports include the manufacture of optical, photographic and cinematographic apparatus, instruments and materials, for which the index rose from 46.6 in 1994 to 87.5 in 2008. This increase in complementarity stems from annual average growth of over 35% in China's exports from that subsector to Latin American countries in the years studied. The value exported by the Chinese economy to the region thus reached a level of US$1.5 billion in the last year considered.

The TCI of the ceramics manufacturing subsector rose by 36.1 points between 1994 and 2008, reaching a level of 59.0, representing an increase in the share

[20] See Hoekman, Mattoo and English (2002) for further details.

FIGURE 8

Trade complementarity index between Brazil and Latin America and between China and Latin America, 1994-2008



Source: United Nations Commodity Trade Database (COMTRADE).

of that subsector's imports from China from 3.8% to 28.2% with respect to total Latin American imports in that subsector. Moreover, there was an increase of over 32 points in China's TCI with Latin American countries, in relation to the electric energy distribution and control equipment manufacture subsector, which in 2008 attained a level of 76.6.

Thus far, the analysis has focused on the general features of the Brazilian and Chinese export baskets to Latin America, highlighting the sectors and subsectors considered most important. The next indicator to be reviewed involves a subsector approach, defining annual gains and losses of a set of subsectors present in Brazilian and Chinese exports to Latin American countries.

This method of analysis is based on the hypothesis that a country's share in world markets should remain constant through time. The difference between export growth defined by that constant share standard and the observed export performance is attributed to the competitiveness effect; and real export growth is divided into competitiveness, export basket composition, and market distribution effects (Leamer and Stern, 1970, p. 171). For that purpose, the competitiveness effect measure (CE) is used, which relates changes in the market share and value exported from Brazil and China by subsectors, as follows:

$$CE_j^k = \left(\frac{m_{i,j,t}^k}{M_{i,w,t}^k} - \frac{m_{i,j,(t-1)}^k}{M_{i,w,(t-1)}^k} \right) \times M_{i,w,t}^k$$

Where: $\frac{m_{i,j,t}^k}{M_{i,w,t}^k}$ = share of country j in the imports of country i of sector k in the final period t; $\frac{m_{i,j,(t-1)}^k}{M_{i,w,(t-1)}^k}$ = share of country j in the imports of country i of sector k in the initial period $(t\text{-}1)$; and $M_{i,w,t}^k$ = total value of imports of country i of sector k in the final period t.

The competitiveness effect is calculated as the difference between the value actually exported by each subsector from the Chinese and Brazilian economies in the last year analysed, and the value that should have been exported for each country to maintain the same market shares in the initial year of the analysis. Thus, if the competitiveness effect is equal to zero, it means that there was no competitiveness gain. The competitiveness effect will be used to measure the net gain or loss of competitiveness of the exports of each Brazilian and Chinese subsector to Latin America.[21] It would also be possible to review the product and market effects on changes in sector shares, but the competitiveness effect is sufficient for the specific purpose of comparing the performance of Chinese and Brazilian exports.

Table 8 shows the competitiveness effect for selected subsectors. Those subsectors were defined on the basis of choosing those showing a net average competitiveness

[21] See Leamer and Stern (1970); Batista (2002).

TABLE 8

Gain and loss of competitiveness of selected sectors of Brazilian and Chinese exports to Latin America, 1994-2008 and 2003-2008
(Thousands of dollars per year)

Country	Subsector	China		Brazil	
		1994-2008	2003-2008	1994-2008	2003-2008
BR	Extraction of oil and natural gas	8	-147	121 942	207 429
BR	Livestock	-241	-846	30 363	77 845
BR	Slaughtering and preparation of meat and fish products	9 404	14 644	25 024	-8 949
BR	Tractors and machinery and equipment for agriculture	4 103	9 666	22 403	10 579
BR	Soaps, detergents, cleaning products and perfume articles	5 093	7 265	21 977	33 016
BR	Dairy products	1 384	3 836	17 270	45 550
BR	Construction, assembly and repair of aircraft	177	67	14 474	21 165
BR	Seasonal crops	2 093	-23 802	13 302	5 599
BR	Production of alcohol	0.00	-0.04	12 835	28 334
BR./CH	Automobiles, trucks and utility vehicles	20 983	55 648	182 257	62 840
BR./CH	Pesticides	23 701	38 549	13 261	37 587
BR./CH	Non-ferrous metal metallurgy	31 254	63 946	28 019	62 699
BR./CH	Machinery and equipment for use in mineral extraction and construction	33 991	85 410	19 732	-15 981
BR./CH	Insulated electric wires, cables and conductors	51 640	97 325	10 303	22 656

Continues overleaf

Table 8 (concluded)

Country	Subsector	China		Brazil	
		1994-2008	2003-2008	1994-2008	2003-2008
BR./CH	Inorganic chemical products	62 379	109 232	13 670	23 164
BR./CH	Footwear	64 707	43 321	12 495	-20 315
BR./CH	Pharmaceuticals	127 422	258 534	14 349	-22 359
BR./CH	Telephony, radio telephony and television and radio transmission	508 102	1 135 711	137 401	211 079
BR./CH	Construction and repair of ships	12 933	35 239	14 474	21 165
CH	Professional safety clothing accessories	11 772	27 313	31	204
CH	Fibres, wires, cables and continuous filaments, artificial and synthetic	10 060	25 231	-498	-6 127
CH	Office machinery	15 045	12 003	3 421	11 244
CH	Products of wood, cork and braided material – except furniture	16 409	34 770	-4 284	-291
CH	Electrical material for vehicles - except batteries	18 212	43 055	2 269	34 570
CH	Miscellaneous chemical products and preparations	20 064	25 284	-10 103	-8 317
CH	Resins and elastomers	20 872	45 757	-28 650	3 946
CH	Measurement, testing and control apparatus and instruments[a]	22 238	45 449	-1 689	5 503
CH	Glass and glass products	23 803	41 828	2 364	14 271
CH	Trucks and buses	24 163	65 109	-18 779	113 127
CH	Other electrical equipment and apparatus	27 232	44 297	-2 540	4 522
CH	Instruments for medical-hospital use[b]	18 814	40 748	-378	8 698
CH	Equipment for distribution and control of electric energy	27 319	51 905	-4 131	14 290
CH	Electric batteries and accumulators	30 651	51 942	3 124	16 465
CH	Textile articles made from fabrics - except clothing	30 934	70 335	7 124	28 406
CH	Machinery-tools	32 850	66 920	3 614	2 560
CH	Tubes - except iron and steel	35 126	85 877	9 778	34 031
CH	Woollen fabrics and articles	38 251	61 283	-9 609	2 648
CH	Ceramic products	38 334	82 600	666	1 285
CH	Travel articles and miscellaneous leather articles	39 109	46 725	1 830	6 885
CH	Metalwork articles and instruments, locks and manual tools	44 051	91 996	-7 021	21 968
CH	Furniture items	48 196	93 608	7 410	28 976
CH	Other machinery and equipment of specific use	48 760	111 798	5 892	18 391
CH	Organic chemical products	50 500	59 900	-22 396	23 443
CH	Spare parts and accessories for motor vehicles	55 711	136 154	-124 549	270 715
CH	Fabrics - including yarn and fabric	58 492	110 611	4 454	6 899
CH	Lamps and lighting equipment	58 511	71 484	-2 461	-1 481
CH	Motors, pumps, compressors and transmission equipment	78 693	142 070	-3 026	55 897
CH	Miscellaneous metal products	82 944	172 942	-367	33 517
CH	Other transport equipment	84 334	108 130	7 655	4 778
CH	Electrical appliances	85 983	130 241	-2 803	-22 110
CH	Plastic products	89 971	172 458	2 847	47 048
CH	Optical, photographic and cinematographic apparatus	91 916	114 099	-6 059	-8 273
CH	Garment manufacture	96 984	154 763	-2 625	-1 039
CH	Machinery and equipment of general use	116 118	252 846	-12 695	9 604
CH	Electrical generators, transformers and motors	116 438	206 431	-5 565	45 015
CH	Iron and steel	117 106	315 229	-76 199	411
CH	Basic electronic material	182 325	270 257	-10 083	-8 248
CH	Radio, television, sound and video	424 964	458 761	8 269	-40 883
CH	Electronic system equipment for data processing	580 361	640 900	433	-5 275
	Total - all subsectors	*4 445 013*	*7 428 127*	*110 019*	*1 768 881*

Source: United Nations Commodity Trade Database (COMTRADE).

[a] Except equipment used in the control of industrial processes.
[b] This subsector includes apparatus and instruments for medical-hospital, dental and laboratory uses, and orthopaedic apparatus.
BR: Brazil.
CH: China.

gain of more than US$10 million per year, considering the change between the years 1994 and 2008, referred to as long period. The "country" column indicates the country to which the subsector belongs. A second period of analysis from 2003 to 2008 is referred to as the "short period", because, as shown above, in 2003 there was a change in the trend of Brazilian exports to America.

An analysis of the long period shows that nine subsectors produced exclusive competitiveness gains for Brazilian exports, 11 subsectors recorded competitiveness gains in amounts above US$10 million per year in both countries, and 40 subsectors were defined by competitiveness gains for Chinese exports. This result shows the competitive superiority of China's exports to Latin American countries, compared to Brazil's exports to the same destinations. China's net total competitiveness gain in the long period, including subsectors that are not identified in table 8, amounts to US$4,445 million per year, translating into a net gain of US$62.2 billion over the entire period analysed. In contrast, the net total competitiveness gain of Brazilian exports to Latin America amounted to US$110 million per year, for a cumulative value of US$1.5 billion. The superiority of China's exports to the region is clear when comparing the results, because their competitiveness gain is 40 times higher than that of Brazil's exports to the same group of countries. The reader is reminded that this superior performance model of China's exports had been defined in the indicator series shown above.

On the other hand, there has been a considerable improvement in the net total competitiveness gain of Brazilian exports in the short period, in other words since 2003. Between 2003 and 2008, this value amounted to US$1,769 million per year, for a cumulative value of US$8.9 billion. Despite this recovery in the competitiveness of Brazil's exports to Latin American countries, the total net competitiveness gain for China was even higher, reaching a level of US$7,428 million per year, or a cumulative US$37.1 billion over the short period. This shows that the total net competitiveness gain for China's exports to Latin America in the long period was well distributed, and that 67% of those gains were obtained in the short period. The characterization of Brazilian exports shows that total net competitiveness gains were heavily concentrated in the short period.

The nine subsectors selected for exclusive competitiveness gains by Brazilian exports display a concentration in natural-resource-intensive activities. The subsector recording the largest competitiveness gain in the long period was oil and gas extraction, and the gain was intensified in the short period. In this group of nine subsectors, the only ones not relating to natural resource intensive products are the following: Tractors and machinery and equipment agriculture; Construction, assembly and repair of aircraft; and soaps, detergents, cleaning products and perfume articles. It is worth noting that the first subsector mentioned is formed by multinationals, whereas the second is based on performance of a single enterprise.

An analysis of the nine selected subsectors shows that the competitiveness of Brazilian exports compared to Chinese exports to Latin America is increasing in natural-resource-intensive subsectors, the manufacture of tractors and agricultural implements, and in the aviation sector. Since 2003 there has been a recovery in the competitiveness of the automotive chain, including parts and accessories manufacture. In the other subsectors —mainly electro-electronics, machinery and labour-intensive equipment— China is clearly more competitive. In other words, Brazilian exports have become more competitive than those of China in just 10 of the 60 subsectors listed in table 8. The capacity of the Chinese economy to diversify and add value to its export basket for Latin America, shown in this subsector-competitiveness model, had been noted above when reviewing the external sales of that country worldwide.

IV
Final comments

This article has reviewed Chinese and Brazilian export performance of in Latin America. It started by evaluating the importance of the external sector in China's growth dynamic, and showed that GFCF has contributed more than net exports to GDP growth. As argued in the section II, however, this does not mean that exports are unimportant.

The analysis showed that the trend of China's exports of industrialized products to Latin America outpaced the Brazilian equivalent. This divergence becomes more

accentuated as from 2005, despite an increase in the growth rate of Brazilian exports from industrial sectors to Latin American countries in 2003. Nonetheless, the trend of China's industrial exports to Latin America, in value terms, has outpaced the equivalent indicator for Brazilian exports since the second quarter of 2007. Moreover, related to the virtuous dynamic of the trend of China's exports to Latin American countries, the share of imports from China in Latin America's total imports has grown, and trade intensity has also increased between the two regions. In contrast, the share of imports from Brazil in the total imports of Latin American countries stagnated between 1994 and 2008, as did Brazil's trade intensity index (TII) with Latin America.

In terms of the quality of China's exports to Latin America, a sectoral deconcentration process has been unfolding, along with an increase in the relative share of higher value-added sectors during the years analysed in this article. This deconcentration of external sales from the Chinese economy to Latin America was not merely sectoral, because from 2004 on a deconcentration trend has been visible in China's exports to its three main Latin American partners. In counterpart, the sectoral concentration of Brazil's exports to Latin America has increased slightly, with a heavy concentration of those exports in South American countries, particularly in Argentina.

The superior performance of China's exports to Latin America compared with those of Brazil is also reflected in those two countries' TCIs with the Latin American region —increasing in China's trade with Latin America but decreasing in the case of Brazil. At the subsector level, Brazilian exports have become more competitive basically in natural-resource intensive sectors; tractors and agricultural equipment; and aviation, while the automotive chain staged a recovery between 2003 and 2008. In all other sectors, Chinese exports has shown a clear advantage. This resulted in a net competitiveness gain for Chinese exports to Latin America that is 40 times greater than the same indicator for the Brazilian economy in the period 1994-2008, considering all export subsectors.

(Original: Portuguese)

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The country brand trap

Rodrigo Berríos and Rodrigo Saens

ABSTRACT

Data on 14,284 bottles of wine from six regions or countries, namely Argentina, Australia, Chile, California (United States), Burgundy (France) and South Africa, and from five vintages (1997, 1999, 2001, 2004 and 2005), are used to estimate a hedonic price model that causally relates wine prices to individual quality and country brands. A positive and statistically significant relationship between price and individual quality is confirmed, and it is found that the premium or penalty attaching to wines because of their associated country brand has held steady over time, as has price-quality elasticity. Individual quality being equal, Chilean and Argentine wines continue to suffer a penalty of over 50% relative to Californian wines. Another finding is that the country brand problem will not be solved until countries that are newcomers to the industry, such as Chile and Argentina, succeed in producing a critical mass of wines of outstanding quality, for this is the factor that will ultimately determine whether their producers benefit from a good collective image or reputation.

KEYWORDS

Wine, hedonic pricing model, country brand, price-quality elasticity, exports, marketing, statistics, Argentina, Chile, Australia, France, South Africa, United States

JEL CLASSIFICATION

L15, D4, Q13

AUTHORS

Rodrigo Berríos, Lecturer of the Department of Management, University of Talca, Chile. roberrios@utalca.cl

Rodrigo Saens, Assistant Professor of the Department of Economics and Finance, University of Talca, Chile. rsaens@utalca.cl

I
Introduction

The hopes surrounding the entry strategy followed by Chilean winemakers in the United States market in the 1990s, which consisted in offering good wines at low prices, have given way 20 years on to a growing frustration. In the words of one of the best winegrowers in the industry: "Chilean wines are drunk essentially because they are cheap."

If price is a signal of quality, it might be suggested that the strategy of entering the United States market with a large-scale, low-priced and relatively undifferentiated initial offering risks protracting indefinitely the period in which Chilean wine, having gained a reputation for cheapness, is penalized by consumers unwilling to pay the prices its sensory or objective quality merit.

Consumers are unlikely to discern the quality of an experience good like wine, particularly when it is produced in a little-known country like Chile. Instead, they tend to infer quality from the good's price. The modest initial success of the Chilean strategy at a time when there were no cheap wines on the United States market, and the ensuing stagnation as other competitors (such as the South Africans and the Argentines) came in with even lower prices, are two developments that may be due to the same cause.

A number of organizations have argued for the need to speed up the differentiation of Chilean wine, and three approaches have been suggested for this: (i) creating a country image or brand that confers identity and enhances the value of the various wines produced in Chile, (ii) investing more in innovation and quality, as the Australians have done, and (iii) changing the expectations of United States consumers by producing world-class wines.

The aim of this study is to supply empirical evidence that can be used to assess the brand power of a country like Chile which is a new entrant in the market. Using the hedonic price method of Rosen (1974), it analyses how sensitive international wine prices are to indicators of quality and reputation. The study includes five cross-sectional samples of five vintages between 1997 and 2005, using indicators published by *Wine Spectator* for red wines produced in Argentina, Australia, the United States (Napa and Sonoma), Chile, France (Burgundy) and South Africa.

In public policy terms, the challenge for a new entrant country is to induce consumers to rate its different wines on their own merits (individual quality) rather than inferring their quality in a general way from its weak country image (collective reputation). This is not easy. According to Roberts and Reagans (2007), consumers are more comfortable assessing the best-known wines, such as those of France and California, than wines that are not well represented in the United States quality classification, such as those of Argentina, Chile and South Africa.

The findings of this study reveal that the problem will not be solved until the countries that have recently entered the industry, such as Chile and Argentina, produce a critical mass of wines of outstanding quality, which is what ultimately creates a good collective image or reputation for a country's producers.

The marketing short cut of building image without quality does not work. Even when quality is heavily invested in, as has been done by the Australians, building up a reputation in the wine market is a slow and cumbersome process, particularly if the aim is to compete with French and Californian wines, which defined and shaped the cultural meaning of modern wine by constructing powerful and unique image associations. It is precisely this inertia that is responsible for the heavy price penalty still paid by Chilean and Argentine wines.

Nor are there any easy solutions to this inertia along the lines suggested by Gibbs, Tapia and Warzynski (2009), who argue that globalization and the unprecedented increase in products of non-traditional origin in the United States market have increased the proportion of consumers seeking more information on the objective quality of wine, thus enhancing the importance of the individual quality classifications published by specialist journals such as *Wine Spectator*. If this theory were correct, the price-quality elasticity of wines would be increasing and the country penalty paid by Chilean and Argentine wines would be decreasing over time. The findings of the present study provide evidence for the opposite: price-quality elasticity appears to have been stable over the 1997-2005 study period. The market still goes on reputation.

But the battle between the leading global brands may be an opportunity for the newcomers. The findings of this study show that France is losing brand power by comparison with California, and also relative to some of the new entrant countries. A possible cause of this is

an abuse of reputation on the part of the dominant brand at the end of its cycle.

This article is organized as follows. Section II briefly reviews the literature. The stylized facts, drawing on indicators of wine quality and reputation by country of origin, are explained in section III. Section IV presents the empirical model and analyses the main findings. Lastly, section V summarizes the principal conclusions.

II

Image or quality?

In the wine market, better quality is no guarantee of a higher price. The relationship between price and quality depends more on consumers' perceptions of the wine's country of origin than on the individual quality of the product. According to the findings of Brooks (2003) on the basis of data from the United States market, any Chilean or Argentine winemaker can only charge half as much as a winemaker producing wine of the same quality in the Napa Valley of California.

As argued by Costanigro, McCluskey and Mittelhammer (2007), a country's image is a kind of public good. The fate of any pioneering exporter from Chile trying to compete in the premium market in the United States or Europe will depend on the image that has been projected by Chilean wines as a whole, i.e., on what Tirole (1996) calls collective reputation.

In these circumstances, all the wines of a newcomer country, be they good or middling, are heavily penalized. The situation is particularly bad for the ambitions of winemakers from the New World. Landon and Smith (1998) highlight the fact that prices for wines from France (Bordeaux) in the United States market owe 20 times as much to their past reputation as to their objective individual quality. Country images are slow to change, and there is a strong incentive for reputations to be abused—a commercial practice that will go unnoticed for a considerable time.

Following Tirole (1996) and Winfree and McCluskey (2005), we can understand a winemaking reputation as the accumulated prestige, renown and image associated with the name of a producer (individual reputation) or a group of producers (collective reputation) as a result of the quality history of their wines over a substantial period of time.

As Combris, Lecocq and Visser (1997) and Barber, Almanza and Donovan (2006) argue, the fact that wine is an experience good means that consumers are not able to distinguish its quality before trying it. It is the prestige associated with a region or country which assures consumers that wines from there are of a certain quality, and this country image can only be altered at the margins and very slowly by the entry of a few wines of a quality superior to that of the wines currently available.

According to Castriota and Delmastro (2008), consumers are willing to pay a price premium for this assurance, particularly if the region is world-renowned, such as Bordeaux in France or Napa in California. Furthermore, Lockshin and Rhodus (1993) and Schamel and Anderson (2003) argue that the existence of aggregated wine brands makes life easier for consumers, who would otherwise be faced with the need to pick out a bottle from among thousands.

The difficulty consumers have in distinguishing quality will mean that they do not discriminate much between individual brands, thus facilitating their proliferation to the point where there are thousands in the United States market, making them increasingly meaningless as a guide to wine quality. In this situation, it is not profitable for producers to invest individually in creating brand power. Only if they choose to collaborate will winemakers from a particular region be better placed to make these investments and generate a powerful collective brand, as, according to Aylward and Zanko (2006), California did in the 1970s.

Most other regions of origin, and particularly those in new entrant countries, will become aggregated brands by default, essentially because their low prices create a perception of lower quality, or at best because they suggest a different style of wine.

Brooks (2001 and 2003) bears this out by showing how countries operate as collective brands in the wine market, introducing a price differential that cannot be accounted for by any other variable. Thus, a wine from the Napa Valley in California will sell for twice as much as a wine of the same quality from Chile or Argentina. Similar findings have been obtained by Schamel (2000 and 2002) and Schamel and Anderson (2003) for Napa Valley wines relative to those from

Oregon, Washington, New Zealand, Australia, Chile, Argentina and South Africa.[1]

As is pointed out by Gergaud and Livat (2007) and Costanigro, McCluskey and Mittelhammer (2007), in building a reputation or a brand, or both, the objectives are always the same: to differentiate a region's wines in order to enhance their perceived quality and thereby command a higher price.

1. Newcomers from the ends of the earth

According to Moguillansky, Salas and Cares (2006), the value for money strategy followed by the major Chilean exporters, consisting in offering medium-quality wines at prices lower than those charged by European producers, may have been an initial success, securing 5% of the United States import market in 20 years, but it resulted in 80% of Chilean wines being concentrated in the low-price segment.

According to Van Tienhoven (2008), this association of Chilean wine with low prices is the only image that the bulk of United States consumers have been able to perceive, so that they have stereotyped it as an acceptable wine, but one suitable only for ordinary use. As Stein (2008) explains, this has become a real image trap for producers, preventing consumers from paying for the real quality of the product.

United States consumers lack the time and motivation to ascertain the individual quality of a wine. That is what reputations are for. According to Schamel and Anderson (2003), consumers use the stereotyped image of a product's country of origin as a rule of thumb to guide their purchasing, especially in the case of cheap wines.

The market is continually reinforcing these stereotypes. Consumers see that in supermarkets and specialist outlets, Argentine, Chilean and South African wines are on the shelves where the cheap wines are stacked, while Californian wines, and especially French ones, are on the expensive shelves. Accustomed to associating quality directly with price, consumers learn to relate quality to origin. As Lockshin and Rhodus (1993) and Chaney (2000) point out, rightly or wrongly, the country a wine comes from is ascribed a quality in its own right. In short, this is a veritable vicious circle for new entrants.

2. The sample

The sample of 14,284 red wines is from *Wine Spectator*. The low presence of Argentine, Chilean and South African wines in *Wine Spectator* reflects the reality of their penetration of the United States market, which only began in the 1990s. This is why the analysis begins with the 1997 vintage, as earlier than that it would not have been possible to arrive at econometric estimates of the parameters studied.

The sampling method used is similar to the cluster method, with a full selection of all its elements (wines). Each cluster is a region/country chosen a priori for its role in the price dynamic of this market. Burgundy, whose wines have traditionally had a strong presence in the United States market, embodies the French export strategy. The Napa and Sonoma valleys exemplify the successful ascending strategy of California, while Australia, Argentina, Chile and South Africa exemplify the strategy of those newcomer countries that have managed to improve their positioning in the United States over the past two decades.

The differing sample sizes that ensue for the various regions/countries (see table 1) reflect the actual weight of their wines in the United States market for acceptable to excellent wines (70 to 100 points) as covered by *Wine Spectator*. Variations in sample size between vintages reflect supply or demand factors, or both, an example being the volume goals of the industry plan in Australia.

The share of wines from newcomer countries (and from France) in the *Wine Spectator* universe is greater than their share of the actual United States market, where four of every 10 wines are from Napa and Sonoma, two are from the rest of California, one is from another state in the United States, and just three are imported. This is because countries tend to export their best wines.

Although selecting just some of the competing regions/countries means that the sample is skewed in favour of new entrant wines (four out of every 10 wines are from these countries), the inclusion of all wines from each region/country selected means that these retain their original proportions, allowing realistic comparisons to be made between their quality averages and proportions of outstanding wines; it also provides robust sample sizes for the econometric estimates.

[1] The fact that Napa also has a better reputation than the states of Oregon and Washington rules out the possibility that its premium may be due to variations in labour costs relative to other countries, and shows how geographical brands can be circumscribed to just a single region in a country.

TABLE 1

Sample used, by country and vintage

Vintage	Country or region of origin						
	Argentina	Australia	California	Chile	Burgundy	South Africa	Vintage total
1997	76	358	1 018	191	544	107	2 294
1999	114	514	1 102	219	575	115	2 639
2001	120	624	1 217	250	339	212	2 762
2004	328	674	1 159	234	360	236	2 991
2005	358	622	1 471	284	609	254	3 598
Country total	*996*	*2 792*	*5 967*	*1 178*	*2 427*	*924*	*14 284*

Source: prepared by the authors on the basis of data from *Wine Spectator*.
Note: Each value in the table represents the annual number of red wines from each country/region used in this study. Most wine is sold two or three years after the year of the vintage.

III

The stylized facts: an interpretation

The average price and quality indicators in table 2 show that consumers' willingness to pay is heavily influenced not so much by the objective quality of a wine as by the reputation or image, or both, of its country of origin, with French wines fetching the highest price relative to their average quality, which was actually lower than that of their main competitor, California, and similar to that of new entrants, such as Chile, in the late 1990s.

This can be seen more plainly in the evolution of the price per unit of average quality ratio for French

TABLE 2

Evolution of the price and quality of wines from six countries of the world, 1997-2005

Vintage	Indicator	Country or region of origin					
		Argentina	Australia	California	Chile	Burgundy	South Africa
1997	Price	15.6	26.2	40.8	13.8	75.0	19.5
	Quality	81.4	86.4	87.6	82.9	83.5	84.5
	Ratio	0.20	0.30	0.47	0.17	0.90	0.23
1999	Price	20.1	29.3	46.4	16.2	56.3	20.0
	Quality	84.5	86.5	87.6	83.8	84.7	84.6
	Ratio	0.24	0.34	0.53	0.19	0.66	0.24
2001	Price	21.9	28.8	48.0	16.3	59.0	23.9
	Quality	84.1	86.8	86.0	83.4	86.3	85.4
	Ratio	0.26	0.33	0.56	0.19	0.68	0.28
2004	Price	25.2	37.2	59.5	20.0	76.0	26.1
	Quality	85.6	88.0	87.2	84.5	87.9	85.8
	Ratio	0.30	0.42	0.68	0.24	0.86	0.30
2005	Price	25.4	38.8	55.6	22.2	84.2	27.1
	Quality	85.3	88.6	86.9	85.6	89.9	85.6
	Ratio	0.30	0.44	0.64	0.26	0.99	0.32

Source: prepared by the authors on the basis of data from *Wine Spectator*.
Note: The values in the table are the annual country averages for each indicator. Most wine is sold two or three years after the year of the vintage. The *Wine Spectator* rating runs from 50 points (very poor) to 100 points (outstanding).

wines, which was still three times that of wines from new entrant countries and one and a half times that of Californian wines in 2005, at the end of the period analysed. According to Heslop, Cray and Armenakyan (2009), nothing seems to have changed in the mindset of United States consumers, for whom French wine continued to be synonymous with excellence.

When the evidence is analysed more carefully, however, it becomes clear that something began to change for French wines in the late 1990s, with their price/quality ratio dropping sharply from 0.9 to 0.68 between 1997 and 2001, and thereby converging towards the rising ratio of Californian wine, suggesting a weakening both of their brand and of their price premium.

This decline was only temporary, however. From 2001, the French reacted by steadily raising the mediocre average starting quality of their wines, until they attained the remarkable level of 90 points in 2005. Achieving this meant steadily increasing the proportion of outstanding wines awarded 90 points and over to 44%, more than any competitor, while at the same time drastically curtailing exports of poor-quality wines, as can be seen in table 3.

This change was not down to chance. The most plausible explanation is the growing difficulty the French were having in continuing to sell what were merely acceptable wines at two or three times the price of equivalent New World wines. The analysis by Barco, Navarro and Langreo (2005) supports this hypothesis, noting that the French share of United States wine imports dropped from 28% to 14% between 1993 and 2003, largely owing to the entry of Australian wines.

Cox and Bridwell (2007) round out the hypothesis by showing how the French successfully repositioned their wines in the highest-quality segments from 1999 on, raising their prices by up to 100% and at the same time pulling out of the lower-quality segments where their cost structure did not allow them to compete.

Thus, the final average price/quality ratio of 0.99 for French wines needs to be analysed with care and always in the awareness that it is circumscribed to very good or outstanding wines, a segment where wines from France still retain their glamour. In most of the market, however, French wines are losing brand power relative to Californian ones, along with their ability to command a price premium.

The initial paradox in the situation of French wine in 1997, with its low average quality and excellent reputation, is consistent with the theories of Tirole (1996). A high level of collective prestige creates irresistible incentives for some producers, distributors or both to sell wines of middling quality at high prices. This happened in the late 1990s in the United States, as reported by Landon and Smith (1997 and 1998).

According to Roberts and Reagans (2007), it is very likely that the gradually increasing transparency of the wine market (greater disclosure of ratings) made it less tolerable for consumers to keep paying more for poor French wines than for better New World ones.

1. The marketing short cut

Building a reputation like that of France, which dominated the United States market for about a century, is a process that it is practically impossible to replicate. As Hadj and Nauges (2007) explain, this reputation was shaped from 1855 onward by means of strict quality rules that endure today, and through image associations that penetrated deeply into the outlook of the country's consumers.

From Hollywood cinema, with soldiers savouring a French wine in the din of the battle for Europe, to mass

TABLE 3

Number of outstanding wines in the Californian market, by country, 1997-2005

	Vintage									
	1997		1999		2001		2004		2005	
	N>90	Percentage	N>90	Percentage	N>90	Percentage	N>90	Percentage	N>90	Percentage
Argentina	3	4	18	16	18	15	62	19	57	16
Australia	70	20	98	19	137	22	228	34	246	40
California	267	26	200	18	275	23	336	29	377	24
Chile	9	5	17	8	30	12	30	13	40	21
France (Burgundy)	83	15	104	18	82	25	122	34	268	44
South Africa	2	2	12	11	31	15	51	22	86	34

Source: prepared by the authors on the basis of data from *Wine Spectator*.
Note: The figures in each cell show the number (N) and percentage of wines from each country scoring 90 or over in the *Wine Spectator* classification.

tourism to French castles and vineyards, where Americans adopted the language and experience of wine, image associations that projected French brand strength were created (Keller, 1993), the result being that consumers would pay more for the experience of consuming the country's wines than their objective quality merited.

It is a myth that the rising California brand was constructed quickly. Brosnan (2006) reports that it took the best producers about 30 years to attain the quality and consistency of French wines, but almost a century to adapt the best of their tradition to a unique and glamorous cultural setting in the Napa Valley. This meant that their best wines were able to generate emotional benefits more like those of French ones, but seemingly only within the United States market.

When Australian wines made their entry in the 1990s, they were able to adapt global technology and rapidly caught up with the quality of French and Californian wines. The stumbling block was the lack of a winegrowing history, and the method chosen to remedy this was an unconventional marketing campaign linking Australian wines with concepts such as straightforwardness, friendliness and honesty, in contrast to the snobbish associations of French wine.

They achieved a partial success. According to Heslop, Cray and Armenakyan (2009), the merit of fun, cheap wines (such as Yellow Trail) was to attract consumers who were tired of specialized criticism. Although the "fun" stereotype of Australian wines generated volume, it did not result in glamour or in prices reflecting their quality, and nor did it at all enhance their brand power relative to California.

Table 3 shows the number and proportion of outstanding wines (over 90 points on the *Wine Spectator* scale) produced each year by the winegrowers of each region/country.

A comparison of the proportions confirms the pattern of reputation abuse, excessive image dominance or both that has already been touched upon.

While the proportion of outstanding Australian wines rose from 20% in 1997 to 40% in 2005, the figure for California fell from 26% to 24%. The Australians have shown a greater commitment to quality than the successful Californian producers, whose indicator ranks about equal with those of countries with a low collective commitment such as Argentina and Chile.

These findings confirm the misgivings of Shapiro (1983) concerning the stagnation and erosion of average quality that can result from a successful collective reputation. Despite producing the world's largest number of outstanding wines, the Napa Valley has drawn in an enormous influx of free riders looking to charge a price premium purely by claiming location in the Valley. Benjamin and Podolny (1999) estimate that 50% of bottles labelled as being from Napa are actually from other valleys, this being made possible by the laxity of United States rules of origin legislation.

2. Critical mass

Production of a large absolute number of outstanding wines translates directly into prices that are proportional to the reputation of the region concerned, and thus leverages the image of iconic countries or regions.

California may have a low indicator of collective commitment (and lower average quality than competitors like Australia), but its larger absolute number of outstanding wines (377 versus 246) and its rising reputation have assured its dominance of the high-priced segment of the market, sending out an important signal of quality for all its wines. As table 2 shows, France continues to command extraordinary prices with a smaller but still considerable number of outstanding wines.

According to Easingwood (2007), consumers use a region or country's mass of high-priced wines to infer the quality of the rest of its wines. This critical mass not only interacts with reputation, but actually creates it. It is currently helping California more than France, which can no longer project its brand influence on to its lower-quality wines.

The change in brand power in most of the United States market has been mainly a matter of changing images. California has been supplanting France, much as Pepsi has been overtaking Coca-Cola among the younger generations: it is cooler. Quality does not seem to be such a big issue and consumers do not much understand it. According to Costanigro, McCluskey and Goemans (2009), the exact mechanism whereby a reputation emerges and is converted into higher prices is not yet fully understood.

To sum up, in public policy terms the findings of the descriptive analysis call into question the effectiveness of marketing and investment in quality as quick methods of freeing producers from the country brand trap they are caught in. As tables 2 and 3 highlight, there are no short cuts when it comes to solving this problem: the inertia of the brand image created by France, and later by California, makes it very intractable.

IV
Empirical model and findings

In most empirical studies relating wine price to quality, variants of the following equation are estimated:

$$lnp_i = \beta_0 + \beta_1 \, lnx_i + \beta_2 \, lnY_i + \beta_3 D_j \qquad (1)$$

where p_i is the price of bottle i, x_i is the individual sensory or "objective" quality score awarded to the wine after a blind tasting, and Y_i is a vector of control variables, which include the age of the wine, the amount produced and the individual reputation or brand of the producer or vineyard. Price-quality elasticity is given by the coefficient β_1, since the specification is double-logarithmic.

Landon and Smith (1997 and 1998) show how leaving out regional reputation or wine origin variables leads to overestimation of the importance of quality in price-setting, as their impact on this is several times greater.

Following the same approach, Schamel (2000), Schamel and Anderson (2003) and Costanigro, McCluskey and Goemans (2009) incorporate as predictors of wine prices not just the reputation of the producer (individual reputation) but also the reputation of the wine's country or region of origin (collective reputation).

To calculate the (percentage) premium or penalty in the price of a country's wines relative to the price of a benchmark region or country's wines, a dichotomous variable D_j is incorporated into equation (1), taking the value 1 if the wine is from region/country j and 0 if it is not. β_3 will be positive (negative) and statistically significant when the reputation of the region/country as a wine producer is better (worse) than that of the region/country used as the benchmark.

In this study, the region/country used as the benchmark is California. Thus, the absolute value of β_3 is the percentage premium or penalty (collective reputation) of the region/country's wine relative to Californian wine.

Models like the one expressed in equation (1) can be used to measure, separately, how much the reputation of the country of origin and the actual quality of the wine influence consumers' willingness to pay.

1. Estimating the model

The data for estimating equation (1) come from five cross-sectional series reported by *Wine Spectator* for the 1997, 1999, 2001, 2004 and 2005 vintages. These series include: market price (in each year's current dollars), brand, number of cases sold, age, sensory quality score, and country and region of origin of each bottle.

Age is obtained by subtracting the year of the vintage from the year in which the wine was rated. This variable would be expected to have a coefficient with a positive sign. Letting a wine age is an investment decision: this option is chosen when the increase in the selling price resulting from the expected increase in quality exceeds the costs (including capital costs) of storing the product.

It is also to be expected that the amount of wine produced will have a negative sign as an explanatory variable in vector Y_i, in equation (1): consumers sense that to produce large amounts of a particular wine, a vineyard will have to buy in grapes from other estates, thus losing control over the quality of the product.

Schamel (2000) and Costanigro, McCluskey and Mittelhammer (2007) measure a producer's reputation by the number of outstanding wines (those scoring 90 or over on the *Wine Spectator* scale) produced by the vineyard in the last two years.

2. Findings

Table 4 presents the outcome of five cross-sectional regressions used to analyse the relationship between price, quality rating, individual reputation and collective reputation by region/country in the wine market. Given that price and the other non-dichotomous variables are all expressed in log terms, the coefficients can be interpreted as elasticities.

The five regressions show price-quality elasticity coefficients that are statistically significant, positive in sign and of the expected magnitude, within the range of the findings reported by Brooks (2001) and Schamel (2000).

The results also indicate that, contrary to what Gibbs, Tapia and Warzynski (2009) expected, price-quality elasticity has held fairly steady over time, ranging between 2.7 and 4.5.

Assuming a best case scenario in which price-quality elasticity was 4.5 and Chilean winemakers increased average quality on the *Wine Spectator* scale by one percentage point, approaching the quality of Napa Valley wines (not an easy task), the market price of Chilean wines would rise by an average of 4.5%, i.e., just US$ 1,

TABLE 4

Evolution of price-quality elasticity and the country of origin premium (penalty) in the United States wine market, 1997-2005

Variable	Vintage				
	1997	1999	2001	2004	2005
Constant	-12.257 (11.8)	-16.274 (-17.5)	-8.231 (-10.5)	-13.034 (-14.5)	-15.822 (-17.4)
Individual price-quality elasticity	3.545 (15.3)	4.533 (21.9)	2.735 (15.6)	3.826 (19.1)	4.504 (22.2)
Individual price-reputation elasticity	0.125 (9.2)	0.081 (6.8)	0.150 (13.6)	0.126 (11.9)	0.121 (12.2)
Argentina brand	-0.331 (-5.1)	-0.433 (-9.7)	-0.475 (-10.8)	-0.559 (-17.8)	-0.546 (-18.9)
Australia brand	-0.193 (-7.1)	-0.322 (-14.4)	-0.406 (-18.3)	-0.426 (17.2)	-0.458 (-19.1)
Chile brand	-0.339 (7.8)	-0.382 (-10.1)	-0.599 (-18.3)	-0.597 (-16.1)	-0.564 (-17.8)
France brand	0.570 (15.7)	0.146 (4.9)	-0.092 (-3.1)	-0.135 (-4.2)	-0.225 (-8.6)
South Africa brand	-0.435 (-8.7)	-0.496 (-11.0)	-0.496 (-15.0)	-0.540 (-15.2)	-0.612 (-17.9)
Age of wine	0.609 (24.7)	0.506 (19.5)	0.537 (20.1)	0.511 (19.2)	0.453 (15.8)
Cases produced	-0.121 (-17.2)	-0.133 (-22.5)	-0.136 (-24.8)	-0.123 (-21.3)	-0.148 (-27.9)
Adjusted R^2	0.64	0.63	0.63	0.62	0.58
Observations	1 842	2 639	2 646	2 881	3 407

Source: prepared by the authors on the basis of data from *Wine Spectator*.
Note: The values in the cells show the parameters estimated for each variable in cross-sectional regressions, one for each year. The quality variable is the score awarded to the producer's wine in the *Wine Spectator* classification. Prestige or individual reputation is equivalent to the number of wines with the producer's brand scoring over 90 points in the classification. All variables other than the dichotomous variables by country are measured in natural logarithms. Prestige or the country brand is obtained by estimating the coefficient of a dichotomous variable taking the value 1 if the wine is produced in the country and 0 if it is not. The numbers in parentheses are Student's t-statistics.

from US$ 22 to US$ 23 a bottle. Thus, increasing the average price of a region's wines by improving their quality is too slow a process.

Where the evolution of the France and California brands is concerned, United States consumers were prepared to pay 57% more for French wines than for Californian wines of the same quality in the case of the 1997 vintage, but their willingness to pay this price premium quickly diminished, something that can be clearly seen in the coefficients of the France brand: starting in 2001, the French premium first disappeared and then became a penalty, until by 2005 consumers were paying 22% less for these wines than for Californian wines of the same quality. This reveals the decline in the country's brand power compared to that of California.

The possibility that France may retain brand power in the small segment of outstanding wines cannot be ruled out and is suggested by the descriptive data, but this is hard to prove econometrically owing to the small quantity and limited quality variance of wines in this segment, and exceeds the scope of this study.

Argentina, Chile and South Africa have not improved their brand power at all, and their wines are subject to a fairly similar pricing penalty. In particular, consumers have been penalizing Chilean wines with a discount (in dollars per bottle) that increased from 34% in 1997 to 56% in 2005, as the country brand coefficients in table 4 show.

The decline in the brand power of Chilean wines has been magnified in relative terms by the rise in the

brand power of California to the detriment of France. If this is corrected for by comparing the Chile data with those of France as a benchmark, it transpires that the price penalty for Chilean wines compared to French ones of the same quality actually fell from 96% to 78% (this is obtained by adding up the absolute values of each country's coefficients).

The results in table 4 also reveal that the price penalty for Australia was just 10% less than Chile's in 2005. This finding should not be interpreted as meaning that the Australian investment in marketing and quality was pointless; it only illustrates the difficulty of gaining market power when competing with strong reputations.

