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Ex-post Evaluation of the employment effects of a Preferential Trade Agreement: methodological issues, illustrated with a reference to Chile

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Abstract

This paper presents a discussion of the major methodological issues relating to some key studies assessing the employment effects of a particular PTA using different methodologies (General and Partial Equilibrium, Gravitational models, Micro simulations, Econometrics using panel data, etc.). In this line, the paper discusses an accounting model for decomposing the ex – post employment performance as related to Latin America Preferential Trade Agreements (PTAs), proposing this method to evaluate the Chile – Mexico PTA as an illustration.

The paper defines a research agenda using an Employment ex – post performance decomposition model, to disentangle the effects of different forces on changes in employment. Advantages from implementing this proposal include: a) Availability of a method that could be replicated to study the impacts of PTAs in other countries, both regarding output and employment; b) Development of improved databases for bilateral trade analysis and c) Estimation of sectoral capital stocks, which are an important subject of its own right, for development and growth analysis.

Introduction

The social situation in Latin America presents disturbing trends. This is not just ECLAC's concern.[1] A recent study commissioned by UNDP (Ganuza et al., 2004, pp.1) says: "But, at some point around 1995, growth collapsed, particularly regarding South American countries. The same happened to exports: it was widely hoped that these would provide the kick-off to growth after the reforms, but, in sharp difference with the Asian experience, in Latin America the export-led growth is anything but a development miracle. Growth has not just being slower than under the import-substitution period, but export growth has slowed down and is still mainly composed of primary commodities. Income distribution has worsened… A key question is, then, if the [macroeconomic and trade] reforms are a reason, or at least a contributing factor, to the region's poor performance since the mid-nineties…"

These social trends are related to the employment performance, as employment[2] is the main source of income for most households across Latin America. The employment performance of the Latin American economies has been disappointing after the international trade liberalization and the reforms. As shown recent ECLAC studies, the unemployment rate has hovered above 10% from 2000 onward (Cepal (2004), pp.100), while the labor participation rate stays around 58% (ibid).

Thus, the apparent employment implications of globalization and trade liberalization are questioned by the population. In fact,

1 Cf. Cepal 2004: Panorama social de América Latina, LC/L2220-P/E, ch-1
2 Employment meaning here that the person is actively engaged in a productive activity, whether formal or otherwise.

Gutierrez (2004) found that for Brazil, Chile and Colombia about three fourths of the net employment creation during the nineties came from domestic demand rather than from exports. These trends provide the incentive to look further on the employment effects of PTAs (Preferential Trade Arrangements / Agreements).

The 'first wave' of preferential international trade agreements (PTAs)[3] after the Second World War and up to the sixties was focused in preferential liberalization of merchandise trade, with a key role assigned to tariffs. With the United States reaction to the European Union in the eighties, leading to a number of free trade arrangements (FTA), a 'second wave' of PTAs was launched, but the focus was still mainly in merchandise trade, although a number of other issues emerged, such as non-tariff barriers, dispute resolution and competition policy. In the nineties, a 'third wave' of PTAs arrived, with a larger scope of issues, including trade in services, and investment issues loomed large, together with government procurement, and labor and environmental themes.

Against this background, Latin American countries since the nineties have concluded and implemented a number of PTAs, with potentially significant effects on trade, production and employment. In the literature there is abundant analysis of the ex – ante effects of this activity for the countries involved, for the countries excluded, and for the world at large.[4] The ex – post assessment of these developments for Latin American economies is considerably shorter, although there is a wealth of ex – post studies for Mexico, mainly related to NAFTA.[5] The treatment of the employment effects of Latin American PTAs is rather limited, including the works of Hinojosa-Ojeda (2000), and Guarda et al.(2004a, 2004b) on the Chile – Canada Free Trade Agreement and on the Chile – Mexico FTA, and assessments of trade liberalization for most of the countries of the region by Ganuza et al (2004, 2005).[6] The Chile – Mexico PTAs provide, in fact, an interesting case for two reasons: their South – South nature, and the length of the historical experience: their first PTA was signed in 1991, and implemented in 1992; it was followed by a FTA signed in 1998 and implemented since August 1999.

This paper explores some methodological issues related to assessing the ex – post employment effects of PTAs for Latin America, using the Chile – Mexico PTAs as an illustration. Merchandise trade flows reached $198.9 billions for Mexico in 2003, 206% above their 1991 level, while Chile's merchandise trade reached $38.4 billion dollars that year, a 134% increase above 1991. Bilateral merchandise trade[7] between Chile and Mexico climbed from $ 178 million in 1991 up to $1,397 million dollars in 2003, increasing by 687%. Thus, these PTAs seem to have worked. The questions of the employment implications seem relevant, albeit on a modest scale: bilateral trade is 3.6% of total merchandise trade for Chile, and a mere 0.7% for Mexico. Several reasons suggested choosing Chile to illustrate some methodological points:

- Reasonably long experience with PTAs, within the context of an open economy;
- Data availability, which means not only trade, production and employment data at a particular moment, but for the relatively long period covered by implemented PTAs;

3 A PTA is defined as an arrangement among member countries to reduce or eliminate tariffs and other barriers to trade among themselves. A free trade arrangement (FTA) is a PTA where tariffs among members are nil. They retain, however, differentiated tariff structures vis-à-vis non members, so requiring rules of origin to avoid trade deflection. Cf Panagariya (2000) for a review. The three 'waves' are analysed by Adams et al. (2003).

4 For surveys of the theoretical analysis of PTAs, cf. Pomfret (1997) and Panagariya (2000). Pomfret also gives an historical analysis.

5 Cf. Agama & McDaniel (2002), Haar et al. (2004), Hilberry & McDaniel (2002), Ianchovichina et al. (2001), Kose et al. (2004), Márquez & Pagés (1997), Martinez-Vazquez, Jorge & Duanjie Chen (2001) and World Bank staff (2000).

6 This study uses a general equilibrium modeling approach, so is subject to the caveat discussed in section 2.

7 Bilateral data issues are discussed in section 3. The figures quoted here are the simple average from those reported by both countries to the United Nations COMTRADE database. Total merchandise trade data are from IMF Balance of Payments database. There is no publicly available bilateral data on trade in services.

- Stability of macroeconomic policies;
- Little sectoral policy biases.

In section 2 there is a discussion of the major methodological issues, starting with a review of some key studies Section 3 discusses an accounting model for decomposing the ex – post employment performance as related to a specific PTA. The following section discusses some implementation issues of the proposed model for the case of the Chile – Mexico PTA. Section 5 concludes. Some significant trade data problems and methods for dealing with them are discussed in Appendix 3, while Appendix 4 presents results from a gravity model applied at the micro level for some products imported by Chile.

I. Methodological considerations

To assess the employment effects of a particular PTA, it is first required to isolate the effects of a PTA on trade and investment, since these are the two primary mechanisms for generating effects on the PTA members. This section presents a review of existing studies.

A. Review of former studies

The general literature on the relationships between trade and employment is exceedingly vast and there is here no attempt to a full survey. The focus is rather on reviewing studies related to ex – post assessments of employment effects of PTAs in Latin America. A summary of representative studies is provided in Table 1, presenting first those related to trade liberalization and employment, then those dealing with the effects of particular PTAs on employment.