Considering that Australia sells three times as much in volume terms and commands an average price 10% higher than Chile's for a given quality, Australian wines have more country brand power than their Chilean competitors.

3. Price-quality elasticity by country

The price-quality elasticity obtained is really an average of the price-quality elasticities of the different countries analysed.

With a view to ascertaining whether this parameter has evolved similarly or differently from country to country, the equation (1) model was reestimated, but this time with separate specifications by country. The country brand variable disappears from the equation.

If, as Gibbs, Tapia and Warzynski (2009) claim, the globalization of the wine market has caused price-quality elasticity to rise with time, the importance of country brands ought to have diminished: wines should increasingly be assessed on their individual quality and less on their region or country of origin.

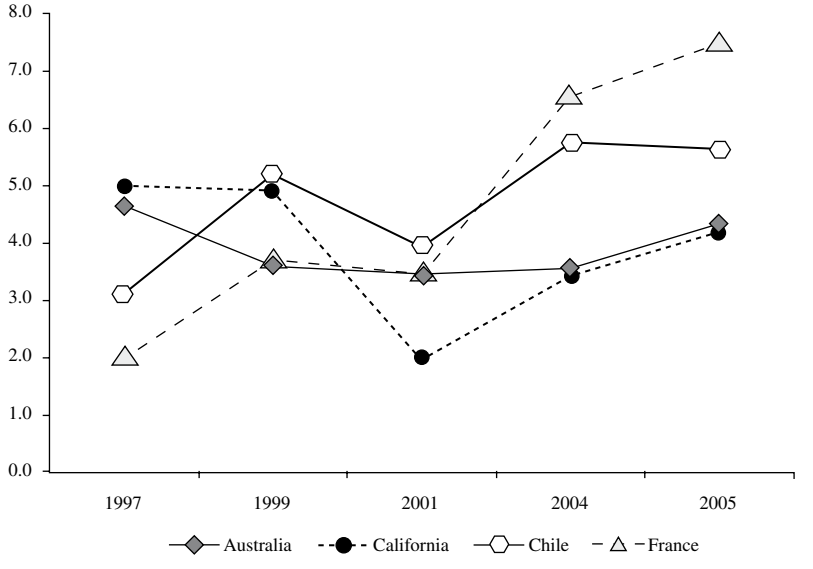
However, figure 1 shows that this elasticity has only clearly risen in the case of France; for California, on the other hand, price-quality elasticity has declined as the region has enhanced its reputation and brand power.

In the present study, this finding is largely explained by the shift in reputation and brand power between the two places of origin. Consumers do not go to great lengths to check the quality of Californian wine: its growing reputation suffices for them to pay the asking price. Conversely, the higher prices of French wines make it worthwhile for consumers to incur the opportunity cost of checking their prices.

The other countries analysed present a modest upward trend, which is good news for the new entrants, but it is much too slight for us to infer that consumers are choosing on the basis of quality: it is still country brands they go by.

FIGURE 1

Price-quality elasticities by country, 1997-2005



Source: prepared by the authors on the basis of data from *Wine Spectator*.

4. Explaining country image

The specifications analysed in table 4 and figure 1 monitor the evolution of the brand power of the various competing countries, with a negative finding for New World wines: because of their weak country brands, improving individual quality is too slow a way of increasing the average prices of their wines.

The coefficient that measures a region's brand power does not reveal how far this is determined by the actual (sensory or objective) quality of its wines and how far by its image alone. The two concepts are intertwined and hard to disentangle.

In an effort to explain what the country brand concept means, an additional specification is added to the model proposed in equation (1): the dichotomous variable representing each region/country is replaced by the number of wines produced by a country's winemakers that are rated outstanding (scoring 90 or over) on the *Wine Spectator* scale.[2]

Country prestige becomes a variable. In other words, it varies between countries depending on the number of outstanding wines each one produces and is constant for all a country's wines. Thus, as table 3 shows, a bottle of wine in the 1997 sample will take one of the following values: 3, 70, 267, 9, 83 or 2 depending on whether it is from Argentina, Australia, California, Chile, France or South Africa, respectively.

With this way of recasting the model, clearly, the assumption is that the reputation of a country which only produces nine outstanding wines, like Chile in 1997, cannot but be very low compared to that of a region like California which produces 267. The objective is a different one: if the goodness of fit of the model and the statistical significance of this new variable can be demonstrated, the results will serve to show the critical mass of outstanding wines that a new entrant country needs to have in order for the prestige thus acquired to rub off on the rest of its wines.

[2] Besides being intuitively reasonable as a way of explaining a country's prestige or brand, the critical mass or number of outstanding wines is an econometrically attractive variable: constant for a given country's wines, but differing greatly between countries, it covaries with wine price and has a low correlation with the other explanatory variables of the model.

TABLE 5

Evolution of price-quality elasticity and price-country brand elasticity in the United States wine market

Variable	Vintage				
	1997	1999	2001	2004	2005
Constant	-3.361 (-3.34)	-14.301 (-15.41)	-7.868 (-9.76)	12.361 (-13.56)	15.700 (-16.91)
Price-quality elasticity	1.575 (6.87)	3.943 (18.83)	2.394 (13.28)	3.369 (16.38)	4.085 (19.68)
Price-producer brand elasticity	0.192 (13.2)	0.096 (7.93)	0.171 (15.12)	0.141 (13.06)	0.103 (10.32)
Price-country prestige elasticity (no. of wines >90 points)	0.088 (10.16)	0.151 (15.36)	0.199 (19.55)	0.218 (19.07)	0.253 (22.93)
Age of wine	0.507 (19.6)	0.492 (18.49)	0.617 (23.01)	0.617 (23.36)	0.553 (19.43)
Cases produced	-0.187 (-28.3)	-0.160 (-28.96)	-0.153 (-28.84)	-0.142 (-25.73)	-0.141 (-27.22)
Adjusted R^2	0.57	0.59	0.60	0.59	0.62
Observations	1 842	2 639	2 646	2 881	3 407

Source: prepared by the authors on the basis of data from *Wine Spectator*.
Note: the values in the cells show the parameters estimated for each variable in cross-sectional regressions, one for each year. Individual quality is measured by the score awarded to the producer's wine in the *Wine Spectator* classification. The individual prestige and country prestige variables equate to the number of wines from the producer and from all the country's producers, respectively, scoring over 90 points in this classification each year. All the variables are measured in natural logarithms. The values in parentheses are the Student's t-statistic.

The findings reported in table 5 show that price-country prestige elasticity, i.e., the sensitivity of wine prices to the number of outstanding wines produced by winemakers in the producer's country of origin, was not only statistically significant for all the vintages analysed, but rose from about 0.1 in 1997 to 0.25 in 2005.

The price of wine in the United States market, heavily determined by image effects predating the vintages of the year 2000 (the period of French predominance), would come to acquire a larger quality component: the critical mass of outstanding wines. Image would operate through this.

Considering that for the 2005 vintage California had a critical mass of 377 outstanding wines and Chile only 40 (as shown in table 3), it can be concluded that Californian wines, on average, cost 213% = 0.253 x 843% as much as Chilean ones, a result that is in line with previous results shown in table 4.

An increase in the critical mass of outstanding wines not only raises the average quality of a country's wines, but also leverages its image, increasing the average price of all its wines. If Chilean winemakers were to double their output of outstanding wines from 40 in the 2005 vintage to 80, then, all other things being equal, the average price of their wines would rise by some 25% = 0.253 x 100%, i.e., from US$ 22 to just over US$ 28 a bottle on average.

These findings show how, through exposure to specialized professional criticism, a country producing a large quantity of outstanding wines sends out a powerful signal of quality to the market, enhancing perceptions and prices for all its wines.

V

Conclusions and limitations

On the basis of data for red wines in the United States market, this study has set out to evaluate empirically how important individual product quality is in a wine's market price as against the collective reputation of its region or country of origin. Another objective has been to suggest public policy approaches that can help new entrant countries such as Argentina and Chile to enhance the positioning of their country brand more effectively.

The estimates of the hedonic price model reveal that country brands still exert a considerable effect on the prices of all wines, something that a new entrant country such as Chile, subject as it is to a price penalty that has remained almost unchanged since the late 1990s, cannot easily remedy.

Although the increasing critical scrutiny to which producers have been exposed has made the wine market more transparent than it was in the 1990s, this has only partially eroded the role of reputations; thus, although France's reputation has declined as a result, the same has not happened with California's.

In estimating the model by region/country, the findings of this study have shown that, with the exception of France, price-quality elasticity has proved stable over time rather than rising as suggested by Gibbs, Tapia and Warzynski (2009), confirming once again that the market continues to judge the quality of wines more on their collective reputation than on their individual quality, as would happen in a transparent market.

The message for wines from new entrant countries such as Chile is straightforward: it is not possible to improve a country brand with a "value for money" concept. Despite its initial effectiveness as a penetration strategy, this has equated to devaluing the reputation of good Chilean wines in advance.

It is extraordinarily difficult to convince the wine market to appreciate new entrants. The findings of this research reveal that producers from France formerly, and those from California today, have been able to deploy their superior brand power and command higher prices even with an average quality that may be lower than that of new entrants. Their power has consisted, and still consists, in a strong collective image.

This study has also revealed that when the market is opaque, the average quality of the dominant country brand has a natural tendency to stagnate or even decline, owing to the entry of free-riding producers who use the good reputation of their region of origin to sell low-quality wines for high prices. For new entrant countries such as Argentina and Chile, however, hoping that a dominant collective reputation may decline for this reason is a slow and uncertain approach.

Although, as Roberts and Reagans (2007) point out, the wine ratings of specialist journals such as *Wine Spectator* have helped to increase transparency in the market, consumers' relationship with these publications is not direct but is affected by their price and is subject to a lag.

This explains why regions such as California can carry on dominating the bulk of the market, and commanding a price premium, by producing a large mass of outstanding wines, even if their average regional quality is lower than that of other contenders. It is the absolute critical mass of outstanding wines rather than the proportion of outstanding wines that creates a signal of quality or brand halo around all a country's wines in the minds of consumers.

The results obtained in this study reveal that increasing the critical mass of outstanding wines (scoring 90 or over in the *Wine Spectator* classification) enhances a new entrant country's reputation, and thereby strengthens the average price-quality ratio of its wines, more quickly than does raising average quality. A country's collective reputation or brand acts as a public good, and the resulting premium or penalty extends to all the region/country's wines.

Consequently, rather than using marketing in an effort to change the narrative through image association, it would be more fruitful to strongly encourage and reward (subsidize) outstanding quality in Chilean and Argentine wines until a substantial critical mass has been attained. There will be no solution to the country brand problem until these new entrant countries produce a critical mass of outstanding wines, this being the factor that will ultimately determine whether their producers benefit from a good collective image or reputation.

Limitations of the study

The *Wine Spectator* data present some shortcomings. One stumbling block in these and other investigations is that it is not entirely clear how *Wine Spectator* arrives at prices, and aggregate volumes by country are not that precise. This is made up for, in our view, by the opportunity to conduct causal analyses of the importance of country brands and individual quality in determining prices.

(Original: Spanish)

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Peru: integration, sectoral specialization and synchronization with international gross domestic product cycles

Mario D. Tello

ABSTRACT

This paper analyses the way the integration of trade, finance and sectoral specialization relates to the degree of synchronization between the gross domestic product (gdp) cycles of Peru and those of the 31 countries with which it trades most. The analysis is based on estimation of a system of simultaneous equations with panel data in which account is also taken of the repercussions of preferential trade agreements (ptas). The findings reveal robust two-way relationships between synchronization and financial integration, between the latter and trade integration, and between trade integration and sectoral specialization. ptas did not influence the different variables considered. This evidence suggests that greater trade integration in Peru would intensify the effects of partner countries' gdp cycles on Peruvian output in contexts like the 2008 and 2010 crises.

KEYWORDS

Economic integration, trade policy, financial policy, production specialization, preferential agreements, economic growth, business cycles, gross domestic product, mathematical modelling, Peru

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F4, C33, O11

AUTHOR

Mario D. Tello, CENTRUM Católica and Department of Economics of the Catholic University of Peru. mtello@pucp.edu.pe

I
Introduction

When it comes to considering the repercussions of international cycles and crises on an economy, one type of approach uses models, empirical regularities and synchronization of international business cycles between countries as its basis (e.g., Fidrmuc and Korhonen, 2009; Backus, Kehoe and Kidland, 1992), while another type estimates the effects of external crises, volatility or shocks on economic growth or performance (e.g., Edwards, 2007; Aghion and Banerjee, 2005; De Gregorio and Lee, 2003; Loayza and Hnatkovska, 2003). In this latter tradition, the author (Tello, 2009b) estimated the impact of external shocks and preferential trade agreements (PTAs)[1] on real per capita gross domestic product (GDP) growth in the Peruvian economy over the period from 1950 to 2007.

The study concluded that external shocks did not alter Peru's long-run economic growth during that period, although they did affect per capita GDP and its annual rate of change in the short term. The strength and duration of these impacts depended on the handling of stabilization policies (or programmes) and on the size of the external shocks. Again, the PTAs implemented since the 1970s have not contributed to higher rates of productivity and per capita output growth. The effects of these agreements have generally been limited by the type of development models implemented and by the complete failure to reduce non-tariff trade barriers. These trade restrictions have continued to limit access to the export markets of the country's main trading partners, even though tariff barriers have progressively come down as a result of these agreements, which are variously unilateral, bilateral or regional, and multilateral in nature.

The present study is an exploratory one, and it addresses the subject of external crises. Following the first approach, it analyses the effects of (trade and financial) integration, sectoral specialization levels and PTAs on the degree of synchronization between the GDP cycles of Peru's main trading partners and Peru's own GDP. This approach is thus used to evaluate the effect in terms of the correlation of partner countries' GDP cycles deriving from a greater or lesser flow of goods and capital or from the degree of differentiation between these countries' sectoral structures. The main conclusion from the body of evidence reported for the 1982-2006 period is that the international cycles arising because of internal shocks in leading trade partners have affected Peru's real GDP cycles. In contrast, a second important conclusion from the estimations is that the PTAs implemented by Peru during the period considered have not had a statistically significant influence on the degree of synchronization between Peru's GDP cycles and those of its main trading partners.

This study consists of five sections. Section II summarizes the theoretical aspects supporting the interrelationship between the degree of synchronization of GDP cycles, trade and financial integration, and the degree of sectoral specialization between the trading countries. Section III describes the specification to be estimated and lists the variables to be considered and the information sources used. Section IV summarizes the findings in the form of a hypothesis, given the exploratory nature of the study. Section V sets out the conclusions. References are given at the end of the paper.

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[1] A preferential trade agreement is defined as a set of instruments that countries use for the purpose of reducing or removing restrictions on commerce in traded goods, services and factors. These agreements can be of four kinds: (i) unilateral, where an economy unilaterally reduces its trade restrictions; (ii) bilateral or regional, where two or more countries agree to reduce trade restrictions discriminately (as countries that are not members of the agreement are excluded from its benefits) and reciprocally; (iii) generalized system of preferences, where a country agrees to reduce its trade restrictions discriminately for a group of countries, without requiring the reductions to be matched by them; and (iv) multilateral agreement, this being a regional agreement covering a large number of countries, such as the member countries of the World Trade Organization (WTO).

II

Synchronization of cycles and relationship to the degree of integration in trade, finance and sectoral specialization: conceptual considerations

Intuitively, the more closely countries are integrated, the more strongly business cycles will be transmitted between them. Integration may occur through trade in goods and services or through flows of capital and financial assets. However, this intuitive argument is not theoretically sound. Furthermore, there is a striking discrepancy between the empirical evidence for the degree of output "synchronization" or "co-movement"[2] between countries and the theoretical models that seek to explain this degree of synchronization or movement.

Calderón, Chong and Stein (2007), based on Stockman (1988), summarize some of the theoretical arguments[3] using the components of the correlation coefficient for the real GDP of two countries, Y_i and Y_j.

$$\rho_{ij} = \sigma_k \cdot \left(\sigma_i \cdot \sigma_j\right)^{-1/2} \cdot \sum_{k=1}^{N_s} w_{ki} w_{kj} + \sigma_{ij} \cdot \left(\sigma_i \cdot \sigma_j\right)^{-1/2}; \quad w_{ki} = Y_{ki} / Y_i; w_{kj} = Y_{kj} / Y_j \tag{1.1}$$

where ρ_{ij} is the correlation coefficient for the GDP cycles of countries i and j, and N_s is the number of sectors.

The first addend of (1.1) reflects the contribution made to the correlation coefficient or degree of cycle synchronization between two countries by the impact of specific shocks (assumed to be equal for both countries) in industry or sector k. These "random" shocks are independent of other sectors and of time; σ_k is the variance of shocks that are the same for all industries k; σ_i and σ_j are the variances of each country's GDP; and w_{ki} and w_{kj} are the share of sector k in each country's total GDP. The second addend reflects the contribution made to the degree of cycle synchronization in two countries by aggregate and country-specific shocks. σ_{ij} is the covariance of these shocks between the two countries, and $\sigma_{ij}.(\sigma_i.\sigma_j)^{-1/2}$ is the correlation resulting from the two countries' shocks.

Standard comparative advantage theory predicts that the more highly the countries possessing such an advantage are integrated, the more they will specialize, and trade will be essentially intersectoral (i.e., goods and services from different industries will be exchanged). Thus, changes in w_{ki} are expected to correlate negatively with changes in w_{kj}; also negative, accordingly, will be the contribution to the degree of synchronization of the first component resulting from industry-specific shocks. This implies that the higher the level of integration owing to inter-industry trade, the less synchronized the two economies' GDP cycles will be.

Conversely, if trade is dominated by competitive advantages, and thus by intra-industry commerce, greater integration will mean a higher degree of association between sectoral shares and thus greater synchronization of the two countries' GDP cycles.[4] In this case, the correlation of shocks between the countries would reinforce the effects of sector-specific shocks. These opposing signs between the degree of synchronization and that of integration depend on whether the latter induces a higher or lower degree of intersectoral specialization.[5]

Insofar as financial integration also has consequences for sectoral specialization, this too will affect the degree of synchronization. Thus, Kalemli-Ozcan, Sørensen

[2] This is measured by Pearson's coefficient of correlation between the GDP of two countries or a group of countries.

[3] Other summaries of the theoretical models for the relationship between synchronization of international cycles and trade and financial integration can be found in Ambler, Cardia and Zimmermann (2002); Canova and Dellas (1993); Baxter (1995); Kollman (2001); Kose and Yi (2002 and 2001).

[4] Krugman (1993) and Kose and Yi (2001), among many others, have developed this line of theory.

[5] Specialization in sectors is consistent with both intra- and inter-industry trade. In the first case, it involves a more refined kind of specialization, such as vertical specialization (Kose and Yi, 2001) within the same industry.

and Yosha (2001 and 2003) argue that while industrial specialization brings a number of benefits to an economy, if output is not insured against the risks of this specialization then the GDP variance resulting from it will entail losses of welfare that may be greater than the benefits. Although specific types of insurance (catastrophe insurance with futures contracts, for example) may provide a way of offsetting these risks, it is by geographically diversifying their income sources through the international capital market that countries and regions insure themselves against the risk of specialization. Consequently, if interregional and international capital is well integrated, countries and regions can insure against industry/sector shocks and thereby position themselves to better exploit the comparative or competitive advantages they possess.

As in the case of goods and services trade integration, the greater the degree of financial integration, the lower the degree of synchronization will be if the trade between countries is inter-industrial, and the higher it will be when trade is intra-industrial. The synchronization of cycles between countries is said to be "asymmetrical" in the first case and "symmetrical" in the second.

The second component contributing to the degree of synchronization is the one resulting from country-specific (and not sector- or industry-specific) shocks. The degree of trade and financial integration can also affect this component. Thus, demand shocks in one country can have spillovers that increase the covariance of countries' GDP. Such increases in demand in country *i* entail greater demand for goods from country *j*; the higher the degree of integration, the greater the demand effect thus transmitted to other countries will be. Consequently, this second component (when $\sigma_{ij} > 0$) can offset and even exceed the effects of the first component if the advantages are comparative in nature and reinforce them if the advantages are competitive. In these cases, increases in trade integration will lead to increases in the synchronization of the two economies' GDP cycles.

Frankel and Rose (1998) add that policy coordination between regions heightens the effects of integration on the synchronization of international cycles. Coe and Helpman (1995) and Lichtenberg and Van Pottelsberghe (1998) stress the transmission of productivity shocks between countries. Transmission of such shocks by technological diffusion, foreign investment flows and technology sources is intensified by trade and financial integration.

A second group of theoretical and empirical arguments regarding the interrelationships between integration, sectoral specialization and synchronization were made by Backus, Kehoe and Kidland (1993), who discovered what is known as the "quantity anomaly". In a world free of market distortions and with free movement of factors and access to trade in goods, positive shocks that increase returns in a country or a sector of it entail factor and asset movements that result in negative GDP correlations. Kose and Yi (2006, 2002 and 2001) show that models of international cycles cannot replicate empirical evidence on the degree of synchronization between countries. These models predict that the more trade or financial integration there is, the lower the degree of GDP synchronization between countries will be.

Because of this discrepancy between the empirical evidence and theoretical models, some of the literature has concentrated on introducing "factors or conditions" into output or markets such that they can account for the degree of synchronization between countries. One direct channel, mentioned earlier, is the degree of sectoral specialization. Thus, the more the structures of countries' production sectors differ, the less their GDP cycles will be synchronized. Two indirect channels, also described earlier, operate through the effects of trade and financial integration on sectoral specialization.

The direct channels of trade and financial integration are taken from the standard models of international trade, and introduce some changes of factors or conditions into output and markets. Thus, for example, Kose and Yi (2001) introduce trade within a single industry or sector in goods deriving from "stages in the production process", and obtain a higher degree of synchronization when "trade intensity" between countries increases. Heathcote and Perri (2002a and 2002b), Calvo and Mendoza (2000) and Mendoza (2002) show that distortions in the international capital market (such as limitations on the ability to lend or borrow capital internationally, or liquidity constraints affecting investors) can increase the degree of GDP synchronization between countries.

There is a fairly plentiful empirical literature dealing with the effects of trade and financial integration and of the degree of specialization on GDP synchronization between countries. Among the most recent studies, that of Calderón, Chong and Stein (2007) stands out. This uses a sample of 147 countries in the 1960-1999 period and employs cross-sectional and panel data econometric techniques, concluding that: (i) increases in integration or the intensity of goods trade induce greater synchronization of GDP cycles between countries; (ii) the repercussions of trade intensity are greater for the sample of developed countries than for the sample of developing countries; and (iii) the repercussions of trade intensity are more marked for countries with similar sectoral structures.

Second, Imbs (2004) works with quarterly data on 24 countries (six developing, including Peru, and 18 developed) for the 1980-1999 period and with a system of four simultaneous equations, and finds as follows: (i) specialization patterns have substantial effects on economic cycles between countries, which are independent of the degree of trade and financial integration; (ii) in the presence of a variety of financial integration measures, regions with a high level of financial integration present greater synchronization of GDP cycles despite their sectoral specialization; and (iii) if trade is intra-industrial, there are also increases in GDP synchronization between countries.

Lastly, García-Herrero and Ruiz (2008), working with a sample of 109 countries (88 of them developing) for the 1990-2004 period and with a system of four simultaneous equations, estimate the incidence of trade, financial and specialization integration on the synchronization of Spanish GDP cycles with those of the country's trading partners. These authors find that: (i) the intensity of trade and the similarity between the sectoral structures of Spain and its trading partners positively affect GDP cycle synchronization between Spain and its trading partners, and (ii) notwithstanding this, financial integration negatively affects synchronization. This finding is consistent with standard models of international cycles.

To sum up, the theoretical considerations and empirical evidence described in this section indicate that while the synchronization of an economy's GDP cycles with those of the countries with which that economy trades goods, services and financial assets is associated with the degree of integration between the countries' sectoral structures in terms of trade, finance and specialization, these relationships are not straightforward but have direct and indirect components and depend on other factors, such as the sources determining trade, distortions in goods, services and financial markets, and the existence of different stages in the production process.

The purpose of the present study is to empirically identify these associations and interrelationships for the Peruvian economy in the 1982-2006 period. To do this, it will specify a system of simultaneous equations similar to that of the two earlier studies (Imbs, 2004; García-Herrero and Ruiz, 2008) and add the effects of PTAs. These agreements contribute to trade integration between their member countries and are expected to have the same effects on GDP synchronization as on trade integration.

III

Specification of the system of equations and information sources

1. The model: specification and basic variables

Theoretical considerations (described in the previous section) have been formalized and summarized by Imbs (2004) and García-Herrero and Ruiz (2008) using the following system of equations:

$$\rho_{jt} = \alpha_0 + \alpha_1 \,.\, T_{jt} + \alpha_2 \,.\, S_{jt} + \alpha_2 F_{jt} + X_1 \,.\, \phi_1 + \varepsilon_{1jt}; \quad (2.1)$$

$$T_{jt} = \beta_0 + \beta_1 \,.\, S_{jt} + \beta_2 \,.\, F_{jt} + X_2 \,.\, \phi_2 + \varepsilon_{2jt}; \quad (2.2)$$

$$F_{jt} = \delta_0 + \delta_1 \,.\, \rho_{jt} + \delta_2 \,.\, T_{jt} + X_3 \,.\, \phi_3 + \varepsilon_{3jt}; \quad (2.3)$$

$$S_{jt} = \gamma_0 + \gamma_1 \,.\, T_{jt} + \gamma_2 \,.\, F_{jt} + X_4 \,.\, \phi_4 + \varepsilon_{4jt}; \quad (2.4)$$

$$j = 1, 31; \; t = 1982\text{-}2006$$

where ρ_{jt}, T_{jt}, S_{jt} and F_{jt}, termed "basic variables", are the degree of GDP synchronization (as measured by the correlation coefficient for GDP cycles), integration of trade in goods, financial integration and the degree of sectoral specialization, respectively, between Peru and its trading partner, country j, in year t; the matrix X_i is formed by the control variables for each equation i, and ε_{ijt} is the error of equation i, country j, year t. This system captures direct and indirect effects and the theoretical interdependences between the degree of GDP cycle synchronization, financial and trade integration, and sectoral specialization.

Equation (2.1) captures the total effects of these last three factors and of the control variables on the degree of GDP synchronization. Equations (2.2), (2.3) and (2.4) capture the indirect effects of the degrees of integration in finance, trade and sectoral specialization

and the interdependences between these variables. Thus, in equation (2.2), if trade between Peru and country *j* is dominated by inter-industry trade (and there are no shocks in the countries), then an increase in specialization will generate a higher degree of goods integration and vice versa. In equation (2.4), similarly, if trade is dominated by inter-industry flows, then a higher degree of goods integration will entail greater sectoral specialization. If the sign were the opposite, then trade between Peru and country *j* would be dominated by intra-industry flows.

The degrees of financial and trade integration may be complementary or substitutive. They will be complementary if financial flows or foreign investment go to the export sectors where Peru has comparative advantages. In this case, the signs of the coefficients of the variables F_{jt} and T_{jt} in equations (2.2) and (2.3), respectively, will be positive. These degrees will be substitutes if financial flows and foreign investment go to sectors competing with imports. In this case, the signs of the coefficients will be negative. The degree of financial integration can also affect the degree of sectoral specialization, as noted in the previous section. Its effect will be positive if financial integration induces intra-industry specialization and negative if financial integration induces inter-industry specialization.

The Hodrick-Prescott (1997) filter was used to measure the GDP cycles of Peru and its partner countries.[6] The degree of synchronization, ρ_{jt}, is Pearson's correlation coefficient calculated from 1970 to year *t* between the estimated real GDP cycle of partner country *j* and the estimated real GDP cycle of Peru.

Two indicators are used for the degree of trade integration:

$$T_{1jt} = N_t^{-1} \cdot \sum_{i=1970}^{t} \left(X_{ji} + M_{ji}\right) / \left(Y_{ji} + Y_i\right); \qquad (2.5)$$

$$T_{2jt} = \left(2.N_t\right)^{-1} \cdot \sum_{i=1970}^{t} \left(X_{ji} + M_{ji}\right) \cdot Y_{wi} / \left[\left(Y_{ji}\right) \cdot \left(Y_i\right)\right]; \quad t \leq 2006 \qquad (2.5)'$$

where N_t is the number of years from 1970 to year *t*; X_{ji} and M_{ji} are the values of exports from Peru to country *j* and imports by Peru from country *j*, respectively, in year i ($\leq t$); Y_{ji} is the dollar GDP of country *j* in year *i*; Y_i is the dollar GDP of Peru in year *i*; and Y_{wi} is the dollar GDP of the world in year *i*. The first indicator represents the value of goods trade flows relative to the GDP of Peru and its partner countries, and the second represents this value relative to world GDP.

Where the degrees of financial integration and specialization are concerned, two indicators are also used for each degree. These are:

$$F_{1jt} = N_t^{-1} \cdot \sum_{i=1982}^{t} I_{ji} / \left(Y_{ji} + Y_i\right); \qquad (2.6)$$

$$F_{2jt} = N_t^{-1} \cdot \sum_{i=1982}^{t} I_{ji}; \qquad (2.6)'$$

$$S_{ijt} = -N_t^{-1} \cdot \sum_{i=1970}^{t} \sum_{k=1}^{5} / S_k - S_{kj} / \qquad (2.7)$$

$$S_{2jt} = - \sum_{i=1970}^{t} N_t^{-1} \cdot / \sum_{k=1}^{5} / S_k - \sum_{k=1}^{5} S_{kj} / \qquad (2.7)'$$

where I_{ji} is the stock of foreign investment from country *j* in Peru in year *i*, and s_k and s_{kj} are the real GDP shares of sector *k* in Peru and in country *j*. The sectors are: agriculture, mining, manufacturing, construction and services. The numbering N_t starts in 1982 for the two investment indicators and in 1970 for all the other variables. Sectoral GDP figures were available up to 2006.[7]

The indicators for the degree of financial integration represent the relative size (relative, that is, to the GDP of Peru and its trading partners) and the absolute size of the stock of foreign investment from Peru's trading partners. At the same time, the two indicators of sectoral specialization represent the degree of similarity in sectoral structures between Peru and its partner countries. A smaller difference in the degree of sectoral specialization between Peru and country *j* implies an S_{jt} value close to zero (0) and a greater difference in this degree implies negative values well below zero (0) for S_{jt}.

[6] With the parameter λ=100, which has the role of penalizing the variability of the trend component of the GDP variable. Estimates were also produced using another two measures of cycles: the GDP variation rate and the errors of a quadratic regression for GDP in Peru and its partner countries. The results obtained using these indicators do not alter the conclusions of the present study.

[7] Indicators for the four basic variables are given in table A1 of the annex.

2. Preferential trade agreements (ptas)

The variables representing PTAs and included as control variables in matrix X_i are of three types for bilateral or regional agreements and two types for unilateral and multilateral generalized system of preferences (GSP) agreements. For the first two types of agreements, the variables are:

— A_j = discrete variable taking the value one (1) for every year considered, always provided Peru and country j are members of agreement A, failing which it will take the value zero (0). This variable is meant to capture the "country" effect on the dependent variable without taking the agreement into account.

— DA_{jt} = discrete variable taking the value one (1) if Peru and country j are members of agreement A during period t of the agreement's implementation, failing which it will take the value zero (0). This variable is meant to capture the "trade creation" effect of agreement A on the dependent variable. In theory, this effect ought to be similar to the effect of the degree of trade integration.

— TA_{jt} = variable taking the value of the time variable (numbering from 1 to 25 representing the years from 1982 to 2006) in the period of implementation of Peru's agreement A and zero (0) in other periods. This variable is meant to capture the permanent effect of the agreement on the trend of the dependent variable.

The variables for the other three types of agreement are:

— A_t = binary variables taking the value one (1) in the implementation period of the unilateral/multilateral agreement or GSP agreement granted to Peru and zero (0) in other periods. This variable is meant to capture the temporary effect of the agreement on the level of the dependent variable.

— TA_{jt} = variable taking the value of the time variable (numbers 1 to T representing the years from 1982 to 2007) in the period of implementation of Peru's agreement A and zero (0) in other periods. This variable is meant to capture the permanent effect of the agreement on the trend of the dependent variable.

The names of the agreements A considered are:[8]

— AC, Andean Community, initiated in 1970 and in force since 1971. Peru withdrew temporarily in 1993 before rejoining in 1997. In accordance with the notation for trade agreements, the variables corresponding to this agreement are AC, DAC and TAC.

— ACAR, partial scope economic complementation agreement (ECA) between the AC (excluding the Plurinational State of Bolivia) and Argentina; in force since 2001. The variables corresponding to this agreement are ACAR and DACAR.

— ACBR (ECA 39), partial scope economic complementation agreement between the AC and Brazil in 1999. The variables corresponding to this agreement are ACBR, DACBR, TACBR.

— ECA 38, the Chile-Peru Economic Complementation Agreement, in force since 1998. The variables corresponding to this agreement are CHI, DCHI, and TCHI

— ATPDEA, the Andean Trade Promotion and Drug Eradication Act, which is a generalized system of preferences granted by the United States to the member countries of the AC. These preferences were initiated in the Andean Trade Preference Act (ATPA), a preferential trade agreement signed by the States of the AC in 1992, and continued in expanded form in 2001 with the ATPDEA; consequently, this agreement takes values of one (1) from 1993 onward. The variables corresponding to this agreement are ATPDEA and TATPDEA.

— UA, unilateral arrangement applied during the liberalizing period of the Peruvian economy, running from 1991 to 2007. This variable also captures some of the liberalizing policies or structural reforms that were implemented in this period. The variables corresponding to this arrangement are UA and TUA.

— MA, Uruguay Round multilateral agreement applied since 1994. The variables corresponding to this agreement are MA and TMA.

The additional control variables for the degree of synchronization equation, X_1, are:

— Dif-Infla$_{jt}$ = the absolute value of the inflation difference between Peru and its partner country j in period t. This variable is meant to capture the effect of economic policy convergence between the two countries on the degree of GDP synchronization between them.

Binary variables are also introduced to capture the effects of countries being members of geographical regions. These include North America, Central America, the Southern Cone, the European Union, Asia, and other America. This group of variables is similar to the variable A_{jt}. The effect of the geographical area of the Andean region is captured by the variable AC.

[8] A detailed listing of characteristics of the preferential agreements considered can be found in Tello (2009a).

3. Control variables

The control variables for the rest of the X_i equations ($i = 2, 3, 4$), as the case may be, are:

— Y_t = the real GDP (in 1990 dollars) of Peru. This variable is meant to capture the effect of domestic demand or growth on the dependent variables of equations (2.2), (2.3) and (2.4). This effect may be pro-trade (positive sign) or anti-trade (negative sign).[9] Equation (2.3) also includes the per capita GDP, *Yp*, of the partner country as a factor incentivizing foreign investment in Peru. The theoretically expected sign of this coefficient is positive.

— Dif-Yp_{jt} = the absolute value of the difference in real per capita GDP between Peru and partner country j in period t. This variable is meant to capture the effect of differences in development level on the dependent variables of equation (2.2), T_{jt} and equation (2.3), F_{jt}.

A positive sign for the Dif-Yp_{jt} coefficient in the equation for the degree of goods trade integration, T_{jt}, means that the source of the trade is comparative advantage and inter-industry trade predominates. A negative sign for the coefficient means that the source of the trade is competitive advantage and it is intra-industry trade that predominates. An alternative interpretation, which produces opposing signs, is the possibility that the divergence in development levels may increase the diversification of markets, thus reducing the degree of integration of each country j.

In the case of the equation for the degree of financial integration, F_{jt}, whose indicators measure the relative and absolute size of the stock of foreign investment from country j, the effect of the Dif-Yp_{jt} variable is open to two possible interpretations. In the first, much as in the case of the degree of trade integration, the Dif-Yp_{jt} variable indicates the source of international advantages (comparative or competitive). Thus, a positive sign for the coefficient of this variable implies that the size of the stock of foreign investment from country j in Peru is mainly determined by the exploitation of the resources from which Peru's comparative advantages derive. A negative sign means that exploitation takes place in sectors with a competitive advantage. The second interpretation, as a source of attraction for foreign investment, is caused by the divergence in the countries' development level.[10] Thus, the greater the difference between Peru's per capita GDP and the partner country's, the less attractive the country will be to foreign investors, and vice versa. The evidence given in table 1 shows that the negative sign consistent with this latter interpretation predominates.

In the case of equation (2.4) for the degree of similarity in sectoral structure, the sign theoretically expected for the impact of Dif-Yp_{jt} is positive. In other words, the smaller the difference in development level between Peru and the partner country, the smaller the difference in the countries' sectoral structures will be.

$$SIMILAR_{jt} = 1 - \left(Y_{jt} + Y_t\right)^{-2} \cdot \left(Y_t^2 + Y_{jt}^2\right);$$
$$-\infty < SIMILAR_{jt} \leq 1/2$$

The $SIMILAR_{jt}$ variable represents the degree of similarity (in terms of GDP) between Peru and partner country j. The sign of the coefficient for this variable in equations (2.2) and (2.3) is similar to that of the per capita GDP differential, insofar as it represents (comparative or competitive) international advantages. Intuitively, the sign of the coefficient in equation (2.4) would be expected to be positive. Similarity between economies that trade with each other also implies similarity in the degree of sectoral specialization.

$RERb_{jt}$ = the bilateral real exchange rate of Peru with country j in period t, where $RER_{jt} = [IE_{ijt} * CPI_{jt}] / CPI_{it}$; E_{ijt} is the nominal bilateral exchange rate of Peru with country j, defined as the price of the currency of country j in terms of the currency of Peru; IE_{ijt} is the exchange-rate index with base year 2000, and $IE_{ijt} = (E_{ijt} / E_{ij\,2000})$ *100; CPI_{it} is the consumer price index of Peru in period t with base year 2000; and CPI_{jt} is the same index for country j.

The coefficients of this variable represent the combination of relative supply and demand price effects on the degrees of trade and financial integration. A positive coefficient means that the supply price effect has prevailed over the demand effect, and both degrees of integration would increase with a rise in $RERb_{jt}$ if foreign investment went to export sectors. A negative sign for the coefficient means that the demand price effect is the one that predominates, and both degrees would decrease with increases in $RERb_{jt}$ if foreign investment went to export sectors.

$ARAN_{jt}$ = the (percentage) simple or weighted average most-favoured-nation (MFN) tariff applied by importing country j to Peru's export goods in period t. This variable represents the trade barriers put up by partner countries. Theory says that the sign of the coefficient

[9] The estimates of equation (2.3) also include per capita GDP, *Yp*, which represents the development level of Peru as a pull factor for foreign investment. The theoretical sign expected of this coefficient is positive.

[10] This argument was made by Lucas (1990).

of this variable for the two degrees of integration will be negative provided that foreign investment flows go to export sectors.

$DIST_{jt}$ = the distance in kilometres between the capitals of Peru and partner country *j*. The theoretical sign is similar to that for tariffs.

Lastly, the following characteristics of partner countries *j* trading with or investing in Peru were also introduced as control variables for equations (2.2), (2.3) and (2.4):

— $LANG_j$ = dummy taking the value one (1) if partner country *j* has the same official language as Peru and zero (0) in all other cases. The theoretical sign for the coefficient of this variable is positive in each of the three equations.

— $BORD_j$ = dummy taking the value one (1) if partner country *j* shares a border with Peru and zero (0) in all other cases. The theoretical sign expected for the coefficient of this variable is also positive for all three equations.

— COL_j = dummy taking the value one (1) if partner country *j* has had a colonial relationship with Peru and zero (0) in all other cases. The sign for the coefficient of this variable is the same as in the two previous cases.

— ISL_j = dummy taking the value one (1) if partner country *j* is an island and zero (0) in all other cases.[11] The theoretical sign for the coefficient of this variable is negative.

— SEA_j = dummy taking the value one (1) if partner country *j* is surrounded by land (practically landlocked) and zero (0) in all other cases. The theoretical sign expected for this variable as regards the degrees of trade and financial integration is negative.

— $AREA_j$ = the size of partner country *j* in square kilometres.

A number of information sources were drawn upon for the variables used. Real GDP (in 1990 dollars) and sectoral GDP were taken from UNCTAD (2009). Data on the stock of foreign investment come from INEI (2009). The data on the characteristics of the countries and bilateral exchange rates were taken from Tello (2009a). Export and import flows are from United Nations (2009).

4. Initial hypotheses

Figure 1 summarizes the theoretical hypotheses specified in the system of equations.

In the case of the Peruvian economy, whose export structure is dominated by commodities[12] and whose main trading partners are industrialized countries,[13] the expectation is that, in the absence of country shocks, the theoretical relationships deriving from inter-industry trade and comparative advantages will predominate. Specifically, the indicators for degrees of specialization,

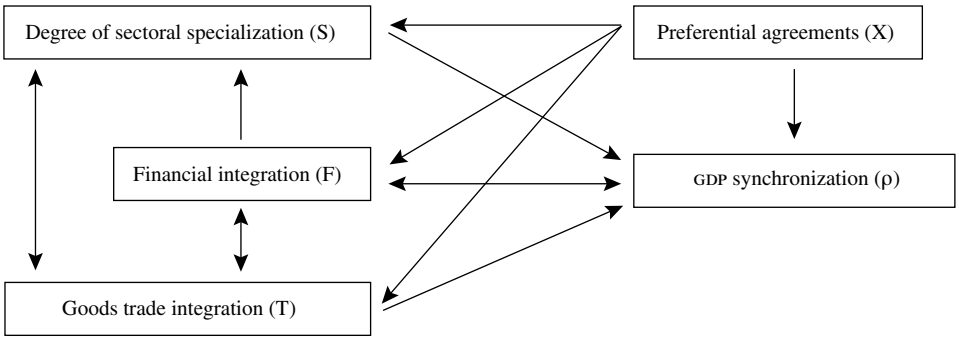
[11] The partner countries deemed to be islands are Australia, New Zealand, Japan and Singapore.

[12] In 2007, 84% of all exports by value were commodities and 62% were mining products (Tello, 2011).

[13] Of the 31 main countries Peru trades with, 17 are high-income countries. The value of exports to these countries represented 60% of total exports by value in 2007.

FIGURE 1

Theoretical relationships between gdp cycle synchronization and specialization, trade and financial integration, and ptas



Source: prepared by the author.
GDP: gross domestic product.
PTAs: preferential trade agreements.

integration of goods trade and financial integration would be expected to negatively affect the degree of synchronization between the GDP cycles of Peru and those of its main trading partners. In other words, all the α_i coefficients of equation (2.1) should be negative. Similarly, the degree of synchronization should negatively affect the degree of financial integration, i.e., δ_1 should be negative and there should be an inverse relationship between the degree of specialization and the degree of trade integration, so that coefficients β_1 and γ_1 are less than zero (0). Meanwhile, given that foreign firms also predominate in Peru's commodity export sectors (Távara and Tello, 2010), there should be a complementary relationship between the degree of trade integration and the degree of financial integration and, consequently, the signs of coefficients β_2 and δ_2 in equations (2.2) and (2.3), respectively, should be positive. By the same token, the indicator of financial integration should negatively affect the indicator of specialization, i.e., γ_2 should be less than zero (0).

IV

Estimations and findings: the case of Peru, 1982-2006[14]

Unlike the studies of Imbs (2004) and García-Herrero and Ruiz (2008), which estimate the system of simultaneous equations without considering the differences between countries, the estimates reported in table 1 present the coefficients and efficient estimators derived from the set of regressions carried out with the efficient three-stage ordinary least squares method (OLS-3),[15] using panel data and incorporating the differences between countries[16] in accordance with the formulation of Baltagi (2005).[17]

The estimation was carried out in four steps: (i) estimation of OLS errors for each of the four equations in the system; (ii) estimation of the variance and covariance matrices of the random effects deriving from the differences between countries and the errors of each equation,[18] using the OLS errors; (iii) determination of the Cholesky matrices of the inverses of the two previous matrices;[19] and (iv) estimation of the coefficients of the system of equations using the OLS-3 method with instrumental variables. These variables are transformations of the exogenous variables of the system, previously multiplied by the Cholesky matrix of the inverse of the matrix of variances and covariances of error vector ε of the system of equations.[20]

Eight regressions were carried out for each of the equations in the system derived by combining the six indicators representing the degrees of integration in trade, finance and specialization. The first column of table 1 shows the coefficients of the regressions that had the highest and most relevant degree of fit for each of the equations in the system. These coefficients correspond to indicators ρ, T_2, F_2 and S_1. The second column

[14] The empirical analysis in this section is exploratory in character, owing to the limitations of the information used in the present study. Consequently, the econometric evidence reported in this section cannot be treated as definitive findings. Rather, it may be interpreted as offering technical hypotheses with a likelihood of being correct, since the evidence (with all the shortcomings of the information available) supports them. Once the data limitations have been dealt with, the hypotheses formulated in this section can be appropriately verified.

[15] Vector autoregression models (VARs) have not been considered owing to the limitations on the number of periods and for the sake of comparability with the estimates of García-Herrero and Ruiz (2008) and Imbs (2004).

[16] (Unreported) estimates were also carried out with OLS, two-stage OLS for each of the equations in the system and three-stage OLS for the whole system. In addition, two alternative measurements of the Hodrick-Prescott cycles were used: the errors of the quadratic regression in time for GDP (Peru's and its partner countries') and their respective GDP variation rates. In most cases, the results of all these estimates and measurements were similar to those reported here.

[17] This method was selected to ensure that the variance and covariance matrices of the equation error components were defined as positive. The four equations were converted into a system of matrices $Y = Z\beta+\varepsilon$. According to Baltagi (2005), the estimator β_e and the variance and covariance matrix V of this efficient OLS-3 estimator are, respectively: $\beta_e = (Z^{*\prime}P\,Z^{*})^{-1}.(Z^{*}Py^{*})$ and $V = (Z^{*\prime}P\,Z^{*})^{-1}$, where $P = X^{*}(X^{*\prime}X^{*})^{-1}X^{*\prime}$, and $X^{*} = \Omega^{-1/2}.(I\otimes X)$, $Z^{*} = \Omega^{-1/2}.Z$; $y^{*} = \Omega^{-1/2}.y$; $E(\varepsilon\varepsilon') = \Omega$, X is the matrix formed by the 40 predetermined model variables (including the constant and time).

[18] Where the error vector $\varepsilon = (\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{2t}, \varepsilon_{2t})$ is defined as: $\varepsilon_j = (I\otimes e)\,\mu_j+\nu_j$; μ_j is the random vector of the effects of the 31 countries (N) for each equation j; ν_j is the error vector of each equation; and e is a vector whose size matches the number of years.

[19] The respective matrices are: $E(\mu\mu') = \Sigma_\mu$ and $E(\nu\nu') = \Sigma_\nu$.

[20] This Cholesky matrix ($\Omega^{-1/2}$) is a function of the two Cholesky matrices of the inverse matrices of the errors of the random country effects ($\Sigma_\mu^{-1/2}$) and the errors of each equation ($\Sigma_\nu^{-1/2}$). Specifically: $\Omega^{-1/2} = \Sigma_1^{-1/2}\otimes P + \Sigma_\nu^{-1/2}\otimes Q$, $\Sigma_1 = Np\Sigma_\mu+\Sigma_\nu$, $Np = 25$ is the number of years, $P = I\otimes Jp$, $Q = I-P$, Jp is a square matrix of order Np whose elements are equal to $1/Np$.

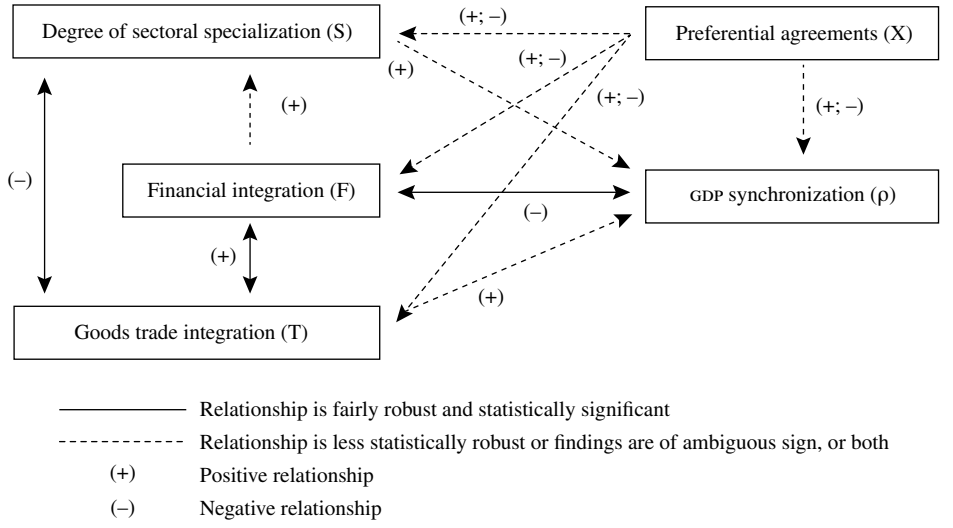
presents the percentage of positive and statistically significant coefficients from the eight estimations carried out for each equation. The third column shows the percentage of negative and statistically significant coefficients from the eight estimations carried out for each equation. These latter two columns show the degree of statistical robustness of the coefficients in the presence of variations in the indicators of financial, trade and specialization integration.

The last two rows of table 1 show the averages of the dependent variables and the coefficients of determination of the regressions in the first column.

Figure 2 shows the statistical results of the estimates of the coefficients that measure the relationships between the degrees of synchronization, trade and financial integration and the degree of sectoral specialization of the four-equation system described in table 1. These results support the following hypotheses:

FIGURE 2

Peru: empirical relationships between gdp cycle synchronization and specialization, trade and financial integration, and ptas



Source: prepared by the author.
GDP: gross domestic product.
PTAs: preferential trade agreements.

TABLE 1

Estimated coefficients of the equations for synchronization, trade integration, financial integration and specialization. Efficient panel three-stage ols method, Peru, 1982-2006

Factor	(2.1) Degree of synchronization			(2.2) Degree of trade integration			(2.3) Degree of financial integration			(2.4) Degree of specialization		
	Coefficient	Positive sign (%)	Negative sign (%)	Coefficient	Positive sign (%)	Negative sign (%)	Coefficient	Positive sign (%)	Negative sign (%)	Coefficient	Positive sign (%)	Negative sign (%)
1. Basic variables												
Constant	0.1723	50.0	12.5	-0.7989	37.5	37.5	120.2522	25.0	25.0	1.1847*	62.5	0.0
$(T_2)^2$ T	-0.0412	50.0	0.0				70.97***	75.0	0.0	-11.9***	12.5	50.0
$(F_2)^2$ F	-0.0005*	25.0	62.5	0.0026	62.5	0.0				0.1099***	50.0	25.0
$(S_1)^2$ S	-0.0022	50.0	25.0	-0.0953***	25.0	75.0						
ρ							-218.6***	12.5	87.5			

Continues overleaf

Table 1 (concluded)

Factor	(2.1) Degree of synchronization			(2.2) Degree of trade integration			(2.3) Degree of financial integration			(2.4) Degree of specialization		
	Coefficient	Positive sign (%)	Negative sign (%)	Coefficient	Positive sign (%)	Negative sign (%)	Coefficient	Positive sign (%)	Negative sign (%)	Coefficient	Positive sign (%)	Negative sign (%)
2. Preferential trade agreements (PTAs)												
CHI	-0.2664	25.0	12.5	-0.8416	37.5	12.5	58.5489	25.0	0.0	-34.5*	0.0	12.5
DCHI	0.0152	0.0	12.5	0.0411	0.0	12.5	2.2246	0.0	0.0	0.3258	0.0	0.0
TCHI	-0.1187	25.0	0.0	-0.9615	12.5	0.0	9.4115	0.0	0.0	-9.02	0.0	0.0
AC	0.1998	25.0	37.5	-0.1583	37.5	12.5	100.7731	25.0	0.0	-14.8	0.0	0.0
DAC	0.1608	12.5	12.5	-1.4274***	12.5	62.5	131.0232	25.0	0.0	-24.98	0.0	0.0
TAC	-0.0086	12.5	12.5	0.0978***	62.5	12.5	-11.7654	0.0	25.0	1.98	0.0	25.0
ACBR	0.1122	62.5	12.5	-1.9626*	12.5	50.0	-45.2430	0.0	0.0	-15.11	0.0	50.0
DACBR	-0.0505	0.0	0.0	-0.1411	0.0	0.0	-19.5742	0.0	0.0	-2.24	0.0	0.0
TACBR	0.0045	0.0	12.5	0.0078	0.0	0.0	0.7367	0.0	0.0	0.22	0.0	0.0
ACAR	-0.1790	25.0	12.5	0.7787	37.5	12.5	-48.1836	12.5	0.0	2.99	0.0	0.0
DACAR	-0.2381	12.5	12.5	0.0611	0.0	0.0	-17.2676	0.0	0.0	5.06	0.0	0.0
TACAR	0.0142	12.5	12.5	-0.0127	12.5	0.0	1.4801	0.0	0.0	-0.4001	12.5	0.0
ATPDEA	0.0203	0.0	0.0	0.1829	12.5	0.0	-93.2900	0.0	0.0	17.7	0.0	0.0
TATPDEA	0.0001	0.0	0.0	-0.0161	0.0	12.5	8.2432	0.0	0.0	-1.5	0.0	0.0
UA	0.0416	0.0	0.0	0.2443	0.0	0.0	-71.8163	0.0	0.0	2.84	0.0	0.0
TUA	-0.0047	12.5	12.5	-0.0232	0.0	0.0	6.6685	0.0	0.0	-0.41	0.0	0.0
MA	-0.1460	12.5	12.5	0.7944	0.0	0.0	-86.6109	0.0	0.0	9.11	0.0	0.0
TMA	0.0100	12.5	12.5	-0.0545	0.0	0.0	5.7680	0.0	0.0	-0.58	0.0	0.0
3. Control variables												
Y				-0.1E-11	37.5	12.5	-0.16E-10	0.0	50.0	-0.34E-12	0.0	50.0
Yp							0.0354***	75.0	0.0			
Dif-Yp				0.33E-6***	37.5	62.5	-0.0329***	0.0	75.0	-0.0001	0.0	0.0
DIF-INFLA	-0.0001***	0.0	100.0									
RERb				0.0539*	50.0	12.5	3.8021**	37.5	37.5			
TARIFF				0.0025	62.5	12.5	0.0451	25.0	50.0			
TIME	-0.0014	12.5	12.5	0.1057***	75.0	12.5	-4.8353*	0.0	37.5	-42.9715*	0.0	62.5
DIST				-0.0005***	37.5	50.0	-0.0185	50.0	25.0	-0.0020	0.0	50.0
LANG				-1.8506**	0.0	87.5	-3.8455	25.0	25.0	-1.0539	0.0	37.5
BORDER				1.5706*	37.5	25.0	-99.6162	0.0	25.0	33.801**	75.0	0.0
SEA				1.8465***	87.5	12.5	-185.50**	25.0	50.0	16.3041	0.0	0.0
SIMILAR				0.858E-10***	37.5	62.5	0.248E-7***	87.5	12.5	-0.27E-8***	0.0	100.0
AREA				1.396***	100.0	0.0	-177.33***	0.0	100.0	58.492***	62.5	0.0
COL				0.1558	25.0	25.0	412.55***	75.0	0.0	-45.717**	0.0	50.0
ISL				0.8559	12.5	37.5	46.62	0.0	25.0	3.556	50.0	0.0
North America	0.1273	62.5	12.5									
Central America	0.0915	37.5	37.5									
Southern Cone	0.3526***	62.5	37.5									
Other America	-0.0058	0.0	75.0									
European Union (EU)	-0.232**	25.0	75.0									
Asia	-0.201	37.5	37.5									
Dependent average[a]		0.064			0.001	0.687		3E-4	77.190		-36.834	-37.107
R^2	0.635			0.944			0.676			0.885		

Source: prepared by the author.

Notes: All the regressions were based on 775 observations.

(i) With the exception of the first equation, where there is only one dependent, all the equations give the average of the two dependent options used: 2.2 (T1/T2); 2.3 (F1/F2) and 2.4 (S1/S2).

(ii)The estimated coefficients of each equation correspond to the regressions used in the indicators: ρ, T_2, F_2 and S_1.

[a] Average of the dependent variable. The nomenclature of the trade agreements and the control variables are described in section III of this article.

* 10% significance level,

** 5% significance level,

*** 1% significance level.

GDP: gross domestic product.

ACAR: partial scope economic complementation agreement between the Governments of Colombia, Ecuador, Peru and Venezuela, Andean Community member countries, and the Government of Argentina.

ACBR: partial scope economic complementation agreement between the Governments of Colombia, Ecuador, Peru and Venezuela, Andean Community member countries, and the Government of Brazil.

CHI: Chile-Peru Economic Complementation Agreement.

ATPDEA: Andean Trade Promotion and Drug Eradication Act.

UA: unilateral arrangement applying during periods of liberalization in the Peruvian economy.

MA: Uruguay Round multilateral agreement.

H1: (degree of synchronization). *When country effects are taken into account, the repercussions of trade integration and the degree of specialization as derived from the theory of comparative advantages based on natural resources are dominated by country shocks and have what are statistically quite robust*[21] *effects on the degree of synchronization of gdp cycles between Peru and each of the 31 main trading partner countries*.[22] *Thus, increases in trade integration, in the degree of similarity in sectoral structure, or both, lead to a greater degree of gdp cycle synchronization. Meanwhile, the effect of the degree of financial integration is more robust than the effects of the above, apparently exceeding the effect of inter-industry trade. Consequently, the higher the degree of financial integration, the lower the degree of cycle synchronization.*

Specifically, the percentages of statistically significant positive coefficients for T_i and S_i (i = 1, 2) were 50%, while in the case of negative coefficients for F_i the figure was 62.5%. One implication of this evidence is that the degree of synchronization of GDP cycles internationally has increased with the higher degree of trade integration, and it is therefore possible that the crises of 2008 and 2010, the latter originating in the developed countries, may have affected Peru's GDP cycles.

H2: (interrelationships between basic variables). *The evidence reveals a variety of interrelationships, most of them statistically robust, between degrees of synchronization, trade and financial integration and the degree of sectoral specialization. On the one hand, the interrelationships between trade integration and the degree of specialization, those between the degree of trade and financial integration, and those between the degree of synchronization and financial integration are statistically robust*[23] *and two-directional. On the other, the effect of financial integration on the degree of specialization is less robust, with a positive relationship between the two indicators predominating*.

The interrelationship between trade integration and financial integration is indicative of complementarity between the flow of goods and that of foreign investment. In other words, the relationship between the trade and financial integration indicators for Peru in the 1982-2006 period was positive. At the same time, the greater difference in the degree of sectoral specialization resulted in a higher degree of trade integration, and this in turn increased the degree of sectoral specialization. It should be stressed again that the S_{jt} indicators are negative values, and when these decrease this implies a larger differential in Peru's degree of specialization relative to its trading partner. The evidence is also robust as regards the effect of the cycle synchronization level on the degree of financial integration, although the effect of this on sectoral specialization is less robust. In this last case, however, financial integration has induced a greater similarity in the structures of production sectors. This finding is consistent with the higher degree of sectoral diversification of foreign investment in Peru.[24]

H3: (effect of preferential trade agreements). *Virtually the majority of ptas have had no statistically robust effect on the degree of gdp cycle synchronization, trade and financial integration or sectoral specialization*.

Only the Andean Community (AC) agreements and the economic complementation agreement between the AC and Brazil have had a statistically robust effect on the degree of trade integration and on the degrees of synchronization and sectoral specialization. With the latter agreement, it was country effects and not the agreement itself that affected these degrees. The dominant effect of the first agreement on the degree of integration was the permanent effect of the AC in creating more trade with its member countries.

H4: (effects of control variables on the degree of synchronization). *The degree of synchronization of gdp cycles in Peru and its partner countries has been greater in the case of the countries of North America and the Southern Cone and lesser in the case of the countries of the European Union and the rest of the American continent*.

In all these regions, the percentages of statistically significant coefficients were 62.5% or over. Furthermore, there is robust evidence that the degree of synchronization increases when the inflation differential between economies is reduced.

H5: (effects of the control variables on the degree of trade integration). *The estimates reported in table 1 indicate*

[21] I.e., when the percentage of statistically significant coefficients is 50% or greater.

[22] Note that the similarity between countries in their degree of sectoral specialization increases as S_i approaches zero (0).

[23] A statistically robust bicausal relationship has been considered for the variables (T,F,S) when the sum of the percentages of the (two) relevant coefficients that are statistically significant (of T, F or S) exceeds 100%.

[24] In the 2001-2005 period, 31.7% of foreign investment flows went to the mining sector, 54.1% to the telecommunications sector and 13.8% to the service sector (Távara and Tello, 2010).

that differences in countries' development levels or the degree of similarity (in gdp size) relative to countries that have traded with Peru, together with geographical characteristics (such as distance, geographical area and access to the sea) and cultural ones (such as language), have exercised a statistically significant and robust influence on the degree of trade integration between these countries.

The evidence shows that growing differences in development level or a growing degree of similarity in GDP size between countries increase market diversification and thus trade in goods and service between Peru and the trade partner. Again, trade restrictions (such as higher transport costs because partner countries are further from Peru or impose tariffs) have limited the degree of trade integration, whereas the geographical size, real exchange-rate and language variables have increased it. The effect of the other control variables on the degree of trade integration was not statistically robust.

H6: (effects of the control variables on the degree of financial integration). *According to the predictions of the new endogenous growth theories, increasing differences in development levels between Peru and its trade partners have not promoted a greater degree of financial integration, and have consequently had a negative effect on the relative and absolute size of foreign investment flows from partner countries. Similarly, trading partner countries with a similar level of gdp to Peru or high levels of per capita gdp have had a positive effect on financial integration. With the exception of the distance, geographical area, colonial relationship and gdp size of Peru variables, the effect of the control variables on the degree of financial integration is not statistically robust*.

Lucas (1990) provides theoretical and empirical arguments to support the thesis that foreign investment flows are greater between rich countries and smaller between rich and poor countries or between poor countries. The findings for Peru accord with these arguments, which assert that the availability of resources may not be enough for foreign producers to invest in poor countries. Endowments of human capital and technical know-how may also affect the profitability of countries' sectors, even those that do not possess comparative advantages. Accordingly, the degree of statistical robustness has been greater for partner countries with a higher degree of development than Peru's GDP size, which does not positively affect financial integration.

Meanwhile, there is reasonably robust evidence[25] that financial integration is greater with partner countries that are distant from Peru (the North America, Europe and Asia regions, for example)[26] and countries with which a colonial relationship has existed, and lower when tariffs or the geographical size of partner countries are larger.

As regards the effects of control variables on the degree of sectoral specialization, the statistical results show a number of inconsistencies with competitive advantage theories and the expected signs of the coefficients. Thus, for example, the evidence is statistically robust as regards the positive effects of similarity in GDP size between the trading partner country and Peru on the difference in these countries' degree of specialization. However, the size of the degree of similarity coefficient is very small. Similarly, there were positive effects on differences in sectoral structures, although statistical robustness was less for the colonial relationship and geographical distance of the partner country from Peru variables, and with Peruvian GDP. The magnitude of the coefficient of the variable is very small in this last case too. Again, the partner with border and partner's geographical area variables had a negative and statistically robust effect on the difference in degrees of sectoral specialization. The findings for the other variables were less robust.

[25] Percentage of statistically significant coefficients of 50% or over.
[26] More than 50% of Peru's exports by value go to the markets of the United States, the European Union, Japan and China.

V

Conclusions and final considerations

This exploratory study has presented a range of evidence and hypotheses concerning the interrelationships between the synchronization of Peru's total GDP cycle with the GDP cycles of 31 countries with which Peru trades[27] and the degree to which Peru is integrated in respect of trade, finance and sectoral specialization with these same countries. It has also estimated the repercussions of preferential trade agreements on these interrelationships. Subject to the limitations of the variables and measurements and the statistical fragility of the econometric method used, the evidence reported in this study reveals two main conclusions.

The first is that there is a statistically robust relationship between GDP cycle synchronization, financial and trade integration, and sectoral specialization. However, the two-way relationships that are most robust are those between the synchronization of GDP cycles and the degree of financial integration, between the latter and the degree of trade integration, and between this and the difference in the degree of sectoral specialization between Peru and its international trading partners. One implication of these interrelationships is that increases in the relative size of Peru's trade flows relative to the real GDP of the 31 trading partner countries could heighten the degree of real GDP cycle synchronization between these countries and Peru. Again, albeit with less statistical robustness, increases in the differential between the degree of sectoral specialization in Peru and in its partner countries could also increase the level of these countries' GDP cycle synchronization. The second conclusion yielded by the evidence reported is that, in general, annualized PTAs have not had any statistically noticeable effect on the synchronization of international cycles, trade and financial integration or the degree of sectoral specialization.

Both conclusions suggest that the high level of sectoral specialization in the Peruvian economy (its tradable sector in particular)[28] and increasing trade integration have amplified the impact of the international cycles of the country's leading trade partners on the Peruvian economy's GDP cycles. In consequence, economic policies designed to diversity production sectors, export markets, or both, may help to offset the adverse effects of international crises in the short and long term.

[27] These countries account for over 80% of Peru's total export and import flows.

[28] Where some 90% of the value exported is accounted for by agricultural and mining resource-intensive commodities.

TABLE A1

Indicators of the degrees of synchronization, trade and financial integration and sectoral specialization in Peru and its main trading partners, 1982-2007

Partner country	ρ-HP	T1	T2	F1	F2	S1	S2
1. Germany							
1982	-0.14(-)	5.59(-)	0.13(-)	1.4(+)	1 090 000(+)	-51.85(-)	-48.87(-)
2007	-0.33(+)	3.6(-)	0.1(-)	2.53(+)	5 499 231(+)	-38.18(-)	-35.81(-)
2. Argentina							
1982	0.14(+)	10.62(+)	0.32(+)	15.95(-)	1 740 000(-)	-42.1(-)	-39.55(-)
2007	0.54(+)	15.32(+)	0.6(+)	-0.33(+)	1 223 846(+)	-28.44(-)	-22.72(-)
3. Australia							
1982	-0.29(+)	1.35(-)	0.03(+)	0.24[a](+)	106 667[a](+)	-35.83(-)	-35.83(-)
2007	0.38(+)	1.16(+)	0.04(+)	0.2(-)[b]	86 154(-)[c]	-25.6(-)	-21.02(-)
4. Austria							
1982	0.03(+)	1.31(+)	0.04(+)	0.52(+)	50 000(+)	-45.82(-)	-41.45(-)
2007	-0.24(-)	1.11(-)	0.04(-)	0.9(+)	203 077(+)	-31.9(-)	-30.37(-)
5. Belgium							
1982	0.29(-)	9.61(+)	0.26(+)	1.38(+)	160 000(+)	-48.97(-)	-48.97(-)
2007	-0.16(-)	8.25(-)	0.29(-)	11.09(+)	2 967 692(-)	-35.59(-)	-34.68(-)
6. Bolivia (Plurinational State of)							
1982	0.26(-)	17.88(-)	2.6(+)	49.32(-)	1 500 000(-)	-23.25(+)	-17.14(+)
2007	0.21(-)	21.2(+)	4.44(+)	2.56(+)	101 539(+)	-23.91(-)	-16.08(-)
7. Brazil							
1982	0.19(+)	6.98(-)	0.18(+)	5.45(-)	1 670 000(-)	-47.95(-)	-45.52(-)
2007	0.73(+)	8.61(+)	0.28(+)	15.95(+)	12 901 923(+)	-29.96(-)	-28.55(-)
8. Canada							
1982	-0.2(-)	2.66(-)	0.06(+)	11.36(-)	3 780 000(-)	-35.72(-)	-35.72(-)
2007	0.1(+)	3.19(+)	0.1(+)	11.67(+)	9 243 846(+)	-24.37(-)	-22.36(-)
9. Chile							
1982	0.24(+)	18.13(+)	0.89(+)	34.38(-)	1 690 000(-)	-28.62(-)	-25.17(-)
2007	0.37(+)	34.06(+)	1.84(+)	187.08(+)	21 656 154(+)	-22.88(-)	-11.64(-)
10. China							
1982	-0.68(-)	2.34(-)	0.06(+)	0.02[d](-)[e]	50 00[d](-)[f]	-92.73(-)	-92.73(-)
2007	0.58(+)	4.68(+)	0.14(+)	10.2(+)	4 698 462(+)	-78.85(-)	-78.44(-)
11. Colombia							
1982	0.2(+)	20.64(+)	0.86(+)	40.13(+)	2 560 000(+)	-36.78(-)	-34.75(-)
2007	0.55(+)	32.67(+)	1.61(+)	185.81(+)	27 371 539(+)	-25.76(-)	-22.08(-)
12. Republic of Korea							
1982	-0.77(-)	2.47(+)	0.08(+)	0.12[e](+)	576 92[e](+)	-43.39(-)	-43.15(-)
2007	0.12(-)	4.53(+)	0.15(+)	2.94(+)[g]	1 723 846(+)[g]	-36.87(-)	-34.14(-)
13. Ecuador							
1982	0.55(-)	39.52(-)	3.21(-)	30.25(-)	1 150 000(-)	-25.85(-)	-23.33(-)
2007	0.25(-)	44.38(+)	4.35(+)	28.16(+)	2 160 769(+)	-26.08(+)	-12.98(-)
14. Spain							
1982	-0.11(+)	3.48(-)	0.09(+)	6.14(+)	1 320 000(+)	-43.34(-)	-37.85(-)
2007	-0.3(+)	4.15(+)	0.13(+)	259.41(+)	143 273 462(+)	-30.17(-)	-27.48(-)
15. United States							
1982	-0.62(-)	5.76(-)	0.14(-)	3.5(+)	11 380 000(+)	-43.37(-)	-43.37(-)
2007	0.1(+)	4.31(-)	0.12(-)	10.4(+)	95 065 000(+)	-34.2(-)	-31.88(-)
16. Finland							
1982	0.2(-)	2.12(-)	0.07(+)	0.05[g](-)[h]	33 33[g](-)[h]	-40.51(-)	-37.32(-)
2007	0.08(+)	2.44(+)	0.09(+)	0.18(+)	47 692(+)	-29.62(-)	-26.04(-)
17. France							
1982	0.07(+)	1.59(-)	0.04(+)	9.85(+)	5 890 000(-)	-45.09(-)	-45.09(-)
2007	-0.43(+)	1.37(-)	0.04(-)	2.43(+)	328 462(+)	-34.01(-)	-32.57(-)
18. Italy							
1982	0.21(-)	3.66(-)	0.09(+)	3.35(+)	1 460 000(+)	-45.28(-)	-43.65(-)
2007	-0.18(+)	3.09(-)	0.09(-)	5.12(+)	7 206 154(+)	-32.91(-)	-31.64(-)

Continues overleaf

Table A1 (concluded)

Partner country	ρ-HP	T1	T2	F1	F2	S1	S2
19. Japan							
1982	-0.23(-)	5.93(-)	0.14(-)	5.19(-)	5 750 000(-)	-49.62(-)	-45.07(-)
2007	-0.16(-)	3.45(-)	0.09(-)	0.98(+)	3 425 385(+)	-35.93(-)	-33.42(-)
20. Luxembourg							
1982	-0.3(+)	44.46(+)	5.31(+)	169.16(-)	4 970 000(-)	-48.97(-)	-48.97(-)
2007	-0.34(+)	33.87(-)	4.47(-)	6.03(-)	691 923(-)	-37.62(-)	-35.08(-)
21. Mexico							
1982	0.78(-)	3.93(-)	0.11(+)	0.4(-)	80 000(-)	-36.02(-)	-36.02(-)
2007	-0.1(+)	5.36(+)	0.18(+)	19.88(+)	16 684 231(+)	-26.07(-)	-24.8(-)
22. New Zealand							
1982	0.07(-)	8.58(-)	0.37(+)	0.24[i](+)[j]	100 000[i](+)[j]	-32.98(-)	-32.63(-)
2007	0.3(+)	5.7(-)	0.29(-)	2.37(+)	263 462(-)	-22.56(-)	-20.54(-)
23. Panama							
1982	0.58(+)	11.89(-)	2.02(-)	272.12(+)	80 000(+)	-38.45(-)	-38.45(-)
2007	0.45(+)	12.88(+)	2.3(+)	553.73(+)	30 725 000(+)	-31.83(-)	-28.21(-)
24. Netherlands							
1982	-0.09(-)	8(-)	0.2(+)	5.23(+)	890 000(+)	-40.28(-)	-40.28(-)
2007	-0.12(-)	6.16(-)	0.19(-)	112.24(+)	52 818 077(+)	-28.37(-)	-26.96(-)
25. Portugal							
1982	0.27(-)	1.38(+)	0.05(+)	-0.237(-)	-100 007(-)	-31.52(-)	-28.63(-)
2007	-0.34(+)	1.31(-)	0.06(-)	8.21(-)	1 427 692(-)	-23.78(-)	-18.86(-)
26. United Kingdom							
1982	-0.63(-)	3.91(-)	0.09(+)	2.44(+)	1 240 000(+)	-44.06(-)	-44.06(-)
2007	0.1(-)	2.61(-)	0.08(-)	75.78(+)	109 920 385(+)	-31.85(-)	-30.5(-)
27. Singapore							
1982	0.53(-)	1.49(+)	0.12(+)	4.86[k](+)	86 956 5[l](+)	-54.03(-)	-54.03(-)
2007	0.41(+)	1.77(-)	0.12(-)	21.63(+)[l]	4 750 000(+)[l]	-40.72(-)	-40.21(-)
28. Sweden							
1982	-0.05(-)	4.04(-)	0.11(+)	7.92(+)	1 030 000(+)	-43.48(-)	-43.48(-)
2007	0.11(-)	3.38(-)	0.12(-)	6.33(-)	1 250 769(-)	-32.7(-)	-31.33(-)
29. Switzerland							
1982	0.08(+)	4.98(-)	0.14(+)	40.58(-)	5 140 000(-)	-48.72(-)	-48.72(-)
2007	-0.15(-)	3.29(-)	0.11(-)	28.41(+)	8 023 077(+)	-35.37(-)	-34.85(-)
30. Uruguay							
1982	0.49(+)	2.71(+)	0.25(+)	120.15(-)	4 080 000(-)	-35.07(-)	-29.72(-)
2007	0.54(+)	3.67(+)	0.46(+)	109.27(+)	6 653 846(+)	-24.75(-)	-18.44(-)
31. Venezuela (Bolivarian Republic of)							
1982	0.1(+)	13.41(-)	0.43 (+)	17.24(-)	1 750 000(-)	-52.66(-)	-46.05(-)
2007	0.37(+)	22.65(+)	1.03(+)	1.27(-)	93 846(-)	-44.32(-)	-40.57(-)

Source: prepared by the author.
Notes: The indicators r-HP, T1, T2, F1, F2, S1 and S2 represent cycle synchronization and, with two indicators apiece, trade integration, financial integration, and specialization, as defined in section III.
For indicators T1 and F1, the figures are expressed with E-04 and E-06 decimals, respectively.

[a] Figure for 2002. [b] Figure for 2003-2007. [c] Figure for 2003-2007. [d] Figure for 1983. [e] Figure for 1984-1990. [f] Figure for 1983-1990. [g] Figure for 1995-2007. [h] Figure for 1985-1990. [i] Figure for 1985. [j] Figure for 1986-1990. [k] Figure for 2004. [l] Figure for 2005-2007. The indicator for the degree of specialization, S_i, is multiplied by 100; the range is from –200% to 0%. The signs in parentheses for the degrees of synchronization correspond to the sign of the growth rates of the correlation coefficients for 1982-1990 (for the 1982 row) and 1991-2006 (for the 2007 row). Thus, a positive sign in 1982 means that the correlation coefficient increased in the 1982-1990 period. The S1 information is for 1982-2006. The signs in parentheses for the rest of the indicators are the annual rates of change in each indicator in the 1982-1990 and 1991-2007 periods.

(Original: Spanish)

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The evolution of opportunities for children in Chile, 1990–2006

Dante Contreras, Osvaldo Larrañaga, Esteban Puentes and Tomás Rau

ABSTRACT

In this paper we measure the evolution of inequality of opportunity in Chile. These measures assess how unequal the distribution of socioeconomic outcomes is, based on exogenous circumstances. The results show a reduction in inequality of opportunity from 1990 to 2006. The gains are of two classes. First, social service coverage has increased substantially, leading to a general improvement in opportunities. Second, the gaps in access probabilities among population subgroups have been reduced, making the playing field more balanced. These results should be interpreted as partial evidence for the evolution of opportunities in Chile. We also found a significant gap in the opportunity index across Chile, which reflects differences in both coverage rates and the distribution of opportunities within regions. The reduction in inequality is good news, but Chile still has a long way to go to achieve an equitable distribution of welfare.

KEYWORDS

Children, social development, equality of opportunities, education, health, sanitation, measurement, social indicators, health indicators, Chile

JEL CLASSIFICATION

D31, D63, I3

AUTHORS

Dante Contreras, Department of Economics, Microdata Centre, University of Chile. contreras.dante@gmail.com

Osvaldo Larrañaga, United Nations Development Programme (UNDP) and Department of Economics, University of Chile. osvaldo.larranaga@undp.org

Esteban Puentes, Department of Economics, Microdata Centre, University of Chile. epuentes@fen.uchile.cl

Tomás Rau, Institute of Economics, Pontificia Universidad Católica de Chile. trau@uc.cl

I
Introduction

Chile has undergone sustained economic growth since the mid-1980s, recording an average annual rate of 5% from 1987 to 2008. Poverty reduction has benefited from the expansion of the economy: the percentage of the population in poverty in 2006 was only one third of the share in 1990. The cost of the optimal transfer to eliminate poverty was 4.6% of GDP in 1990, versus only 0.9% in 2006 (Larrañaga, 2009). These results represent a dramatic decline in poverty in a relatively short period.

Chile still shows a high level of income inequality, however, compared with developed countries. Chile's Gini coefficient is approximately 25 points higher than the average for developed countries, according to data reported in De Ferranti and others (2003). Nevertheless, all indicators show that income inequality has fallen in Chile since 2000. The decline in inequality is related to a reduction in the wage premium following a large expansion in tertiary education (Eberhard and Engel, 2008; Larrañaga and Herrera, 2008). Income inequality has also declined in other Latin American countries in the past several years, which reflects increases in export prices and domestic wages (CEDLAS, 2009).

Another important dimension of the distribution of welfare is inequality of opportunity, a dimension that has traditionally been neglected because of the lack of empirical measures to assess and monitor it. The distinction between inequality of outcomes and inequality of opportunity is of interest, as pointed out by Ferreira and Gignoux (2008), because of the widespread normative view that inequality of opportunity is important in the design of public policy. Disadvantaged groups should be compensated through public policies that balance the playing field and thus ensure that the distribution of outcomes is not dependent on exogenous circumstances.

In this paper we apply some recently developed methodologies to measure the evolution of inequality of opportunity (Paes de Barros, Molinas and Saavedra, 2008). These measures assess how unequal the distribution of socioeconomic outcomes is among subgroups, grouped by circumstances. These circumstances are exogenous factors that contribute to determining socioeconomic outcomes. The more unequal the distribution of outcomes due to differences in circumstances, the more unequal is the distribution of opportunity in the country.

The focus of the analysis is the population under 18 years of age. This is the period of the life cycle in which most cognitive and non-cognitive skills are determined. These skills, in turn, have a strong influence on adult socioeconomic outcomes, such as labour market productivity, social behaviour, political participation and health status.

The paper assesses the impact of circumstances on the following intermediate outcomes: access to preschool, access to sanitary infrastructure, nutritional status and timely completion of secondary education. Circumstance variables include gender, the mother's education level, the father's education level, the location of the household, per capita household income and family structure.

The results show a reduction in inequality of opportunity between 1990 and 2006. The gains are of two classes. First, social services coverage has increased substantially, leading to a general improvement in opportunities. Second, the gaps in access probabilities among population subgroups have been reduced, making the playing field more balanced. These results should be interpreted as partial evidence for the evolution of opportunities in Chile. Data are not available for assessing the evolution of other important socioeconomic outcomes, such as health-related variables and school quality.

At the same time, there is a significant gap in the opportunity index across Chile, which reflects differences in both coverage rates and the distribution of opportunities within regions. Some convergence occurred in 1990–2006, as the regions that lagged the most in the beginning of the period posted the largest gains in the opportunity index. There are still large regional differences, however, which add to the inequality of opportunity in the country.

The paper is organized as follows: in section II we discuss the relationship between achievements, resources and opportunities; section III presents the methodology to compute an opportunity index for children; section IV describes the data set and estimates; section V presents the main results; section VI decomposes changes in the index in terms of changes in coverage and changes in the dissimilarity index; and section VII concludes.

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II

Outcomes, resources and opportunities

Human welfare has different dimensions, including income, health and education. Monetary income represents purchasing power for goods and services that satisfy human needs; good health is a state of physical and mental well-being that allows people to live long and satisfactory lives; and education generates knowledge and learning capacities. These outcomes are intertwined by complex cause-effect links, so that some have a positive influence on others and vice versa.

Socioeconomic outcomes are determined by resources. Examples of resources include parents' education and income, school inputs, nutrition intakes and characteristics of dwellings and neighbourhoods. The distinction between resources and outcomes is somewhat arbitrary. Some resources represent intermediate outcomes, which are determined by other, more basic resources. For example, graduation from high school is an educational outcome determined by school and household inputs, but it is also a resource for future income generation.

Resources can be classified as exogenous or endogenous to the individual. An exogenous resource is called a circumstance, as is the case of parental household endowments. Children do not choose the time and location of their birth, the education level of their parents, household income, number of siblings, and so forth. However, these variables shape the formation of skills in the early stages of the life cycle. Endogenous resources are those that are chosen by the individual, such as the effort exerted in schools and jobs, the allocation of time among competing ends, and the allocation of income between consumption and savings.

The classification of resources into endogenous or exogenous categories is contingent to the age of the individual. While most, if not all, family resources are exogenous to children, adults have the greatest command over their living conditions. The scope of endogenous choices is also dependent on socioeconomic status. Sen (1999) defines poverty as the lack of freedom to choose the type of life in which an individual would have reasons to live.

The line between exogenous and endogenous resources is not well defined. The debate about the penal responsibilities of young offenders or the mentally ill illustrates some of the complexities that arise when one tries to ascertain how responsible people are for their acts. In our discussion, one dimension of endogeneity that is particularly relevant for public policy is family choices that affect children's expectations. Variables such as family structure, location of residence and preschool attendance are, to a certain extent, chosen by families. These factors are exogenous to the child, but endogenous to their families. This leads to the question of whether public policies should compensate for family choices that are bad for children.

The issue is related to the discussion of familism versus de-familism in public policies (Esping-Andersen, 1999). The former view establishes that families are responsible for the welfare of their members and public policies should intervene only when families do not have the necessary resources or capacities to take care of their own. De-familism prioritizes individual rights and establishes that the state has obligations to individuals, regardless of their family resources or choices.

The relationship between outcomes, resources and opportunities is also time and place contingent. This introduces an important caveat in empirical assessments of the distribution of opportunities. For example, life expectancy represents a main health outcome. A person who died at 65 years old in Chile in 2009 would have had a shorter life-span than the average individual, but in 1960 that was seven years more than the average. Likewise, being literate represented a substantial achievement in education decades ago, but today people need to be functionally literate to perform adequately in society.

As for resources, good nutrition, vaccines, mother-child health services, drinkable water and other sanitary infrastructure represent key resources for health outcomes. Only a fraction of the population had access to these resources decades ago, but now coverage is almost universal. Quality of life thus depends on access to health care services that address old-age health risks, such as physical and mental disabilities, coronary disease and others.

Similarly, granting universal access to primary education and ensuring that most children complete six or eight years of schooling is a reasonable policy goal in very low-income countries. For a middle-income country, however, achieving social and economic inclusion requires no less than complete secondary education.