TABLE 1

EX-POST ASSESSMENTS OF EMPLOYMENT EFFECTS OF PTAS IN LATIN AMERICA AND THE CARIBBEAN: REVIEW OF STUDIES

Author(s)	Method	PTAs covered	Key findings
Meller & Tokman 1996 (A); Paes de Barros et al. 1996 (B); Saavedra 1996 (C)	Labor content of imports vs. labor content of domestic production (both for domestic consumption and exports), before and after trade reform. No formal model used.	No specific PTA. Rather, the process of trade reform in Chile (A), Brazil (B) and Peru (C), after the 1982 shock (Chile), and their later trade openings for Brazil (1987–1993) and Peru.	Country size affects the impact of trade reform. Larger countries (Brazil) are much more oriented to domestic demand rather than exports. Employment response depends on firm size: large firms reduce employment, while small and micro enterprises increase employment
Márquez & Pagés 1997	Formal model for aggregate employment, which is derived from perfect competition profit maximizing representative firm using a Cobb-Douglass technology. There is explicit recognition of trade policy, represented by several indicators, such as the trade-weighted exchange rate, average tariffs and trade openness.	No specific PTA. The purpose is to assess trade liberalization. The sample includes 18 Latin American and Caribbean countries. A single equation is estimated for the pooled data, using a panel data approach.	Trade liberalization has a small negative direct effect on employment. Real exchange rate appreciation (often has been caused by increased capital inflows after the reforms), also contributes to a negative effect on employment. Trade liberalization has not contributed enough to output growth to compensate the net negative effect on employment. Neither openness nor real exchange rate appreciation affect the unemployment rate. All these results hold also for employment in manufacturing
Levinsohn 1996	Statistical measurement of the behaviour of a panel of Chilean manufacturing establishments using the Davis & Haltiwinge, 1992 approach. Both nonparametric and parametric tests are used with these micro data.	No specific PTA is covered; the study addresses the trade reforms of Chile. The sample period is 1979 through 1986.	Net job creation masks the strong dynamic nature of job creation and destruction. High rates of job reallocation[a] within each sector prevail, even if net job creation is nil In the sample period, about 25% of workers changed jobs each year. No significant differences across firms with different trade orientation (exports, import-substitution or non-tradeables) could be detected: trade orientation did not matter for job performance. Firm size is strongly associated with job destruction.
Pavcnik 2002	A formal micro approach is adopted, using Chilean manufacturing panel data. The study models productivity through a production function, using semiparametric estimation.	No specific PTA is covered; the study addresses the trade reforms of Chile. The sample period is 1979 through 1986.	Trade liberalization increased manufacturing plant productivity, particularly for the import-competing sector. This result is robust regarding several indicators for trade exposure, such as import /output ratio, tariffs and exchange rate. The evidence for export-oriented plant is inconclusive, as it could result from responses to the exchange rate. Plant exit ("death") from the industry is a mechanism contributing to productivity gains, as exiting plants are, on the average, 8% less productive than surviving plants.
Ganuza et al 2004	1. An ex – post decomposition model for growth and the balance of payments 2. General equilibrium (CGE) macro modeling for assessing trade liberalization 3. General equilibrium micro modeling for estimating income distribution effects	Trade liberalization during the '90s across a sample of 16 Latin American and Caribbean countries[b]). Different scenarios are simulated, such as WTO free trade and the implementation of the Free Trade Agreement of the Americas (FTAA).	Economic growth did not significantly increase after trade liberalization Vulnerability to world market fluctuations remained, pointing to insufficient trade diversification. For most countries within the region export growth has been lower than world trade growth, suggesting decreased competitiveness, while import dependency has increased. Structural trade deficits have ensued, turning the countries more dependent on foreign capital. Using the macro CGE model the simulation under little wage increase closure leads to an increase in employment, under the trade liberalization scenarios.
Casacuberta et al. 2004	Microeconomic model of production function, estimated using a panel data approach for Uruguayan manufacturing establishments. The indicator for trade opening is the change in the formal average tariff rates	The study addresses the 1982-1995 period in Uruguay manufacturing industry, considering both, unilateral tariff reductions and Mercosur (PTA with Argentina, Brazil and Paraguay)	Trade openness (as measured by average tariffs) led manufacturing firms to change their productive processes to technologies that were more capital-intensive, increasing labor productivity (but not capital productivity). Job creation was significantly below job destruction, resulting in net job losses, arising mainly from both downsizing of surviving firms and collapse of less competitive ones. Labor unions were able to partially mitigate the job destruction effects Job creation did not vary by firm size, but job destruction is stronger for small firms, so net job losses are higher for them. Net job destruction effects were similar for white and blue collar workers

Table 1 (continuation)

Author(s)	Method	PTAs covered	Key findings
Guardia et al. 2004a	Partial equilibrium static analysis to estimate trade creation and trade diversion for the traded goods. Based on the estimate of the increase in exports, estimation of the economywide effect on employment, using the 1996 input-output matrix. The analysis is focused on the effects on the Chilean economy.	Canada – Chile (Free Trade Agreement operating since July 1997)	Net total welfare gains from trade creation of $19.8 million (fob) for Chile, for ($6.9 million from exports plus $12.9 millions from imports). Net employment increase of 13 thousand jobs for Chile, due to $276 million (fob) increase in exports of goods. The jobs created by the PTA represent a 3.4% of total net job created during the 1997-2003 period.
Guardia et al. 2004 b	Partial equilibrium analysis to estimate trade creation and trade diversion for the traded goods. Based on the estimate of the increase in exports, estimation of the economy wide effect on employment, using the 1996 input-output matrix. The analysis is focused on the effects on the Chilean economy.	Chile– Mexico Economic Complementation Agreement N° 17, operating since 1992; Free Trade Agreement operating since August 1999)	Net total welfare gains from trade creation of $115 million (fob) for Chile, for 1992-2003 ($72 million from exports plus $46 millions (cif) from imports). Net employment increase of 73 thousand jobs for Chile, due to $883 million (fob) increase in exports of goods. The jobs created by the PTA represent a 6.5% of total net job created during the 1992-2003 period. Foreign direct investment from Mexico into Chile increased from an annual average of $6.7 million (1991-1998) to $ 21.5 million after the FTA (1999-2003)
Hinojosa_Ojeda et al 2000	Formal partial equilibrium modeling, Assuming a CES function for import aggregation (using Armington elasticities which are econometrically estimated at the 4-digit sectors), the potential impact of imports on domestic production is estimated	NAFTA, focused on the Mexico – United States trade	The overall pattern of Mexico – US trade changed radically a decade before NAFTA. The lower tariffs brought by NAFTA have no significant impact on the rate of growth of imports or exports yet. Imports from Mexico due to NAFTA would imply 37,000 jobs lost for the United States (average 1990-1997), while the US economy averaged gross job creation of 2.4 million jobs and a gross destruction of 4.8 million jobs+
Ganuza et al. 2005	Follow Standard Computarized General Equilibrium (CGE) , linked with household micro simulations models to assess the impact of trade liberalization, exchange rate manipulation, capital inflows, and terms of trade changes on output, employment and poverty. Simulation assume that foreign saving is fixed and the exchange rate is flexible.	Trade liberalization across a sample of 16 Latin American and Caribbean countries[b]). Different scenarios are simulated: such as WTO multilateral liberalization and Free Trade Agreement of the Americas (FTAA) implementation.	Result indicate that liberalization increased output, reduced poverty, and had positive effects on employment or wages, but increase skilled-unskilled wage gaps in some countries led to increased income inequality. FTAA and WTO liberalization have positive effects on the level of economic activity and contribute to reducing the poverty incidence in a majority of the countries.
Berrenttoni and Cicowiez 2005	Follow Computerized General Equilibrium (CGE) using GTAP data basis, and household micro simulations	CAN-MERCOSUR Economic Complementation Agreement N° 56 . The main objective was to determine the impact of trade liberalization	Trade Liberalization has a positive increasing effect on employment. These increases are graters in The Andean Community sub region and less in the case of MERCOSUR. Skilled employment register grater increases than unskilled employment. In general trade growth is more than employment growth, especially in countries with more population (Argentina and Brazi).
Botero, 2005	Follow CGE using GAMS and Colombia National Accounts	Economic Employment effects to Colombia of Free Trade Agreement of the Americas (FTAA) and FTA with United States	Liberalization under both scenarios: FTAA and FTA with USA had positive effects on employment, with growth rates of 2.4% and 1.7% respectively. If government apply a policy to increase labor skill un 10%, employment will increase 3.2% and 2.6% under FTAA and FTA within USA.

Source: Author on the basis of different studies referred above

Notes: [a] Job reallocation is defined as the sum of the (absolute values of) job creation plus job destruction;

[b] The 16 countries considers are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Paraguay, and Peru. In Ganuza et al (2005), Guatemala is replaced by Cuba;

As Table 1 shows, only a handful of studies deal specifically with the assessment of employment effects of a particular PTA. Thus, a summary review of the far more numerous studies dealing with the issues of trade liberalization/reforms and employment comes first. Even for this limited purpose there are problems. The three 1996 studies of the cases of Brazil (Paes de Barros et al. 1996), Chile (Meller and Tokman 1996) and Peru (Saavedra 1996) use the same method. As Márquez & Pagés (1997) point out, a significant shortcoming of this approach is that there is no control for other simultaneous events that may affect labor demand (such as output growth, changes in the real exchange rate, across-the-board variations in real wages, other macro policies being implemented at the same time, international commodity price swings, etc). In the case of Brazil, for instance, the study estimates that about half a million jobs were lost between 1987 and 1995, with about 80% of the loss concentrated in 1995. Although the decrease in tariffs meant an increase in imports and some displacement of domestic production, "it is not clear whether this outcome was driven by trade reforms or by the sharp real exchange rate appreciation suffered by Brazil that year" (Márquez & Pagés 1997, pp.4).