The relative nature of outcomes and resources is also an issue for other dimensions of the distribution of welfare. A leading example is the poverty line, or income threshold, used to define poverty status. Developed countries use higher poverty lines than poor countries, because the amount of income that is needed to achieve a decent standard of living depends on consumption patterns that are socially determined. Many years ago Adam Smith pointed out that a woman in Ireland could walk the streets barefoot without feeling ashamed, whereas an Englishwoman could not because of the higher standard of living in that country at the time.

III
Methodology[1]

Consider m circumstance groups, and denote the unconditional probability of access to a particular outcome as $\overline{p}$. Paes de Barro, Molinas and Saavedra (2008) consider the minimum proportion of all available opportunities that one must reallocate to ensure equal access for all circumstance groups, that is, a situation in which $p(x_j) = p_j$ is equal to $\overline{p}$, where x_j represents a circumstance group, $j = 1, \ldots, m$. They propose the following index based on the dissimilarity index:

$$D = \frac{1}{2\overline{p}} \sum_{j=1}^{m} \alpha_j \left| p_j - \overline{p} \right|,$$

where $\alpha_j = N_j/N$ corresponds to the proportion of individuals in circumstance group j. As this expression indicates, the index is proportional to the mean absolute distance between group-specific access probabilities and the overall access probabilities. In this sense, it is a measure of the inequality of opportunity.

The sample analog is:

$$D = \frac{E\left|P\left(I=1|x\right) - P\left(I=1\right)\right|}{2P\left(I=1\right)},$$

where I is an indicator function, which is equal to one (1) if an individual had access to a given opportunity and zero otherwise.

The computation of the inequality-of-opportunity index is similar to the parametric approach for computing the dissimilarity index. First, assume that we have a random sample from the population, with information on whether person i had access to a given opportunity ($I_i = 1$ if that person had access and $I_i = 0$ otherwise) and a vector of variables indicating his or her circumstances, $x_i = (x_{1i}, \ldots, x_{mi})$. Then we can rewrite the index as follows:

$$D = \frac{E\left|P\left(I=1|x\right) - P\left(I=1\right)\right|}{2P\left(I=1\right)} = \frac{E\left|P\left(I=1|x\right) - E\left(P\left(I=1|x\right)\right)\right|}{2E\left(P\left(I=1|x\right)\right)},$$

where the second equality comes from $P(I=1) = E(I) = E(E(I \mid x))$ by the law of iterated expectations. This expression also indicates the central role of group-specific coverage rates, $P(I=1 \mid x)$, in estimating D. Given this information, we estimate the inequality-of-opportunity index in three steps. First, we estimate the conditional probabilities. The simplest way of estimating conditional probabilities is to assume a separable logistic regression:

$$Ln\left(\frac{P\left(I=1|x_1,\ldots,x_m\right)}{1-P\left(I=1|x_1,\ldots,x_m\right)}\right) = \sum_{k=1}^{m} h_k\left(x_k\right),$$

where x_k denotes a k-dimension vector of circumstances.

In the second step, we predict, for each individual in the sample, the probability of access to the opportunity under consideration, using the estimated coefficients in step one:

$$\hat{p}_i = \frac{Exp\left(\hat{\beta}_o + \sum_{k=1}^{m} x_{ki}\hat{\beta}_k\right)}{1 + Exp\left(\hat{\beta}_o + \sum_{k=1}^{m} x_{ki}\hat{\beta}_k\right)}.$$

[1] This section closely follows Paes de Barros, Molinas and Saavedra (2008).

In the final step, we compute

$$\overline{p} = \sum_{1}^{n} w_i \hat{p}_i$$

and

$$\hat{D} = \frac{1}{2\overline{p}} \sum_{i=1}^{n} w_i \left| \hat{p}_i - \overline{p} \right|,$$

where $w_i = 1/n$ or some sampling weights.

Since, almost surely, $\underset{n\to\infty}{Lim}(\overline{p}) = P(I = 1)$ under the assumption that the regression has been correctly specified and its coefficients are consistently estimated, then we also have

$$\mathrm{v}\ \underset{n\to\infty}{Lim}\left(\sum_{i=1}^{n} w_i \left| \hat{p}_i - \overline{p} \right| \right) = E\left| P\left(I = 1 | x\right) - P\left(I = 1\right) \right|$$

almost surely. Hence, $\hat{D} \xrightarrow{p} D$. Paes de Barros, Molinas and Saavedra (2008) discuss the properties of the estimator, such as consistency and asymptotic variance.

Because $\overline{p} = M/N$, where M is the number of opportunities available and N is the number of opportunities needed to ensure access for all, we can reinterpret $\overline{p}$ as the percentage of the total number of opportunities required for universal access that are actually available. This interpretation indicates that $\overline{p}$ is a measure of the stock of available opportunities, but it is insensitive to how these opportunities are allocated.

Thus, the natural way to proceed is to relate D and $\overline{p}$. Since the inequality-of-opportunity index, D, is the proportion of opportunities that must be reallocated for equality of opportunity to prevail, then $1 - D$ is the proportion properly allocated and $M(1 - D)$ is the total number of opportunities allocated according to the principle of equal opportunity for all. Hence, Paes de Barros, Molinas and Saavedra (2008) define $0 = M(1 - D)$ as the available opportunities allocated according to the principle of equal opportunity. Finally, the overall measure of opportunity is given by

$$r = \frac{O}{N} = \frac{M}{N}\left(1 - D\right) = \overline{p}\left(1 - D\right),$$

which can be interpreted the percentage of available opportunities allocated according to the equality-of-opportunity principle. We estimate this index of children's opportunities in the following sections.

IV
Data and estimation

The estimates are based on data from the 1990, 1996 and 2006 editions of the National Characterization Socioeconomic Survey (CASEN). CASEN is a multi-topic household survey with a large sample size (75,000 households in 2006), which has been conducted every two or three years since 1987 and is the traditional source for statistics on income distribution, poverty and the impact of social spending in Chile. The data is collected by the Microdata Centre of the University of Chile by mandate of the Ministry of Planning and Cooperation (MIDEPLAN).

Paes de Barros and others (2009) analyse the evolution of inequality of opportunity for 19 Latin American countries and conclude that Chile has the highest level of equality. The objective of our research is to study inequality within Chile, and some of the indicators used by Paes de Barros and others (2009) are not relevant in this case. For example, timely competition of sixth grade is not an issue, because Chile has a high coverage level of primary education. We therefore chose a different set of variables that are more likely to affect the formation of human capital in Chile: namely, access to preschool, timely completion of secondary education, access to sanitary infrastructure and nutritional status[2] (see table 1).

The importance of schooling for explaining most adult socioeconomic outcomes is extensively documented in the literature (see the review in Cunha and others, 2005). Access to preschool and graduation from high

[2] Our study thus complements the evidence in Paes de Barros and others (2009). Moreover, we perform the analysis by geographical region, which allows us to identify the most disadvantaged regions and compare the regional evolution over time.

TABLE 1

Indicators of inequality of opportunity

Number	Indicator	Type of service	Access or direct benefit	Universe (child's age)
1	Probability of completing secondary education (12th grade) on time	Education	Direct benefit	18
2	Access to preschool	Education	Access	0–5
3	Access to a good nutrition	Health	Access	0–5
4	Access to water and sanitation	Housing	Access	0–16

Source: prepared by the authors.

school represent primary outcomes in current education. Preschool attendance contributes to the formation of basic cognitive and non-cognitive skills that are needed in later stages of the educational cycle, while graduation from high school is currently the minimum level of education required for accessing most non-professional jobs. In 1990 only 16% of the child population (under 6) attended preschools and only 46% of the population of 18-year-olds had already completed secondary education. Moreover, preschool attendance and high school graduation rates were highly differentiated by household per capita income.

Access to sanitary infrastructure is defined as a categorical variable equal to one (1) when children live in dwellings with access to drinkable water and sewage treatment, and zero (0) otherwise. Sanitary infrastructure represents a basic input to health status and has been a factor behind the reduction in child mortality and morbidity. Healthier children become healthier adults, live longer and better lives, exhibit better education results and are more competitive in the labour market (Case, Fertig and Paxson, 2003; Case, Lubotsky and Paxson, 2002). In 1990, 71% of children under 16 years old had access to sanitary infrastructure. Access was strongly determined by location: children living in rural areas were particularly disadvantaged, with coverage reaching only 41%.

Finally, nutritional status is measured as a dichotomous variable that takes the value one (1) when the child's weight is normal and zero (0) otherwise. The latter category includes both over- and underweight children. Underweight children are likely to lack essential nutrients, which hinders their physical and intellectual development and has negative long-run effects on socioeconomic outcomes, while being overweight is considered a major risk to future health conditions and can also hinder emotional development. In 1990, 85% of children were classified as having good nutritional status, 9% were underweight and 5% were overweight. Good nutritional status was dependent on the socioeconomic status of the parental household: the share of children with good nutritional status was 93% in the highest income per capita quintile and 81% in the lowest quintile.

The estimation of the opportunity index requires classifying the population into subgroups according to type. The set of circumstance variables, $x = (x_1, \ldots, x_m)$, includes parents' education, per capita family income, gender, number of siblings, family structure (number of siblings, single-parent household), and area of residence (urban versus rural).[3] The functions $\{h_k\}$ that relate each circumstance with outcomes are specific to each dimension: quadratic on education, logarithmic on income and nonparametric (dummy variables) on age and other dimensions. All functions end up being linear in the parameters, so that $h_k(x_k) = x_k\beta_k$. From the estimation of this logistic regression, we obtain estimates of the parameters $\{\beta_k\}$, denoted $\{\hat{\beta}_k\}$. Table 2 provides a complete specification of this logistic regression, which uses the same circumstance variables as Paes de Barros and others (2009).[4]

TABLE 2

Specification of separable logistic regression function

Circumstance	Specification
Gender	Free (dummy)
Parents' education	Quadratic
Per capita income	Logarithmic
Number of Siblings	Linear
Presence of parents	Free (dummy)
Area of residence (urban versus rural)	Free (dummy)

Source: prepared by the authors.

[3] In the case of education, we also used age to predict the probability of completing each grade.

[4] Another circumstance that may be of interest is the ethnicity or race of the head of the household. Unfortunately, this information is available only for the 2006 CASEN, so the empirical application excludes this circumstance unless it is explicitly mentioned.

V
Results

Tables 3 to 6 show the results for the dimensions under evaluation: access to preschool, timely completion of secondary school, access to sanitary infrastructure and nutritional status, respectively. Each table shows the opportunity index in 1990, 1996 and 2006, providing an overview of the evolution of opportunities over the period.

Recall that the opportunity index is the product of the average coverage rate and one (1) minus the dissimilarity index, $O = p(1 - D)$. Thus, the index shows the percentage of available opportunities allocated according to the equality-of-opportunity principle. The average coverage and the dissimilarity index for each dimension and year are listed in the statistical annex.

Table 3 shows that the opportunity index for access to preschool at the national level increased from 13.3% in 1990 to 34.2% in 2006. This represents a significant improvement in the allocation of preschool attendance, although the 2006 rate is still low in absolute terms.

The opportunity index for access to preschool varies considerably across regions, although that variance fell during the period. All the regions improved significantly, but the regions that lagged the most in 1990 posted the largest gains in 2006. Thus 6 of the 13 regions had an opportunity index below 10% in 1990, whereas all but one was above 30% in 2006. This resulted in a reduction in the variance of the opportunity index among regions, although differences are still large: in 1990, the region with the best results (Tarapacá) had triple the rate of the least advanced region (Los Lagos), but the gap fell to approximately 50% in 2006.

The opportunity index for timely completion of secondary education shows a similar trend, as shown in table 4. Between 1990 and 2006, this opportunity index increased from 38% to 58% at the national level. Thus, in 2006, three out of every five 18-year-olds was graduating from high school. The results are consistent with Paes de Barros and others (2009), who find a significant increase in the probability of completing sixth grade on time between 1996 and 2006.[5] The table also shows a significant reduction in regional variation in the period. The gap between the highest and lowest regional indices decreased from a factor of three in 1990 to a factor of two in 2006.

[5] Paes de Barros and others (2009) do not analyse the evolution of the probability of completing twelfth grade on time.

TABLE 3

Evolution of the opportunity index for access to preschool

Region	Year			Total increase 1990–2006
	1990 (percentages)	2000 (percentages)	2006 (percentages)	
I Tarapacá	23.5	28.2	43.4	0.20
II Antofagasta	12.2	27.6	33.6	0.21
III Atacama	16.6	29.3	35.1	0.18
IV Coquimbo	12.0	28.7	37.9	0.26
V Valparaíso	13.5	26.3	35.5	0.22
VI Libertador General B. O'Higgins	10.6	20.8	30.9	0.20
VII Maule	8.6	21.0	34.6	0.26
VIII Biobío	10.6	20.4	30.7	0.20
IX La Araucanía	7.9	19.7	29.9	0.22
X Los Lagos	7.5	15.2	29.0	0.21
XI Aisén del General C. I. del Campo	10.4	29.0	44.0	0.34
XII Magallanes and A. Chilena	16.5	26.0	44.4	0.28
RM Santiago Metropolitan Region	18.0	25.6	35.9	0.18
National	*13.3*	*23.6*	*34.2*	*0.21*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE 4

Evolution of the opportunity index for timely completion of secondary school

Region	Year			Total increase 1990–2006
	1990 (percentages)	2000 (percentages)	2006 (percentages)	
I Tarapacá	53.9	60.0	63.3	0.09
II Antofagasta	44.0	38.8	51.7	0.08
III Atacama	32.0	31.9	64.6	0.33
IV Coquimbo	36.1	53.7	59.9	0.24
V Valparaíso	37.1	43.9	56.5	0.19
VI Libertador General B. O'Higgins	29.6	50.5	57.3	0.28
VII Maule	21.1	46.7	53.1	0.32
VIII Biobío	38.8	39.9	61.5	0.23
IX La Araucanía	28.3	41.4	53.1	0.25
X Los Lagos	19.1	42.0	51.3	0.32
XI Aisén del General C. I. del Campo	16.7	34.9	40.1	0.23
XII Magallanes and A. Chilena	46.3	65.6	72.3	0.26
RM Santiago Metropolitan Region	46.9	55.1	61.8	0.15
National	*37.9*	*48.0*	*58.4*	*0.21*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

Not surprisingly, the regions with the best results in the opportunity index for high school graduation also have the highest positions in the opportunity index for access to preschool. Conversely, those with the worst results in graduation from secondary school also have the lowest index for access to preschool.

Table 5 shows the evolution of the opportunity index for access to potable water and sanitation. Opportunities in this area have improved significantly over time, as also reported by Paes de Barros and others (2009). The national opportunity index increased from 60% in 1990 to 83% in 2006, and the regions that lagged behind in 1990 posted the largest gains. In 1990, the most advanced regions had opportunity-adjusted coverage rates of around 80% or higher, while the lagging regions, which were mostly rural, recorded index values below 40%. The only way to improve the national index in this context was through substantial increases in the least advanced regions, which was precisely what happened during the period.

Finally, table 6 presents the evolution of the opportunity index for nutrition. This time, the opportunity index shows little progress during the period, rising slightly from 83% to 87% at the national level. One obvious explanation for this is that the high value of the index in the initial year offers little room for further improvement. This also explains the homogeneity in the distribution of opportunities across regions. However, the poor nutritional status includes both underweight and overweight children. In 1990 the ratio between these two categories was 2:1 in favour of the underweight, whereas in 2006 the ratio was 2.5:1.0 in favour of the overweight. Thus, the stability in the opportunity index over time reflects compensating trends in the poor nutritional category.

TABLE 5

Evolution to the opportunity index for access to water and sanitation

Region	Year			Total increase 1990–2006
	1990 (percentages)	2000 (percentages)	2006 (percentages)	
I Tarapacá	91.3	85.0	91.9	0.01
II Antofagasta	75.5	97.9	98.6	0.23
III Atacama	73.1	88.5	91.7	0.19
IV Coquimbo	40.0	68.8	83.3	0.43
V Valparaíso	65.2	82.6	88.3	0.23
VI Libertador General B. O'Higgins	43.3	61.7	77.6	0.34
VII Maule	37.0	54.1	68.3	0.31
VIII Biobío	41.8	60.6	72.9	0.31
IX La Araucanía	25.6	45.8	54.0	0.28
X Los Lagos	26.6	47.4	62.2	0.36
XI Aisén del General C. I. del Campo	52.8	70.1	89.8	0.37
XII Magallanes and A. Chilena	85.7	96.3	97.0	0.11
RM Santiago Metropolitan Region	86.5	90.1	94.0	0.07
National	*58.5*	*74.2*	*82.7*	*0.24*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE 6

Evolution of the opportunity index for access to good nutrition

Region	Year			Total increase 1990–2006
	1990 (percentages)	2000 (percentages)	2006 (percentages)	
I Tarapacá	85.1	88.1	88.1	0.03
II Antofagasta	86.6	86.0	86.0	–0.01
III Atacama	86.0	85.3	85.3	–0.01
IV Coquimbo	81.6	84.7	84.7	0.03
V Valparaíso	76.8	87.3	87.3	0.11
VI Libertador General B. O'Higgins	82.5	84.9	84.9	0.02
VII Maule	79.5	85.9	85.9	0.06
VIII Biobío	83.4	84.4	84.4	0.01
IX La Araucanía	82.3	84.2	84.2	0.02
X Los Lagos	86.0	86.1	86.1	0.00
XI Aisén del General C. I. del Campo	84.9	78.7	78.7	–0.06
XII Magallanes and A. Chilena	85.2	88.0	88.0	0.03
RM Santiago Metropolitan Region	83.8	86.1	86.1	0.02
National	*82.6*	*85.7*	*85.7*	*0.03*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

VI

Decomposing the change in the opportunity index

Paes de Barros, Molinas and Saavedra (2008) propose a simple decomposition of the opportunity index into situations A and B. These can correspond to two points in time in a single country or to two countries at the same point in time. Thus, any change in the index can be decomposed into a scale effect, $\Delta\overline{p}$, and a distributional effect, Δ_D

$$\Delta = O^B - O^A = \overline{p}^B\left(1 - D^B\right) - \overline{p}^A\left(1 - D^A\right) = \Delta_{\overline{p}} + \Delta_D$$

where

$$\Delta_{\overline{p}} = \overline{p}^B\left(1 - D^A\right) - \overline{p}^A\left(1 - D^A\right) = \left(\overline{p}^B - \overline{p}^A\right)\left(1 - D^A\right)$$

and

$$\Delta_D = \overline{p}^B\left(1 - D^B\right) - \overline{p}^B\left(1 - D^A\right) = \overline{p}^B\left(D^A - D^B\right)$$

As can be easily checked, $\Delta\overline{p} + \Delta_D = \Delta$.

We go beyond this decomposition and implement a Oaxaca decomposition to Δ_D, so as to explain the distributional change as stemming from changes in circumstances (quantities) or changes in the parameters (prices). Hence,

$$D^B - D^A = D\left(X^B\beta^B\right) - D\left(X^A\beta^A\right) = \Delta_\beta + \Delta_X$$

where

$$\Delta_\beta = D\left(X^B\beta^B\right) - D\left(X^B\beta^A\right)$$

and

$$\Delta_X = D\left(X^B\beta^A\right) - D\left(X^A\beta^A\right)$$

Then, the total decomposition can be written as follows:

$$\Delta = \Delta_{\overline{p}} + \Delta_{\overline{D}} = \Delta_{\overline{p}} + \overline{p}^B\Delta_\beta + \overline{p}^B\Delta_X$$

The first term corresponds to changes in the coverage of the opportunity (the scale effect), the second term is the change in the distribution of opportunities as a result of changes in the coefficients that relate circumstances and outcomes (the price distribution effect) and the third is the change in the distribution of opportunities stemming from changes in the circumstances faced by children (the endowment distribution effect).

Decomposition results

Table 7 presents the decomposition of the changes in the opportunity index for access to preschool from 1990 to 2006, in terms of the scale effect and the distribution effect. The scale effect explains 17 of the 21 percentage points of the increase in this opportunity index at the national level. Thus, during this period there was a large, across-the-board expansion in preschool for all subgroups, regardless of type or circumstance. This can also be seen at the regional level, as the scale effect explains most of the increase in the opportunity index in every region.

Changes in the dissimilarity index explain the remaining 4 percentage points of the increase in the opportunity index. This effect reflects a more balanced distribution of opportunity among types of children, with a reduction in the gap between the most and least advantaged groups in terms of access to preschool. The Oaxaca decomposition of the distribution effect shows that the 4 percentage point impact results from large offsetting effects in circumstances (endowments and prices). Changes in endowments cause the opportunity index to increase by 14 points. This happens when the subgroups with the highest probability of attending preschool experience the largest increase in their share in the total population. This is an expected development in the context of a growing economy, because people become more educated, migrate to fast growing regions, have fewer children, and so on. On the other hand, price changes cause a decrease in the opportunity index of about 10 points. This effect originates in a reduction in the coefficients that link the disadvantaged and access to preschool, a result that has to be interpreted in the context of a large-scale effect that benefits all subgroups.

The scale effect also dominates in the decomposition of changes in the opportunity index for completing secondary education (table 8). This effect explains

TABLE 7

Decomposition of the change in the opportunity index for access to preschool

Region	Decomposition: Increase HOI 1990–2006			Total increase
	Scale effect: $\Delta\overline{p}$	Distribution effect: $\overline{p}^{B}\Delta_{\beta}$	Distribution effect: $\overline{p}^{B}\Delta_{x}$	
	(1)	(2)	(3)	(1)+(2)+(3)
I Tarapacá	0.17	–0.08	0.11	0.20
II Antofagasta	0.19	–0.16	0.19	0.21
III Atacama	0.16	–0.08	0.11	0.18
IV Coquimbo	0.21	–0.19	0.23	0.26
V Valparaíso	0.19	–0.14	0.17	0.22
VI Libertador O'Higgins	0.16	–0.10	0.14	0.20
VII Maule	0.20	–0.23	0.29	0.26
VIII Biobío	0.17	–0.14	0.17	0.20
IX La Araucanía	0.17	–0.18	0.22	0.22
X Los Lagos	0.17	–0.20	0.24	0.21
XI Aisén del General C. I. del Campo	0.28	–0.39	0.44	0.34
XII Magallanes and A. Chilena	0.24	–0.20	0.23	0.28
RM Santiago Metropolitan Region	0.16	–0.07	0.09	0.18
National	*0.17*	*–0.10*	*0.14*	*0.21*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE 8

Decomposition of the change in the opportunity index for timely completion of secondary education

Region	Decomposition: Increase HOI 1990–2006			Total increase
	Scale effect: $\Delta\overline{p}$	Distribution effect: $\overline{p}^{B}\Delta_{\beta}$	Distribution effect: $\overline{p}^{B}\Delta_{x}$	
	(1)	(2)	(3)	(1)+(2)+(3)
I Tarapacá	0.07	–0.01	0.03	0.09
II Antofagasta	0.06	0.00	0.02	0.08
III Atacama	0.25	–0.05	0.12	0.33
IV Coquimbo	0.15	0.04	0.05	0.24
V Valparaíso	0.14	0.02	0.03	0.19
VI Libertador General B. O'Higgins	0.18	0.03	0.07	0.28
VII Maule	0.22	–0.02	0.12	0.32
VIII Biobío	0.17	0.02	0.03	0.23
IX La Araucanía	0.16	0.05	0.04	0.25
X Los Lagos	0.22	–0.07	0.17	0.32
XI Aisén del General C. I. del Campo	0.19	–0.02	0.06	0.23
XII Magallanes and A. Chilena	0.18	0.00	0.08	0.26
RM Santiago Metropolitan Region	0.12	0.01	0.02	0.15
National	*0.15*	*0.03*	*0.03*	*0.21*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

15 of the 21 percentage points of the increase in the national index in 1990–2006. Every type or population subgroup increases its probability of graduating from high school, representing an across-the-board improvement in opportunities. The scale effect also dominates at the regional level, accounting for over half of the increase in the opportunity index in each region.

Changes in the direction of a more balanced distribution of opportunities in the dissimilarity index explain the remaining 5 percentage points of the increase. This time changes in endowments and prices work in the same direction, with both causing the opportunity index to increase. Therefore, all three effects are responsible for having created more opportunities to complete secondary education over time and more equality of opportunity among subgroups.

Table 9 shows that the large gains in the opportunity index for accessing sanitary infrastructure result from an across-the-board increase in coverage and from changes in endowments. The former explains 14 of the 24 percentage points of the increase in the opportunity index, while the latter explains the remaining 10 percentage points.

Changes in endowments are particularly important for regions that show the largest gains in the opportunity index, which are also the regions that lagged behind in the initial year. In seven of the thirteen regions, the opportunity index for accessing sanitary infrastructure increased by over 30 percentage points in the period under analysis; in four of these seven regions, the endowment effect explains at least half of the increase.

Finally, table 10 presents the decomposition of changes in the opportunity index for nutritional status. There is relatively little change in this index, so the decomposition is less informative than in the previous cases. Nonetheless, the scale effect predominates, explaining 2.3 of the 3.1 percentage points of the increase in this opportunity index.

TABLE 9

Decomposition of the change in opportunity index for access to water and sanitation

Region	Decomposition: Increase HOI 1990–2006			Total increase
	Scale effect: $\Delta\overline{p}$	Distribution effect: $\overline{p}^{B}\Delta_{\beta}$	Distribution effect: $\overline{p}^{B}\Delta_{x}$	
	(1)	(2)	(3)	(1)+(2)+(3)
I Tarapacá	0.00	0.00	0.01	0.01
II Antofagasta	0.16	–0.03	0.10	0.23
III Atacama	0.13	–0.02	0.07	0.19
IV Coquimbo	0.25	–0.03	0.21	0.43
V Valparaíso	0.16	–0.02	0.09	0.23
VI Libertador General B. O'Higgins	0.19	0.01	0.14	0.34
VII Maule	0.17	0.01	0.13	0.31
VIII Biobío	0.21	–0.06	0.15	0.31
IX La Araucanía	0.18	–0.04	0.15	0.28
X Los Lagos	0.21	–0.06	0.20	0.36
XI Aisén del General C. I. del Campo	0.24	–0.03	0.16	0.37
XII Magallanes and A. Chilena	0.08	0.00	0.04	0.11
RM Santiago Metropolitan Region	0.05	0.01	0.02	0.07
National	*0.14*	*0.00*	*0.09*	*0.24*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE 10

Decomposition of the change in the opportunity index for good nutrition

Region	Decomposition: Increase HOI 1990–2006			Total increase
	Scale effect: $\Delta\overline{p}$	Distribution effect: $\overline{p}^{B}\Delta_{\beta}$	Distribution effect: $\overline{p}^{B}\Delta_{x}$	
	(1)	(2)	(3)	(1)+(2)+(3)
I Tarapacá	0.022	0.004	0.004	0.031
II Antofagasta	–0.010	–0.007	0.012	–0.006
III Atacama	–0.011	–0.008	0.012	–0.007
IV Coquimbo	0.024	0.004	0.002	0.031
V Valparaíso	0.092	–0.015	0.029	0.106
VI Libertador General B. O'Higgins	0.018	0.004	0.002	0.024
VII Maule	0.056	0.000	0.008	0.064
VIII Biobío	0.006	–0.001	0.006	0.010
IX La Araucanía	0.012	0.004	0.003	0.019
X Los Lagos	–0.002	–0.004	0.008	0.001
XI Aisén del General C. I. del Campo	–0.061	–0.031	0.031	–0.061
XII Magallanes and A. Chilena	0.022	0.004	0.002	0.028
RM Santiago Metropolitan Region	0.017	0.003	0.003	0.024
National	*0.023*	*0.006*	*0.002*	*0.031*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

VII
Concluding remarks

The paper assesses the impact of circumstances on the following intermediate outcomes: access to preschool, timely completion of secondary education, access to sanitary infrastructure and good nutritional status. The circumstances include gender, the mother's level of education, the father's level of education, the location of the household, per capita household income and family structure.

The results show a reduction in inequality of opportunity between 1990 and 2006. The gains are of two classes. First, coverage has increased substantially, leading to an across-the-board improvement in opportunities. Second, there has been a reduction in the access probabilities across population subgroups, resulting in a more balanced playing field.

The evidence presented in the paper suggests that Chile has been successful in reducing inequality of opportunity, together with poverty and income inequality. However, the starting point of the sample period was characterized by high inequality in opportunities and outcomes. Thus, while the reduction in inequality is good news, Chile still has a long way to go to achieve an equitable distribution of welfare.

The results in this paper must be interpreted simply as a gauge of the evolution of opportunities in the country, because they are based on a specific set of intermediate outcomes. Other key determinants of human capital need to be evaluated in the future to support this assessment of the evolution of opportunities, including health-related variables and the quality of schooling.

There is a significant gap in the opportunity index across Chilean regions, which reflects differences in both coverage rates and the distribution of opportunities within regions. The regions converged somewhat in 1990–2006, as the regions that lagged the most in 1990 posted the largest gains in 2006. There are still large regional differences, however, which add to the inequality of opportunity.

(Original: English)

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STATISTICAL ANNEX

TABLE A-1

Dissimilarity index for timely completion of secondary education (*D*)

Region	Year			Reduction 1990-2006
	1990	2000	2006	
I Tarapacá	0.10	0.09	0.07	0.03
II Antofagasta	0.13	0.15	0.10	0.03
III Atacama	0.17	0.20	0.07	0.10
IV Coquimbo	0.20	0.12	0.08	0.13
V Valparaíso	0.17	0.14	0.09	0.08
VI Libertador General B. O'Higgins	0.23	0.13	0.07	0.16
VII Maule	0.28	0.15	0.10	0.18
VIII Biobío	0.17	0.17	0.08	0.08
IX La Araucanía	0.25	0.19	0.11	0.15
X Los Lagos	0.27	0.14	0.09	0.18
XI Aisén del General C. I. del Campo	0.23	0.14	0.15	0.09
XII Magallanes and A. Chilena	0.14	0.09	0.03	0.10
RM Santiago Metropolitan Region	0.13	0.12	0.09	0.04
National	*0.18*	*0.15*	*0.09*	*0.09*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE A-2

Coverage of timely completion of secondary education (*p*)

Region	Year			Increase 1990-2006
	1990	2000	2006	
I Tarapacá	0.60	0.66	0.68	0.08
II Antofagasta	0.50	0.46	0.57	0.07
III Atacama	0.39	0.40	0.69	0.31
IV Coquimbo	0.45	0.61	0.65	0.19
V Valparaíso	0.45	0.51	0.62	0.17
VI Libertador General B. O'Higgins	0.39	0.58	0.62	0.23
VII Maule	0.29	0.55	0.59	0.30
VIII Biobío	0.47	0.48	0.67	0.20
IX La Araucanía	0.38s	0.51	0.59	0.21
X Los Lagos	0.26	0.49	0.57	0.30
XI Aisén del General C. I. del Campo	0.22	0.40	0.47	0.25
XII Magallanes and A. Chilena	0.54	0.72	0.75	0.21
RM Santiago Metropolitan Region	0.54	0.62	0.68	0.14
National	*0.46*	*0.56*	*0.64*	*0.18*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE A-3

Dissimilarity index for access to preschool (*D*)

Region	Year			Reduction 1990-2006
	1990	2000	2006	
I Tarapacá	0.10	0.09	0.04	0.06
II Antofagasta	0.12	0.10	0.04	0.08
III Atacama	0.12	0.09	0.05	0.06
IV Coquimbo	0.18	0.13	0.06	0.12
V Valparaíso	0.13	0.10	0.06	0.07
VI Libertador General B. O'Higgins	0.21	0.15	0.09	0.12
VII Maule	0.24	0.15	0.09	0.15
VIII Biobío	0.16	0.15	0.07	0.09
IX La Araucanía	0.24	0.16	0.10	0.14
X Los Lagos	0.22	0.16	0.09	0.13
XI Aisén del General C. I. del Campo	0.17	0.11	0.05	0.12
XII Magallanes and A. Chilena	0.11	0.09	0.04	0.07
RM Santiago Metropolitan Region	0.11	0.12	0.05	0.06
National	*0.17*	*0.13*	*0.07*	*0.10*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE A-4

Coverage of access to preschool (*p*)

Region	Year			Increase 1990-2006
	1990	2000	2006	
I Tarapacá	0.26	0.31	0.45	0.19
II Antofagasta	0.14	0.31	0.35	0.21
III Atacama	0.19	0.32	0.37	0.18
IV Coquimbo	0.15	0.33	0.41	0.26
V Valparaíso	0.15	0.29	0.38	0.22
VI Libertador General B. O'Higgins	0.13	0.24	0.34	0.20
VII Maule	0.11	0.25	0.38	0.27
VIII Biobío	0.13	0.24	0.33	0.21
IX La Araucanía	0.10	0.23	0.33	0.23
X Los Lagos	0.10	0.18	0.32	0.22
XI Aisén del General C. I. del Campo	0.12	0.33	0.46	0.34
XII Magallanes and A. Chilena	0.19	0.29	0.46	0.28
RM Santiago Metropolitan Region	0.20	0.29	0.38	0.18
National	*0.16*	*0.27*	*0.37*	*0.21*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE A-5

Dissimilarity index for access to water and sanitation (*D*)

Region	Year			Reduction 1990-2006
	1990	2000	2006	
I Tarapacá	0.03	0.05	0.03	0.00
II Antofagasta	0.07	0.01	0.00	0.07
III Atacama	0.09	0.04	0.03	0.06
IV Coquimbo	0.27	0.15	0.07	0.20
V Valparaíso	0.12	0.07	0.04	0.08
VI Libertador General B. O'Higgins	0.27	0.19	0.10	0.18
VII Maule	0.32	0.23	0.14	0.18
VIII Biobío	0.23	0.17	0.11	0.12
IX La Araucanía	0.37	0.27	0.22	0.16
X Los Lagos	0.36	0.25	0.17	0.19
XI Aisén del General C. I. del Campo	0.18	0.13	0.04	0.14
XII Magallanes and A. Chilena	0.05	0.01	0.01	0.04
RM Santiago Metropolitan Region	0.04	0.03	0.02	0.02
National	*0.18*	*0.11*	*0.07*	*0.11*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE A-6

Coverage of access to water and sanitation (*p*)

Region	Year			Increase 1990-2006
	1990	2000	2006	
I Tarapacá	0.94	0.89	0.94	0.00
II Antofagasta	0.81	0.99	0.99	0.18
III Atacama	0.80	0.93	0.94	0.14
IV Coquimbo	0.55	0.81	0.90	0.35
V Valparaíso	0.74	0.89	0.92	0.18
VI Libertador General B. O'Higgins	0.60	0.76	0.86	0.26
VII Maule	0.55	0.70	0.80	0.25
VIII Biobío	0.54	0.73	0.82	0.28
IX La Araucanía	0.41	0.63	0.69	0.28
X Los Lagos	0.41	0.64	0.75	0.33
XI Aisén del General C. I. del Campo	0.65	0.80	0.94	0.29
XII Magallanes and A. Chilena	0.90	0.97	0.98	0.08
RM Santiago Metropolitan Region	0.90	0.93	0.96	0.05
National	*0.71*	*0.83*	*0.89*	*0.18*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE A-7

Dissimilarity index for good nutritional status (*D*)

Region	Year			Reduction 1990-2006
	1990	2000	2006	
I Tarapacá	0.02	0.02	0.01	0.01
II Antofagasta	0.02	0.02	0.01	0.01
III Atacama	0.01	0.02	0.01	0.01
IV Coquimbo	0.02	0.02	0.01	0.01
V Valparaíso	0.03	0.01	0.01	0.02
VI Libertador General B. O'Higgins	0.02	0.02	0.01	0.01
VII Maule	0.02	0.02	0.01	0.01
VIII Biobío	0.02	0.02	0.01	0.01
IX La Araucanía	0.02	0.02	0.01	0.01
X Los Lagos	0.01	0.02	0.01	0.00
XI Aisén del General C. I. del Campo	0.02	0.03	0.02	0.00
XII Magallanes and A. Chilena	0.02	0.02	0.01	0.01
RM Santiago Metropolitan Region	0.02	0.02	0.01	0.01
National	*0.02*	*0.02*	*0.01*	*0.01*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

TABLE A-8

Coverage of good nutritional status (*p*)

Region	Year			Increase 1990-2006
	1990	2000	2006	
I Tarapacá	0.87	0.83	0.90	0.03
II Antofagasta	0.88	0.87	0.87	–0.01
III Atacama	0.87	0.86	0.88	0.01
IV Coquimbo	0.83	0.85	0.87	0.04
V Valparaíso	0.79	0.89	0.89	0.10
VI Libertador General B. O'Higgins	0.84	0.85	0.88	0.04
VII Maule	0.81	0.83	0.89	0.07
VIII Biobío	0.85	0.84	0.87	0.02
IX La Araucanía	0.84	0.85	0.86	0.02
X Los Lagos	0.87	0.87	0.89	0.02
XI Aisén del General C. I. del Campo	0.86	0.80	0.82	–0.04
XII Magallanes and A. Chilena	0.87	0.85	0.92	0.06
RM Santiago Metropolitan Region	0.85	0.86	0.88	0.02
National	*0.84*	*0.86*	*0.88*	*0.03*

Source: Authors' calculations, on the basis of the National Characterization Socioeconomic Survey (CASEN) for 1990, 2000 and 2006.

Chile: building a computable general equilibrium model with an application to the Bío Bío region

Cristián Mardones P.

ABSTRACT

This paper describes the building of a regional computable general equilibrium model applicable to the analysis of development policies and major economic shocks for specific regions of Chile. Then is generated an application for the Bío Bío region which reveals that the effects of the current fisheries crisis (caused by the scarcity of jack mackerel) can be expected to result in the production structure becoming further specialized in the wood and cellulose industries. It also finds that sectors with few production linkages to the fisheries sector are strongly affected through indirect channels that would be hard to identify without a general equilibrium approach.

KEYWORDS

Economic development, regional development, development policy, economic indicators, economic conditions, exports, imports, income, consumption, production specialization, industry, case studies, Chile

JEL CLASSIFICATION

C68, R11, R13

AUTHOR

Cristián Mardones, Assistant Professor, Department of Industrial Engineering, University of Concepción. crismardones@udec.cl

I
Introduction

Analysing regional economic policies in a general equilibrium framework is intuitively attractive because it makes it possible to establish indirect links that would otherwise be hard to detect quantitatively. By capturing first- and second-order effects, computable general equilibrium (CGE) models can be used to identify transmission mechanisms and the total effects of a policy or shock on domestic, interregional, external and factor markets, with explicit consideration of the behaviour of economic agents in the form of adjustments via market-clearing prices. In practice, however, alternative regional evaluation tools are more commonly used, such as multipliers based on input-output matrices or econometric models. Partridge and Rickman (2010) argue that the limited use of regional CGE models is explained by their complexity and by shortcomings in their formulation, implementation and description.

Applications using CGE models at national level usually deal with international trade, public finance, energy, the environment, income distribution, and poverty, among other things (see Devarajan and Robinson, 2002). A variety of applications for Latin American countries can be reviewed in De Miguel and others (2010). The literature on regional CGE models is thematically diverse, but less plentiful.[1] Recent research includes the work of Julia-Wise, Cooke and Holland (2002), who analyse property taxes in the state of Idaho; Miguel-Vélez, Cardenete and Pérez-Mayo (2009), who study a rise in fuel taxes; Rickman and Snead (2007), who examine the growth and equity effects of subsidies to formal childcare for low-income families; Liu (2006), who deals with the economic repercussions of building an industrial science park in the south-eastern region of Taiwan; Conrad and Heng (2002), who discuss the role of public infrastructure in regional growth; Seung and others (2000), who evaluate the repercussions of reallocating water between the farming and tourism sectors; Patriquin and others (2002), who use an environmentally extended model incorporating natural capital in a region of Canada; Giesecke (2002), who identifies the causes of growth divergence between two regions of Australia; and Kim and Kim (2002), who consider the growth and equity effects of a regional development strategy based on investment incentives in the Republic of Korea.

In Latin America, applications of CGE models for regional impact analysis are relatively thin on the ground, and publications concentrate on countries such as Brazil and Colombia. In the case of Brazil, Haddad (1999) uses the B-MARIA model, based on the multiregional MONASH-MRF model of the Australian economy, to evaluate structural changes in the economy and changes in inequity in the event of unilateral liberalization of international trade; Haddad, Domingues and Perobelli (2002) consider alternative economic integration strategies on the basis of a national model and then, in a second stage, introduce an interregional model to generate a top-down disaggregation of the national results; Domingues and Lemos (2004) also focus on the regional consequences of trade liberalization strategies in Brazil, employing a multiregional model based on the MONASH-MRF model; Domingues and others (2002) explore changes in the interregional trade flows of 27 Brazilian states. In the case of Colombia, Iregui (2005) quantifies the welfare effects of a decentralization process using a multiregional CGE model; subsequently, Haddad and others (2009) construct a spatial general equilibrium model for the Colombian economy, including a detailed treatment of interregional trade, scale economies, market imperfections and transport costs.

The present study introduces a regional CGE model that is relatively easy to implement for other Latin American countries wishing to evaluate economic repercussions in a specific region.

In Chile, there have been empirical applications that have employed a general equilibrium approach, but only to investigate country-level impacts, as no studies have used a regional CGE there. The following may be cited as examples: Coeymans and Larraín (1994) analyse the repercussions following the signing of the United States-Chile Free Trade Agreement; Harrison, Rutherford and Tarr (1997, 1998 and 2005) investigate the effects of a policy of unilateral trade liberalization and the signing of free trade agreements (FTAs); Schuschny, Durán and De Miguel (2008) evaluate the effects of FTAs with Asian countries; O'Ryan and others (2011) examine the socio-economic and environmental effects

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[1] See Partridge and Rickman (1998), Rodríguez (2007) and Partridge and Rickman (2010) for an exhaustive review of the applications.

of FTAs; Holland and others (2005) study agricultural pricing policies and identify their effects on the economy and on urban-rural migration; O'Ryan, Miller and De Miguel (2003), O'Ryan and others (2005) and Dessus and O'Connor (2003) simulate environmental policies and their repercussions on the economy; Pereira and others (2009) focus on the introduction of copper mining royalties designed to attenuate "Dutch disease" and increase export diversification; and Mardones (2010 and 2011) analyses various reforms to the Chilean tax system.