The method used by Márquez & Pagés (1997) is also problematic. Although they strive for controlling for the simultaneity bias, the effects of some key forces —say the interest rates or terms-of-trade— are left out. Using a Cobb-Douglass production function imposes constant returns to scale, as well as a unitary elasticity of substitution, features called into question by contemporary trade theory, which uses imperfect competition (with increasing returns to scale) to account for intra-sectoral trade. The use of a single aggregate measure for employment deprives the analysis of the possibility of focusing on important policy issues.

The Levinson (1996) study is a welcome contrast, being devoid of such questionable assumptions. It stands firmly on ex – post ground, but the reported lack of influence of trade orientation may be subject to caveat, considering the serious difficulties for measuring this variable,[8] and the fact that there are numerous forces working on the employment dynamics at the same time, even at the firm level. A sensibility analysis carried out with different definitions of trade orientation would be most welcome, to further test the robustness of Levinson's findings. The microeconomic establishment-based approach can hardly be used to assess PTAs, of course, unless there was a situation where no other significant events were affecting the firm's employment demand, nor the workers supply.

Pavcnik (2002) follows a very careful path to tell her story, using the same 1979-1986 sample panel data on Chilean manufacturing establishments used by Levinson. She corrects the production function for both simultaneity and plant selection bias (arising from ignoring exiting plants). Unfortunately, the production function specification is again Cobb-Douglass, so the caveat mentioned above apply. In fact, she finds that "… the input coefficients also suggest the existence of increasing returns to scale in all sectors, with only slight presence in food processing and the highest in the wood and glass industry" (pp.260). Another potentially significant issue for a study which is based on plant-level data is the fact that trade orientation at the plant level was not available, being approached by the three-digit ISIC aggregate. There are a number of potential problems with this approach, including ignoring secondary output, which in Chile varied from 0.3% to 9.3% in 1996.[9] Finally, this study concentrates on plant productivity, rather than on employment.

The Casacuberta et al. (2004) study is also quite interesting, following the micro-econometric approach of using establishment level panel data, in a similar vein to Pavcnik (2002),

8 For a concise and very readable survey of the issues regarding measurement of trade openness at the macro level, cf. Berg and Krueger (2003).

9 Since these figures are industry aggregates at the 12-sector aggregation used for the 1996 input-output matrix, it should be clear that the figures for particular plants may be significantly higher.

but focused on employment. The employment dynamics are measured as in the Levinson study, by the indicators developed by Davis and Haltiwanger (1992). One issue with this study is the use of average nominal tariffs, which has been severely criticized in the literature on trade openness (Berg and Krueger 2003). It is unclear if the reported results would hold using alternative measures.

The Ganuza et al. (2004) study should be commended, from an ex – post assessment viewpoint, because it uses a balance-of-payments decomposition model, following Fitzgerald & Sarmad (1997). This tool allows for estimating changes in the current account balance decomposed (in a rather detailed way) into those arising from external sources, those due to domestic adjustments, and the effects of interactions. As for the use of a general equilibrium model, it is subject to all the limitations mentioned in the literature[10] (Dee & Gali 2003), making it a fine tool for ex – ante studies (or counterfactuals, as in the present case) rather than for assessing ex – post results.

Guardia et al. (2004a. 2004b) should be congratulated for tackling the ex – post assessment of specific PTAs, those of Chile – Canada and Chile – Mexico, albeit only from the viewpoint of one of the members (Chile). As both studies use the same methods, they are jointly commented. These studies can be viewed as a starting point, as there are several issues suggesting an opportunity for improvements. First, however, it should be pointed out that there are some methodological points which are not clear from the documents: how are the PTAs trade welfare estimates arrived at? Apparently, from the formulas offered, the authors take the values (at constant prices, of course) of imports in years 0 (before the PTA comes into effect) and 1 (later, presumably 2003) without taking into account the shifts in the demand curve (for a discussion, cf. Appendix 1). If they do account for this aspect, it is not mentioned in the documentation. Another issue is how the effect of the PTA on exports is obtained; this is a key aspect for the impact on employment, which relies on getting this vector right; again, the document is silent so the reader wonders if something like the CMS (constant market share) model was used. There is no differentiation of changes in net employment that might arise from sources which are unrelated to the PTA. The changes in the ratio of labor requirement per unit of output during the period (1996 to 2003) are significant, and hardly related to these PTAs, given the small share of final demand they represented. Technological and organizational shifts affecting the coefficients of the Leontief matrix are also a source of concern, as these studies used the 1996 matrix for 2003. As the experience with national accounting reveals, it is highly implausible that there would be any constancy in the coefficients for such an extended period. Services are excluded from the scope of these studies, although some guesstimates can be produced regarding bilateral flows. Last, but not least, the effects of the PTAs on foreign direct investment should be estimated (more on this in Appendix 4), so the vector of final demand, and the vector on capital can be properly incorporated. In short, to move forward, an economywide ex – post assessment requires an output and employment decomposition in the grand tradition of Chenery.

As for Hinojosa-Ojeda et al.(2000), their methodology has appealing features, and is clearly focused on assessing employment effects of a particular PTA, namely NAFTA, from a United States perspective. Among the limitations is the fact that the results are sensitive to the particular functional forms and parameter estimates of the key behavioural assumptions. The use of universal Armington elasticities for both the US and Mexico is probably acceptable in this particular case, considering the flow of technology and the maquila economy. Also, trade diversion is ignored under this methodological approach (Hinojosa-Ojeda et al. 2000, pp.24), but their preliminary analysis of this issue (ibid., pp.67-68) suggests that trade diversion is probably significant only in the garment and textile industries. It would be interesting to compare the results from this

[10] One key limitation is that general equilibrium model results are significantly dependent upon the specific functional forms and numeric parameters used, as well as the equilibrium path exogenously assumed.

behaviorally-based approach with an empirically based one, using, say, a gravity model for directly estimating the PTA ex – post effects on exports and imports.[11] Other limitations of this study are that there is no treatment of services, nor of foreign direct investment, particularly outflows from the U.S. to Mexico.

Berrenttoni and Cicowiez (2005) and Ganuza et al. (2005) following similar methodology, and with different scopes found that trade liberalization has a positive increasing effect on employment. The important conclusion in both papers was that skilled employment register grater increases than unskilled employment, producing an increase skilled-unskilled wage gaps in some countries, leading to increased income inequality. In the case of Ganuza et al. (2005), if countries apply a uniform tariff cut unilaterally, the earnings gap between skilled and unskilled workers was expected to increase in 6 country cases (Brazil, Costa Rica, Cuba, the Dominican Republic, Ecuador and El Salvador), In 7 cases (Argentina, Bolivia, Chile, El Salvador, Nicaragua, Peru and Venezuela), the simulation of further unilateral trade opening shows no substantial shifts in skill inequality. Only in Honduras, Mexico and Uruguay smaller earnings gap was expected. For the case of multilateral WTO liberalization simulation scenarios the skilled/unskilled wage gap showed a skill bias.

The main conclusion of Ganuza et al. (2005) of positive impact of regional and multilateral liberalization (WTO and FTAA), in the sense of reducing the poverty, could be criticized because labor market parameters are crucial to explain variations in poverty and inequality in the micro simulations,[12] in addition, because the models are national with exogenous international prices, taken by CGE simulations, the Panagariya (2000) critique holds.

Botero (2005) makes a calibration to solve a CGE model to evaluate *ex-ante* the Colombian liberalization under two possible scenarios: a) A Free Trade Agreement with United States; and b) the Free Trade Agreement of the Americas (FTAA) implementation. The model considers 52 sectors for imports, 42 for exports and seven trade blocks or countries (United States, Venezuela, the rest of the Andean Community, Mercosur, the rest of FTAA, European Union and the rest of the world).[13] To evaluate the model, total tariff cuts are assumed in each simulation. As the set-up also considers labor market, results indicate not only GDP impact, but also employment effects. Particularly liberalization had positive impact on employment, increasing more under FTAA than in FTA with the United States. Additionally if government apply a policy to increase labor skill in 10% —an arbitrary assumption—, the employment growth rate could be greater than in previous cases (see table 1).

The next section summarizes a critical view on the different approaches taken to empirically analyze PTAs, both using the equilibrium model and the gravity model approach. It also provides an overview of the Yeats method for static assessment.

[11] Chávez & Rivadeneyra 2002 provide an estimate for NAFTA effects on Mexican merchandise trade using a gravity model. Their model, however, is for aggregate exports and imports, without sector de-aggregation.

[12] The approach of micro simulation applied in Ganuza paper assume that occupational shifts may be proxied by a random selection procedure within a segmented labor market structure. This procedure allows one to impose counterfactual changes in key labor market parameters (participation rate, unemployment, employment composition by sectors, wage structure, etc.) on a given distribution derived from household survey data and estimate the impact of each change on poverty and income distribution at the household level. Originally, this type of methodology of counterfactual microsimulations was used by Orcutt (1957) for tax incidence analysis in developed countries, and more recently used by Almeida dos Reis and Paes de Barros (1991) for an analysis of inequality in the full distribution of earnings. (For more details see Gupta and Kapur, 2000; Frenkel and Gonzales, 2000, and Ganuza el al, 2000).

[13] This country classification allows the use of Armington assumption and the definition of eight types of compound goods: The domestic, and those of each one of the trade blocks or countries considered in the model.

B. Some considerations regarding empirical assessments of PTAs

Practitioners have essentially taken one of two approaches to assessing actual PTAs. The first approach has been to conduct a conterfactual analysis, based either on partial equilibrium models (say Hinojosa-Ojeda et al. (2000) for the NAFTA impact on US employment), or on general equilibrium models.[14] The second approach is using the bilateral trade gravity equation.

1. Equilibrium model PTAs assessments

Regarding equilibrium models, the procedure is to assume a certain model structure, with specific functional forms and parameters (numerically specified), calibrated to a base period, usually some year before the PTA.[15] The model is then given an exogenous shock, usually by changing the tariffs; non-tariff provisions of the PTA are somehow transformed into tariff equivalencies. From this shock comes a new equilibrium of the model, so the difference with the base year equilibrium provides the effects that can be attributed to the PTA. Panagariya (2000, pp.326) notes two major problems with this approach.

First, the use of Armington elasticities.[16] These are derived assuming that demand for a good is differentiated according to its geographic origin. This assumption then implies that each country enjoys some monopoly power, but the small countries union assumes no change in the terms-of-trade, so these two assumptions are inconsistent.

Second, even if there were no significant inconsistencies from the previous point, there remains the problem of functional forms and numeric parameters. Panagariya (2000, pp. 326) criticizes the use of Stone-Geary utility functions or the linear expenditure system to represent demand functions, as these strongly limit the possibilities of substitution effects.[17] In a more general vein, the use of particular functional forms for ex – post assessment, given the unknown nature of the true model(s) and the limited empirical base of this approach, turn it into a risky venture.

Surveys of assessments of PTAs using general equilibrium models include De Rosa (1998), Scollay and Gilbert (2000) regarding APEC, and Robinson and Thierfelder (2002). The surveyed CGE studies suffer from a significant number of theoretical and practical difficulties, as indicated by Adams et al. (2003, pp. 31), including fixed terms of trade (which is inconsistent with a PTA), ignoring non-tariff barriers and exemptions such as rules of origin or provisions of local content, and provisions related to non-merchandise trade. Parameters are usually imposed from the researchers prior beliefs,[18] although ordinarily related to some estimates in the econometric literature. Thus, this type of models are useful for ex – ante assessments of PTAs, but one must turn to other tools for ex – post PTA evaluation.

At an aggregate level, PTA effect might be derived from a production function and the change in output associated with the increase in trade arising from the PTAs. Thus, at a very

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14 For a review of models applied to Chile, most of which are focused in the Chile – USA FTA, cf. Cabezas (2003). A recent model designed to assess the aggregate effects of both the Chile – European Union and the Chile – USA FTAs is Chumacero et al. (2004).

15 Please note that this procedure assumes that in the base year the economy is in long – term equilibrium.

16 Named after Armington (1969).

17 Panagariya (2000, pp.326) indicates that if the PTA partner's product present a high degree of substitutability with that of the outside country, but low substitutability with the product of the home country, then an FTA is likely to be harmful. He adds that "even the widely used, standard CES utility function rules out this possibility by assumption".

18 As an illustration, Harrison et al. (1997, pp.15), evaluating trade policy options for Chile, assumed a central value of 30 for the imports elasticity of substitution, meaning a 1% increase in the tariff rate would drive the imported quantity down by 30%. Their 'low' value is an elasticity of 8. These values, of course, reflect implicit assumptions regarding the composition of the products (and sectors of activity), i.e., the product mix bundled under each product category in their study.

aggregate level, a result such as the one-shot 1% increase in Chile's GDP stemming from the combined effects of the EU and NAFTA PTAs with Chile (Chumacero et al. 2004, pp.19) could be used to assess the employment implications. Since that study indicates that 80% of the gain in GDP accrues to higher total factor productivity (TFP), one can infer that the increase in employment due to these PTAs would hardly be larger than 0.1%, considering a labor share of 50% in value added. In fact, if the European Union and the United States continue signing free trade agreements with other countries —as has been their policy— then the advantages for Chile will be further reduced, with the corresponding decrease on the overall employment effect. This type of erosion of temporary PTA advantages is clearly taking place within NAFTA, with Mexico losing to China. And there is a significant list of new U.S. FTAs either signed or in the pipeline, such as CAFTA, Jordan, Singapore, Morocco, Australia and the South African Customs Union,[19] plus Colombia, Ecuador and Peru.

2. Gravity model PTAs assessments: an introduction

By contrast to the equilibrium modeling approach outlined above, ex – post studies of actual PTAs attempt to measure trade effects applying econometric methods, controlling for other influences. The gravity model is the key econometric tool applied. The model was originally formulated by Tintner, by an analogy to physics, stating that trade between two countries is positively related to their size and negatively related to their distance. As the literature on the gravity model increased, so did eventually their theoretical foundations. The gravity model can be theoretically derived as a reduced form from a general equilibrium model of international trade in goods.[20] A prime example under neoclassical assumptions is provided by Deardorff (1995), where the gravity model is derived from applications of the Hecksher – Ohlin model. In the first application, the gravity model is applicable if demands are uncorrelated with supplies, under the assumption of identical and homothetic preferences. In the second application, the gravity model works if countries produce different goods and preferences are represented by Cobb – Douglass or CES forms. A particularly interesting example of the economic theory behind the gravity model is provided by Anderson & van Wincoop (2001), which they carefully develop to reach a reduced form equation, which they empirically estimate, and apply to (partially) solving the so called "border puzzle" of trade among Canadian provinces compared to their trade with U.S. states (inter-provincial trade being many times larger than provincial-state trade, in spite of seemingly small barriers between Canada and the United States).

Redding & Venables (2003) proposal for evaluating PTA welfare effects based on a rigorous, sophisticate, theoretically derived gravity model, is criticized by Balitreri and Hillberry (2004), not on theoretical grounds, but on the practical implications of their empirical estimates. The reduced form gravity model proposed by Redding and Venables (2003) is developed from the insight that a country's export performance is the result of the interplay of two groups of forces: those related to external demand and those flowing from domestic supply. The 'external geography' of a country —its geographic location, particularly if it is near (or within) a fast-growing region that will generate dynamic demand for its exports— is a prime factor regarding demand for a country exports, contributing to what they label as 'foreign market access'. What these authors call the 'internal supply capacity' depends on the country 'internal geography' (such as access to ports) and business environment (such as institutional quality). An attractive feature of their method is that they provide a rigorous, theoretically based decomposition of export performance, a major step forward from the old fashioned CMS approach mentioned above.

[19] Botswana, Lesotho, Namibia and South Africa.