The importance of having regional CGE models is that these can be used to analyse policies, shocks or both that are specific to a region, and likewise those of a national or international character, but concentrating on the economic repercussions for a particular region. Their usefulness becomes apparent when evaluating simulations of counterfactual scenarios that have effects on a variety of representative households, economic sectors and production factors which are impossible to capture with a partial equilibrium analysis.

General equilibrium effects can be important at the regional level insofar as policies and shocks affect sectors with strong production linkages or regions whose production structures are highly specialized. The specific issues that can be addressed with this tool are various, and may include determining how a region will be affected by social policies, stricter environmental regulations, energy price shocks, development policies aimed at particular economic sectors,[2] royalties on economic activities, and employment subsidies, among other things. Generally speaking, it is possible to model any impact on an exogenous variable or parameter represented in the model.

Although it is possible to use input-output models to obtain these proxies for a region, Rickman (1992) and Gillespie and others (2001) have shown that these overestimate economic repercussions in the absence of oversupply, since the assumptions of fixed prices and perfectly elastic supply do not allow the displacement of other economic activities and employment creation to be estimated. Furthermore, the lack of an economic structure means that fiscal policies cannot be evaluated in input-output models (Partridge and Rickman, 2010).

The regional CGE models used in the literature can be classified into two major categories: region-specific and multiregional. The main constraint causing models of the first type rather than the second to be chosen (apart from the difficulty of developing and programming them) is the availability of region-level data, in particular up-to-date input-output matrices for each region and interregional trade data. Chile does have regional input-output matrices (base year 1996) that fit the region-specific model, but interregional trade is not available, and even in the methodological detail of their construction (Riffo and others, 2006) it is mentioned that the data on a region's trade with other regions are not direct but are simply an adjustment account.

A CGE model for a specific region is designed with reference to a particular area within a country and is characterized by its similarity to a country-level model, with the difference lying in the treatment of the external sector, which in this case consists of the rest of the country and the rest of the world. Its main limitation is the inability to evaluate effects on other regions and on the country as a whole, something that becomes more important when the region is highly integrated into the rest of the national economy, since the picture of impacts that it provides is incomplete owing to the failure to capture interregional feedback effects. This limitation would not be completely removed with a multiregional CGE model, however, since in empirical applications the number of regions and sectors is usually small because of computing and data constraints (Wittwer and Horridge, 2010).

The present study sets out to fill the gap in this area by implementing a region-specific CGE[3] for the analysis of Chile's regional economies, modifying the equations of a standard country-level CGE model for this purpose (Löfgren, Harris and Robinson, 2001); this new model is called REGCGE. To show the benefits of this tool for the evaluation of regional public policies or economic shocks, an application specific to the Bío Bío region is generated. This analyses the macro, intersectoral, employment and household effects of the current fisheries crisis caused by the scarcity of jack mackerel, this choice being guided by the recent availability of a social accounting matrix (base year 2006) (Mardones and Saavedra, 2011) to calibrate the proposed model.

This paper is novel, and not only at the regional and national level, since the literature contains just one published study using the same methodology to model falling fish catches and rising fuel prices in Alaska (Waters and Seung, 2010), although neither model specifies

[2] In Chile, for example, there has been a growing concern in recent years to produce long-term development strategies for the country's regions based on efforts to use regional development agencies to consolidate and fortify certain sectors of the economy.

[3] The strategy of modelling a specific region that has commercial ties with the rest of the country and the rest of the world fully concords with the structure of the databases of regional input-output matrices for Chile made available to the public by the National Statistics Institute (INE) in 2004.

endogenous interactions between fishing activity and changes in the biomass (stock) of the resource. Although there are other models specifying dynamic interactions in ecological and economic systems, such as Eichner and Pethig (2007) and Finnoff and Tschirhart (2005), these possess different characteristics to multisectoral CGE models like the one analysed in this study.

The rest of the article is structured as follows. Section II details the structure of the proposed regional CGE model and the regional social accounting matrix used to calibrate it. Section III details the application of the model to the Bío Bío region, using simulations of negative impacts affecting fishing productivity to represent the scarcity of jack mackerel, catches of which have fallen by over 45% since 2006. The aim is to determine the effects of this crisis on regional economic development. Lastly, section IV presents the main conclusions and future extensions of this study.

II
Methodology

1. Social accounting matrix

A basic condition for applying a CGE model is to have data available to calibrate it. In Chile, INE (2004) has published regional input-output matrices (base year 1996), which are essential for constructing regional social accounting matrices (Pyatt and Round, 1985), these in turn being the data needed to calibrate a regional CGE model. Although CGE models do not generally use a very recent base year (trusting that alterations in the economic structure take place in the medium and long term), 15 years is too long for the model application to constitute a reasonable proxy for the regional economy.[4, 5] Consequently, use is made of a social accounting matrix for the Bío Bío region (base year 2006) constructed by Mardones and Saavedra (2011), who updated the INE regional input-output matrix with information from the 2006 Annual National Industry Survey (ENIA), national accounts, customs, the sixth Family Budget Survey and the 2006 National Socio-economic Survey (CASEN), among other sources, using the indirect cross-entropy method[6] developed by Robinson, Cattaneo and El-Said (2001).

The methodology used to construct it consisted, in a first stage, in obtaining a regional social accounting matrix (SAM) for 1996, this being the initial element required to apply the updating methods. It was based mainly on the input-output matrix for the Bío Bío region, with base year 1996 (details of its construction in Riffo and others, 2006). Given the limited availability of regional sectoral information, the SAM included 20 production sectors. Information on value added and regional intermediate consumption by sector, updated to 2006, was then incorporated and this, along with the use of some estimates, allowed the intermediate consumption matrix (a component of the SAM) to be updated using the RAS method, which is an indirect method for obtaining an input-output matrix. The vector of value added updated to 2006 was based on Central Bank of Chile statistics on regional gross domestic product (GDP) by class of economic activity in the 2003-2006 period. In the case of manufacturing industries, both value added and total expenditure on intermediate purchases in these sectors were obtained from ENIA 2006, prepared by the INE. The use of this matrix, some known information (such as exports to the rest of the world and public investment) and proxies that mainly involved taking as constant some regional proportions from 1996 or some national proportions allowed an updated regional SAM to be obtained using the cross-entropy method. Besides using the 1996 SAM as a starting element, this method required the definition of constraints given by known (or reasonably estimated) information, much of which came from estimates arrived at using the RAS method. Each of these constraints was programmed using the cross-entropy method, following which the trial and error process was initiated with a view to implementing

[4] MIDEPLAN (2005) provides a description and analysis of Chile's regional economies based on regional input-output matrices (base year 1996).

[5] Rojas (2009) develops a social accounting matrix for the Metropolitan Region of Santiago (base year 1996), the key inputs being the regional input-output matrix and assumptions about known linear relationships between national and regional data.

[6] The optimization method can be used to obtain a social accounting matrix from an older matrix by incorporating errors in the variables, inequality constraints and updated information on some parts of the matrix and not only the row and column totals.

the greatest possible number of constraints, so that the method would converge on a solution.

A problem that can arise when an indirect method is used to update the SAM is that the original ratio between technical coefficients is maintained. This means that even if the data are updated, the effects and ratios will be the earlier and not the latest ones. This point was addressed by employing an optimization procedure for updating the SAM, which included constraints associated with the intermediate consumption and value added of each activity on the basis of ENIA data or, if these were lacking, ratios based on regional sectoral GDP.

This can be corroborated by observing the change in the technical coefficients of the 2006 and 1996 SAMs. To simplify the results, table 1 presents an aggregation of the 20 original sectors into just five, labelled natural resources, industry, construction, commerce and services.

By way of example, it is concluded that an economic transformation took place over the decade, with capital intensity declining in the natural resource sector and increasing in the industrial sector, which fits with what has been observed in the region. Specifically, this trend towards lower capital intensity and rising intermediate consumption of inputs can be seen in the fishing sector (see figure 1).

Regarding inclusion of the government in the SAM, in Chile all taxes and operating surpluses raised, among other revenue, are transferred to the central government (except for the collection of municipalities' autonomous revenues not transferred from the centre). These resources are then transferred from the centre to each region via a number of instruments such as the Regional Development Fund, Regionally Allocated Sectoral Investment and Locally Allocated Regional Investment (see Rojas, 2009, for further details). The output of the public administration is valued on a cost basis.

Because of the above, it is considered that the revenues of the central government and municipalities are consolidated in the Government Account of the Bío Bío region's SAM with a view to carrying out spending on goods, benefits, allocations or direct transfers, with the difference (saving/dissaving) being transferred to the central government via the current account balance with the rest of the country. By virtue of this, the CGE model includes just a single agent called Government that explicitly redistributes these resources, without modelling the central government. This approach is usual in region-specific models (see, for example, Miguel-Vélez, Cardenete and Pérez-Mayo, 2009). Conversely, bottom-up models that model a number of regions tend to explicitly differentiate a central government and a regional one (Giesecke, 2002), while authors such as Kim and Kim (2002) model a government for each region.

Another important point about the economy of the Bío Bío region is the question of where corporate profits go. Because the parent companies are outside the region but inside the country, 68% of the payment to capital of firms established in the region flows to the rest of the country through the capital account.

Basically the aggregate schema the regional SAM must have to calibrate the model is as shown in table 2.

TABLE 1

Comparison of technical coefficients in the 1996 and 2006 SAMs

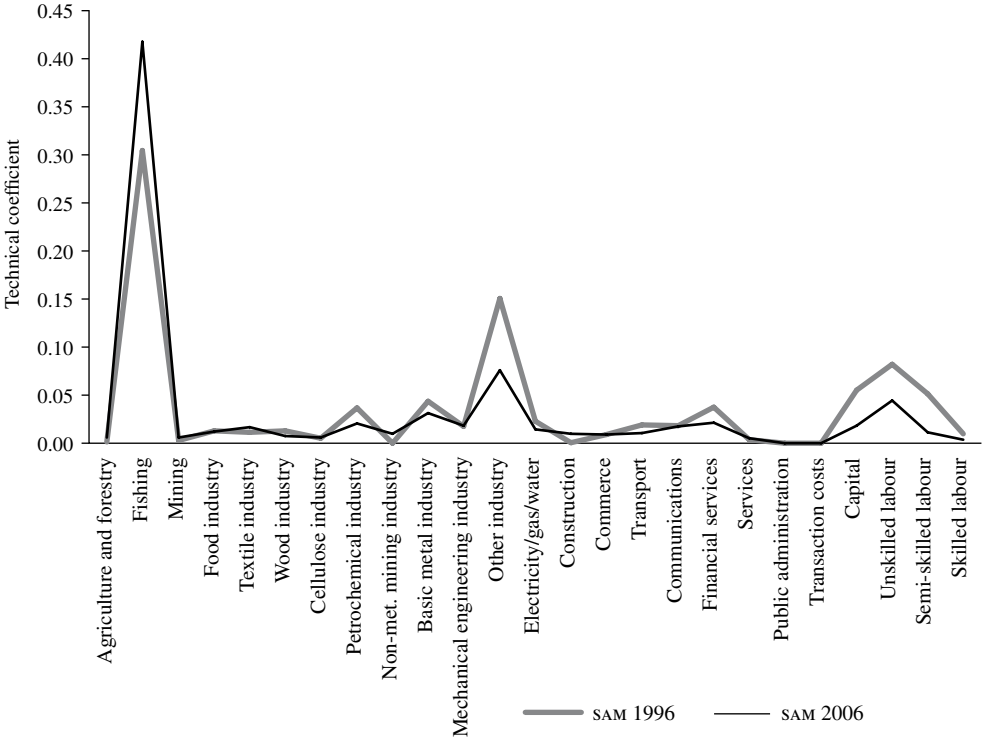
	Nat. res. 1996 SAM	Nat. res. 2006 SAM	Industry 1996 SAM	Industry 2006 SAM	Construction 1996 SAM	Construction 2006 SAM	Commerce 1996 SAM	Commerce 2006 SAM	Services 1996 SAM	Services 2006 SAM
Natural resources	0.21	0.23	0.21	0.16	0.02	0.03	0.01	0.04	0.00	0.02
Industry	0.20	0.25	0.20	0.23	0.37	0.38	0.17	0.27	0.16	0.20
Construction	0.00	0.02	0.00	0.03	0.00	0.02	0.01	0.02	0.02	0.03
Commerce	0.01	0.03	0.01	0.03	0.00	0.02	0.03	0.04	0.03	0.03
Services	0.09	0.11	0.11	0.10	0.06	0.07	0.29	0.32	0.12	0.12
Capital	0.29	0.20	0.25	0.28	0.25	0.21	0.22	0.13	0.35	0.29
Unskilled labour	0.15	0.10	0.06	0.04	0.20	0.15	0.18	0.08	0.13	0.07
Semi-skilled labour	0.02	0.02	0.02	0.04	0.04	0.06	0.05	0.06	0.05	0.07
Skilled labour	0.01	0.01	0.02	0.02	0.04	0.03	0.04	0.02	0.10	0.12

Source: prepared by the author.

SAM: social accounting matrix.

FIGURE 1

Technical coefficients for the fishing sector in the 1996 and 2006 sams



Source: prepared by the author.

2. Modelling design

A relative fast way of attempting to model a region economically using the data structure of table 2 is to use a standard country-level model. However, the drawback of this option is that the region's trade interaction and capital flows with the rest of the world and the rest of the country have to be aggregated. This aggregation means that international shocks cannot be simulated independently of the region's trade with the rest of the country; furthermore, the results obtained would be skewed by the exchange rate, since proper modelling ought to take explicit account of the fact that trade with the rest of the country is conducted in the domestic currency (one to one fixed exchange rate between the region and the rest of the country), while trade with the rest of the world is carried out with a different exchange rate reflecting the product of the foreign currency by the country's domestic currency.

Dividing trade with the rest of the country from trade with the rest of the world entails incorporating new equations, variables, parameters and elasticities into the standard country-level model (see appendix 1) and thereby turning it into an explicitly regional model, the most salient alterations being in the features that model export and import quantities and prices, with differentiated tariffs for the rest of the country and the rest of the world. It is also necessary to include two exchange rates and two current account balances, one for the rest of the country (which will be in deficit, for example, if the capital is owned by the rest of the country) and one for the rest of the world (which will be in surplus, for example, if the region is a net exporter). Interregional migration should be taken into account to reflect labour mobility if there are pay differentials between the region and the rest of the country; given the complexity of the process and the fact that only one region is being explicitly modelled, it is assumed that the labour supply relates positively to movements in the region's wages relative to those of the rest of the country. The regional consumer price index (CPI) is determined endogenously in the model, while the national CPI is assumed to be exogenous (this assumption is facilitated by the region's share of total national GDP, which is about 9%, and its strong export orientation). It is also necessary to modify the region's macroeconomic variables and rules of closure so that the

TABLE 2

Aggregate regional social accounting matrix (sam)

Accounts	Activities	Goods	Factors	Institutions	Capital accounts	Rest of country	Rest of world
Activities		Domestic sales					
Goods	Intermediate consumption			Final consumption and government spending	Gross capital formation and stock changes	Exports to rest of country	Exports to rest of world
Factors	Payment to factors of production					Payment to factors from rest of country	Payment to factors from rest of world
Institutions	Production taxes, value added tax	Import taxes	Household factor income	Transfers between institutions		Transfers from rest of country	Transfers from rest of world
Capital accounts				Household and government saving		Rest of country saving	Rest of world saving
Rest of country		Rest of country imports	Rest of country factor income				
Rest of world		Rest of world imports	Rest of world factor income				

Source: prepared by the author.

macroeconomic aggregates reflect the above changes. Although the model permits different rules of closure, just like the standard country-level CGE version, for this regional application it is assumed that investment is a proportion of absorption, that exchange rates are fixed and current account balances flexible, and that government saving is flexible in the presence of fixed tax rates. All these characteristics make it possible to obtain a model that provides a more realistic fit for a regional economy.

The rest of the design decisions for the region-specific CGE model are similar to those for a standard country-level CGE model (Löfgren, Harris and Robinson, 2001). They include basic aspects such as the number of representative consumers, production sectors, factors of production, institutions and the region's external sector. This is followed by the selection of the functional forms to be used to model consumer preferences, firms' production technologies and the flow of resources between institutions, which affect problems of optimization for economic agents.

3. The regional cge model

In the regional CGE (REGCGE) model proposed, the production of goods and services creates demand for factors of production that generate value added and for intermediate goods and services that are used as inputs. Intermediate inputs can be produced locally in the region or imported from the rest of the country, the rest of the world, or both. The demand for labour and capital as factors of production interacts with the regional supply of factors of production in factor markets, determining the market-clearing prices for these factors. Payments to factors of production determine income levels for the region's households, which in turn (and depending on the preferences of these households) determine demand for goods and services. Equilibrium occurs when the prices allow equaling the supplies and demands in all the markets (of goods and factors).

The model recreates an economic system characterized by the interaction of different agents whose behaviour, based on microeconomic optimization, is defined by the specification of linear and non-linear equations. These economic agents modify their consumption and production decisions when there are changes in the relative prices of products, inputs or factors of production, or when exogenous shocks occur.

Like any model, the REGCGE requires specific functional forms to be defined for its variables and parameters. The functional forms are the standard ones in economics. The demand functions are based on Stone-Geary utility functions, while the production functions are based on constant elasticity of substitution (CES) or Leontief functions. There are also CES functions that allow a degree of substitution between regional and external production; this latter also nests a CES function which can be used to substitute external production in the rest of the country and the rest of the world. The general

behaviour of the model is illustrated and described below (see figure 2).

Production Y_i may be destined for exports X_i or domestic sales D_i, the transformation occurring via a constant elasticity CES function (σ_{cet}) subject to the relative prices of the two destinations. Furthermore, exports may be destined for the rest of the country $X_i^{restofcountry}$ or the rest of the world $X_i^{restofworld}$, and this depends on a CES transformation function with elasticity (σ^x) subject to the relative prices of the two destinations external to the region. Goods and services (A_i) for intermediate or final use may be produced domestically or imported (M_i), the composition varying in accordance with their relative prices and a CES function with elasticity of substitution $\sigma_{armington}$. In turn, imports may come from the rest of the country $M_i^{restofcountry}$ or the rest of the world $M_i^{restofworld}$, and this depends on a CES transformation function with elasticity (σ^m) subject to the relative prices of the two suppliers external to the region. The final uses of goods and services are private consumption (C), investment (I), government spending (G) and exports (X).

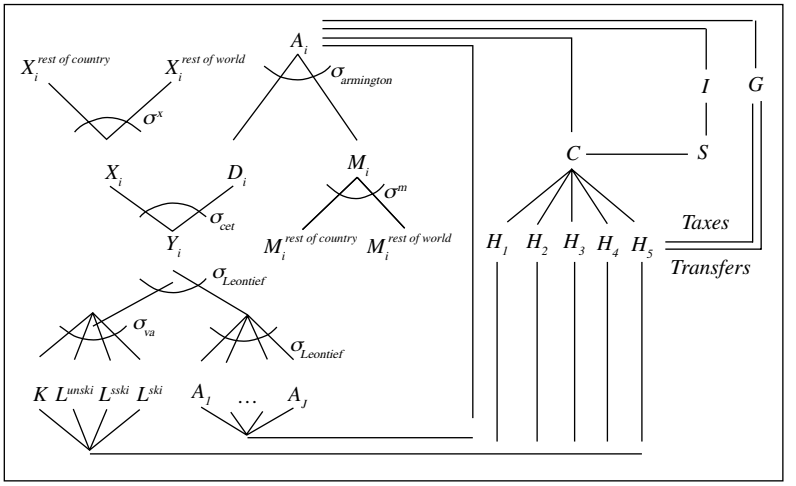
Private consumption is carried out by households representative of the income quintiles (H_q), which maximize their (Stone-Geary) utility function subject to their budget constraints, giving rise to an extended linear expenditure system. In addition, households make transfers to other households, pay taxes and receive government transfers, while the remaining income is saved. The saving generated by households, government, rest of country and rest of world in the region is used as capital for private, public and foreign investment.

External saving or dissaving is represented by two current account balances and two exchange rates, one for the rest of the country and one for the rest of the world. If the current account balance is fixed, then the exchange rate is endogenous, while if the current account balance is variable, the exchange rate is fixed.

The factors of production possessed by households are capital and labour (skilled, semi-skilled and unskilled), for the use of which they receive payment from the firms that employ them alongside intermediate goods to produce other goods and thus maximize benefits given the technological constraint available, this being a Leontief production function that nests functions of value added (CES function of production factors with elasticity of substitution σ_{va}) and of aggregate intermediate consumption (Leontief function of the inputs of each economic sector). To provide an indirect

FIGURE 2

Simplified illustration of the workings of the regcge model



Source: prepared by the author.

$\sigma_{armington}$: Armington elasticity.
$\sigma_{leontief}$: Leontief function.

cet: constant elasticity of transformation.
ski: skilled work.
unski: unskilled work.
sski: semi-skilled work.
H_1: quintile 1, H_2: quintile 2, H_3: quintile 3, H_4: quintile 4, H_5: quintile 5.

measure of migration, a labour supply function linked to the region's wages relative to those in the rest of the country is generated.

All this recreates an economic general equilibrium model in which prices are determined endogenously within the model and clear the markets for goods, inputs and factors of production.

The equations, variables and parameters of the proposed REGCGE model are presented in appendix 2. Once it has been ensured that the model can be solved by checking that it presents the same number of equations and variables, the next step is programming, which consists in codifying the new system of non-linear equations representing the model. Then, during the calibration stage, the value of the parameters of the behavioural equations is inferred from the SAM values and the values for the elasticities are determined. It is also necessary to programme the outputs or reports with the results to assess whether the model replicates this matrix in the baseline scenario. Lastly, the counterfactual scenarios are generated as simulations by changing the values of an exogenous variable or parameter.

III

Application to the Bío Bío region of Chile

1. Economic description of the Bío Bío region

Between 2003 and 2009, the Bío Bío region's share of national economic activity dropped from 9.5% to 8.7%. The average rate of regional GDP growth in the period was 2.5%, which was below the national average of 3.8%. Manufacturing industry is the main economic activity in the region, contributing 36.2% of regional GDP, i.e., more than a third, while nationally manufacturing contributes just 16.2% of GDP.

The fishing sector accounts for only a small share of regional GDP (averaging 2.7% between 2003 and 2008), but has the strongest backward linkages in the region, which means that some of the region's poor economic performance in recent years can be put down to the decline in fishing activity resulting from the scarcity of jack mackerel.[7]

Services and commerce account for 56.1% of employment in the region, industrial activity for 13.6% and fishing for just 1.6%.

From an international trade standpoint, economic activity in the region has a strong export base (in 2009, exports represented 38.3% of the Bío Bío region's GDP), the mainstays of which are wood, cellulose, the food industry, fishing, agriculture and petrochemicals.

[7] Activity in the fishing sector has declined, with negative growth rates of 11.1% in 2007 and 9.3% in 2008 (there are as yet no official figures for 2009 and 2010).

2. An application of the model to a regional shock: the jack mackerel crisis

Industrial fish catches in the Bío Bío region have fallen steadily over recent years. According to figures from the National Fisheries Service (SERNAPESCA), the catch was 1,600,132 tons in 2006, falling to just 1,100,690 tons in 2009 (preliminary figures for 2010 give a catch of 487,901 tons, a substantial drop on 2009, but this partly reflects the consequences of the earthquake of 27 February that year). The main species implicated in the decline is jack mackerel, catches of which fell by 45.4% between 2006 and 2009 (and by 83% between 2006 and 2010). The non-industrial catch has experienced substantial fluctuations, rising from 808,667 tons in 2006 to 948,470 tons in 2009 before dropping back to 596,676 tons in 2010, with the bulk of the catch consisting of sardines, while the jack mackerel catch represented just 1.7% of the total in 2009 and 4.8% in 2010.

In percentage terms, there has been an average annual decline of 11.8% in the total catch (industrial and non-industrial) and 16.3% in that of the industrial sector taken by itself (see tables 3 and 4).

The sector's export volumes have been heavily affected in all product categories (see table 5).

With the scarcity of jack mackerel, the current situation in the fishing industry is very difficult. The long-run sustainability of the activity has been compromised by over-exploitation of stocks, and this has led recently to a discussion of changes in the quota system. A brief historical summary will now be given to explain the situation.

TABLE 3

Bío Bío region: industrial fish catch, 2006-2010
(Tons)

Year	Total	Jack mackerel	Anchovy	Sardine	Atlantic mackerel	Hake	Hoki	Alfonsino	Other fish
2006	1 660 132	1 147 200	161 100	67 747	221 613	37 506	20 110	2 371	2 487
2007	1 564 794	1 062 622	157 986	82 401	210 677	30 473	16 595	2 629	1 412
2008	1 139 731	646 314	173 980	205 782	56 635	30 190	22 488	2 608	1 734
2009	1 100 690	626 806	154 418	219 153	46 175	27 766	24 897	1 108	367
2010	487 901	195 151	70 413	148 522	8 834	26 286	16 982	810	20 904

Source: National Fisheries Service (SERNAPESCA).

TABLE 4

Bío Bío region: non-industrial fish catch, 2006-2010
(Tons)

Year	Total	Sardine	Anchovy	Bacaladillo or mote	Atlantic menhaden	Jack mackerel	Pomfret	Pompano	Other fish
2006	808 667	288 918	185 404	283 793	21 678	16 495	1 809	7 344	3 227
2007	518 746	126 666	339 169	14 587	13 118	15 865	2 742	2 778	3 820
2008	740 586	485 249	163 452	52 733	17 112	8 045	3 137	4 667	6 191
2009	948 470	493 869	241 492	158 486	22 956	10 594	9 969	3 222	7 881
2010	596 676	386 719	121 440	29 445	6 408	28 513	9 233	1 957	12 961

Source: National Fisheries Service (SERNAPESCA).

TABLE 5

Bío Bío region: fishing sector exports, 2003-2010
(Tons)

Product	2003	2004	2005	2006	2007	2008	2009	2010
Tinned jack mackerel	72 258	86 770	99 722	88 477	87 225	50 023	48 629	22 832
Hake fillets	36 838	18 219	10 859	8 330	9 074	6 760	9 214	6 511
Fresh and frozen products	100 792	140 138	170 730	156 858	172 594	82 258	135 801	60 657
Fishmeal	307 886	259 537	289 016	264 583	250 485	222 281	358 194	142 184
Other (not otherwise specified)	40 375	38 274	31 145	18 187	12 002	29 372	33 705	17 872

Source: National Institute of Statistics (INE), Bío Bío region.

Fishing grew strongly in the first half of the 1990s, with catches reaching some 4 million tons a year. Activity then slowed in the second half of the decade, however, owing to rising sea temperatures caused by El Niño in 1997, which drove jack mackerel away from the coasts. Furthermore, fishing outside the exclusive economic zone by the Chilean, Russian and Chinese fleets (these latter two using factory ships) led to a substantial decline in biomass. In 1999, Chile established catch quotas to bring some order to the industry, but the current situation is so precarious that although a jack mackerel quota of over 1.3 million tons was authorized in 2010, just 224,000 tons were caught that year. To preserve stocks, the National Fishing Council approved a cut in the jack mackerel quota to just 315,000 tons in 2011.

The consequences of the jack mackerel crisis have been particularly serious in the Bío Bío region, as it accounts for 90% of the national catch.[8] Thus, the reduction in stocks has directly affected the productivity of the fishing industry. A priori, the expectation must be

[8] A report providing background can be seen at http://24horas.cl/videos.aspx?id=92311

that this would affect the rest of the region's economic system because of the close production linkages that exist with the food, chemical, metal-mechanical industries, among others, and because of the effects on employment and household incomes. Given these circumstances, the present study applies the REGCGE model, simulating a negative impact on the productivity of the fishing industry in order to identify the indirect economic effects of the jack mackerel crisis.

The following arguments can be made to justify treating the decline in jack mackerel productivity as a decline in the productivity of the fishing sector as a whole for modelling purposes.

In the Bío Bío region, jack mackerel, sardine and anchovy, all pelagic species, account for about 80% of the total industrial catch. Fishing grounds are "multi-species", so it can be concluded that the production structure of the industrial catch is similar. Furthermore, all three species are used mainly for the manufacture of fishmeal, suggesting that production linkages are similar in the region. Nonetheless, Peña, Basch and Vergara (2003) argue that there is a significant degree of production heterogeneity in the fleet in terms of differences in the fishing yields achieved by boats of different sizes and displacements.

Just one article was found in the published literature studying the 31% reduction in the walleye pollock allowable catch in Alaska and a 125% increase in fuel prices using the IMPLAN computable general equilibrium model (Waters and Seung, 2010). The application proposed in this document is novel, since it does not use an existing model, as the above-mentioned study does, but constructs the model it employs.

3. Calibrating the model with a SAM, Bío Bío region

The Bío Bío region SAM used to calibrate the regional CGE model has a sectoral disaggregation of 20 economic sectors: agriculture and forestry; fishing; mining; food, beverages and tobacco; textile, wearing apparel and leather; wood and furniture; cellulose and paper; petrochemical; production of non-metallic mineral products; basic metal; metal-mechanic; other industry; electricity, gas and water; construction; commerce, restaurants and hotels; transport; communications; financial services; services; and public administration. The labour factor is disaggregated into three occupational categories (skilled, semi-skilled and unskilled labour) and households are divided into income quintiles.

This matrix was updated by Mardones and Saavedra (2011) from the 1996 regional input-output matrix (see section II, point 1). The aggregate detail of this matrix can be seen in appendix 3.

4. Simulation results

The calibrated model replicates the baseline scenario for the Bío Bío region in 2006. Given the information about the overall decline in the jack mackerel catch (industrial and non-industrial) from 2006 to 2009 (2010 is excluded because of the effects of the February earthquake), catch volumes are projected as a trend over the medium term. The results project a cumulative drop of 40.8% for the region's total catch, with jack mackerel stocks being almost wholly depleted by 2012 (see table 6).

Lack of availability of fish stocks could thus be simulated as declining productivity in the sector, since with the same factors of production there is a smaller catch (or, alternatively, as an alarming decline in the size of the specimens caught, which is what is observed). To make the results more sensitive, reductions of 30%, 40% and 50% in the fishing sector's total factor productivity (relative to base year 2006) are considered.

Furthermore, given that a static CGE model is being used, scenarios with lower and higher elasticities are tried out in order to vary the reaction speed of resource reallocation with a view to assessing the temporary

TABLE 6

Bío Bío region: projected fish catch, 2006-2012
(Tons)

Year	2006	2007	2008	2009	2010 (p)	2011 (p)	2012 (p)
Total	2 468 799	2 083 540	1 880 317	2 049 160	1 754 919	1 608 705	1 462 491
Jack mackerel	1 163 695	1 078 487	654 359	637 400	382 732	182 431	1 264

Source: prepared by the author.

(p): projection.

effects of the shock over the shorter and longer term (see appendix 4).[9] For the shorter-term effect, specifically, use is made of lower elasticities between capital and labour (0.6); value added and aggregate intermediate inputs (0); elasticity of spending in the linear expenditure system (LES) demand system (0.6); and trade elasticities of 0.6 for primary sectors, 0.4 for industry and 0.3 for services. For the longer-term effect, use is made of larger elasticities between capital and labour (1.2); value added and aggregate intermediate inputs (0.4); elasticity of spending in the LES demand system (1.4); and trade elasticities of 1.8 for primary sectors, 1.2 for industry and 0.9 for services.

The main effects on the region's economy of a negative impact on fisheries productivity resulting from the jack mackerel crisis will now be described.

[9] Regarding this way of looking at the repercussions of a 40% decline in productivity, it should be pointed out that this does not actually happen all at once but is gradual, so it would be more accurate to divide the drop in productivity into annual declines and use a dynamic model to simulate it, since the static model will overstate the impact. One way of dealing with this problem is to allow greater long-term substitution with greater elasticities. However, this approach is only an approximation that does not include dynamic processes or capital accumulation (this footnote has been included in response to an anonymous referee who picked up strongly on this point).

Fishing activity is drastically curtailed by the shock, but while this was expected to impact sectors directly connected to this activity, such as the food and metal-mechanic, other sectors are even more affected, including other industry, construction, commerce, financial services, transport and communications, among others. These results may not seem very intuitive a priori, and they would be unlikely to be identified by a partial equilibrium analysis (the indirect link accounting for many of these effects will be identified in the following paragraphs). Conversely, activity in a few sectors increases, among them mining, cellulose, wood and chemicals. This reinforces the idea of the production structure of the Bío Bío region becoming increasingly specialized in the wood and cellulose industry as a result of the jack mackerel crisis (see table 7).

The decline in fishing activity leads to a marked reduction in fisheries exports both to the rest of the country and to the rest of the world. Because of relative price changes and resource reallocation, however, there is a rise in the exports of the wood, cellulose, chemicals, non-metallic mining, basic metal, metal-mechanics, and agriculture and forestry sectors, among others. The percentage changes in the volumes exported to the rest of the country and the rest of the world (see tables 8 and 9) are fairly small between the two regions, which

TABLE 7

Bío Bío region: sectoral activity level

Activity	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Agriculture and forestry	677.1	0.0	-0.2	-0.6	0.1	-0.1	-0.6	0.1	-0.1	-0.5
Fishing	548.0	-25.2	-32.2	-38.5	-24.2	-30.7	-36.5	-23.6	-29.8	-35.3
Mining	128.0	1.0	1.8	3.4	1.0	1.7	2.9	1.0	1.7	2.6
Food industry	921.5	-0.1	-0.3	-0.7	-0.1	-0.3	-0.7	-0.1	-0.3	-0.8
Textile industry	213.8	-0.1	-0.2	-0.5	-0.2	-0.3	-0.7	-0.2	-0.5	-0.8
Wood industry	992.3	0.4	0.8	1.4	0.7	1.1	1.7	0.9	1.4	2.1
Cellulose industry	784.5	0.3	0.6	1.0	0.5	0.8	1.3	0.7	1.1	1.6
Petrochemical industry	1 039.2	0.2	0.4	0.9	0.2	0.4	0.8	0.2	0.4	0.8
Non-metallic mineral industry	250.3	-0.3	-0.6	-1.0	-0.4	-0.7	-1.1	-0.4	-0.7	-1.2
Basic metal industry	417.4	-0.3	-0.3	-0.1	-0.4	-0.5	-0.5	-0.5	-0.6	-0.7
Metal-mechanic industry	283.0	-0.2	-0.4	-1.0	-0.3	-0.6	-1.2	-0.4	-0.8	-1.4
Other industry	80.5	-2.1	-2.8	-3.8	-2.1	-2.8	-3.7	-2.1	-2.8	-3.7
Electricity/gas/water	589.7	0.0	-0.1	-0.4	0.0	-0.2	-0.5	-0.1	-0.3	-0.6
Construction	921.5	-0.8	-1.7	-3.5	-1.0	-1.8	-3.2	-1.0	-1.8	-3.1
Commerce	1 234.1	-0.8	-1.3	-2.1	-0.9	-1.3	-2.1	-0.9	-1.4	-2.1
Transport	760.2	-0.6	-1.1	-1.9	-0.7	-1.1	-1.9	-0.7	-1.2	-1.8
Communications	288.1	-0.5	-1.0	-1.8	-0.6	-1.1	-1.9	-0.7	-1.2	-1.9
Financial services	788.4	-0.8	-1.3	-2.1	-0.9	-1.4	-2.1	-0.9	-1.4	-2.1
Services	1 251.7	-0.4	-0.8	-1.7	-0.5	-1.0	-1.8	-0.6	-1.1	-1.9
Public administration	402.2	0.0	-0.3	-1.2	-0.2	-0.6	-1.4	-0.3	-0.8	-1.6

Source: prepared by the author.

[a] Millions of pesos.

TABLE 8

Bío Bío region: volume of exports to the rest of the country

Activity	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Agriculture and forestry	61.0	0.575	1.057	2.038	0.600	0.933	1.427	0.616	0.881	1.203
Fishing	178.2	-44.943	-58.865	-72.425	-42.955	-55.653	-67.624	-41.656	-53.661	-64.841
Food industry	147.0	0.126	0.303	0.690	0.104	0.191	0.329	0.071	0.094	0.104
Textile industry	42.4	1.034	1.713	2.973	0.897	1.390	2.138	0.795	1.182	1.708
Wood industry	119.4	0.814	1.363	2.378	1.004	1.619	2.594	1.171	1.852	2.861
Cellulose industry	107.9	0.623	1.021	1.737	0.772	1.229	1.943	0.907	1.421	2.177
Petrochemical industry	415.2	0.758	1.270	2.223	0.810	1.319	2.134	0.842	1.351	2.112
Non-metallic mineral industry	35.8	1.046	1.776	3.158	0.853	1.367	2.172	0.730	1.127	1.688
Basic metal industry	141.1	1.138	1.975	3.596	0.938	1.606	2.728	0.793	1.357	2.244
Electricity/gas/water	110.8	1.034	1.878	3.557	0.975	1.636	2.732	0.907	1.453	2.276
Construction	41.9	0.370	0.412	0.339	0.169	0.048	-0.296	0.048	-0.150	-0.590
Commerce	34.2	-0.140	-0.210	-0.319	-0.269	-0.424	-0.675	-0.345	-0.541	-0.851
Financial services	34.5	0.116	0.275	0.620	-0.055	-0.020	0.061	-0.157	-0.192	-0.226
Services	35.2	0.954	1.667	3.013	0.716	1.145	1.807	0.548	0.816	1.174

Source: prepared by the author.

[a] Millions of pesos.

TABLE 9

Bío Bío region: volume of exports to the rest of the world

Activity	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Agriculture and forestry	33.5	0.577	1.059	2.038	0.600	0.932	1.427	0.615	0.880	1.202
Fishing	3.7	-44.952	-58.861	-72.422	-42.972	-55.657	-67.616	-41.662	-53.658	-64.847
Mining	2.3	2.418	4.188	7.599	2.372	3.881	6.425	2.284	3.707	5.862
Food industry	329.7	0.126	0.303	0.690	0.104	0.190	0.329	0.072	0.095	0.105
Textile industry	20.0	1.038	1.717	2.979	0.898	1.392	2.140	0.793	1.182	1.706
Wood industry	656.4	0.813	1.363	2.379	1.004	1.619	2.594	1.171	1.851	2.861
Cellulose industry	491.2	0.622	1.021	1.737	0.772	1.229	1.943	0.907	1.421	2.176
Petrochemical industry	267.6	0.758	1.270	2.223	0.810	1.319	2.134	0.843	1.351	2.113
Non-metallic mineral industry	11.2	1.041	1.776	3.158	0.852	1.372	2.179	0.726	1.130	1.694
Basic metal industry	9.6	1.141	1.968	3.591	0.932	1.602	2.722	0.796	1.361	2.241
Metal-mechanic industry	40.1	1.158	1.867	3.137	0.973	1.462	2.161	0.841	1.205	1.665
Other industry	4.7	-0.530	-0.361	0.361	-0.742	-0.742	-0.467	-0.849	-0.934	-0.870
Transport	9.4	0.638	1.053	1.808	0.437	0.660	0.990	0.309	0.448	0.618
Communications	4.1	0.758	1.222	2.103	0.514	0.783	1.149	0.367	0.514	0.660

Source: prepared by the author.

[a] Millions of pesos.

can be explained by the fact that relative interregional prices have not been altered in the modelling (even though it is possible to simulate different prices with the proposed model).

Imports from the rest of the country in all production sectors decline, mainly because of lower incomes. The largest percentage decline is seen in basic metal; other industry; wood; non-metallic mining; services; electricity, gas and water; textiles; chemicals; communications; and metal-mechanics. Imports from the rest of the world decline in all economic sectors except the fishing sector, although the base volume is so small that the sector's initial trade pattern remains unaffected. Differences in the percentage changes between imports from the rest of the country and the rest of the world are fairly small between the two regions, and this is owed, as in the case of exports, to the fact that relative interregional prices have been left unaltered in the modelling (see tables 10 and 11).

TABLE 10

Bío Bío region: volume of imports from the rest of the country

Activity	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Agriculture and forestry	40.8	-0.786	-1.834	-4.110	-0.814	-1.689	-3.293	-0.832	-1.624	-2.971
Mining	455.6	-0.384	-0.537	-0.738	-0.345	-0.463	-0.602	-0.319	-0.418	-0.529
Food industry	185.8	-0.892	-2.090	-4.695	-0.974	-2.059	-4.072	-1.042	-2.079	-3.865
Textile industry	103.5	-1.796	-3.149	-5.699	-1.772	-2.972	-4.942	-1.761	-2.889	-4.623
Wood industry	20.9	-2.420	-3.783	-6.089	-2.479	-3.781	-5.739	-2.538	-3.822	-5.651
Cellulose industry	41.9	-1.779	-2.668	-4.084	-1.833	-2.712	-3.978	-1.881	-2.766	-3.985
Petrochemical industry	279.8	-2.163	-3.295	-5.141	-2.146	-3.204	-4.743	-2.136	-3.155	-4.568
Non-metallic mineral industry	11.5	-2.215	-3.753	-6.594	-2.112	-3.451	-5.598	-2.052	-3.278	-5.139
Basic metal industry	23.4	-3.166	-4.765	-7.333	-3.052	-4.518	-6.625	-2.975	-4.365	-6.263
Metal-mechanic industry	427.6	-1.586	-2.816	-5.172	-1.583	-2.691	-4.534	-1.584	-2.629	-4.263
Other industry	17.8	-3.342	-4.875	-7.200	-3.173	-4.543	-6.402	-3.072	-4.358	-6.020
Electricity/gas/water	3.3	-1.595	-3.037	-6.012	-1.628	-2.918	-5.190	-1.629	-2.859	-4.857
Commerce	114.7	-1.514	-2.432	-4.039	-1.462	-2.285	-3.556	-1.436	-2.213	-3.352
Transport	179.9	-1.906	-3.209	-5.574	-1.786	-2.895	-4.652	-1.712	-2.720	-4.225
Communications	48.0	-1.809	-3.160	-5.707	-1.747	-2.921	-4.847	-1.718	-2.805	-4.481
Financial services	159.4	-1.887	-3.010	-4.948	-1.791	-2.778	-4.284	-1.734	-2.650	-3.973
Services	18.3	-1.858	-3.443	-6.537	-1.793	-3.165	-5.478	-1.761	-3.024	-5.019
Public administration	3.1	-0.353	-0.962	-2.342	-0.481	-1.123	-2.278	-0.610	-1.219	-2.342

Source: prepared by the author.