[20] Adams et al. (2003, pp.31) mention Baier & Bergstrand (2001) deriving the gravity model from a model of monopolistic competition; Feenstra, Markusen and Rose (2001) derive it from a model of reciprocal dumping with trade in homogenous goods.

The literature on using the gravity model for assessing (static effects) of trade creation / trade diversion effects of Mercosur are reviewed in Adams et al. (2003, pp.44), where they cite six studies published between 1995 and 2001

Last, but not least, an important extension of the gravity model is to the assessment of foreign direct investment, as FDI is mentioned as a major reason for undertaking PTAs. Adams et al. (2003) provide a recent example of such an application. This is an area of significant interest, but the literature on it is still rather scarce.

Appendix 4 presents an exploratory analysis of gravity equations for Chile.

3. The Yeats method for static evaluation of PTAs effects on trade

Yeats (1997) developed a method for empirically assessing the effects of Mercosur on Argentina and Brazil. First, he defines an indicator of 'regional orientation' for a product j, Rj, specified by:

$R_j = A_j / B_j$

Where

A_j = Share of exports of j to PTA partner within total exports to partner

B_j = Share of exports of j to ROW (rest of the world) within total exports to ROW

This RO (regional orientation) index will take values from zero to infinity. A value of 1 indicates the same export participation rate for the PTA member as for the rest of the world. It should be stressed, however, that this index does not provide, per se, evidence on the effects of a PTA (Mercosur, in Yeats example). The index may be shifting through time for a number of reasons that are unrelated to the PTA itself, such as the PTA partner growing faster than the world average, or the ROW markets of j's export shifting for their own reasons (fiscal and monetary policies, differing growth rates, etc).

The second indicator applied by Yeats is the 'revealed comparative advantage', RCA_j,
Again related to a specific product j, and defined as

$RCA_j = C_j / D_j$

Where

C_j = share of exports of product j to ROW over total exports from this country to ROW.

D_j = share of world exports of product j over total world exports of all products.

Although this method applied by a virtuoso may yield useful insights on the implications of PTAs when there are widespread effects (as in the case of Mercosur), given the serious limitations of this method to disentangling PTA effects from other causes that may be generating the observed results, it is not further discussed.[21]

[21] Adams et al. (2003, pp. 45) indicate that Nagarajan (1998) criticizes the Yeats application to Mercosur, due to emphasizing intra-block trade compared to extra-regional exports, when it should focus on extra-regional imports.

II. Employment ex – post performance decomposition model

A. Introduction

The aggregate employment implications of a particular PTA may be rather small, as indicated for the combined effects of the Chile —European Union and Chile— US FTAs studied by Chumacero et al (2004), as already mentioned.[22] On a sectoral basis, however, effects may be significant, as some activities may enjoy gains or endure losses distinctly different of the economy-wide aggregate. Regarding trade effects on goods, the gravity model can be used to estimate the ex – post impacts on a product-by-product base. Regarding services, there are generally no bilateral trade data available, but two indirect, rough indicators might be estimated for transport and tourism; these are discussed in section 6. For foreign direct investment, if a gravity model gives adequate results, ex–post PTA effects may be estimated for the Chile – Mexico case. Since there are a number of forces which affect the observed performance of employment, including technological and organizational changes, it is not simply a matter of measuring the direct proportions that the PTA presents regarding trade.

These considerations suggest a strategy for tackling the ex–post employment implications of a PTA:

22 Remember the combined effect would increase employment by 0.1% in the long run.

a) Estimate the PTA effect on exports and imports by sector using the gravity model. The estimation might be applied selectively, using a filter to identify those products which are more interesting. A simple criterion might be the trade intensity index, choosing those products with a higher than average index, or those exhibiting significant dynamism (and a significant share at the final year). Another criterion might select products based on their relative labor intensity. In all cases, appropriate quantum indicators should be used. As a check, some estimate of elasticities should be generated, so the two alternative approaches could be confronted. Rough guesstimates for trade in services should be done, at least for the two major categories, tourism and cargo shipping.

b) Same for the PTA effects on foreign direct investment (as done by Adams et al. 2003).

c) Design an accounting structure for explicitly recognizing the PTAs effect within the demand – supply economy-wide balance.

d) Define mechanisms linking the changes in the economy-wide balance with the identified PTA direct effects. Ideally, these links should be as 'mechanical' as possible, to diminish the behavioral content of the results, so as to increase their robustness.

e) Apply the above system to the relevant period(s)

Section 6 discusses some practical implementation issues of this strategy. Now we must proceed to define the accounting structure.

B. Conceptual accounting structure

Since the interest is focused on the economy-wide employment effects, the national accounts system (SNA)[23] provides a natural framework. To start from a simple structure, consider the layout of Table 2. Each element of the structure is given a label, with the codename convention depicted in the table.

The following naming conventions apply:

C = Column vector
M = Matrix
R = Row vector
S = Scalar

[23] Cf. United Nations et al. (1993) for the official guidelines regarding the SNA.

TABLE 2
CONCEPTUAL ACCOUNTING STRUCTURE FOR PTA EFFECTS ANALYSIS
(Compact Scheme)

Interindustry matrix	N° of rows	Intermediate demand	Intermediate demand	Final consumption	GFAF	Exports of goods and nonfactor services	Changes in Stocks	Final demand	Total demand
Product origin by industry		1. By industry	2. Total	3. Total	7. Total	10. Total	11. Total	12. Total	13. Total
Number of columns --->		n	1	1	1	1	1	1	1
5. Total inputs	n	M_CIT	C_CIT	C_CFT	C_FAFT	C_XT	C_CST	C_DFT	C_DT
6. Total inputs aggregated	1	R_CIT	S_CIT	S_CFT	S_FAFT	S_XT	S_CST	S_DFT	S_DT
7. Value added	1	R_VA	S_VA						
8. Taxes on products	1	R_TXQ	S_TXQ						
9. Total output at basic prices	1	R_VBB	S_VBB						
10. Employment	1	R_EMP	S_EMP						

Source: Author, on the basis of United Nations et al. (1993).

To save space, the sectoral structure is not detailed within the table. The method, in fact, is quite independent of a particular sectoral taxonomy. For the application to the Chile – Mexico case, though, it may be of interest to apply a classification such as,

- Primary products
- Manufactured products
    - Natural-resource-based products
    - Low-tech products
    - Medium-tech products
    - High-tech products
- Services
    - Non-tradeables (primarily construction)
    - Transportation (excluding tourism)
    - Communications[24]
    - Tourism
    - Other services (financial, business, personal, social and public administration)

This suggested classification requires ten sectors.

There are six data rows and 8 data columns in table 2. Following the SNA conventions, the rows display the structure of supply and the columns that of demand. The entire economic activity of a country is thus covered and the economy-wide balance is clearly depicted. A summary review of the accounting structure is presented below.

The first row of table 2 (labeled “5. Total inputs”) refers to the n sectors of economic activity (n = 10 in the suggested sectoral taxonomy); this row shows the inputs delivered by each of the n sectors to the components of demand. The components of demand are intermediate demand, final demand, and their sum, total demand. Total inputs include both domestically produced inputs and imported inputs, hence its name.

[24] Although conceptually these should exclude communications related to tourism, in practice data limitations would preclude such separate treatment.

The second row (labeled 6) is the sum of the n preceding rows, providing the “Total input aggregated” vector. The third row is value added, the fourth is taxes on products[25] and the fifth is total output (at basic prices). The last row (labeled 10) is employment, which is the ultimate focus of interest.

The first data column (labeled “1. By industry”) records intermediate demand by each of the n industries. Thus, it shows the inputs required by each sector, so the element M_CIT is the n x n matrix of total intermediate demand.[26] The second column is the column-wise sum of the first column, hence total intermediate demand. The third column is final consumption, then comes gross fixed asset formation, exports of goods and nonfactor services and changes in stocks, adding up to final demand. The last column records the sum of intermediate and final demand. All columns other than the first have a single number of columns, as shown.

All flows are recorded at (constant) basic prices, and employment is recorded in labor units (such as man-hours). The SNA balances apply, defining the accounting relationships, such as:

R_CIT + R_VA + R_TXQ = R_VBB

In the simple scheme of Table 2 there is no room for an explicit accounting of the flows related to the PTA. Moving to a more complex accounting structure, consider Table 3. In the rows, total inputs supplied to the demanding columns are now split according to their origin, into domestically produced (row 1) and imported (row 4), both detailed in n rows according to the sectoral taxonomy. Then, for intermediate demand, matrix M_CIT is now the sum of matrices M_CIN + M_CIMT. Similar balances apply to other columns, so C_DFT = C_DFN + C_DFM (final demand balance), and C_DT = C_DTN + C_DTMT, which allow relating Table 2 and Table 3. Total exports of goods and services (column 10 in table 2) are now split in those exports generated by the PTA (col. 8) and those unrelated to the PTA (col. 9).

Five rows have been added to those shown in the preceding table (see table 3). Manufactured (i.e. man-made) capital formation (row 11) is gross fixed assets formation allocated to each user sector, so it complements the column 7, which displays this variable by sector of origin, as is usually provided by national statistics. Row 12 is the corresponding depreciation (consumption of fixed capital in the SNA terminology). Rows 13 to 15 are not flows, but record stocks of total manufactured capital (row 13), in machinery and equipment (row 14) and in structures (buildings, row 15). Again, the usual balances apply, so the capital stock at year end equal the initial stock, plus the gross fixed asset formation, less the depreciation. The reason for extending the standard SNA table with this information will become apparent below.

But a PTA may generate not only specific exports. It also affects imports and may affect foreign direct investment flowing into the country, so the accounting structure must deal with these phenomena. Thus the final accounting structure is presented in Table 4. Total imported supply (row 4) is split in two: the PTA-related imports (row 2) and the remaining imports (row 3). The balances are kept, so M_CIMT = M_CIMA + M_CIMB for intermediate demand by industry. In a similar vein, total gross fixed assed formation (column 7) is split on its PTA and non-PTA components by sector of origin (columns 4 and 5, which add up to column 6). Column 7 is now the column-wise sum of column 6. The final accounting structure is thus of size (5n+10 rows) x (4n + 9 columns), n being the number of sectors in the economy.

[25] This refers to special taxes (net of subsidies). General taxes such as VAT are left out, since the whole table is set up at basic prices, not at purchaser prices.
[26] The M_CIT matrix name stands for total intermediate consumption, spelled backward. It forms the core of the input-output analysis.

Table 3

CONCEPTUAL ACCOUNTING STRUCTURE FOR PTA EFFECTS ANALYSIS

(Middle Scheme)

Interindustry matrix	N° of rows	Intermediate demand	Intermediate demand	Final consumption	GFAF	Exports of goods and nonfactor services			Changes in Stocks	Final demand	Total demand
Product origin by industry		1. By industry	2. Total	3. Total	7. Total	8. PTA	9. Non PTA	10. Total	11. Total	12. Total	13. Total
Number of columns --->		n	1	1	1	1	1	1	1	1	1
1. Domestic origin supply	n	M_CIN	C_CIN	C_CFN	C_FAFN	C_XNA	C_XNB	C_XN	C_CSN	C_DFN	C_DTN
4. Imported supply, total	n	M_CIMT	C_CIMT	C_CFMT	C_FAFM	C_XMA	C_XMB	C_XM	C_CSM	C_DFM	C_DTMT
6. Total inputs aggregated	1	R_CIT	S_CIT	S_CFT	S_FAFT	S_XA	S_XB	S_XT	S_CST	S_DFT	S_DT
7. Value added	1	R_VA	S_VA								
8. Taxes on products	1	R_TXQ	S_TXQ								
9. Total output at basic prices	1	R_VBB	S_VBB								
10. Employment	1	R_EMP	S_EMP								
11. Manuf.capital formation	1	R_FAF	S_FAF								
12. Manuf.capital depreciation	1	R_KDEP	S_KDEP								
13. Manuf.capital stock	1	R_KST	S_KST								
14. Manuf.capital stock in Machinery & Equipment	1	R_KSE	S_KSE								
15. Manuf.capital stock in structures (buildings)	1	R_KSC	S_KSC								

Source: Author, on the basis of United Nations et al. (1993).

Table 4

CONCEPTUAL ACCOUNTING STRUCTURE FOR PTA EFFECTS ANALYSIS

(Detailed Scheme)

Interindustry matrix	N° of rows	Intermediate demand	Intermediate demand	Final consumption	Gross fixed asset formation by sector of origin			GFAF	Exports of goods and nonfactor services			Changes in Stocks	Final demand	Total demand
Product origin by industry		1. By industry	2. Total	3. Total	4. PTA	5. Non PTA	6. Total	7. Total	8. PTA	9. Non PTA	10. Total	11. Total	12. Total	13. Total
Number of columns --->		n	1	1	n	n	n	1	1	1	1	1	1	1
1. Domestic origin supply	n	M_CIN	C_CIN	C_CFN	M_FAFNA	M_FAFNB	M_FAFN	C_FAFN	C_XNA	C_XNB	C_XN	C_CSN	C_DFN	C_DTN
2. Imported supply, PTA related	n	M_CIMA	C_CIMA	C_CFMA	M_FAFMAA	M_FAFMAB	M_FAFMAT	C_FAFMA	C_XMAA	C_XMAB	C_XMAT	C_CSMA	C_DFMA	C_DTMA
3. Imported supply, non PTA related	n	M_CIMB	C_CIMB	C_CFMB	M_FAFMBA	M_FAFMBB	M_FAFMBT	C_FAFMB	C_XMBA	C_XMBB	C_XMBT	C_CSMB	C_DFMB	C_DTMB
4. Imported supply, total	n	M_CIMT	C_CIMT	C_CFMT	M_FAFMTA	M_FAFMTB	M_FAFM	C_FAFM	C_XMA	C_XMB	C_XM	C_CSM	C_DFM	C_DTMT
5. Total inputs	n	M_CIT	C_CIT	C_CFT	M_FAFA	M_FAFB	M_FAFT	C_FAFT	C_XA	C_XB	C_XT	C_CST	C_DFT	C_DT
6. Total inputs aggregated	1	R_CIT	S_CIT	S_CFT	R_FAFA	R_FAFB	R_FAFT	S_FAFT	S_XA	S_XB	S_XT	S_CST	S_DFT	S_DT
7. Value added	1	R_VA	S_VA											
8. Taxes on products	1	R_TXQ	S_TXQ											
9. Total output at basic prices	1	R_VBB	S_VBB											
10. Employment	1	R_EMP	S_EMP											
11. Manuf.capital formation	1	R_FAF	S_FAF											
12. Manuf.capital depreciation	1	R_KDEP	S_KDEP											
13. Manuf.capital stock	1	R_KST	S_KST											
14. Manuf.capital stock in Machinery & Equipment	1	R_KSE	S_KSE											
15. Manuf.capital stock in structures (buildings)	1	R_KSC	S_KSC											

Source: Author, on the basis of United Nations et al. (1993).

C. Decomposing changes in employment

The ex – post analysis of changes in employment should ideally disentangle the separate effects of the forces bearing on employment in a particular period. The employment effects of a particular PTA require that it be traced to those (previously identified)[27] changes in trade and investment, as recorded in the accounting structure. One way of doing this is to adapt the inter-industry growth decomposition methodology pioneered by Chenery (1960), and later applied to study the sources of growth by Dervis, de Melo and Robinson (1982, pp.92 ff). The key notion is that employment is the result of two variables: output and average labor productivity. This approach was used at ECLAC for the study of changes in employment in Brazil, Chile and Colombia during the nineties (Gutierrez 2004).

Using the accounting structure outlined above and the decomposition methodology,[28] it is possible to decompose the change in total output and employment into changes arising from:

- Final consumption of domestically produced products;
- Gross capital formation from domestically produced products (separated into PTA- and non-PTA –related investment);
- Exports (separated into PTA- and non-PTA – related components);
- Imports substitution (separated into PTA- and non-PTA – related components);
- Changes in input-output coefficients.

The changes in the input-output coefficients take place as the technology changes, and may be linked to changes in the corresponding sectoral capital stocks. These, in turn, can also be decomposed into changes arising from the gross investment (separated into that related to the PTA or otherwise), so eventually it might be feasible to provide a further decomposition.

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27 That identification is achieved through the application of the gravity model.

28 An illustration of the type of relationships and the formal decomposition analysis (without the complexities arising from isolating the PTA effects) is presented in Appendix 1.

III. Decomposition model implementation issues

The decomposition model outlined above places a significant burden on the historical data required to implement it. These data issues may be grouped in four major categories.