[a] Millions of pesos.

TABLE 11

Bío Bío region: volume of imports from the rest of the world

Activity	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Agriculture and forestry	19.5	-0.790	-1.836	-4.112	-0.816	-1.689	-3.295	-0.832	-1.628	-2.974
Mining	2.8	-0.353	-0.529	-0.705	-0.318	-0.459	-0.600	20.683	36.053	61.101
Fishing	1.1	24.383	46.584	92.315	22.106	39.753	70.778	-0.318	-0.388	-0.529
Food industry	15.6	-0.888	-2.089	-4.694	-0.972	-2.059	-4.073	-1.043	-2.080	-3.865
Textile industry	29.0	-1.796	-3.148	-5.699	-1.773	-2.973	-4.942	-1.759	-2.887	-4.622
Wood industry	8.1	-2.416	-3.777	-6.082	-2.467	-3.780	-5.731	-2.529	-3.819	-5.648
Cellulose industry	8.1	-1.776	-2.676	-4.082	-1.826	-2.715	-3.973	-1.889	-2.777	-3.987
Petrochemical industry	49.1	-2.162	-3.294	-5.141	-2.146	-3.205	-4.744	-2.136	-3.154	-4.567
Non-metallic mineral industry	8.5	-2.220	-3.754	-6.600	-2.115	-3.461	-5.611	-2.056	-3.285	-5.141
Basic metal industry	46.6	-3.165	-4.766	-7.334	-3.054	-4.518	-6.623	-2.975	-4.362	-6.260
Metal-mechanic industry	131.8	-1.586	-2.816	-5.172	-1.582	-2.691	-4.534	-1.584	-2.629	-4.263
Other industry	5.7	-3.341	-4.873	-7.205	-3.167	-4.542	-6.404	-3.080	-4.368	-6.022
Electricity/gas/water	5.1	-1.570	-3.042	-6.024	-1.631	-2.927	-5.206	-1.652	-2.871	-4.856
Commerce	147.6	-1.514	-2.433	-4.039	-1.461	-2.284	-3.555	-1.435	-2.213	-3.351
Transport	4.5	-1.910	-3.221	-5.575	-1.798	-2.908	-4.661	-1.731	-2.729	-4.238
Communications	11.4	-1.815	-3.165	-5.707	-1.745	-2.920	-4.840	-1.719	-2.806	-4.481

Source: prepared by the author.

[a] Millions of pesos.

Given that the region has a fixed exchange rate with the rest of the country (the peso) and a fixed exchange rate with the rest of the world (the peso multiplied by the foreign currency), current account balances with both zones are endogenous. In the baseline scenario, exports to the rest of the world are greater than imports from the rest of the world, the result being a build-up of reserves (although these resources are subsequently transferred to the rest of the country). Exports to the rest of the country are lower than imports from the rest of the country, which means that the region has a negative current account balance.

The simulations show the surplus with the rest of the world and the deficit with the rest of the country becoming larger. The former is due to a small increase in exports and a drastic decline in imports from the rest of the world. The latter is explained by a drastic fall in exports and a smaller drop in imports from the rest of the country (see table 12).

The decline in fishing activity affects the labour market. Because the model assumes perfect labour mobility, the excess supply of labour is reallocated to the remaining production sectors, with activity there increasing, but results in a drop in the price of factors of production to rebalance the factor market. The most pronounced drop in factor income is seen at the more highly skilled levels (see table 13).

Since payment to factors of production flows to the households that possess these factors, we can see that the shock caused by the fishing crisis is progressive, i.e., it affects in greater proportion the families with the greatest income levels, basically because these families have the most skilled labor and capital (see table 14).

The decline in the consumption of the households is proportionally greater in families with greater incomes, which accounts for the somewhat counter-intuitive

TABLE 12

Bío Bío region: current account balance

	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Rest of world	1 444.3	1.2	2.1	3.8	1.5	2.4	3.7	1.7	2.6	3.9
Rest of country	-2 802.8	1.4	1.3	0.4	1.3	1.2	0.6	1.2	1.2	0.6

Source: prepared by the author.

[a] Millions of pesos.

TABLE 13

Bío Bío region: factor income

	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Capital	3 179.8	-1.6	-2.7	-4.4	-1.6	-2.6	-4.0	-1.7	-2.5	-3.8
Unskilled	857.3	-1.2	-1.9	-3.2	-1.0	-1.6	-2.4	-0.8	-1.4	-2.1
Semi-skilled	629.6	-2.2	-3.7	-6.5	-1.8	-3.1	-5.1	-1.5	-2.7	-4.3
Skilled	572.8	-2.7	-4.8	-8.7	-2.3	-4.0	-6.8	-2.0	-3.5	-5.8

Source: prepared by the author.

[a] Millions of pesos.

TABLE 14

Bío Bío region: household income

Households	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Quintile 1	185.2	-0.5	-1.3	-3.4	-0.4	-1.2	-2.7	-0.5	-1.2	-2.5
Quintile 2	349.2	-1.6	-2.8	-5.0	-1.4	-2.4	-4.0	-1.3	-2.2	-3.5
Quintile 3	462.7	-2.5	-4.1	-7.0	-2.3	-3.7	-5.8	-2.1	-3.4	-5.2
Quintile 4	646.3	-3.0	-4.9	-8.4	-2.8	-4.5	-7.1	-2.7	-4.2	-6.5
Quintile 5	1 398.1	-3.1	-5.3	-9.1	-2.9	-4.7	-7.6	-2.8	-4.4	-6.9

Source: prepared by the author.

[a] Millions of pesos.

results of the changes in sectoral activity (see table 7): because the income of families with higher purchasing power falls, so does their consumption in sectors such as construction (real estate), services, commerce and financial services. Although the income of the poorer quintiles also contracts, their consumption of goods and services in these sectors has less of an impact (see table 15).

The macroeconomic effects at the regional level (in constant pesos) reveal a drop in GDP of between 0.8% and 2.0%, depending on the elasticities used and the scale of the shock. Each of the individual components of GDP is lower, except for exports to the rest of the world, owing to the change in the production structure resulting in a greater concentration on the wood and cellulose industry. Private consumption contracts by between 0.6% and 3.5%, investment falls by between 0.8% and 4.5%, government spending without countercyclical and pro-employment policies changes by between 0.1% and -1.5%, the volume of aggregate exports is down by between 1.4% and 2.1%, and imports are between 1.5% and 4.3% lower. The rise in exports to the rest of the world (of between 0.6% and 2.0%) is not enough to offset the decline in exports to the rest of the country (of between 4.3% and 6.7%), and the fall in imports from the rest of the world (of between 1.7% and 4.8%) is even greater than the fall in imports from the rest of the country (of between 1.4% and 4.2%) (see table 16).

In addition to simulating the repercussions of the impact on the fishing sector, it is important to evaluate some type of economic policy designed to mitigate the social impact of the jack mackerel crisis. One of the options that have been discussed is to auction fishing quotas to improve efficiency, as this would offset the

TABLE 15

Bío Bío region: household consumption

Households	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Quintile 1	327.9	3.6	3.1	-0.2	2.6	2.1	-0.4	1.9	1.3	-1.0
Quintile 2	450.4	1.3	0.4	-2.7	0.8	0.0	-2.3	0.5	-0.4	-2.4
Quintile 3	508.4	-0.8	-2.3	-5.7	-1.0	-2.3	-4.9	-1.1	-2.4	-4.6
Quintile 4	659.0	-2.2	-4.2	-7.8	-2.2	-3.9	-6.7	-2.2	-3.8	-6.2
Quintile 5	1 074.6	-4.3	-6.6	-10.0	-3.8	-5.7	-8.2	-3.5	-5.1	-7.3

Source: prepared by the author.

[a] Millions of pesos.

TABLE 16

Bío Bío region: macroregional effects

	Baseline scenario[a]	Low elasticities *(percentages)*			Medium elasticities *(percentages)*			High elasticities *(percentages)*		
		Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50	Fish 30	Fish 40	Fish 50
Absorption	5 064.3	-0.5	-1.4	-3.2	-0.7	-1.5	-3.0	-0.8	-1.5	-2.9
Consumption	3 006.9	-0.6	-1.6	-3.5	-0.7	-1.6	-3.1	-0.8	-1.6	-3.0
Investment	1 076.1	-0.8	-2.0	-4.5	-1.0	-2.0	-4.0	-1.1	-2.1	-3.9
Government consumption	918.8	0.1	-0.2	-1.1	-0.1	-0.5	-1.3	-0.3	-0.7	-1.5
Exports	3 385.6	-1.8	-2.1	-2.0	-1.6	-1.8	-1.8	-1.4	-1.6	-1.6
Imports	-2 573.2	-1.5	-2.5	-4.3	-1.5	-2.4	-3.8	-1.5	-2.3	-3.6
Exports to rest of world	1 881.6	0.6	1.0	1.8	0.8	1.2	1.9	0.9	1.4	2.0
Exports to rest of country	1 504.0	-4.7	-5.9	-6.7	-4.4	-5.6	-6.4	-4.3	-5.4	-6.2
Imports from rest of world	-437.3	-1.7	-2.8	-4.8	-1.7	-2.7	-4.3	-1.7	-2.7	-4.1
Imports from rest of country	-2 135.9	-1.4	-2.4	-4.2	-1.4	-2.3	-3.7	-1.4	-2.3	-3.5
Regional GDP	5 876.7	-0.8	-1.3	-2.0	-0.8	-1.3	-1.9	-0.8	-1.2	-1.8

Source: prepared by the author.
GDP: gross domestic product.

[a] Millions of pesos.

decline in productivity, while in the case of fishing sector workers, it has been suggested that they should be given occupational training and early retirement. If a short-term approach is taken, early retirement looks like an attractive way of dealing rapidly with the social problem; this economic policy can be modelled as a direct income transfer to fisheries workers. In the REGCGE model, however, it is not possible to allocate this targeted transfer only to workers in the fisheries sector; rather, it has to be included as an average transfer to all households by income quintile. An alternative adopted in the literature is to use a microsimulation methodology to analyse the effects using data disaggregated at the household level.

Specifically, with non-parametric microsimulations (see Ganuza and others, 2005) it is assumed that changes in the demand for labour and the remuneration of the different types of labour generated by the REGCGE model can be passed through to microdata, using a household survey with a random selection of individuals who change economic sector and remuneration as projected by the REGCGE model. Thus, it is possible to determine the disaggregated effects on pay and income, and thence on poverty and income distribution.

Table 17 presents the results of the household inequality and poverty microsimulations under different scenarios. The baseline scenario uses data for the Bío Bío region from the CASEN 2006 survey (this survey year is taken for the sake of consistency with the SAM used). The Fish 30, Fish 40 and Fish 50 scenarios represent the impact on the baseline scenario given the labour market changes generated by the REGCGE model. To avoid presenting too many scenarios, only Fish 30 is considered with low elasticities, Fish 40 with medium elasticities and Fish 50 with high elasticities. Also considered are policy scenarios involving direct transfers to fishery workers in the three poorest quintiles in the form of early retirement with between 20% and 100% of the income they originally received before the impact on the fishing industry.

Setting out from these results, it can be concluded that poverty increases by between 0.49 and 1.01 percentage points, depending on the depth of the impact the fishing crisis has on productivity, while inequality as measured by the Gini coefficient is unchanged. Early retirement policies would improve poverty and inequality indicators, but only marginally; the greatest impact arises with an early retirement pension of 100%, as a result of this being targeted only on fishery workers from the three poorest quintiles, but again the medium- and long-run effects on the pressures affecting the whole labour market are not reflected in it.

TABLE 17

Bío Bío region: results of microsimulations

Scenario	Poverty *(percentages)*	Gini coefficient for household income
Baseline	20.68	0.5488
Fish 30	21.17	0.5488
Fish 30 subsidy of 20%	21.15	0.5487
Fish 30 subsidy of 40%	21.13	0.5486
Fish 30 subsidy of 60%	21.11	0.5486
Fish 30 subsidy of 80%	21.10	0.5485
Fish 30 subsidy of 100%	21.10	0.5485
Fish 40	21.38	0.5492
Fish 40 subsidy of 20%	21.36	0.5491
Fish 40 subsidy of 40%	21.35	0.5490
Fish 40 subsidy of 60%	21.32	0.5489
Fish 40 subsidy of 80%	21.31	0.5489
Fish 40 subsidy of 100%	21.31	0.5488
Fish 50	21.69	0.5488
Fish 50 subsidy of 20%	21.67	0.5487
Fish 50 subsidy of 40%	21.66	0.5486
Fish 50 subsidy of 60%	21.63	0.5485
Fish 50 subsidy of 80%	21.63	0.5485
Fish 50 subsidy of 100%	21.62	0.5485

Source: prepared by the author.

IV
Conclusions

A regional computable general equilibrium model is developed. This is called the REGCGE model and is standardized for the data available from regional input-output matrices in Chile. Its purpose is to analyse policies or economic impacts that are particularly relevant when dealing with regional problems. Although this study does not extend the modelling knowledge frontier, it may serve socially useful purposes in a country like Chile where little research has been done on regional problems.

To illustrate its potential and benefits, an application is generated for the Bío Bío region, given the availability of a SAM updated to 2006 using indirect methods. Specifically, it simulates the effects of the scarcity of fish stocks (the so-called jack mackerel crisis), modelling this as declining productivity in the fishing sector.

The study reveals increased specialization of the Bío Bío region production structure in the wood and cellulose industry in the wake of the fishing crisis.

The negative impact is also felt in the labour market, disproportionately affecting the remuneration of more highly skilled labour, so that the incomes of families at higher socio-economic levels are the most affected by the fish stocks crisis. This comes out particularly strongly in the demand for products consumed by these families, such as construction, services, trade and financial services. Other families' consumption is affected, but proportionally less.

This general equilibrium analysis made it possible to identify unforeseen indirect effects. It was even possible to determine that sectors with limited production linkages to the fishing industry would be strongly affected by the drop in incomes in the wealthiest quintiles.

Because of the above, it can be concluded that this regional CGE model has a significant contribution to make as a tool for the analysis of regional economic policies and shocks in Chile.

Lastly, there is an analysis of economic policies designed to moderate the short-term social repercussions of the fishing crisis using the non-parametric microsimulations methodology.

(Original: Spanish)

APPENDIX 1

regcge model equations

Mathematical representation for a region given that it trades with two major regions, *r*, rest of country and rest of world. A total of *c* goods are marketed in the economy, produced in *a* sectors using *f* production sectors and generating income for *h* families, which also receive transfers from *i* institutions, from other families or from the government, *gov*.

Price equations:

$$PM_c = \sum_{r \in R} \left(\beta^r_{c',c} \cdot PMR_{c,r}^{\,1-\sigma^m_c} \right)^{\frac{1}{1-\sigma^m_c}} + \sum_{c' \in C} \left(PQ_{c'} \cdot icm_{c',c} \right) \tag{1}$$

$$PE_c = \sum_{r \in R} \left(\alpha^r_{c',c} \cdot PER_{c,r}^{\,1-\sigma^x_c} \right)^{\frac{1}{1-\sigma^x_c}} - \sum_{c' \in C} \left(PQ_{c'} \cdot ice_{c',c} \right) \tag{2}$$

$$PMR_{c,r} = pwm_{c,r} \cdot \left(1 + tm_{c,r}\right) \cdot EXR_r \tag{3}$$

$$PER_{c,r} = pwe_{c,r} \cdot \left(1 - te_{c,r}\right) \cdot EXR_r \tag{4}$$

$$PDD_c = PDS_c + \sum_{c' \in C} \left(PQ_{c'} \cdot icd_{c',c} \right) \tag{5}$$

$$PQ_c \cdot \left(1 - tq_c\right) \cdot QQ_c = PDD_c \cdot QD_c + PM_c \cdot QM_c \tag{6}$$

$$PX_c \cdot QX_c = PDS_c \cdot QD_c + PE_c \cdot QE_c \tag{7}$$

$$PA_a = \sum_{c \in C} PXAC_{a,c} \cdot \theta_{a,c} \tag{8}$$

$$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{a,c} \tag{9}$$

$$PA_a \cdot \left(1 - ta_a\right) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a \tag{10}$$

$$CPI = \sum_{c \in C} PQ_c \cdot cwts_c \tag{11}$$

$$\overline{DPI} = \sum_{c \in C} PDS_c \cdot dwts_c \tag{12}$$

Production and marketing equations:

$$QA_a = \alpha^a_a \cdot \left(\delta^a_a \cdot QVA_a^{-\rho^a_a} + (1 - \delta^a_a) \cdot QINTA_a^{-\rho^a_a} \right)^{-\frac{1}{\rho^a_a}} \tag{13}$$

$$\frac{QVA_a}{QINTA_a} = \left(\frac{PINTA_a}{PVA_a} \cdot \frac{\delta^a_a}{1 - \delta^a_a} \right)^{\frac{1}{1+\rho^a_a}} \tag{14}$$

$$QVA_a = iva_a \cdot QA_a \tag{15}$$

$$QINTA_a = inta_a \cdot QA_a \tag{16}$$

$$QVA_a = \alpha_a^{va} \cdot \left(\sum_{f \in F} \delta_{f,a}^{va} \cdot QF_{f,a}^{-\rho_a^{va}} \right)^{-\frac{1}{\rho_a^{va}}} \quad (17)$$

$$WF_f \cdot \overline{WFDIST}_{f,a} = PVA_{a,} \cdot (1 - tva_a) \cdot QVA_a \cdot \left(\sum_{f \in F} \delta_{f,a}^{va} \cdot QF_{f,a}^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{f,a}^{va} \cdot QF_{f,a}^{-\rho_a^{va}-1} \cdot \left(\sum_{f' \in F} \delta_{f,a}^{va} \cdot QF_{f,a}^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{f,a}^{va} \cdot QF_{f,a}^{-\rho_a^{va}-1} \quad (18)$$

$$QINT_{c,a} = ica_{c,a} \cdot QINTA_a \quad (19)$$

$$QXAC_{a,c} + \sum_{h \in H} QHA_{a,c,h} = \theta_{c,a} \cdot QA_a \quad (20)$$

$$QX_c = \alpha_c^{ac} \cdot \left(\sum_{a \in A} \delta_{a,c}^{ac} \cdot QXAC_{a,c}^{-\rho_c^{ac}} \right)^{-\frac{1}{\rho_c^{ac}-1}} \quad (21)$$

$$\frac{PXAC_{a,c}}{PX_c} = QX_c \cdot \sum_{a' \in A} \left(\delta_{a',c}^{a,c} \cdot QXAC_{a',c}^{-\rho_c^{a,c}} \right)^{-1} \cdot \delta_{a',c}^{a,c} \cdot QXAC_{a,c}^{-\rho_c^{a,c}-1} \quad (22)$$

$$QX_c = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + (1 - \delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}} \quad (23)$$

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1 - \delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}} \quad (24)$$

$$QX_c = QD_c + QE_c \quad (25)$$

$$QQ_c = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_c^{-\rho_c^q} + (1 - \delta_c^q) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}} \quad (26)$$

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1 - \delta_c^q} \right)^{\frac{1}{1+\rho_c^q}} \quad (27)$$

$$QQ_c = QD_c + QM_c \quad (28)$$

$$QT_c = \sum_{c' \in C'} \left(icm_{c,c'} \cdot QM_{c'} + ice_{c,c'} \cdot QE_{c'} + icd_{c,c'} \cdot QD_{c'} \right) \quad (29)$$

$$QMR_{c,r} = \beta_{c,r'} \cdot \left(PM_{c'} / PMR_{c,r'} \right)^{\sigma_r^m} \cdot QM_{c'} \quad (30)$$

$$QER_{c,r} = \alpha_{c',c}^r \cdot \left(PE_{c'} / PER_{c,r'} \right)^{\sigma_r^x} \cdot QE_{c'} \quad (31)$$

Equations of flows between institutions:

$$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{f,a} \cdot QF_{f,a} \quad (32)$$

$$YIF_{i,f} = shif_{i,f} \cdot \left[\left(1 - tf_f \right) \cdot YF_f - \sum_{r \in R} trnsfr_{r,f} \cdot EXP_r \right] \quad (33)$$

$$TRII_{i,i'} = shii_{i,i'} \cdot (1 - MPS_{i'}) \cdot (1 - TINS_{i'}) \cdot YI_{i'} \quad (34)$$

$$YI_i = \sum_{f \in F} YIF_{i,f} + \sum_{i' \in INSDNG'} TRII_{i,i'} + trnsfr_{i,gov} \cdot CPI + \sum_{r \in R} trnsfr_{i,r} \cdot EXR_r \quad (35)$$

$$TINS_i = \overline{tins_i} \cdot \left(1 + \overline{TINSADJ} \cdot tins01_i\right) + \overline{DTINS} \cdot tins01_i \quad (36)$$

$$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{i,h}\right) \cdot \left(1 - MPS_h\right) \cdot (1 - TINS_h) \cdot YI_h \quad (37)$$

$$PQ_c \cdot QH_{c,h} = PQ_c \cdot \gamma^m_{c,h} + \beta^m_{c,h} \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c',h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{a,c'} \cdot \gamma^h_{a,c',h}\right) \quad (38)$$

$$PXAC_{a,c} \cdot QHA_{a,c,h} = PXAC_{a,c} \cdot \gamma^h_{a,c,h} + \beta^h_{a,c,h} \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c',h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{a,c'} \cdot \gamma^h_{a,c',h}\right) \quad (39)$$

$$QINV_c = \overline{IADJ} \cdot \overline{qinv_c} \quad (40)$$

$$QG_c = \overline{GADJ} \cdot \overline{qg_c} \quad (41)$$

$$YG = \sum_{i \in INSDNG} TINS_i \cdot YI_i + \sum_{f \in F} tf_f \cdot YF_f + \sum_{a \in A} ta_a \cdot PA_a \cdot Q_a + \sum_{a \in A} tva_a \cdot PVA_a \cdot QVA_a + \sum_{r \in R} \sum_{c \in CM} tm_{c,r} \cdot pwm_{c,r} \cdot QMR_{c,r} \cdot EXR_r + \sum_{r \in R} \sum_{c \in CE} te_{c,r} \cdot pwe_{c,r} \cdot QER_{c,r} \cdot EXR_r + \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YIF_{gov,f} + \sum_{r \in R} trnsfr_{gov,r} \cdot EXR_r \quad (42)$$

$$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNH} trnsfr_{i,\,gov} \cdot CPI \quad (43)$$

Constraint equations:

$$QFS_f = qfs0_f \cdot \left[\sum_{a \in A} \frac{(WF_f \cdot WFDIST_{f,a} \cdot QF_{f,a}) / (QFS_f \cdot CPI)}{wfcountry0_f / cpicountry0}\right]^{etlas_f} \quad (44)$$

$$\sum_{a \in A} QF_{f,a} = QFS_f \qquad \sum_{a \in A} QF_{f,a} = QFS_f \quad (45)$$

$$QQ_c = \sum_{a \in A} QINT_{c,a} + \sum_{h \in H} QH_{c,h} + QG + QINV_c + qdst_c + QT_c \quad (46)$$

$$\sum_{c \in CM} pwm_{c,r} \cdot QMR_{c,r} + \sum_{f \in F} trnsfr_{r,f} = \sum_{c \in CE} pwe_{c,r} \cdot QER_{c,r} + \sum_{i \in INSD} trnsfr_{i,r} + FSAV_r \quad (47)$$

$$GSAV = YG - EG \quad (48)$$

$$MPS_i = \overline{mps_i} \cdot \left(1 + \overline{MPSADJ} \cdot mps01_i\right) + DMPS \cdot mps01_i \quad (49)$$

$$\sum_{i \in INSDNG} MPS_i (1 - TINS_i) \cdot YI_i + GSAV + \sum_{r \in R} EXR_r \cdot FSAV_r = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c + WALRAS \quad (50)$$

$$TABS = \sum_{h \in H} \sum_{c \in C} PQ_c \cdot QH_{c,h} + \sum_{a \in A} \sum_{h \in H} \sum_{c \in C} PXAC_{a,c} \cdot QHA_{a,c,h} + \sum_{c \in C} PQ_c \cdot QG_c + \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \quad (51)$$

$$INVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \quad (52)$$

$$GOVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QG_c \quad (53)$$

Technical note 1: To transform the standard CGE model of Löfgren, Harris and Robinson (2001) into a regional one, changes have been made to equations (1), (2), (3), (4), (33), (35), (42), (47) and (50) and equations (30), (31) and (44) have been included.

APPENDIX 2

regcge model variables

CPI	regional consumer price index
DPI	regional producer price index
DMPS	change in marginal propensity to save
DTINS	change in tax rate
EG	total government expenditure
EH_h	household consumption expenditure
EXR_r	exchange rate in external region *r* (rest of country and rest of world)
$FSAV_r$	external saving in external region *r*
GADJ	government demand adjustment factor
GOVSHR	ratio of government consumption to absorption
GSAV	government saving
IADJ	investment scaling factor
INVSHR	ratio of investment to absorption
MPS_i	marginal propensity to save for non-governmental domestic institutions
MPSADJ	scaling factor for saving rate
PA_a	activity product price for *a*
PDD_c	demand price for commodity *c* produced and sold domestically
PDS_c	supply price for commodity *c* produced and sold domestically
$PER_{c,r}$	export price for commodity *c* by destination region (rest of country and rest of world)
$PINTA_a$	aggregate intermediate input price
$PMR_{c,r}$	export price for commodity *c* by region of origin (rest of country and rest of world)
PM_c	composite price of imports of commodity *c*
PE_c	composite price of exports of commodity *c*
PQ_c	composite price of commodity *c*
PVA_a	price of value added
$PWE_{c,r}$	price of exports by region of destination (rest of country and rest of world)
$PWM_{c,r}$	price of imports by region of destination (rest of country and rest of world)
PX_c	average price of commodity *c*
$PXAC_{a,c}$	price of commodity *c* from activity *a*
QA_a	activity level in the region
QD_c	quantity of sales in the region
$QER_{c,r}$	quantity of exports to each region of destination (rest of country and rest of world)
$QMR_{c,r}$	quantity of imports from each region of origin (rest of country and rest of world)
QE_c	quantity of exports of commodity *c*
QM_c	quantity of imports of commodity *c*
$QF_{f,a}$	quantity of factor *f* demanded by activity *a*
QFS_f	quantity of factor *f* supplied
QG_c	quantity of government consumption
$QH_{c,h}$	quantity of marketed commodity *c* consumed by family *h*
$QHA_{a,c,h}$	quantity of domestic commodity *c* consumed by family *h*
$QINT_{c,a}$	quantity of intermediate demand for commodity *c* from activity *a*
$QINTA_a$	quantity of aggregate intermediate input
$QINV_c$	quantity of investment demand
QQ_c	quantity of composite commodity supply
QT_c	quantity of transport and marketing demanded by commodity *c*
QVA_a	quantity of value added
QX_c	aggregated marketed quantity of commodity
$QXAC_{a,c}$	quantity of output of commodity *c* from activity *a*
TABS	total absorption
$TINS_i$	direct tax rate on institution *i*
TINSADJ	direct tax scaling factor
$TRII_{i,i'}$	transfers to institution *i* from institution *i'*
WALRAS	saving-investment imbalance (should be zero in equilibrium)
WF_f	wage for factor *f*
$WFDIST_{f,a}$	wage distortion factor in activity *a*
YF_f	income of factor *f*
YG	government income
$YIF_{i,f}$	income of institution *i* from factor *f*
YI_i	income of institution *i*

Technical note 2: To transform the standard CGE model of Löfgren, Harris and Robinson (2001) into a regional one, the following variables have been introduced: EXR_r, $FSAV_r$, $PER_{c,r}$, $PMR_{c,r}$, $PWE_{c,r}$, $PWM_{c,r}$, $QER_{c,r}$, $QMR_{c,r}$.

APPENDIX 3

Aggregate social accounting matrix for the Bío Bío region
(Base year: 2006)

	ACT	PROD	CSTTR	CAP	LAB	HOUSE	GOV	DITAX	ACTAX	VATAX	IMTAX	ROW	ROC	S-I	DSTCK	TOTAL
ACT		12 532.9														12 532.9
PROD	6 668.1		853.2			3 019.6	911.6					1 881.7	1 504.0	1 078.6	62.5	15 979.4
CSTTR		853.2														853.2
CAP	3 191.0															3 191.0
LAB	2 083.3															2 083.3
HOUSE				755.4	2 083.3	366.4	8.6									3 213.7
GOV				264.7				112.9	101.8	488.7	13.7					981.7
DITAX						112.9										112.9
ACTAX	101.8															101.8
VATAX	488.7															488.7
IMTAX		13.7														13.7
ROW		470.1														470.1
ROC		2 109.4		2 170.9												4 280.3
S-I						-285.2	61.6					-1 411.6	2 776.3			1 141.1
DSTCK														62.5		62.5
Total	*12 532.9*	*15 979.4*	*853.2*	*3 191.0*	*2 083.3*	*3 213.7*	*981.7*	*112.9*	*101.8*	*488.7*	*13.7*	*470.1*	*4 280.3*	*1 141.1*	*62.5*	*45 506.3*

Source: C. Mardones and J. Saavedra, "Matriz de contabilidad social extendida ambientalmente para análisis económico de la Región del Bío Bío", *Revista de análisis económico*, vol. 26, No. 1, 2011.

Nomenclature:
ACT production activity; PROD products; CSTTR transaction cost; CAP capital; LAB labour; HOUSE households; GOV government; DITAX income tax; ACTAX activity tax; VATAX value added tax; IMTAX import tax; ROW rest of world; ROC rest of country; S-I saving-investment balance; DSTCK change in stock.

APPENDIX 4

Calibration of model elasticities

The elasticities used to calibrate the model are taken from the literature. The elasticity between capital and labour is 0.9 (Claro, 2003); the elasticity between value added and the aggregate intermediate input is 0 (Leontief function); the elasticity of spending in the system of demand (LES) is 1.0 and the Frisch parameter is –2.4 (Nganou, 2004); the constant elasticity of transformation (CET) of the function that divides domestic production from exports and the Armington elasticity of domestic production and imports is 1.2 for primary sectors, 0.8 for industry and 0.6 for services (Jung and Thorbecke, 2003); these last values are also used to divide exports and imports between the rest of the country and the rest of the world.

To increase the sensitivity of the results, different values are considered for parameters and elasticities that might generate a substantial impact.

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The economics of demand-led growth. Theory and evidence for Brazil

José Luís Oreiro, Luciano Nakabashi, Guilherme Jonas Costa da Silva and Gustavo José Guimarães e Souza

ABSTRACT

This article describes the theory of demand-led growth and provides evidence that a demand-led growth regime exists in the Brazilian economy. Based on the methodology developed by Atesoglu (2002), econometric tests of this hypothesis show that almost 85% of the growth rate of real gdp in the period 1990-2005 is explained by demand-side variables, mainly exports and government consumption. As the current fiscal crisis rules out fiscal expansion, Brazil's only option is to adopt an export-led growth model. The article also shows that the maintenance of undervalued real exchange rate is a major determinant of export growth in developing countries such as Brazil.

KEYWORDS

Economic growth, development models, supply and demand, exchange rates, exports, econometric models, macroeconomics, Brazil

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AUTHORS

José Luís Oreiro, Associate Professor of Economics at the University of Brasília and Researcher at the National Council for Scientific and Technological Development. joreiro@unb.br

Luciano Nakabashi, Associate Professor of Economics at the University of São Paulo, FEA-RP/USP and Researcher at the National Council on Scientific and Technological Development. luciano.nakabashi@gmail.com

Guilherme Jonas Costa da Silva, Associate Professor of Economics at Universidade Federal de Uberlândia (UFU). guilhermejonas@yahoo.com.br

Gustavo José Guimarães e Souza, PhD Candidate at the University of Brasilia and Professor at the Catholic University of Brasilia. gustavojgs@gmail.com

I
Introduction

Over the last 25 years, the Brazilian economy has grown at an average rate of 2.6% per year —considerably less than in the period 1950-1980 and lower than average growth rates in other emerging economies such as Russia, India and China. As Brazil's population is growing by nearly 1.5% per year, GDP per-capita is rising by almost 1% annually. At this rate, it will take nearly 70 years for per-capita GDP to reach the current levels of Spain or Portugal. In this respect, the Brazilian economy is now in a situation of near-stagnation.

In the late 1980s and early 1990s, this situation was seen as the result of the persistent high inflation prevailing in the Brazilian economy. In March 1990, the last month of President Sarney's term of office, this developed into hyperinflation as prices rose at a monthly rate of 72%. Annual inflation rates were brought down to below 10% by the successful implementation of Real Plan during President Fernando Henrique Cardoso's first term. This process involved anchoring inflation on the exchange rate, under the crawling-peg exchange rate regime implemented from 1995 to 1998.

Stabilization was not followed by a sustained acceleration of growth, however. The faster growth recorded in the first two years of Real Plan —with average rates of almost 5% per year— was brought to an end due to contagion from the external crises in Mexico, East Asia and Russia.

In early 1999, following a massive loss of international reserves caused by a sudden stop in capital flows to the Brazilian economy, as confidence in the sustainability of the Brazilian exchange-rate regime evaporated, the country's monetary authorities adopted a flexible exchange-rate regime.

The new macroeconomic model was completed in 1999 with the adoption of inflation-targeting enhanced by a fiscal policy that aimed to generate substantial primary surpluses to prevent the public-debt/GDP ratio from exploding.

The new macroeconomic model allowed for sharply lower real interest rates —they fell from almost 25% per year in the period 1994-1998 to nearly 10% in the period 1999-2005— and for a devaluation of the real exchange rate, which was crucial for eliminating the current-account deficits recorded in the period 1994-1998, which reached a level of almost 4% of GDP. Moreover, a fiscal policy that generated significant primary surpluses made it possible to reduce the public-debt/GDP from a peak of 63% in 2002 to its current level of around 45%.

Despite lower real interest rates, less external fragility and stabilization of the public debt, the growth performance of the Brazilian economy remains very weak. Average annual growth in the period 1999-2005 was only 2.3% compared to 3.22% in the period 1994-1998.

Against this backdrop, the key problem is how to produce a persistent increase in the growth rate in the Brazilian economy.

There are two answers to this. The first, based on neoclassical growth models and the growth-accounting methodology, argues that the reason for the Brazilian economy's weak growth performance over the last 25 years is to be found on the supply side of the economy. More specifically, the reasons for the low GDP growth rate were a low level of domestic savings —owing to the negative contribution of the public sector and weak incentives for private savings— and lack of technological dynamism reflected in a very low total-factor-productivity (TFP) growth rate. On this view, a sustained rise in the growth rate would require reform of the social security system to increase government saving, supported by a more open economy to stimulate higher productivity in Brazilian firms.

The second approach to this issue is based on the idea that the macroeconomic model adopted in Brazil in the last decade has undermined aggregate demand and is hampering the real GDP growth rate. This is because the combination of still high real interest rates and the generation of significant (and, in recent years, increasing) primary surpluses is depressing demand. According to this view, the solution for the near-stagnation of the Brazilian economy would be to replace the current macroeconomic model which is based on inflation-targeting under flexible exchange rates and the generation of primary surpluses.

In the belief that both of these views are mistaken, this article adopts a Keynesian approach in which the determinants of long-run growth are to be found on the demand side of the economy rather than on the supply

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side. Nonetheless, the naïve Keynesian view that growth can be stimulated by any policy that increases aggregate demand is rejected. The fiscal crisis in Brazil imposes clear constraints on growth policies based on increasing government consumption. A sustained increase in the growth rate of the Brazilian economy requires the adoption of a new growth model, in which exports drive aggregate demand and thus serve as the engine of long-run growth. Adopting this growth model, however, requires an exchange-rate regime that can keep the real exchange rate undervalued.

This article is organized in five sections, including the introduction. Section II describes the theory of demand-led growth in which the long-run growth-rate of real GDP is a weighted average of the growth rates of government consumption and exports. Section III, based on the methodology developed by Atesoglu (2002), reports econometric tests of the hypothesis that the Brazilian economy is in a demand-led growth regime. The results of the tests showed that nearly 85% of GDP growth in the period 1990-2005 is explained by demand-side variables. Moreover, tests based on the methodology developed by Ledesma and Thirlwall (2002) show that the Brazilian economy's natural growth rate is endogenous, and considerably higher in boom periods. These results show that there are no supply-side constraints preventing a sustained increase in the growth rate of the Brazilian economy. Section IV provides an empirical analysis of the relation between the real exchange rate and the income-elasticity of exports, to show that an export-led growth model requires a competitive real exchange rate levels. Section V summarizes the conclusions.

II

The theory of demand-led growth: the Keynesian view

1. Long-run endogeneity of the supply of factors of production

Neoclassical growth models assume that the fundamental limit to long-run growth is the supply of factors of production. Aggregate demand is relevant only for determining the degree of capacity utilization, but has no direct influence over the rate of growth of productive capacity. In the long-run, Say's law is assumed to hold: supply creates its own demand.

But is the supply of factors of production really independent of demand? This question, originally raised by Kaldor (1988), gave rise to the theory of demand-led growth, premised on the notion that that the means of production in a modern capitalist economy are themselves goods produced within the system. The "supply" of means of production should never be taken as given and independent of the demand for them. In this theoretical framework, the fundamental economic problem is not to allocate a given amount of resources between alternative uses; but to determine of the rate at which those resources are created.

The long-run endogeneity of factors of production can be understood by starting with the supply of capital. The quantity of capital that exists at any point in time —or the productive capacity that exists in the economy— is the outcome of past investment decisions. Thus the stock of capital is not a quantity determined by "nature", but depends on the rate at which entrepreneurs wish to increase it.

This means that investment decisions are the fundamental determinants of the "capital stock". Investment, in turn, is determined by two sets of variables: (i) the opportunity cost of capital (mainly determined by the short-term interest rate set by the central bank); and (ii) expectations for the future growth of sales and production. In this context, if entrepreneurs foresee a strong and sustainable increase in demand for the goods they produce —as would be expected in an economy with a persistently high growth rate— they will make large investment expenditures.

In other words, investment is an endogenous variable that is aligned with the expected growth of aggregate demand, provided one fundamental condition is satisfied: the expected rate of return on capital must be higher than the cost of capital. If this condition is met, the "supply of capital" should not be considered as a constraint on long-run growth.

Although production in the short and medium terms cannot exceed the maximum productive capacity

of the economy, long-run productive capacity must be increased —through investment expenditures— to satisfy the increase in aggregate demand.

The second focus is the "supply of labour", which this theory also does not see as limiting production growth in the long run.

Firstly, the number of hours worked can easily be increased to raise the level of output.

Secondly, the participation rate —the labour force as a proportion of the total working-age population— can increase in response to a strong increase in labour demand (Thirlwall, 2002, p.86). In fact, during boom periods, the opportunity cost of leisure increases, stimulating a vigorous increase in the participation rate. Thus the labour force may grow faster during boom periods as individuals decide to enter the labour force in response to the incentives created by a booming labour market.

It should be noted that population and the labour force are not fixed for the economy as a whole. A shortage of labour —even of skilled workers— can be solved by immigration from other countries. For example, countries such as Germany and France were able to sustain high growth rates during the 1950s and 1960s by employing immigrant workers from the European periphery (Spain, Portugal, Greece, Turkey and southern Italy).

Lastly, it is worth considering whether the rate of technological progress acts as a constraint on long-run growth. Growth will be limited by the pace at which knowledge of information and communications technologies (ICTs) expands if technological progress is exogenous to the economic system; but that is not the case.

Firstly, the pace at which firms innovate is largely determined by their rate of capital accumulation; since a large proportion of technological innovations is embodied in new machinery and equipment.[1]

Secondly, even the small part of technical progress that is disembodied is determined by dynamic economies of scale such as learning-by-doing. A structural relationship therefore exists between the rate of growth of labour productivity and the rate of growth of output, known as the "Kaldor-Verdoorn Law".[2, 3] In this framework, an increase in aggregate demand will cause labour productivity to grow faster, since output growth will accelerate in the wake of stronger demand growth.

From this standpoint there is no such a thing as long-run potential or full-employment output, since the supply of factors of production and the rate of technological progress are both demand-determined. "Full-employment" is essentially a short-run concept that ignores that endogeneity of the long-run "natural growth rate".

2. The determinants of long-run growth

If the supply of factors of production cannot be considered a constraint on long-run growth, what are the determinants of economic growth in the long run? From the Keynesian standpoint, the ultimate determinant of economic growth is aggregate demand. Firms raise their production levels in response to an increase in aggregate demand, provided two conditions are satisfied: (i) profit margins are high enough to give to entrepreneurs the desired rate of return; (ii) the actual profit rate must be higher than the cost of capital. If these two conditions are met, then the rate of growth of real output will be determined by the rate of growth of "autonomous demand" —the part of aggregate demand that is independent of the level of output and income, variations therein, or both.

In the case of open economies, autonomous demand has two components: exports and government consumption expenditure (Park, 2000). Investment is not a component of autonomous demand, since decisions to invest in capital assets are basically determined by the expectations entrepreneurs hold for the future growth of production and sales, according to the "accelerator" investment model (Harrod, 1939). In other words, investment is not an exogenous variable in the growth

[1] This idea was originally expressed by Kaldor (1957) through the "technical progress function", which posits the existence of a structural relationship between the growth rate of output per-worker and the growth rate of capital per worker. According to Kaldor, it is impossible to isolate the increase in labour productivity caused by the introduction of new technologies from that caused by an increase in capital per-worker. The reason is that nearly all technological innovations that raise labour productivity require more capital per worker, since the innovations are embodied in new machines and equipment.

[2] Econometric evidence on the validity of the "Kaldor-Verdoorn Law" for the United States can be found in McCombie and De Ridder (1984).

[3] Ledesma (2002) estimates a demand-led growth model for 17 countries that are members of the Organization for Economic Cooperation and Development (OECD) (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom and United States) in the period 1965-1994. Based on this econometric evidence, a structural relationship can be identified between the growth rate of labour productivity and a set of other variables including the rate of output growth. The estimated structural equation is:

$$r = -0.015 + 0.642y + 0.0002(I/O) + 0.617K + 0.021GAP,$$

where r is the growth rate of labour productivity; y is the growth rate of real output; (I/O) is investment as a proportion of real GDP; K is a index of technological innovation; and GAP is an estimate of the technological gap.

process, since it is actually driven by output growth. The long-run growth rate of real output is thus a weighted average of the rate of growth of exports and the rate of growth of government consumption expenditure.