1. General SNA data: The accounting structure must be estimated, at constant prices, for the period starting before the PTA and for later years.[29] As Chile does not produce an annual inter-sectoral table, it will have to be estimated through updating procedures, taking into account all the available information. There are several procedures for this purpose, such as those proposed by Robinson & El-Said (2000).

2. International economy data: The direct trade and investment effects of the Chile – Mexico PTAs will have to be estimated from the corresponding gravity models, using the COMTRADE data base for trade volumes, and the Chilean data for foreign direct investment.[30] The trade in goods data will first have to be reconciled. The data for bilateral trade in services will have to be guesstimated from the trade in goods (transport and insurance) and tourism (arrivals). Data on exchange rates, unit value of exports and imports, tariffs and other relevant indicators will have to be collected and

[29] For a number of practical reason, data will have to be updated since 1986, as there are no inter.-sectoral data afterwards up to 1996.

[30] For more detailed sectoral allocation of investment, as required by columns 4 to 6, this data must be supplemented with individual project data from other sources, such as CONAMA or SII.

processed from a number of sources, mainly from the UN system.

3. Employment data: Generally, the BADEHOG database provides data at the third ISIC digit, for even years starting in 1990 up to 2000.[31]

4. Capital stock: Total capital stock estimates are available from André Hofman,[32] Statistics Division, ECLAC. Sectoral capital stock estimates will have to be developed for the manufacturing industry (from the ENIA survey) for the years before 2001. Sectoral capital stock estimates are also available from 2001 on for the services sector. From this data, an aggregate estimate can be generated for the remaining sector (primary activities, i.e. agriculture, fishing and mining).

[31] It is expected that the new data to be released around March 2005 will cover 2003.

[32] These refer to variables S_KST, S_KSE, and S_KSC.

IV. Concluding remarks

This paper explores some methodological issues related to assessing the employment effects of PTAs for Latin America, using the Chile – Mexico PTAs as an illustration. It proposes a research agenda using a well-known method, following the grand tradition from Chenery,[33] for decomposing the effects of different forces on changes in employment. Several advances would be gained by implementing this proposal:

- Availability of a method that could be replicated to study the impacts of PTAs in other countries, both regarding output and employment
- Development of improved databases for bilateral trade analysis
- Estimation of sectoral capital stocks, which are an important subject of its own for development and growth analysis
- Policy guidelines or lessons from the Chilean experience that may be useful to other countries

Afterwards, the method can be expanded to tackle the ex – post assessment of other issues, such as gender or the environment (provided environmental matrices are estimated for the period).[34]

[33] For a modern exposition, cf. Dervis, de Melo & Robinson (1982).

[34] In the case of employment only one vector is required (or a matrix of size 2 x n for gender analysis). For environmental analysis, since several indicators must be related to each sector of activity, a matrix is required.

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Appendix

Appendix 1

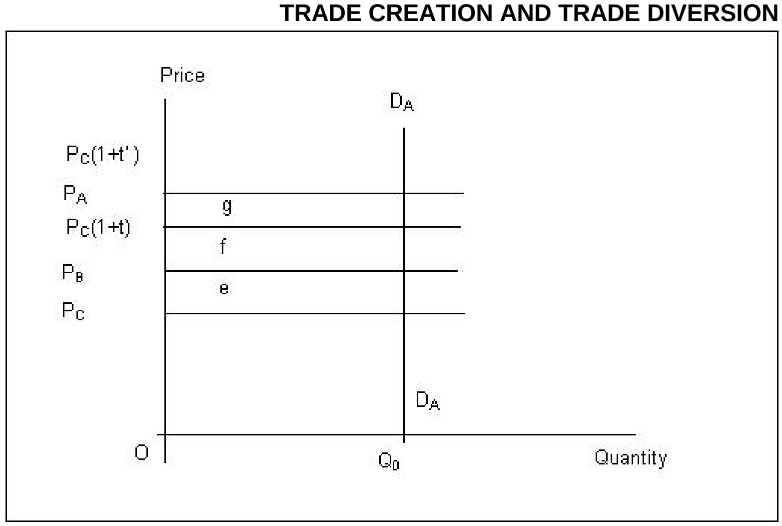
Brief review of the theory of PTAs

This appendix draws heavily from Adams et al. (2003), which is itself mostly based on the book edited by Bhagwati, Krishna and Panagariya (1999), and from the surveys by Pomfret (1997) and Panagariya (2000). The concerns related to the first wave of PTAs generated a body of literature focused on the static effects of PTAs on trade flows and to what extent they would benefit members countries individually, as a group and the world at large. The second wave shifted the focus on the dynamics, asking if PTAs were ‘building blocs’ or ‘stumbling blocs’ to a free-trade world. The third wave is asking to the implications of the non-trade provisions of the PTAs, for members individually and collectively, as well as for the excluded countries and the world as a whole. Given the focus of this paper on employment, welfare implications of PTAs are only sketched below.

1. Static welfare effects of a PTA: The simplest case

Given an initial situation where there are tariffs on imports,[35] a PTA reduces one source of economic distortion by decreasing tariffs among members, but increases another distortion, the geographic disparity in tariffs (discrimination against suppliers from different sources). Thus, a PTA can create trade, improving welfare by shifting production from high-cost domestic producer to lower-cost PTA partner. But it can divert trade, reducing welfare by shifting the source of supply from the lowest-cost supplier (a non-member) to a favored PTA member. The simplest way to introduce these concepts is a model with infinite supply elasticity and zero demand elasticity, as is Figure 1, taken from Panagariya’s (2000). Let us assume that there are three regions: country A, country B and region C (the rest of the world).[36] Countries A and B engage in a PTA. The analysis is carried out from A’s viewpoint.

Figure 1
TRADE CREATION AND TRADE DIVERSION



Source: Panagariya (2000).

[35] The case of tariffs on exports is ignored, given the fact that is has restricted empirical relevance.
[36] In all countries it is assumed that there is perfect competition and constant returns to scale. Price is thus equal to cost.

Assume that country A's demand for a particular product (steel in Panagariya's example) is given by the vertical line D_AD_A. Producers in A, B and C have constant returns to scale, producing at supply curves P_A, P_B and P_C. By assumption, $P_A > P_B > P_C$, with A being the least efficient producer and C the most efficient one.[37] Assume that B applies a (per unit) tariff to imports larger than

(P_B-P_C), so there are no pre – PTA imports from C into B. The pre – PTA situation in A is that A has a nondiscriminatory (*ad valorem*) [38] tariff t, such that $P_A > P_C$ (1+ t) > P_B, so the entire quantity demanded is imported by A from C. Before the PTA, the price paid by A's consumers is P_C (1 + t), with the area (rectangles e + f) collected in tariff revenues by A's government. The fiscal revenue is supposed to be distributed to A's consumers (income distribution policy). After the PTA signed by A and B, country A removes the tariff on B, while keeping it on C. Since P_C (1+ t) > $P_{B,}$ now A imports from B rather than C., at price P_B. As there is no new trade, the change merely substitutes the more efficient C for B; this is trade diversion, in Viner's denomination (Viner 1950). Country A losses the tariff revenue (e + f), with rectangle e used to pay to B's higher-cost suppliers, and rectangle f increasing A's consumer surplus, so the net loss to A (and the world at large) is rectangle e.[39]