For a small open economy that does not have its own convertible currency, export growth is the exogenous variable in the growth process. If government consumption grows faster than export growth, then real output and income will outpace exports. Assuming the income-elasticity of imports is greater than 1 (as is usually the case in open economies), then imports will grow faster than exports, generating a ever larger trade deficit (assuming constant terms of trade), which will be unsustainable in the long-run.[4]

The rate of growth of exports is calculated as the product of the income-elasticity of exports (ε) and the rate of growth of world income (z). Thus the long-run rate of growth of real output (g^*) in the demand-led growth model is given by:

$$g^* = \varepsilon z \qquad (1)$$

In other words, the growth rate of real output is equal to the product of the income-elasticity of exports and the rate of growth of world income.

[4] It is important to note that export growth that outpaces the growth of government consumption is not a sufficient condition for a sustainable growth process in the long-run; balance of payments equilibrium is also required. For open economies with zero-capital mobility this means that the long-run growth rate will be equal to the ratio between the income-elasticity of exports and the income-elasticity of imports, with this ratio being multiplied by the growth rate of world income known as "Thirlwall's Law" (Thirlwall, 1997). The introduction of capital flows does not significantly alter the long-run equilibrium growth rate (McCombie and Roberts, 2002, pp.95-96). The present article is not concerned with balance of payments constraints on Brazilian economic growth, but aims to show the existence of a demand-led growth regime in Brazil. The econometric tests will therefore not use "Thirlwall's Law" .

III

Demand-led growth in Brazil? Some empirical tests

This section reports econometric tests of the hypothesis that growth is driven by aggregate demand in the Brazilian economy. It firstly shows that certain aggregate demand variables play a key role in explaining the growth of the Brazilian economy in the period 1991-2005.[5] In particular, exports and government current consumption are exogenous variables in long-run growth, thus corroborating the demand-led growth model described in Section II. It is also shown that the natural growth rate of the Brazilian economy is endogenous, and determined by the dynamics of the current growth rate driven by aggregate demand. This means that supply conditions do not impose a binding constraint on economic growth. The estimates made for this article —based on quarterly data on unemployment and the growth of the Brazilian economy in the period 1980-2002— show that the natural growth rate can vary from 5.2% per year to 8% in boom periods.

1. Testing the hypothesis of demand-led growth

This subsection uses the Atesoglu (2002) methodology to test the hypothesis that growth in the Brazilian economy is driven by aggregate demand . This involves measuring the relationship between real GDP (Y) and the following variables: real level of exports (X); the real level of investment (I);[6] real government consumption (G); and the real money supply (M2 deflated).[7]

[5] The Brazilian Geographical and Statistical Institute (IBGE) replicated GDP calculations for the years 1995- 2006. As the analyzed series is quarterly and the period of analysis of this study spans from 1991 to 2005, the data used in the estimates are those obtained under the old IBGE methodology.

[6] Public and private.

[7] The reason for using a money-supply variable instead of a long-term interest rate as a proxy for the effects of monetary policy on long-run growth in Brazil needs to be explained. Firstly, the implementation of monetary policy by setting the short-term interest rate only began in 1999 after the establishment of an inflation-targeting regime. Prior to 1999, the Central Bank of Brazil used other operational targets for monetary policy, such as money-supply growth (1994-1995) and the nominal exchange rate (1996-1998). Secondly, Brazil does not have a long-term interest-rate "market" because government bonds (*Letras*

The data on real GDP, real exports, real investments and real government consumption were obtained from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA). The money-supply series was obtained from the Central Bank of Brazil. All series were deflated by the general price index (IGP-DI) calculated by the Getúlio Vargas Foundation (FGV). All variables were transformed to set their 1991 values equal to 100 (1991 = 100), and natural logarithms[8] were applied to these rates. As a result, the estimated coefficients represent the elasticities between the variables in question. The study period spans 60 quarters, from the first quarter of 1991 to the fourth quarter of 2005.

The following unit-root tests were used to check for stochastic trends in the variables: augmented Dickey-Fuller (ADF, t-test), Phillips-Perron (PP, z-test) and the trend-adjusted Dickey-Fuller (DF-GLS test), along with the KPSS stationarity test, proposed by Kwiatkowski, Phillips, Schmidt and Shin (1992).[9] The decision on whether to include the constant or trend, or both, in addition to the number of lags for each series, was made using the Schwarz (SC) and Newey-West (NW) information criteria, supported by the statistical significance of the estimated parameters and the usual diagnostic tests, always starting with the general model and moving to the particular (initial lag = 10). The results, set out in table 1, show that all variables are integrated of order one, or I(1), and are therefore are not stationary.

Financeiras do Tesouro) –are indexed to the short-term interest rate. This eliminates the possibility of capital losses caused by an increase in the short-term interest rate, which means that the *duration* (the sensitivity of bond prices to changes in the interest rate) of such bonds is zero, making them perfect substitutes for bank reserves. This specific institutional feature of the Brazilian economy results in a "contamination" of monetary policy by public debt, creating a *horizontal yield curve*; in other words, a situation where debts of different maturities have the same interest rate, namely the interest rate on loans in the inter-bank market (see Barbosa, 2006).

[8] An L placed before the name of each variable indicates its logarithmic form while DL denotes the first difference of the logarithms.

[9] Following Maddala (2001), confirmatory analysis was used and a significance level of 10% was adopted. In the event of conflicting results, the unit-root test was preferred.

TABLE 1

Unit-root and stationarity tests

Variable	ADF				PP			
	Def.	Set terms	Test	Critical value 10%	Def.	Set terms	Test	Critical value 10%
LY	1	N	0.70	-1.61	2	CT	-3.15	-3.17
D(LY)	0	N	-10.78	-1.61	11	N	-11.76	-1.61
LX	2	N	1.64	-1.61	18	N	1.56	-1.61
D(LX)	1	N	-9.52	-1.61	21	N	-8.45	-1.61
LI	0	N	0.59	-1.61	57	N	1.25	-1.61
D(LI)	0	N	-7.77	-1.61	57	N	-12.88	-1.61
LG	4	N	0.82	-1.61	15	N	1.41	-1.61
D(LG)	3	N	-3.21	-1.61	28	N	-15.62	-1.61
LM2	0	CT	-2.31	-3.17	0	CT	-2.31	-3.17
D(LM2)	1	N	-3.02	-1.61	2	N	-6.42	-1.61
Variable	DF-GLS				KPSS			
	Def.	Set terms	Test	Critical value 10%	Def.	Set terms	Test	Critical value
LY	1	C	-0.59	-1.61	5	CT	0.20	0.12
D(LY)	0	CT	-7.74	-2.87	48	C	0.39	0.35
LX	2	CT	-1.46	-2.87	5	CT	0.23	0.12
D(LX)	1	CT	-8.60	-2.87	18	C	0.15	0.35
LI	0	CT	-2.44	-2.86	5	CT	0.22	0.12
D(LI)	0	CT	-5.62	-2.87	58	CT	0.50	0.12
LG	4	CT	-1.78	-2.88	5	CT	0.21	0.12
D(LG)	3	CT	-2.21	-2.88	15	C	0.14	0.35
LM2	0	CT	-1.14	-2.86	6	CT	0.23	0.12
D(LM2)	1	C	-2.61	-1.61	3	C	0.42	0.35

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA) and "Boletim do Banco Central do Brasil".
Notes: N = None; C = Constant; and CT = Constant and linear trend. In the ADF and DF-GLS tests, the initial number of lags for each series is defined according to the Schwarz information criterion. The Newey-West selection was applied for the PP and KPSS tests.
An L placed before the name of each variable indicates its logarithmic form.
The letters DL denote the first difference of the logarithms.

As all series are I(1), there are no problems of spurious correlation between the dependent and independent variables in the results, when the regression is estimated using variables expressed as first-differences, as shown in table 2.

All non-deterministic variables have the expected signs and are significant at the 5% or 1% levels, including jointly (F-statistic). The diagnostic tests performed on: the model specification (Ramsey RESET), the presence of structural change (Chow) and the existence of multicollinearity (Variance Inflation Factor), together with the traditional selection criteria (Akaike-AIC and Schwarz-SIC) validate the chosen parameterization. Tests on the residuals to check for problems of autocorrelation (Durbin-Watson and Breusch-Godfrey), heteroscedasticity (White, Breusch-Pagan and ARCH) and normality (Doornik-Hansen) showed no evidence of the respective problems. The variables on the right-hand side of the regression equation explain about 47% of the variation in GDP, with the money supply having the greatest impact: a 1% increase in the money supply raises GDP by 0.33%.

The analysis of short-run dynamics shown in table 2 —having removed trends in variables via differentiation— provided important information on the long run. Since all the variables involved are I(1), cointegration is possible. Thus, short-run dynamics and short-run balances are integrated on the basis of the theory developed in Granger (1981) and Engle and Granger (1987).

The regression of the static variables expressed as levels (table 3) is part of the two-stage Engle-Granger (EG) procedure to test cointegration. If the variables are cointegrated (the residual is stationary or I(0)), then it is possible to obtain consistent long-run parameters and the error correction term for the short-run regression.

Although the long-run model is validated by the diagnostic tests performed, the residuals may display autocorrelation, so the standard errors (and t-statistics) shown are corrected by the consistent covariance matrix, and the White autocorrelation and heteroscedasticity test (HAC). The LX and LI variables, significant at 5%, will be significant at 1%, while LG is significant at 1% and LM2 is not significant, in both cases (with or without correction).[10]

To overcome the problem of residual autocorrelation, a long-run dynamic regression was estimated for an

[10] Evidence of autocorrelation is less severe in this case.

TABLE 2

Model using first differences

Dependent variable: DLY Method: Ordinary least squares (OLS)					Observations: 59
Variable	C	DLX	DLI	DLG	DLM2
Coefficient	-0.0054	0.1753	0.3228	0.2087	0.3312
Standard error	0.0076	0.0579	0.1151	0.0556	0.1537
t-stat	-0.7094	3.0296	2.8038	3.7564	2.1547
Variance inflation factor		1.0270	1.0060	1.1810	1.1690
R^2	0.4658	Durbin-Watson			2.3652
Adjusted R^2	0.4262	Breusch-Godfrey		Lags: 2	3.2573
Standard error (eq.)	0.0547			Lags: 4	3.2877
Log-probability	90.3107	ARCH test		Lags: 1	2.3725
Akaike criterion	-2.9618			Lags: 2	3.4820
Schwarz criterion	-2.7158			Lags: 4	4.0796
F-stat	11.7699	White test			15.4668
Chow test	3.0986	Breusch-Pagan test			4.3934
Ramsey RESET test	1.8084	Doornik-Hansen test			4.7683

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA) and "Boletim do Banco Central do Brasil".
Notes:
Durbin-Watson and Breusch-Godfrey tests detect autocorrelation problems.
White and Breusch-Pagan tests detect heteroscedasticity problems.
Ramsey RESET is a diagnostic test performed on the model specification.
ARCH test detects problems of autoregressive conditional heteroscedasticity.
Doornik-Hansen test detects autocorrelation and normality problems.
Chow test is a diagnostic test on the presence of structural change.
The letters DL denote the first difference of the logarithms.
C: Constant.

TABLE 3

Long-run (eg)[a] model

Dependent variable: LY Method: Ordinary least squares (OLS)				Observations: 59 (ADL) and 60 Static regression	
Variable	C	LX	LI	LG	LM2
		Static regression			
Coefficient	0.6599	0.0687	0.3172	0.4134	0.0533
Standard error	0.5207	0.0278	0.1193	0.0680	0.0543
t-stat	1.2674	2.4735	2.6598	6.0805	0.9818
Standard error (HAC)	0.4864	0.0239	0.0847	0.1067	0.0634
t-stat (HAC)	1.3569	2.8783	3.7428	3.8758	0.8397
Variance inflation factor		1.7170	2.3850	3.4210	4.6910
		Autoregressive distributed lag			
Coefficient	1.1726	0.0389	0.0793	0.5966	0.0316
Wald test (F-stat)	3.7628	1.5588	3.1683	10.9340	0.1173
R^2	0.8743	Durbin-Watson			1.9849
Adjusted R^2	0.8513	Breusch-Godfrey		Lags: 2	1.2114
Standard error (eq.)	0.0468			Lags: 4	1.9216
Log-probability	102.3642	ARCH test		Lags: 1	0.0837
Akaike criterion	-3.1310			Lags: 2	0.4808
Schwarz criterion	-2.7789			Lags: 4	0.7408
F-stat	37.8855	White test			57.9920
Chow test	0.2095	Breusch-Pagan test			11.1197
Ramsey RESET test	1.9947	Doornik-Hansen test			14.1386

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA) and "Boletim do Banco Central do Brasil".

Notes: The diagnostic statistics refer to the ADL model with 1 lag.
Durbin-Watson and Breusch-Godfrey tests detect autocorrelation problems.
White and Breusch-Pagan tests detect heteroscedasticity problems.
Ramsey RESET is a diagnostic test performed on the model specification.
ARCH test detects problems of autoregressive conditional heteroscedasticity.
Doornik-Hansen test detects autocorrelation and normality problems.
Chow test is a diagnostic test on the presence of structural change.
ADL: Autoregressive distributed lag model.
HAC: Heteroscedasticity and autocorrelation test (White).
C: Constant.

[a] EG: Two-stage procedure developed by Engle-Granger to test cointegration.

autoregressive distributed lag (ADL) model.[11] This model passes the diagnostic tests. In terms of parameter significance , LX, LI, LG are still significant (at least at 10%) but LM2 is not.

To ensure the estimated relationships are not spurious, the variables in question need to co-integrate. The next step in the Engle-Granger procedure is to check whether the residuals in the long-run relationship are stationary, using the adf test. Nonetheless, it is not advisable to use the values of the traditional tables to test this hypothesis. As these tables are not prepared for the estimated values, we use the adjusted table for estimated values and for the sample size proposed in MacKinnon (1990). The statistical test value (-4.68) rejects the presence of a unit root with 99% confidence, thus pointing to the existence of a long-run relationship between variables.

The existence of cointegrated variables means the error correction model (ECM) can be used. This connects short-run dynamic aspects and long-run ones; in other words, it make it possible to combine the advantages of modeling with variables expressed as differences and as levels.

As Table 4 shows, the variables under study are differentiated, so they are stationary (they originally had a unit root). For the equation to be balanced in the sense of being at the same level of integration, the error correction term (ECT) needs to be I(0). Thus, the

[11] In the static model with the Cochrane-Orcutt and Prais-Winsten transformations, the significance of the parameters is unchanged.

TABLE 4

Short-run (eg)[a] model

Dependent variable: DLY Method: OLS						Observations: 59
Variable	C	DLX	DLI	DLG	DLM2	TCE(-1)
Coefficient	-0.0030	0.1600	0.3438	0.2727	0.1965	-0.5972
Standard error	0.0062	0.0587	0.0996	0.0305	0.0960	0.1044
t-stat	-0.4912	2.7233	3.4532	8.9286	2.0465	-5.7199
Variance inflation factor		1.0310	1.0080	1.2780	1.2250	1.1140
R^2	0.6248		Durbin-Watson			1.9008
Adjusted R^2	0.5894		Breusch-Godfrey		Lags: 2	0.5993
Standard error (eq.)	0.0463				Lags: 4	1.8900
Log-probability	100.7344		ARCH test		Lags: 1	0.1385
Akaike criterion	-3.2113				Lags: 2	0.1474
Schwarz criterion	-3.0001				Lags: 4	0.1624
F-stat	17.6509		White test			10.1296
Chow test	0.7125		Breusch-Pagan test			2.8016
Ramsey RESET test	2.1170		Doornik-Hansen test			17.6178

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA) and "Boletim do Banco Central do Brasil".
Notes:
Durbin-Watson and Breusch-Godfrey tests detect autocorrelation problems.
White and Breusch-Pagan tests detect heteroscedasticity problems.
Ramsey RESET is a diagnostic test performed on the model specification.
ARCH test detects problems of autoregressive conditional heteroscedasticity.
Doornik-Hansen test detects autocorrelation and normality problems.
Chow test is a diagnostic test on the presence of structural change.
The letters DL denote the first difference of the logarithms.
C: Constant.

[a] EG: Two-stage procedure developed by Engle-Granger to test cointegration.

cointegration between the variables in the sense proposed in Engle and Granger (1987) requires the existence of an ecm, and vice-versa. The elasticities are all significant (at the 5% level at least), and close to the values obtained with the usual model expressed in first-difference form. Nonetheless, the coefficient of ECT —which measures the distance of X and Y from the long-run equilibrium and thus reports the speed of adjustment of variables to occasional disequilibria— is about 60%.[12]

For a more robust analysis, the approach described in Johansen (1988 and 1991) and Johansen and Juselius (1990) was used to verify the existence of cointegration and existing relations for the long-run balance. The Johansen procedure is a more general maximum likelihood method that uses a system of dynamic equations, specifically a vector autoregression model (VAR). Johansen's systemic approach is able to identify not only the presence of cointegration but, if confirmed, the number of co-integrating vectors and their specification.

The number of lags was determined according to the modified maximum likelihood (LR), final prediction error (FPE), Akaike (AIC), Schwarz (SIC) and Hannan-Quinn (HQ) criteria, while the decision to include deterministic terms was based on a visual analysis of the series and the Pantula principle. To test for cointegration and, at the same time, whether the number of vectors exists, the trace and maximum eigenvalue statistics are used (table 5).

As both tests suggest the existence of a cointegration vector, the vector error correction (VEC) can be estimated. The long-run elasticities obtained from the cointegration vector are shown in equation (2):

$$\begin{aligned} LY = 1.1972 &+ \underset{\substack{(0.0420)\\[-2.6175]}}{0.1099}LX + \underset{\substack{(0.2856)\\[-2.4714]}}{0.7067}LI + \\ &\underset{\substack{(0.1490)\\[-2.7197]}}{0.4052}LG + \underset{\substack{(0.1045)\\[-0.3077]}}{0.0322}LM2 \end{aligned} \qquad (2)$$

Sample: 1992:3-2005:4; Lags: 1 to 5; There is a deterministic trend in the data.

[12] The negative sign is expected to ensure that any disequilibrium is offset by an opposite movement in the variable being explained.

TABLE 5

Cointegration tests

Trace Test			
Hypothesized no. of EC(s)	Eigenvalue	Trace statistics	0.05 Critical value
None	0.4969	76.9029	69.8189
At most 1	0.3780	39.8108	47.8561
At most 2	0.1523	14.1673	29.7971
At most 3	0.0903	5.2455	15.4947
At most 4	0.0025	0.1336	3.8415
The maximum eigenvalue test			
Hypothesized no. of EC(s)	Eigenvalue	Maximum eigenvalue statistic	0.05 Critical value
None	0.4969	37.0921	33.8769
At most 1	0.3780	25.6435	27.5843
At most 2	0.1523	8.9218	21.1316
At most 3	0.0903	5.1119	14.2646
At most 4	0.0025	0.1336	3.8415

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA) and "Boletim do Banco Central do Brasil".

The parameter estimates in equation (2) are the standard co-integrating coefficients; the values in parentheses are standard errors and the t-statistics are in brackets. All elasticities have the signs expected in the theory and are statistically significant (5%), except, once again, LM2.

Table 6 summarizes the results obtained from VEC, including each equation's error-correction term and the basic diagnostics of the model as a whole. The figures indicate the long-run equilibrium adjustment coefficients obtained from each of the five VEC multiple equations. The significance of the error correction term in each equation indicates that the dependent variable adjusts in response to an imbalance between the dependent variable and the independent variables, thus indicating endogeneity.

The statistics of the VEC test reject the presence of autocorrelation, heteroscedasticity and non-normality in the residuals. In the adjustment matrix, only the error correction terms in the Product and Investment equations are significant (up to 5%), which is evidence for the (weak) exogeneity of exports and government expenditures in the model. Although the money supply does not adjust to long-run disequilibria, it is not significant in the long-run equation.

The analysis of short run-disequilibria and their interaction with the long-run dynamics, provided by the Engle-Granger methodology and the Johansen procedure, provide some interesting conclusions. The signs suggested by the theory are observed empirically for the Brazilian economy in the period examined; and the explanatory variables exports, investment, and government expenditure are all significant in the short and long runs. The money supply is significant only in short-run dynamics, so *it seems unlikely that monetary policy has persistent effects on economic growth in Brazil*. This is because monetary changes, broadly defined, do not have a statistical influence on the behavior of real GDP in the long run.

According to the estimated coefficients of regression equation (2), for each 1% increase in real government consumption, real GDP grows by 0.40%. Thus, assuming that tax revenues in the three spheres of government represent approximately 40% of GDP, an increase in current consumption by government on the order of 1% would generate an increase in tax revenues of approximately 0.16%, thereby worsening the public-sector deficit. Given the high tax burden currently prevailing in the Brazilian economy (about 40%) and the high public-debt/GDP ratio (also around 40%), under current conditions, the government cannot permanently stimulate economic growth by increasing its current consumption. Exports represent the only "autonomous" source of demand that could induce a growth acceleration. In other words, the Brazilian economy needs adopt an export-led growth model.

Apart from the money supply, the results reported in this section are very similar to those found by

TABLE 6

Summary of vec[a] results

	D(LY)	D(LX)	D(LI)	D(LG)	D(LM2)
ECT	-0.7540	0.9970	0.4946	-0.7177	-0.2112
Standard error	(0.2490)	(0.5846)	(0.2423)	(0.3805)	(0.2156)
t-stat	[-3.0285]	[1.7053]	[2.0379]	[-1.8858]	[-0.9794]
Adjusted R^2	0.6757	0.4361	0.4121	0.8157	0.4696
Standard Error (eq.)	0.0405	0.0952	0.0411	0.0620	0.0351
LM stat (Autocor.)	24.2728				
White (Heterosc.)	801.1020				
Lutkepohl (Norm.)	2.8940				

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA) and "Boletim do Banco Central do Brasil".

[a] Vector error correction.

Atesoglu (2002). The causality relations support the Keynesian approach discussed in the previous section, in which exports and government consumption are the key sources of economic growth in the long run. Nonetheless, given the severe fiscal crisis in Brazil, it does not seem possible to boost economic growth through a policy to expand the government's current consumption. A resumption of rapid growth in the Brazilian economy requires the adoption of an export-led growth model.

2. Is the natural growth rate of the Brazilian economy endogenous?

Subsection 1 showed that the observed growth rate of the Brazilian economy is determined by the growth of aggregate demand. This subsection takes the reasoning a step further by showing that the natural rate of growth[13] also adjusts to the economy's actual growth rate in the long term. This means that aggregate-demand growth determines not only the dynamics of the actual growth rate of the Brazilian economy, but also the dynamics of the natural growth rate, which is conventionally linked to technological progress and growth of the labour force.

This subsection is based on a study by Ledesma and Thirlwall (2002). Using the concept defined by Okun (1962 cited by Ledesma and Thirlwall 2002), the natural rate of growth (g_n) is what keeps the level of unemployment constant. Okun (1962 cited by Ledesma and Thirlwall 2002) uses the following specification for the change in the percentage unemployment rate:

$$\Delta\%U = a - b(g) \quad (3)$$

where U is the level of unemployment, g is the rate of growth of output and a and b are two constants. From equation (3), when $\Delta\%U = 0$, the natural rate of growth is defined by a/b.

As some people do not seek work when economic growth is subdued, it is possible that the coefficient a is underestimated. In this case, the natural rate of economic growth would also be underestimated. Moreover, in periods of rapid economic growth, part of the additional work needed to increase production comes from labour that was previously underused, and also from overtime. Thus, b is underestimated, which leads to an overestimation of the natural rate of growth. Accordingly the natural rate of growth may be either under- or overestimated depending on which of two effects predominates.

In an attempt to circumvent these problems a different approach to estimating the natural rate of growth was developed by Thirlwall (1969):

$$g = a_1 - b_1(\Delta\%U) \quad (4)$$

In equation (4), when the variation in the unemployment rate is zero, we have:

$$g = a_1 \quad (5)$$

Thus, the natural rate of growth is defined by the intercept of the regression equation. The problem of using equation (4) is that the natural rate of growth is endogenous, so the estimated coefficients are biased.

[13] In the old neoclassical growth models, represented by Solow (1956), the natural growth rate was exogenous and determined by supply factors including the rate of technological progress and growth of the labour force. In the "new growth theory" which originated in seminal papers by Romer (1986) and Lucas (1988), the natural growth rate is made an endogenous variable in the sense that the rate of technological progress is determined by the model itself. Nonetheless, this is not the meaning of the term "endogenous" as used in this article. Here the term "endogenous natural growth rate" means a real output growth rate that is determined by the rate of growth of aggregate demand in the long term. For a similar interpretation of the term "endogenous" see Libanio (2009).

Once the natural rate of growth is estimated, a dummy variable can be created that takes the value 1 (one) when actual economic growth exceeds the natural rate estimated by equations (3) or (4), and 0 (zero), otherwise. The introduction of the dummy variable gives the following regression equation:

$$g = a_2 + b_2D + c_2(\Delta\%U) \qquad (6)$$

where D is the dummy variable. In specifying equation (6), two natural rates of growth are estimated. The first is estimated for periods in which the growth rate is above the natural rate given by equation (4). In this case, the natural rate of growth is equal to $a_2 + b_2$. The second is estimated for the periods in which the observed growth rate is below the natural rate given by equation (4). In this case, the natural rate is a_2.

A "natural rate" would be expected not to vary when the actual growth rate changes. If this is true, the coefficient of the dummy variable should not be statistically different from zero. Otherwise, the natural rate of growth (g_n) is endogenous and responds to changes that may occur in the actual growth rate (g).

The database used to perform the regression analysis in this study contains GDP and unemployment variables. The level of unemployment is taken from the IBGE Monthly Employment Survey (PME), with the original monthly figures being transformed into quarterly data by calculating the arithmetic mean of the three months in each quarter.[14] The chain index of GDP is based on the System of National Accounts obtained from IBGE (IBGE/SNA).[15] The period of analysis spans the first quarter of 1980 to the last quarter of 2002.[16] As both variables were transformed into growth rates, the first observation in each series was lost, leaving 91 observations for the empirical analysis.

Using the quarterly data series, estimates of the natural rate of growth obtained from equations (3) and (4) are shown in table 7.

The growth rates reported by each of the equations are very similar, which suggests that the estimated natural rate of growth (NRG) is robust, despite the potential problems mentioned above.

A natural rate of growth of around 0.60% per quarter gives an annualized rate close to 2.50%. Thus, the regression equations used suggest that the growth rate that would have kept Brazilian unemployment constant between 1980 and 2002 was close to 2.50%.

Table 8 shows the empirical results obtained from regression equation (6). The symbol MA means that the GDP growth rate is a three-quarter moving average.

The results of regression (6) indicate that the natural rate of growth responds to the economy's real growth rate. The figures in the first line of table 8 suggest that in periods of rapid economic growth the natural rate is around 8%, while in periods of weak economic growth or recession the natural rate is actually negative, at around -3.5 %.

It should be remembered that the data are quarterly so the range of variation is large. One advantage of using moving averages is that they smooth the fluctuations, as

[14] Using the monthly data, each year was divided into four quarters, by adding together the unemployment figures for the three months and dividing by three. 1st quarter unemployment rate (January + February + March) / 3; 2nd quarter unemployment rate (April + May + June) / 3; 3rd quarter unemployment rate (July + August + September) / 3; 4th quarter unemployment rate (October + November + December) / 3.

[15] Seasonally adjusted chained series of the quarterly mobile index, average 1990 = 100.

[16] The period of analysis ends in 2002 because a methodological change was made to the Monthly Employment Survey database in 2003, making it impossible to extend the econometric tests to the most recent period.

TABLE 7

Estimation of the natural rate of growth using the Okun and Thirlwall equations

	Method	Intercept	Slope	DW	R^2 Aj.	NRG
Equation (3)	RR	1.61	-2.70***	2.32	0.11	0.60
		(0.99)	(3.49)			
Equation (4)	OLS	0.59***	-0.053***	1.89	0.15	0.59
		(2.99)	(4.12)			

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA).

Notes: *** Significant at 1%. ** OLS: ordinary least squares; RR is the robust regression method used to correct problems of non-normality of residuals and heteroscedasticity; DW is the value of the Durbin-Watson test for first-order autocorrelation; R^2 Aj. is the adjusted R^2; and NRG is the natural rate of growth.

TABLE 8

Estimation of the natural rate of growth using the Okun and Thirlwall equations with a dummy variable

	Method	Intercept	Dummy coefficient	Slope	DW	R^2 Aj.	NRG ($g<g_n$)	NRG($g>g_n$)
Equation (6)	OLS	-0.84***	2.85***	0.03***	2.28	0.61	-0.84	2.01
		(-4.40)	(10.40)	(-3.35)				
Equation (6) MA	PWER	-0.26*	1.56***	0.011**	1.82	0.54	-0.26	1.3
		(-1.66)	(10.26)	(-2.14)				

Source: Prepared by the authors using data from the System of National Accounts provided by the Brazilian Geographical and Statistical Institute (IBGE/SNA).
Notes: *** Significant at 1%; ** Significant at 5%; * Significant at 10%. OLS: ordinary least squares; PWER is the method of Prais-Wisten with robust errors to correct problems of autocorrelation and heteroscedasticity; DW is the value of the Durbin-Watson test for first-order autocorrelation; R^2 Aj. is adjusted R^2; NRG is the natural rate of growth; and MA is the regression equation using three-quarter moving averages.

can be seen from the results shown in the second row of table 8. In this case, the natural rate of annual growth in "good times" would be around 5.2%, while in "bad times" it would be close to -1%.

The tests show that the natural rate of growth of the Brazilian economy is an endogenous variable and can therefore be affected by the demand conditions prevailing in the economy. Estimates for the natural rate of growth in "good times" vary between 5.2% and 8% per year, which suggests that the Brazilian economy could grow at annual rates well above 3.5% without generating inflationary pressures. The empirical results provide evidence that economic growth in Brazil is not constrained by supply side, but by demand.

IV

An empirical analysis of the relation between the real exchange rate and the income-elasticity of exports

Section III showed that the observed and natural growth rates in the Brazilian economy are both determined by the growth of aggregate demand. It was also noted that aggregate-demand growth is driven by the growth of exports and government expenditures (since investment is endogenous); but a growth regime led by fiscal expansion is not feasible in Brazil owing to the fiscal crisis. This means that growth in Brazil can only be driven by a continuous expansion of exports.

What conditions need to be satisfied for a strong and continuous expansion of exports in Brazil, or in other capitalist economies? In the long run, the rate of growth of exports in a country or region is determined by the worldwide income-elasticity of exports multiplied by the rate of growth of income in the rest of the world. The income-elasticity of exports captures the influence that non-price factors —such as the technological content of exported products, the degree of differentiation of exported products compared to their competitors on the international market, the value added to these products, and so forth— have on the country's external competitiveness. The higher is the income-elasticity of exports, the higher will be a country's growth rate of exports for a given rate of growth of world income. This is the channel through which supply factors can influence, but not determine, the growth rate of real output in the long run.[17]

[17] The inclusion of supply factors in the analysis of this article does not diminish the role of aggregate demand as the ultimate cause of economic growth. The growth rate of real output in the long term is determined by the growth rate of autonomous demand, which is influenced —although not determined— by supply-side factors. Moreover, the inclusion of supply factors in the analysis makes it

Countries on the so-called "technological frontier" should generally have a higher income-elasticity of exports than less developed countries. That is because countries that are closer to the "technological frontier" tend to export products of higher value-added and with greater technological content than countries that are further from the frontier. Thus the "technological gap" will be an important determinant of the income-elasticity of exports and, hence, of the long-run growth rate of exports (Dosi, Pavitt and Soete, 1990, p. 26).

The theoretical and empirical literature on the determinants of the income-elasticity of exports has, however, neglected the role of the real exchange rate as one of its determinants. In fact, empirical work on the variables affecting export performance has been limited to estimating the price-elasticities of exports; and price-elasticity estimates have either shown the opposite sign to that predicted by the theory or have been non-significant.

No attempt has been made to assess the existence of a relationship between the income-elasticity of exports and the real exchange rate. The literature seems to support the hypothesis that the real exchange rate can only influence long-run economic growth through its effect on the willingness of domestic and foreign consumers to spend their income on domestic or foreign goods. The literature neglects the impacts the real exchange rate can have on the economy's productive structure and, hence, on the income-elasticity of exports.

On a purely theoretical level, a relationship can be established between the level of real exchange rate and the income-elasticity of exports, using the Ricardian model of international trade expounded in Dornbusch, Fischer and Samuelson (1977). Based on this model, the degree of productive specialization of an economy —in other words the number of different types of goods produced by the domestic economy— is determined by the ratio between the domestic real wage and real wages paid worldwide.

The higher the real wages paid in the domestic economy compared to the rest of the world, the greater will be the country's degree of productive specialization, or the smaller the number of different types of goods produced in the domestic economy. The greater the degree of productive specialization, the lower will be the rate of export growth generated by a given rate of world income growth —in other words, the lower will be the income-elasticity of exports.

The real exchange rate affects the degree of productive specialization in the economy by directly impacting on real wages. An appreciation of the real exchange rate generally causes real wages to rise, thereby increasing production costs in the country relatively to those prevailing in the rest of the world. This process forces productive activities undertaken in the domestic economy to migrate abroad, resulting in deindustrialization of the domestic economy, with adverse repercussions on its export capacity.

To assess whether the income-elasticity of exports is affected by the real exchange rate and the technological gap,[18] 30 developed and developing countries[19] were analysed using a two-step regression methodology. Firstly the values of the selected countries' income-elasticities of exports were estimated for the period 1995-2005; then the relationship between a country's income-elasticity of exports and its real exchange rate level and technological gap was estimated.

The equation estimated in the first stage is as follows:

$$X_i = c_0 + c_1 Q + c_2 Y^* + \varepsilon_i \qquad (7)$$

where X_i is the real dollar-value of exports by country *i'*, Y^* is the real dollar-value of the rest of the world's GDP, Q is an index of the real exchange rate, taken as an average from the period 1995-2005 (1995 = 100), c_0 is a constant, ε_i is the error term, c_1 represents the exchange-rate elasticity of exports, and c_2 represents the income-elasticity of exports, in other words, the response of each country's exports to changes in the world GDP.[20] All series use quarterly data.

Estimation of the second-stage equation aimed to capture any effects exerted by the real exchange rate and technological gap on the income-elasticity of exports. To this end, an OLS regression was estimated of the values of the income-elasticities of exports estimated

possible to identify a precise channel through which the real exchange rate can influence export growth in the long run. The conclusion of the analysis, set out in the following paragraphs, is that a robust and continuous expansion of exports (which is a necessary condition for Brazil to achieve high rates of growth in the long run) requires the real exchange rate to be kept undervalued.

[18] The technological gap concept is due to Fagerberg (1988).

[19] Argentina, Australia, Austria, Brazil, Canada, Chile, Czech Republic, Denmark, France, Germany, Hungary, Indonesia, Italy, Malaysia, Mexico, Netherlands, New Zealand, Norway, Portugal, Republic of Korea, Russian Federation, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom and United States.

[20] Of the 30 countries reviewed, 24 did not present any problem in the estimation of c_2 in level terms. In the cases of Chile, Denmark, New Zealand, Norway, Portugal and the United Kingdom, exports and world GDP do not cointegrate, so it is impossible to estimate the correct level of the income-elasticity of exports. In two other countries, Austria and Mexico, the real-exchange-rate index in level terms is stationary.

in the first stage against the real-exchange- rate and technological gap indices for the selected countries in the period 1995-2005. The model specification allows for an interaction between the real exchange rate and the technological gap in determining the income-elasticity of exports. Introducing this interaction makes it possible to analyze whether the effect of real-exchange-rate variations on the income-elasticity of exports is affected by the technological gap. Countries with a larger technological gap in relation to the United States could be expected to offset their technological disadvantage through currency depreciation. For countries closer to the technological frontier the opposite result is expected: a higher level of non-price competitiveness allows these countries to maintain an appreciated currency and thus higher real wages.

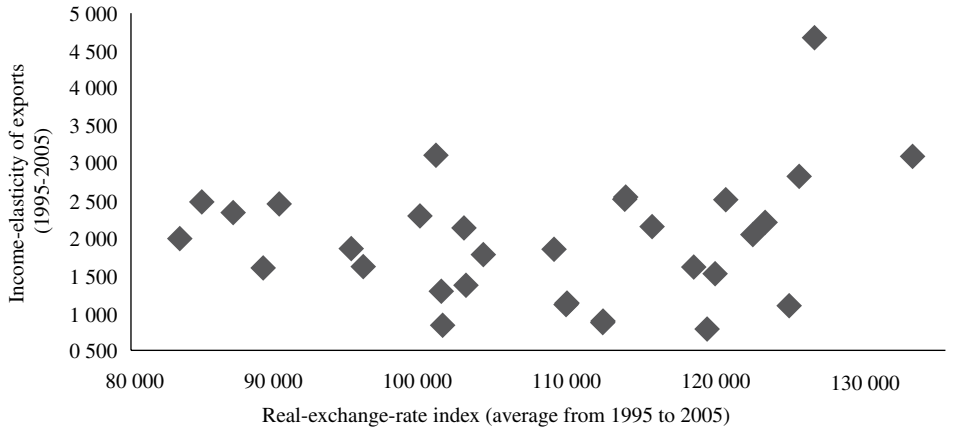
The real-exchange-rate index was calculated using quarterly data on the nominal exchange rate and consumer price indices obtained from *International Financial Statistics* (IFS), and normalized to 100 in 1995. Figure 1 below shows the dispersion of the income-elasticity of exports and the real-exchange-rate index.

Figure 1 reveals the existence of a nonlinear relationship between the income-elasticity of exports and the real exchange rate across the selected countries. For lower levels of the real exchange rate, there appears to be a negative relation between the two variables. At higher levels of the real exchange rate, however, the relation is positive.

The results of the econometric model are shown in table 9.

FIGURE 1

Income-elasticity of exports versus real-exchange-rate index



Source: Prepared by the authors on the basis of data from *International Finance Statistics* (IFS).

TABLE 9

Selected countries: Results of the econometric model for the income-elasticity of exports (1995-2005)

Variable	Coefficient	Standard error	t-statistic	Probability
RER	0.027719	0.013431	2.063739	0.0492
GAP	0.203742	0.112411	1.812469	0.0815
RERGAP	-0.001963	0.001019	-1.926045	0.0651
Constant	-0.919443	1.427213	-0.644222	0.5251
R^2	0.226110			
Durbin-Watson stat	2.116491			
Probability (F-statistic>0)	0.078975			

Source: Prepared by the authors.
Note: (i) White Heteroscedasticity-Consistent Standard Errors & Covariance; (ii) RER is the real-exchange-rate index; (iii) GAP is the ratio between the per-capita income of the country in question relative to the United States; and (iv) Durbin-Watson stat refers to the Durbin-Watson test for detecting autocorrelation between residuals. For a thorough interpretation of the tests, see Asteriou (2006) and Hamilton (1994).

The real-exchange-rate and technological-gap indices have the expected signs and are statistical significant at 5% and 10% respectively. This means that a depreciation of the real exchange rate will increase the income-elasticity of exports, thereby raising domestic export growth for a given growth rate of world income. This result is consistent with the notion that an economy's degree of productive specialization depends critically on the real exchange rate; so the real exchange rate and the long-run growth rate are linked.

It can also be seen that a reduction in the technological gap (represented by a rise in the technological-gap index) will increase the income-elasticity of exports, thus confirming the hypothesis that a higher technological level is associated with exports of higher technology content, thus increasing the country's income-elasticity of exports.

Lastly, there is a small, but statistically significant, negative interaction between the real exchange rate and the technological gap, which confirms the hypothesis that the effect of real-exchange-rate variations on the income-elasticity of exports depends on the size of the technological gap. The negative sign of this variable in the regression estimates is a reflection of the weight of developed countries in the sample. In these countries, the technological gap is smaller, so their external competiveness enables them to maintain appreciated currencies relative to those in developing economies.

The econometric tests show that countries which are further from the "technological frontier" cannot base their growth strategy on a low real exchange rate. In these countries, appreciation of the real exchange rate will eliminate their only means of competing with developed countries, namely an undervalued currency. Developed countries can compensate for a lower real exchange rate with technologically superior products.

There is also a clear positive relationship between the income-elasticity of exports and the level of the real exchange rate for all countries in the sample. This means that, regardless the size of the technological gap, a real-exchange-rate devaluation can raise the long-run growth rate of an economy by increasing its income-elasticity of exports, thereby boosting export growth for a given rate of growth of world income. The real exchange rate is thus a fundamental variable in any country's growth strategy.[21]

[21] For a survey of the literature on the real exchange rate and growth, see Gala (2008).

V
Conclusions

This article has used the demand-led growth model to address two fundamental issues: (i) why the growth rate of the Brazilian economy slowed in the last two decades of the period 1950-1980; (ii) what policies are needed to speed up sustainable growth in the Brazilian economy.

The answer to the first question is based directly on demand-led growth theory. The econometric tests reported in section III show that 85% of Brazil's real GDP growth in the period 1990-2005 is explained by aggregate-demand variables, thus supporting the hypothesis of demand-led growth in the Brazilian economy. Then the methodology developed by Ledesma and Thirlwall (2002) was used to show that the natural rate of growth in the Brazilian economy is endogenous and rises significantly in boom periods. Accordingly, there does not seem to be any supply-side constraint preventing more rapid economic growth.

From this perspective, the early-1980s growth slowdown in the Brazilian economy reflected an exhaustion of the pattern of aggregate-demand growth that had prevailed since 1964, namely an expansion of spending on durable or luxury goods facilitated by the increasing concentration of income in the middle- and upper-income groups. The semi-stagnation of the Brazilian economy is thus explained by the current absence of a consistent pattern of aggregate-demand expansion.

The econometric tests also showed that the government current-consumption multiplier is approximately 0.40%, so a 1% increase in the government's current consumption will generate an increase of 0.37% in Brazil's real GDP. Assuming an average tax rate of about 40% of GDP, it follows that a 1% increase in the government's current consumption will raise tax revenues by just 0.15% of GDP. In the fiscal crisis currently prevailing in Brazil, which involves a combination of a high public debt/GDP ratio, high taxation and low levels of public investment in infrastructure works, it is impossible to stimulate growth

in the Brazilian economy by increasing the government's current consumption. The only alternative is to adopt an export-led growth model.

What conditions need to be satisfied for a robust and continuous expansion of exports in Brazil or other capitalist economies? The econometric tests reported in section III show that countries which are further from the "technological frontier" cannot base their growth strategy on a low real exchange rate. In these countries, appreciation of the real exchange rate will eliminate their only means of competing with developed countries, namely an undervalued currency. In contrast, developed countries can compensate for a lower real exchange rate with technologically superior products.

There is also a clear positive relationship between the income-elasticity of exports and the level of the real exchange rate for all countries in the sample. This means that, regardless the size of the technological gap, a devaluation of the real exchange rate can raise an economy's long-run growth rate by increasing its income-elasticity of exports, thereby boosting export growth for a given rate of world-income growth. The real exchange rate is thus a fundamental variable in any country's growth strategy.

As a corollary of these results, developing countries, such as Brazil, may try to offset the international-competitiveness effects of their technological disadvantage by devaluing the real exchange rate against those of developed countries. This means that the adoption of an export-led growth model in Brazil —a necessary condition for Brazil to achieve high long-run growth rates of— requires an exchange-rate policy that can sustain an under-valued real exchange rate in the long term.

(Original: English)

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Brazil: the international financial crisis and counter-cyclical policies

Tito Belchior Silva Moreira and
Fernando Antônio Ribeiro Soares

ABSTRACT

This article evaluates the effectiveness of the counter-cyclical measures adopted by the Brazilian government to mitigate the effects of the subprime mortgage crisis, by analysing the repercussions of monetary, fiscal and credit policies on several of the main macroeconomic aggregates. The empirical analysis showed that expansionary credit policy was decisive for increasing family consumption and aggregate output during the crisis. While expansionary monetary policy also helped increase aggregate production during that period, investment expenditure did not respond to counter-cyclical policies.

KEYWORDS

Financial crisis, economic conditions, macroeconomy, Brazil, economic policy, business cycles, monetary policy, fiscal policy, credit policy, economic indicators

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AUTHORS

Tito Belchior Silva Moreira, Professor and Research Fellow at the Department of Economics of the Catholic University of Brasilia. tito@pos.ucb.br

Fernando Antônio Ribeiro Soares, Adviser to the Executive Secretariat of the Ministry of Finance of Brazil. fernando.a.r.soares@gmail.com

I
Introduction

The global economy performed vigorously in the first few years of the new millennium, particularly between 2003 and 2007; and the combination of high rates of economic growth with price stability fostered a belief that governments had dominated business cycles.

Nonetheless, although this panorama reflects a period of great evolution in the world economy, the latter, and the United States economy in particular, began to show clear signs of financial fragility as from 2007. That year saw the start of a process of major destabilization of markets, particularly in the real-estate sector.

Disequilibria in the real-estate market, and asset markets generally, reflected both macroeconomic factors and features inherent to the financial market. In the United States, which served as the lightning rod of the global crisis, the high rate of "dissaving" —reflected in the exceptionally large deficits on the current account— and overly expansionary monetary policy provoked large-scale financial leveraging, encouraged by deregulation of the banking sector, and the emergence of various financial innovations, including credit derivatives and uncontrolled securitization.

This process intensified, and the leveraging of firms and families grew exponentially. In 2007, asymptotic borrowing reached its limit. At the first sign of financial fragility in the banks and excessive exposure among borrowers with insufficient payment capacity, creditors called for a replenishment of collateral margin and suspended debt refinancing. This triggered a bank run, with the potential to seriously impair the liquidity of the financial system, or even render it insolvent. In those circumstances, monetary and economic authorities around the world started to implement rescue and bailout operations, the aim of which, in principle, was not to mitigate the economic slowdown but to prevent financial collapse.

The effects of the financial crisis quickly spread to the real side of the economy. Although capital markets (both equity and bank credit) served as the main crisis transmission channel deteriorating expectations also played an important role. The result was a sharp reduction in trade and capital flows worldwide; and investment decisions were put on hold, causing aggregate demand to freeze up.

The main repercussions on the Brazilian economy started to be felt in the second half of 2008, particularly in the last quarter; and they were manifested in the following way: (i) credit crunch both domestically and worldwide; (ii) wealth destruction caused by falling asset prices; (iii) worsening expectations; (iv) plummeting commodity prices; and (v) a reduction in world trade.

Although somewhat late —because, as noted above, the effects of the global crisis initially became discernible in 2007— the Brazilian government authorities started to implement a series of measures to tackle the deterioration in the economic environment —both general (or horizontal) measures and sector-specific (vertical) measures.[1] The aim was to mitigate the impact of the international crisis on Brazil, by avoiding a sharp slowdown in the economy and its negative consequences for output and employment.

In that framework, counter-cyclical fiscal, credit and monetary policies were adopted; and fiscal policy lowered the rate of industrial products tax (IPI) in specific sectors of the economy Credit policy was implemented mainly through banks and public financial institutions, which made up for the lack of private credit in several sectors of the economy, including civil construction and the automotive sector. Lastly, monetary policy implemented a substantial cut in the economy's basic interest rate, which was reflected in both nominal and real rates, thereby demonstrating the predominance of the monetary dimension in the conduct of Brazilian economic policy.

This article does not discuss the origins of, or provide explanations for, the factors causing the crisis in the United States financial system and its repercussions on the world economy. Several authors have already addressed these issues, including Mohan (2009); Rose and Spiegel (2009); Taylor (2009); Kindleberger and Aliber (2009); Krugman (2009); Lopes (2009); Rogoff and Reinhart (2010); Roubini and Mihm (2010); Kacef and López-Monti (2010). The chronology of the crisis is also beyond the scope of this article, and can reviewed in Torres Filho (2008) and Torres Filho and Rodrigues

[1] As horizontal measures are macroeconomic they affect society as a whole. They include the reduction in the basic interest rate. Vertical measures are specific and affect certain productive sectors, such as the automotive sector or civil construction.

Borça Júnior (2008). The core of this analysis consists of an evaluation of the counter-cyclical measures adopted by the Brazilian government to mitigate the effects of the crisis. An analysis is made of the repercussions of monetary, fiscal and credit policies on some of the main macroeconomic aggregates, and in certain sectors of the economy which received government incentives.

The article is structured as follows. Following this brief introduction, section II addresses a number of methodological issues, focusing on the databases; and it describes the main counter-cyclical measures adopted in Brazil. Section III constructs estimates of the effects of the counter-cyclical measures on aggregate demand and its components; and, lastly, section IV presents conclusions.

II

Methodological issues and counter-cyclical measures adopted in Brazil

The variables and respective nomenclatures (in parentheses) used in this article are as follows: Final consumption of families - ($Cons^{fam}$); Gross domestic product at basic prices (Y); Credit to the private sector - ($Cred^{pri}$); Basic interest-rate (percentage) implemented through the Special Settlement and Custody System (SELIC) - (R); Gross fixed capital formation - ($fbcf$); Inflation rate as measured by the Extended National Consumer Price Index (IPCA) - (π); Product taxes - (imp); and Real gross domestic product at market prices deflated by the general price index - domestic supply (IGP-DI) - (pib). Table A.1 in the appendix gives details of the variables used and specifies the sources and units of measurement.

The variables cited were modified to make them stationary and thus avoid spurious regressions. The variables final consumption of families, credit to the private sector and gross fixed capital formation (investment) were normalized with respect to GDP and basic prices. They were also transformed into rates of change and were renamed as $d(Cons_t^{fam} / Y_t)$, $d(Cred_t^{pri} / Y_t)$ and $d(fbcf_t / Y_t)$, respectively.[2]

The real interest rate (ex post) was calculated as the difference between the SELIC rate and the IPCA, and denoted as r_t. The expected value of the IPCA was not used, because that series was only available from 1999 onwards when the inflation-targeting regime began. The real interest rate variable was also transformed into a rate of change and represented through $d(r_t)$.

The Hodrick-Prescott filter was used to calculate the output gap $Hiato_t^{pib}$, defined as the difference between real and potential GDP (trend). A positive value indicates excess demand, whereas a negative value signifies idle productive capacity. Other variables were also measured using the Hodrick-Prescott filter. The real interest rate gap $Hiato_t^r$ was defined as the difference between the real interest rate and the trend. A positive (negative) value indicates a restrictive (expansionary) monetary policy.

The gap in the tax/income ratio, denoted by (IMP_t/Y_t) , was defined as the difference between that variable and its trend. A positive value indicates a restrictive fiscal policy. The gap in credit to the private sector in relation to income $(Cred_t^{pri}/Y_t)$, presented as $Hiato_t^{cred}$, was defined as the difference between $(Cred_t^{pri}/Y_t)$ and its trend. A positive value indicates an expansionary credit policy. Sector variables also were transformed into gaps and were differentiated from their respective trends.

The square of certain variables was used, including $IMP_t/Y_t)^2$, $(Cred_t/Y_t)^2$ and $(IPI_t/P_t)^2$, for the purpose of verifying the existence of a non-linear relation between those variables and the dependent variable. Two dummy variables were also introduced. The dummy variable $D1$, spanning the first quarter of 1991 to the second quarter of 1994, distinguishes the period prior to the real plan —characterized by inflationary instability— from the ensuing period in which inflation was brought under control. The second dummy variable, $D2$, is used to determine the period of the subprime mortgage crisis which spans the first quarter of 2007 to the first quarter of 2010.[3]

The next subsection analyses the effectiveness of the counter-cyclical measures implemented by the government during the subprime mortgage crisis. For

[2] Assuming $(Cons_t^{fam} / Y_t) = a_t$, so $d(Cons_t^{fam} / Y_t) = (a_t - a_{t-1}) / a_{t-1}$.

[3] Dummy variable $D1$ takes the following values: January 1991 to February 1994 = 1, otherwise = 0. dummy variable $D2$, takes the value 1 in the period January 2007 to January 2010, otherwise = 0.

that purpose, empirical tests were performed using the following procedures: (i) checks were made to verify whether the variables used in the econometric models are stationary, to avoid the presence of spurious regressions; (ii) once the stationarity of the series has been confirmed through unit root tests —augmented Dickey-Fuller and Phillips-Perron tests— ordinary least squares (OLS) equations are estimated; (iii) the residuals are analysed using a correlogram, and errors are adjusted using the Jarque-Bera method with the aim of turning the stochastic term into a white noise process; and (iv) the results of the estimated equations are then interpreted in the light of the signs and significance of the estimated parameters.

Counter-cyclical measures in Brazil

Since the deepening of the global financial crisis, the federal government has adopted various measures to contain the effects of the international turbulence on the Brazilian economy. In September 2008, steps were taken to address the major imbalances on the financial market through actions such as dollar auctions held by the Central Bank of Brazil. In other words, large-scale capital flight caused a substantial depreciation, which was alleviated by central bank dollar sales. In addition, new credit lines were created, and financing limits were raised, in an attempt to guarantee the continuity of the country's economic activity. Credit lines were also created for consumption, decrees were signed to guarantee the structure of the banking sector, and the rules for enforcing compulsory deposits were altered.

During the crisis, the Brazilian government adopted counter-cyclical economic policies that went beyond specific measures to alleviate the impact on specific sectors. Monetary and credit policy included a reduction in compulsory bank reserves, cuts in the basic annual interest rate calculated each day by the Special Settlement and Custody System (SELIC), and an increase in the supply of credit by public banks. Those measures aimed to alleviate the negative effects of the crisis on investment and consumption, through lower interest rates and easier credit. Fiscal policy included cuts in certain taxes and a lower primary surplus target.

The aim of both fiscal and monetary policies was to change pessimistic expectations and reduce their negative effect on consumption and investment, and lastly to avert a greater deterioration in the level of output and higher unemployment. In this framework, it was hoped that in 2010 the policies would ensure the continuity of economic recovery and fully reverse the minor recession of 2009, as was subsequently confirmed.

The next subsection provides details of the most important counter-cyclical measures used to tackle the crisis and their chronology.[4] The measures are listed according to their month of implementation.

September 2008

(i) 19 September 2008: Four days after the collapse of Lehman Brothers, which was considered decisive in magnifying the crisis to global proportions, the Brazilian exchange rate depreciated by 5%. To contain the depreciation, or, following Dornbusch (1976), avoid exchange-rate overshooting, the Central Bank of Brazil auctioned US$500 million;

(ii) 24 September 2008: The Central Bank of Brazil issued Circular No. 3.405 increasing from R$100 million (100 million reais) to R$300 million the amount that financial institutions are required to deduct from the calculation of additional reserve requirement on demand deposits, time deposits and saving deposits. It also postponed the collection of compulsory bank deposits on financial leasing operations; and the date for the entry into force of the 25% reserve ratio on deposits received was postponed from 16 January to 13 March 2009;

October 2008

(iii) 1 October 2008: Banco do Brasil, S.A. announced credits amounting to R$5 million to finance the agriculture sector;

(iv) 2 October 2008: The Central Bank of Brazil allowed banks to reduce compulsory reserve requirements by up to 40%, provided they purchased credit operations from other financial institutions. The aim, in this case, was to allow for the transfer of portfolios of banks facing liquidity problems;

(v) 6 October 2008: The Office of the President of the Republic published Provisional Measure No. 442, granting the Central Bank of Brazil powers to purchase the portfolios of banks based in the country. In this case, the objective was to show bank customers that the government was determined to defend deposits and thus avoid bank runs;

(vi) 8 October 2008: Given the sharp exchange rate depreciation of over 9%, the Central Bank of Brazil made dollar sales on the spot market;

(vii) 9 October 2008: In the same week in which the provisional measure was published allowing the Central Bank of Brazil to buy portfolios from banks

[4] For further details on the measures adopted and an analysis of the most relevant ones, see *Relatório das Contas do Governo, exercício de 2009* [Report on government accounts, fiscal year 2009], on the website of the Federal Audit Department (*Tribunal de Contas da União*).

with liquidity problems, the National Monetary Council (CMN) issued regulations on this;

(viii) 13 October 2008: The Central Bank of Brazil raised the limit on the deduction of bank compulsory reserves to increase liquidity in the economy;

(ix) 14 October 2008: The Central Bank of Brazil reduced from 45% to 42% the percentage collection of compulsory reserves and the compulsory special reserve on demand deposits;

(x) 16 October 2008: The Central Bank of Brazil allowed asset sales between banks to increase cash liquidity;

(xi) 21 October 2008: Provisional Measure No. 443 was published, authorizing Banco do Brasil and the Federal Savings Bank (*Caixa Econômica Federal* - CEF) to set up subsidiaries and take shares in financial institutions based in Brazil;

(xii) 22 October 2008: The Tax on Financial Operations (IOF) was lowered to zero in exchange settlement operations associated with foreign investment inflows in Brazil, with the aim of stimulating capital inflows and, thus, reduce pressure on the foreign-exchange market;

(xiii) 27 October 2008: Banks that had paid 60 monthly contributions to the Credit Guarantee Fund, could now reduce the respective amount from the compulsory demand deposit. The aim of this was to increase liquidity in the economy;

(xiv) 30 October 2008: The Federal Reserve System (the United States central bank) and the Central Bank of Brazil set up a financial swap facility for US$30 billion, maturing on 30 April 2009. The aim was to improve liquidity in the international financial system;

(xv) 30 October 2008: The Central Bank of Brazil altered remuneration of the compulsory time deposit with the aim of increasing credit in the market;

November 2008

(xvi) 4 November 2008: The Central Bank of Brazil issued rules governing dollar auctions to finance exports. Given the aforementioned freezing of the international commercial credit market, the central bank took steps to provide a credit to exporters;

(xvii) 6 November 2008: The federal government released credits for a total of US$6.9 billion for small and medium-sized enterprises and for the automotive sector;

(xviii) 11 November 2008: The Government of the State of São Paulo set up a credit line of R$4 billion for the automotive sector. On the same day, the CEF increased the limit for loans to purchase construction materials from R$7,000 reais to R$25,000;

(xix) 12 November 2008: The CEF released a credit line for private individuals amounting to R$2 billion, intended for the purchase of electrical appliances, electronic equipment, furniture and construction materials;

(xx) 13 November 2008: As from 1 December 2008, the additional reserve requirement on time, demand, and saving deposits would be made through government bonds. This expanded the financing capacity of the public sector;

(xxi) 14 November 2008: The Office of the President of the Republic published Provisional Measure No. 452 447, extending for 10 days the deadline for collecting the on industrial products tax (IPI), tax withheld at source and the social security contribution. The collection period for the Social Integration Programme and the Contribution to the Financing of the Social Security System (PIS/COFINS) were also extended by five days. The changing the tax collection date was expected to contribute R$21 million to enterprise cash flows;

(xxii) 21 November 2008: A decree was published lowering the IOF rate from 3.38% to 0.38%, for the financing of motorcycles, motor scooters, and mopeds;

December 2008

(xxiii) 11 December 2008: Decree No. 6.687 reduced the IPI rates on the sale of vehicles and trucks. This measure would be enforced from 15 December 2008 to 31 March 2009;

(xxiv) 11 December 2008: Decree No. 6.691 lowered the IOF rate applicable to credit operations with private individuals;

(xxv) 15 December 2008: The Federal government, through Provisional Measure No. 451, announced the change in rates for personal income-tax (IRPF); and

January 2009

(xxvi) 22 January 2009: Provisional Measure No. 453 was issued, constituting an additional source of funding for the National Bank for Economic and Social Development (BNDES), amounting to R$100 billion, with the aim of increasing availability of long-term credit.

Counter-cyclical measures continued to be implemented in 2009, including a reduction in the IPI rates applied to white-line electrical appliances. Capital goods and construction materials were also temporarily exempted from IPI. Other measures were adopted with respect to credit, including a reduction in the long-term interest rate. In addition, the government adopted a combination of investment and income-generating policies. The first included the creation of the Accelerated Growth Programme (PAC II), while in the social area it

is important to mention the civil construction policy, represented by the *Minha Casa Minha Vida* [My home, my life] programme, and the extra resources made available to the population by increasing the amount of the subsidy paid by the *Bolsa Familia* programme and raising the minimum wage.

Although the details of measures to combat the crisis and their respective chronology may seem mundane, the aim of this article is to analyse the counter-cyclical measures and their effectiveness in reducing the adverse effects of the international crisis. For that reason, the long list presented above is considered relevant for visualizing the path taken by the government in that endeavour.

In brief, the policies applied by the government were implemented in various areas. Firstly, the aim was to maintain the external sector by extending credit to exporters, since traditional credit lines were frozen. With regard to the financial system, measures were taken to maintain the liquidity insolvency of the banks, while signalling to the markets the government's serious intention to prevent a potential bank run. In terms of reviving the economy, an expansionary monetary policy was implemented through cuts in basic interest rates and a major credit expansion. Fiscal policy also had expansionary effects by granting a number of tax exemptions.

III

The effectiveness of counter-cyclical measures in Brazil: aggregate analysis

This section discusses one of the fundamental aspects of this research: the effectiveness of the counter-cyclical policies implemented by the Brazilian authorities in late 2008 and early 2009. To this end, a review is made of economic policy measures, to establish which in fact proved appropriate in combating the economic slowdown and rise in unemployment, and avoiding the effects of the deepening international crisis in Brazil. An analysis is then made of aggregate economic policy measures aimed at producing effects on the economy as a whole.

After that, empirical evidence is presented on the effects of the counter-cyclical policies in the Brazilian economy —in particular, the effects of fiscal, monetary and credit policies on the family consumption, aggregate investment, and the output gap.

1. Counter-cyclical effects of monetary and credit policies on family consumption

The following paragraphs evaluate the repercussions of credit extended to the private sector on aggregate family consumption. This analysis is based on the Keynesian consumption function, which is extended to incorporate the credit variable, such that:

$$Cons_t^{fam} = \beta_0 + \beta_1 Y_t + \beta_2 Cred_t^{pri} \qquad (1)$$

Normalizing equation (1) with respect to aggregate income, gives the following function:

$$Cons_t^{fam} / Y_t = \beta_0 + \beta_1 Cred_t^{pri} / Y_t \qquad (2)$$

A positive sign is expected for the β_1 credit coefficient. In other words, given an increase in the ratio between the volume of lending to the private sector and aggregate income, family consumption is expected to increase as a proportion of the same aggregate income.

To eliminate the possibility of spurious regression, the variables defined in equation (2) were expressed as rates of change. Table A.2 in the appendix shows that the family consumption and private sector credit variables —both in relation to income— are stationary, so the unit root hypotheses is rejected. Equation (2) can then be rewritten in stochastic form. In addition, two variables are added, an interactive variable and the dummy variable $D1$.

$$d(Cons_t^{fam} / Y_t) = \beta_0 + \beta_1{}^* d(Cred_t^{pri} / Y_t) + \beta_2{}^* d(Cred_t^{pri} / Y_t)^* D2 + \beta_3{}^* D1 + u_t \qquad (3)$$

The variable $D1$ is used to capture effects prior to the real plan, which, as has been noted, correspond to a period of uncontrolled inflation. In contrast, the interactive variable $d(Cred_t^{pri} / Y_t)^* D2$, is used to evaluate the effects of the change in the credit/income ratio since the subprime mortgage crisis, in other words from the first quarter of 2007 until the first quarter of 2010 (dummy $D2$), on the dependent variable $d(Cons_t^{fam} / Y_t)$.

The estimated parameter $\hat{\beta}_1$ will indicate the effect of the explanatory variable $d(Cred_t^{pri} / Y_t)$ on the dependent variable $d(Cons_t^{fam} / Y_t)$ throughout the period. Moreover, the sum of the estimated parameters $\hat{\beta}_1$ and $\hat{\beta}_2$ will represent the effect of the variable $d(Cred_t^{pri} / Y_t)$ on the variable $d(Cons_t^{fam} / Y_t)$ in the period between January 2007 and January 2010. The sum of the estimated parameters $(\hat{\beta}_1 + \hat{\beta}_2)$ will reveal the effect of the variable of interest —in this case the joint effect of the variables $d(Cred_t^{pri} / Y_t)$ and $d(Cred_t^{pri} / Y_t)^* D2$— on the dependent variable $d(Cons_t^{fam} / Y_t)$ during the crisis period. In this way, the repercussions of the counter-cyclical policies implemented by the government during the financial crisis can be evaluated. This procedure will also be applied to the other estimations.

The results shown in table 1 represent the estimation of equation (3), which is basically used to analyse how credit, in its various versions, affected family consumption. It can firstly be seen that all of the estimated parameters are statistically significant at the 95% confidence level, except for the parameter representing the intercept $(\hat{\beta}_0)$.

According to the statistics shown in table 1, a 10% increase in the credit variable, specifically through $d(Cred^{pri} / Y)$, is associated with an increase of about 6.1% in family consumption, $d(Cons_t^{fam} / Y_t)$, In other words, credit really does have an effect on aggregate demand through consumption in the period analysed.

The sum of the estimated parameters $\hat{\beta}_1$ and $\hat{\beta}_2$ is 0.095, which means that a 10% increase in credit, $d(Cred^{pri} / Y)$, elicits an increase of about 1% in family consumption, $d(Cons_t^{fam} / Y_t)$ in the crisis period. This shows that the counter-cyclical credit policy implemented by the government to combat the negative effects of the external imbalances had a positive effect on family consumption.

As expected, the dummy variable $D1$ had a negative effect on the family consumption variable, which suggests that the price instability period prior to the real plan reduced family purchasing power and, consequently, had a negative effect on families' final consumption. Looking beyond the effects of the 2008 and 2009 financial crisis, the result of the dummy variable $D1$ is quite interesting, since it clearly shows that the loss of control over prices acted as an inflation tax on society, with a negative effect on final consumption.[5]

Continuing the analysis of the effects of the counter-cyclical monetary and credit policies, equation (3) was modified to incorporate the real interest rate, as shown in equation (4)

$$d(Cons_t^{fam} / Y_t) = \beta_0 + \beta_1^* d(Cred_t^{pri} / Y_t) + \beta_2^* d(Cred_t^{pri} / Y_t)^* D2 + \beta_3^* d(r_{t-1}) + \beta_4^* d(r_{t-1})^* D2 + u_t \quad (4)$$

[5] The regression was adjusted on the basis of an autoregressive moving average (ARMA) model, so that the residuals were turned into a white noise process. The estimated coefficients of AR(1), AR(3), MA(2), MA(3) and MA(4) are statistically significant at the 5% level. This aims to reaffirm the validity of the regression. The correlogram of the residuals was verified and revealed a white noise process.

TABLE 1

Estimation of equation (3): Effect of credit on family consumption
(January 1991-January 2010)

Variable	Coefficient	Standard deviation	Student t-statistic	P-statistic
Intercept	<0.001	0.004	0.275	0.784
$d(Cred^{pri} / Y)$	0.608	0.049	12.272	<0.001
$d(Cred^{pri} / Y)^* D2$	-0.513	0.181	-2.839	0.006
D1	-0.023	0.010	-2.261	0.027
AR(1)	-0.333	0.087	-3.820	<0.001
AR(3)	-0.644	0.089	-7.215	<0.001
MA(2)	-0.226	0.094	-2.417	0.018
MA(3)	0.726	0.086	8.416	<0.001
MA(4)	0.428	0.077	5.540	<0.001
R^2	0.787		F-statistic	29.648
Durbin-Watson (DW)	1.903		P-statistic (F-statistic)	<0.001

Source: Prepared by the authors.
Note: Equation estimated by ordinary least squares (OLS).

To simplify, throughout this article variables expressed as rates (such as the rate of change of the credit/ income ratio, and the rate of change of the real interest rate) are referred to as credit and real interest rate. The results of the estimation of equation (4) are shown in table 2.

The statistics set out in table 2 show that the estimated parameters $\hat{\beta}_1$ and $\hat{\beta}_3$ are statistically significant at the 95% confidence level. Moreover, the parameter $\hat{\beta}_2$ is marginally significant at the 10% significance level. These results suggest that a 10% increase in the credit variable is associated with an increase of around 3.5% in family's final consumption, the sum of the estimated parameters $\hat{\beta}_1$ and $\hat{\beta}_2$ is 0.155, which means that a 10% increase in credit produces a 1.5% increase in family consumption during the crisis period.

The estimated parameters strengthen the hypothesis that the credit policy implemented to mitigate the effects of the global crisis in Brazil was effective, because it had a positive effect on family consumption. These estimations corroborate those shown in table 1.[6]

It can also be seen that a 1% reduction in the variable $d(r_{t-1})$, representing the real interest rate, involves an increase of 0.005% in final family consumption during the period analysed. The estimated coefficient of the interactive variable $d(r_{t-1})^*D2$ is statistically zero at -0.005, which implies that the change in the real interest rate during the crisis period did not affect the change in family consumption. An explanation for that result could be that, when purchasing durable consumer goods, consumers use the financing term as a control variable rather than the interest rate,[7] to ensure that installments are compatible with the availability of income.[8]

2. Counter-cyclical effects of monetary and credit policies on gross fixed capital formation (investments)

This subsection evaluates the repercussions of the real interest rate and lending to the private sector on gross fixed capital formation (FBCF). The analysis was based on the Keynesian investment function,[9] which is expanded to incorporate the credit variable.

$$FBCF_t = \beta_0 + \beta_1{}^*Y_t + \beta_2{}^*r_t + \beta_3{}^*Cred_t{}^{pri} \qquad (5)$$

Normalizing equation (5) through aggregate income gives the following function:

$$FBCF_t / Y_t = \beta_0 + \beta_1{}^*r_t + \beta_2{}^*(Cred_t{}^{pri} / Y_t) \qquad (6)$$

[6] The inclusion of the real interest rate resulted in a loss of significance for the dummy variable *D*1, which refers to the pre-real plan inflationary period, and consequently was rejected from the model.

[7] The basic issue for the consumer would not be the interest charges paid but adapting the loan to his or her budget.

[8] In this case, the regression was also adjusted on the basis of a ARMA process, so that the residuals became white noise. The estimated parameters AR(1), AR(4) and MA(2) are statistically significant at the 1% level. Lastly, the correlogram of the residuals verified the white noise process.

[9] A complete version of the Keynesian investment function would require the inclusion of a variable representing business expectations.

TABLE 2

Estimation of equation (4): Effect of credit and the real interest rate on family consumption
(January 1991-January 2010)

Variable	Coefficient	Standard deviation	Student t-statistic	P-statistic
Intercept	-0.0005	0.002	-0.222	0.824
$d(Cred^{pri} / Y)$	0.355	0.066	5.397	<0.001
$d(Cred^{pri} / Y)^*D2$	-0.200	0.117	-1.709	0.087
$d(r_{t-1})$	-0.005	0.002	-2.089	0.037
$d(r_{t-1})^*D2$	0.006	0.007	0.861	0.389
AR(1)	-0.339	0.076	-4.444	<0.001
AR(4)	0.605	0.068	8.819	<0.001
MA(2)	-0.353	0.100	-3.517	<0.001
R^2	0.710		F-statistic	14.689
Durbin-Watson (DW)	2.103		P-statistic (F-statistic)	<0.001

Source: Prepared by the authors.
Note: Equation estimated by ordinary least squares (OLS).

The coefficients $\hat{\beta}_1$ and $\hat{\beta}_2$ are expected to be negative and positive, respectively. In other words, a reduction in real interest rates is expected to stimulate investment, which would also receive incentives as a result of the credit expansion. Transforming the variables into rates of change gives the equation (7).[10]

$$d(FBCF_t/Y_t) = \beta_0 + \beta_1{}^{*}d(r_t) + \beta_2{}^{*}d(Cred_t^{pri}/Y_t) + \beta_3{}^{*}d(Cred_t^{pri}/Y_t){}^{*}D2 + \beta_4{}^{*}d(r_t){}^{*}D2 + u_t \quad (7)$$

The results for equation (7) are set out in table 3 and show that the estimated parameters $\hat{\beta}_0$, $\hat{\beta}_2$, $\hat{\beta}_3$ and $\hat{\beta}_4$ are not statistically significant at the 95% confidence level. These results are revealing, since they show that the change in the real interest rate did not have effects on the variation of FBCF (investment) in the analysis covering the whole period. This may suggest two consequences: (i) the key factor in the level of investment is entrepreneurial expectations; and (ii) the interest rate which in fact is used to finance a substantial part of private sector investment, is not the economy's basic interest rate or the SELIC.[11]

Another interesting result concerns the statistically zero effect of changes in credit policy during the crisis period. Here again, this result could be related to the pessimistic climate among the business community. Thus, negative expectations for the future of the economy would make credit policy less effective in stimulating new investments during the crisis period. In the climate of pessimism caused by the world recession and, to a lesser extent the domestic one, entrepreneurs opted to postpone investments.

On the other hand, the coefficient $\hat{\beta}_1$ is statistically significant at the 95% confidence level, so credit can be seen as a decisive factor for investments. This estimation can be interpreted as follows: a 10% increase in credit generates an increase in investment of about 4% over the whole period. As that parameter was not altered in response to an expansionary credit policy in the crisis period, $\hat{\beta}_1 + \hat{\beta}_2 = 0.434 + 0 = 0.434$.[12]

3. Counter-cyclical effects of fiscal policy on output

Having evaluated the effects of credit operations and the real interest rate on family consumption and FBCF (investments), the analysis is now extended to measure not only the effects of monetary and credit policy on output, but also those of fiscal policy. The estimated equation is shown below.

$$Hiato_t^{pib} = \beta_0 + \beta_1{}^{*}Hiato_{t-1}^{r} + \beta_2{}^{*}Hiato_{t-1}^{r}{}^{*}D2 + \beta_3{}^{*}Hiato_{t-1}^{imp/Y} + \beta_4{}^{*}Hiato_{t-1}^{imp/Y}{}^{*}D2 + \beta_5{}^{*}Hiato_{t-1}^{cred/P} + \beta_6{}^{*}Hiato_{t-1}^{cred/P}{}^{*}D2 + \beta_7{}^{*}(IMP/Y)^2 + u_t \quad (8)$$

[10] The aim of this is to eliminate risks of spurious regression. The stationarity of the variables can be seen in table A.2 of the appendix.
[11] The relevant rates would be those of the BNDES and other government lending institutions.
[12] The estimated regression was adjusted on the basis of a MA(24) process, so that the residuals displayed a white noise process. The validity of the estimated regression was thus guaranteed.

TABLE 3

Estimation of equation (7): Effect of credit and the real interest rate on gross fixed capital formation
(January 1991-January 2010)

Variable	Coefficient	Standard deviation	Student t-statistic	P-statistic
Intercept	0.004	0.007	0.530	0.598
$d(Cred^{pri}/Y)$	0.434	0.188	2.313	0.024
$d(Cred^{pri}/Y)^{*}D2$	-0.487	0.308	-1.582	0.118
$d(r)$	-0.0007	0.003	-0.190	0.849
$d(r)^{*}D2$	-0.0002	0.014	-0.011	0.991
MA(24)	0.911	0.035	26.188	<0.001
R^2	0.724		F-statistic	36.789
Durbin-Watson (DW)	1.971		P-statistic (F- statistic)	<0.001

Source: Prepared by the authors.
Note: Equation estimated by ordinary least squares (OLS). GFCF: gross fixed capital formation.

Basically, equation (8) shows that the output gap, in other words the difference between actual and potential output, is affected by gaps in the interest rate and credit operations (divergence of variable from its trend) —and the tax gap. Estimations of equation (8) are shown in table 4.

The results set out in table 4 show that the estimated parameters are statistically significant at the 95% confidence level except for the parameters $\hat{\beta}_0$, $\hat{\beta}_3$, $\hat{\beta}_4$ and $\hat{\beta}_7$. It can be seen that taxes, in their various specifications, did not significantly affect the output gap and therefore did not help mitigate the effects of the 2008-2009 global crisis. The estimated coefficient of the square of the tax/GDP ratio is also not statistically significant, thereby suggesting the nonexistence of a non-linear relation between the taxes/GDP ratio and the output gap.

The interest-rate coefficient has the expected negative sign, such that a 10% reduction in the lagged interest-rate variable in involves a 0.05% increase in the output gap. Another conclusion can be drawn from the fact that that result is identical to the ratio between the variation in the real interest rate and the variation in family consumption. Although the coefficient $\hat{\beta}_1$ is statistically different from zero, it is nonetheless very small, which reveals the low elasticity of the output gap with respect to changes in interest rates.

During the crisis period there was a larger negative effect of the real interest rate gap on the output gap. The sum of the estimated parameters $\hat{\beta}_1$ and $\hat{\beta}_2$ produces a negative result of -0.05, which means that 10% reduction in the interest-rate in the crisis period involves a 5% improvement in the output gap —so expansionary monetary policy had a significant effect on the recovery process in the Brazilian economy. Comparing the normal period with the crisis period, it can be seen that the power of the interest rate effect increased by 1,000%, specifically in the crisis period.

The tax gap in relation to income is marginally significant at the 10% level. In this case, it can be concluded that a 10% reduction in the lagged tax variable involves an increase of about 3% in the output gap. The interactive variable $Hiato_{t-1}^{imp/Y}{}^{*}D2$ is not statistically significant, however, which shows that counter-cyclical fiscal policy was not statistically significant in explaining the recovery of the Brazilian economy during the crisis period.

In relation to credit policy, the model estimated from equation (8) produced significant coefficients. Specifically, the estimated coefficients for credit —both covering the whole period analysed and the period subsequent to the sub prime mortgage crisis— statistically affect the output gap. Nonetheless, the values are close to 0, which suggests that credit, in the specification given by

TABLE 4

Estimation of equation (8): Effects of the interest rate gap, credit operations and tax gap on the output gap
(January 1991-January 2010)

Variable	Coefficient	Standard deviation	Student t-statistic	P-statistic
Intercept	0.093	0.064	1.462	0.149
$Hiato_{t-1}^{r}$	-0.005	0.003	-2.009	0.049
$Hiato_{t-1}^{r}{}^{*}D2$	-0.045	0.017	-2.547	0.013
$Hiato_{t-1}^{imp/Y}$	-0.305	0.169	-1.804	0.076
$Hiato_{t-1}^{imp/Y}{}^{*}D2$	-0.289	0.372	-0.777	0.440
$Hiato_{t-1}^{cred/P}$	2.48E-07	8.78E-08	2.828	0.006
$Hiato_{t-1}^{cred/P*}D2$	-2.19E-07	1.09E-07	-2.007	0.049
$(IMP_t/Y_t)^2$	-3.103961	2.206929	-1.406	0.164
AR(4)	0.410	0.112	3.656	<0.001
R^2	0.542		F-statistic	9.314
DW	1.511		P-statistic (F- statistic)	<0.001

Source: Prepared by the authors.
Note: Equation estimated by ordinary least squares (OLS).

equation (8), apparently had little effect on the output gap. Similarly, the sum of the parameters $\hat{\beta}_5$ and $\hat{\beta}_6$ produced a significant statistic with the expected sign (positive), but a value close to 0. Nonetheless, as the values of the credit variable are expressed in billions of reais, the repercussion of a very small value, but statistically different from 0, on a very large value, is not negligible. Consequently, based on the model specified by equation (8), it can be stated that credit produced a considerable effect on the output gap.[13]

[13] Here again the regression was adjusted. An AR(4) was estimated, which was statistically significant at the 1% level. The residuals of the adjusted regression thus displayed a white noise process.

Accordingly, based on the results summarized in table 5, it can be inferred that: (i) family consumption responded positively to the expansionary credit policy; (ii) FBCF (investment) was not sensitive to expansionary monetary and credit policies; and (iii) output was sensitive to the expansionary monetary policy implemented through a cut in real interest rates and it responded positively to the credit expansion. Lastly, the expansionary fiscal policy (which involved tax cuts) did not have the effect on output. This is corroborated by evaluating the government's intertemporal constraint. Basically, forgoing revenue or increasing current expenditure should be offset in the near future with restrictive measures that ensure the solvency of the public accounts.

TABLE 5

Summary of the results of counter-cyclical policies

Dependent variable	Monetary policy	Credit policy	Fiscal policy
Family consumption	Ineffective	Effective	Not evaluated
Investment	Ineffective	Ineffective	Not evaluated
Output	Effective	Effective	Ineffective

Source: Prepared by the authors.

IV

Conclusions

The empirical analysis showed that the expansionary credit policy played a key role in boosting family consumption and aggregate output during the crisis. Expansionary monetary policy was also important in increasing aggregate output in the same period. In contrast, investment expenditure did not prove sensitive to the counter-cyclical monetary, credit and fiscal policies. This result can be explained by the high level of uncertainty and negative expectations regarding the future of the economy, which were possibly decisive for entrepreneurs to adopt a more cautious and conservative stance, suspending a large proportion of ongoing investments and cancelling new projects. Thus, from the aggregate-demand standpoint, monetary and credit policies played an important role in the recovery of the Brazilian economy, whereas, fiscal policy proved ineffective in reviving business activity in the country.

It is worth drawing attention to number of points relating to the cost-benefit ratio of the counter-cyclical policies implemented. The empirical results broadly show that, unlike monetary and credit policies, fiscal policy was not a key player in the recovery of economic activity. Apart from possibly providing a minimum benefit, fiscal policy involved a high cost in the form of additional public debt resulting from a larger nominal fiscal deficit. It will be worth studying the consequences of the use of expansionary fiscal policies in future research, since the empirical analysis shows that short-term benefit was minimal, while the cost, even in the short run, was not negligible. Taking a long-term view, the increase in expenditure, particularly permanent expenses (wages and social security, among others), and the reduction in revenue, will require additional measures to restore the fiscal adjustment, and this could reduce resources available for private investment.

(Original: Portuguese)

APPENDIX

TABLE A.1

Description of aggregate variables

Variable	Acronym	Unit of measurement	Source
Final family consumption	$Cons^{fam}$	R$ million	IPEA
GDP at basic prices	Y	R$ million	IPEA
Basic interest rate implemented through the Special Settlement and Custody System (SELIC)	R	Percentages	IPEA
Gross fixed capital formation	*fbcf*	R$ million	IPEA
GDP at market prices deflated by the general price index - domestic supply (IGP-DI).	*pib*	R$ million	IPEA
Inflation rate as measured by the Extended National Consumer Price Index (IPCA)	π	Percentages	IPEA
Lending to the private sector	$Cred^{pri}$	R$ million	IPEA
Product taxes	*imp*	Chained index (ave. 1995 = 100)	IPEA

Source: Prepared by the authors.
Note: Institute of Applied Economic Research (IPEA).

TABLE A.2

Unit root test
(January 1991-January 2010)

Variables	Augmented Dickey-Fuller test (ADF) (SIC)	ADF (SIC)	ADF (SIC)	Phillips-Perron test	Phillips-Perron test	Phillips-Perron test
	Critical value 5%	Student t-statistic	P-statistic	Critical value 5%	Student t-statistic	P-statistic
$(imp/Y)^2$	-3.471**	-2.861	0.181	-3.470**	-4.614	0.002
$d(r)$	-1.946*	-6.563	<0.001	-1.945*	-9.206	<0.001
$d(fbcf/Y)$	-1.945*	-8.511	<0.001	-1.945*	-10.754	<0.001
$d(Cons_t^{fam}/Y_t)$	-1.946*	-4.945	<0.001	-1.945*	-29.860	<0.001
$d(Cred_t^{pri}/Y_t)$	-1.945*	-8.115	<0.001	-1.945*	-8.143	<0.001
$Hiato^{cred}$	-1.945*	-3.203	0.002	-1.945*	-2.636	0.009
$Hiato^{pib}$	-1.946*	-2.196	0.028	-1.945*	-5.728	<0.001
$Hiato^{imp/Y}$	-1.945*	-4.647	<0.001	-1.945*	-4.712	<0.001
$Hiato^{r}$	-1.945*	-8.743	<0.001	-1.945*	-10.310	<0.001

Source: Prepared by the authors.
Notes: (i) H_0: displays a unit root; (ii) One asterisk (*) represents test with constant; and two asterisks (**) represents a test with a constant and trend; (iii) $dx_t = (x_t - x_{t-1})/x_{t-1} = (\Delta x_t/x_{t-1})$.

SIC: Schwartz information criterion.

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