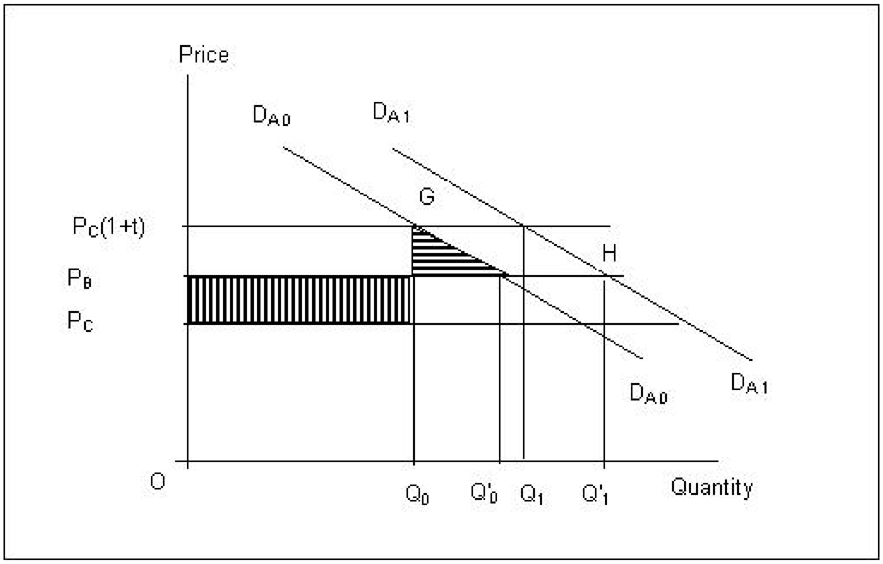
If the initial situation is a higher nondiscriminatory tariff rate t' such that PC (1 + t') > PA, then the demand is initially wholly supplied by domestic producers at price PA (assuming perfect competition within A). After the PTA, supply is shifted to B. The gain to A's consumers is the surplus of the rectangles (f + g). Then the PTA is trade – creating, even though B is not the lowest cost producer (Viner 1950, pp. 43), since it creates trade between A and B. The welfare of B and C is not changed. Since the benefits of trade creation (rectangles f + g) may be larger or smaller than the losses of trade deviation (rectangle e), it cannot be inferred the net welfare gain or loss from OQ0 alone.

2. Keeping it simple: Elastic demand case

Assume now that the demand curve is elastic. For simplicity, A's supply is ignored, so the demand curve may be thought of as A's demand for imports (demand less domestic supply). Figure 2 provides an illustration of this case. The (imports) demand curve for A is $D_{A0}D_{A0}$ (ignore curve $D_{A1}D_{A1}$ for the time being), so the initial (pre – PTA) equilibrium is at point G. After the PTA, the equilibrium is at the intersection of P_B and Q'_0 , There is trade creation, with imports increasing by (Q_0 – Q'_0); A's consumers welfare increases by the horizontally hatched triangle, while they lose the vertically hatched rectangle, as this fiscal revenue is transferred to B's suppliers. The net welfare effect is thus the difference between the two areas.

[37] This assumption is particularly relevant to developing countries, particularly if they are not large.
[38] Panagariya's example is with per unit tariff, rather than an ad valorem tariff rate.
[39] In this very simple model it is implicitly assumed that the additional income flowing to B and the loss to C are exactly compensated.

Figure 2
WELFARE GAIN UNDER TRADE DIVERSION PRE AND POST PTA EQUILIBRIUM



Source: Authors.

3. A complication: Demand shifts

Now consider that there is an exogenous demand shift, for example due to rising income in country A (unrelated to the PTA). The original case was with the flows related to a particular period, say the year immediately after the PTA was formed (period 0), depicted by curve $D_{A0}D_{A0}$ in figure 2. With the new demand curve $D_{A1}D_{A1}$ the post – PTA equilibrium is point H. The trade volume implication of the PTA is ($Q_1 – Q'_1$), with the welfare effects being the difference between the new triangle and the rectangle (P_B - P_C) Q_1. Now the only actually observed points are the two prices P_B and P_C, and the traded volumes Q_0 and Q'_1 . Any statement regarding the ex – post effects of the PTA for country A consequently requires some estimate of A’s actual imported demand function.[40] If the applied analysis seeks to assess the ex – post effects over a number of years, these must be assessed as the sum of the annual effects (for welfare, a time discount rate would presumably be applied). Please note that an explicit recognition of demand shifts requires a modification of the standard formula used for static assessment. Using the standard formula provides biased estimates, as it is clear from the figure.

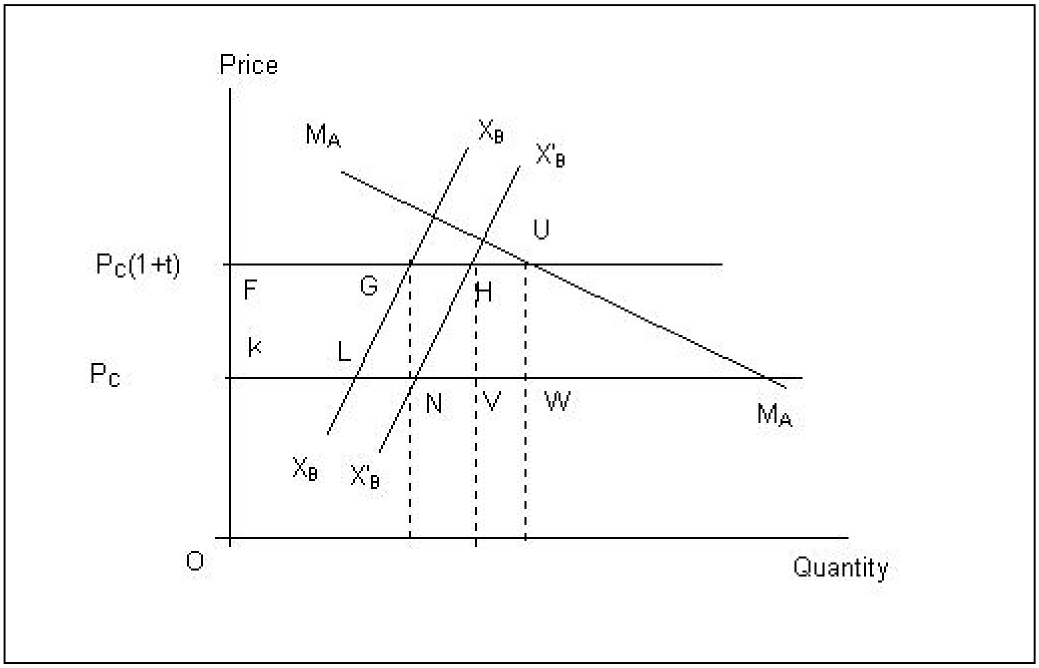
4. Enter the elastic supply

Let us now consider a more realistic case, where B’s export supply is elastic,[41] The initial situation is depicted in Figure 3, with B’s exports supply being X_B X_B, while A’s import demand is given by M_A M_A . The introduction of an elastic supply changes fundamentally the picture, as now A’s imports are not concentrated in a single supplier. Market equilibrium before the PTA is at point U, with A importing FG from B and GU from C; A collects the rectangle FUWK as fiscal revenue. After the PTA between A and B, from the viewpoint of A’s importers B’s supply shift downwards to X'_B X'_B , by the full amount of the tariff.

40 Sometimes the use of Leamer and Stern (1970) constant market share (CMS) models is proposed, but the CMS model relationship to microeconomic fundamentals is thin. For a critical review of CMS, cf. Richardson (1971), pp. 230ff.

41 For simplicity, only the case where B’s supply is not large enough to meet all of A’s demand is considered. For a more detailed treatment, cf. Panagariya (2000), pp.295 ff. Both A and B are assumed to be small enough not to affect world prices (small-union case).

Figure 3
PREFERENTIAL REMOVAL OF A TARIFF PTA BETWEEN A AND B



Source: Author.

Then A's imports from B increase from FG to FH, while those from C decrease from GU to HU. A has a fiscal revenue loss of FHVK (which implies a net welfare loss of that amount, under the fiscal redistribution to consumers assumption),[42] collecting now only HUWV. Country B experiences a net gain of FHNK, and the union of A and B experiences a net loss of triangle HVN. From an observational point of view, only points G and U are observed before the PTA. Since some time later (after the PTA) both A's demand curve (and maybe also B's supply function) will have shifted, the new observation will provide point U_1, rather than U, again requiring (at least) to have some estimate of the import demand function. In fact, if world price P_C has shifted after the PTA, it will not be possible even to know where the new point G lays, unless there is an estimate of B's supply function, as only the new point H will be observed.

5. Beyond partial equilibrium

The Meade – Lipsey model[43] of general equilibrium treats the effects of a PTA on two small countries (A and B), with C being again the rest of the world. Suppose there are three goods: country A specializes completely in producing good 1, exporting it to B and C; country B specializes in good 2, exporting it to A and C, while C produces all three goods, and exports good 3 to A and B. Country C is large enough that A and B cannot influence prices in C. Choose units so that the prices of all three goods in C are unity. Figure 4 (taken from Panagariya (2000)) provides an illustration of market equilibrium before and after the PTA.

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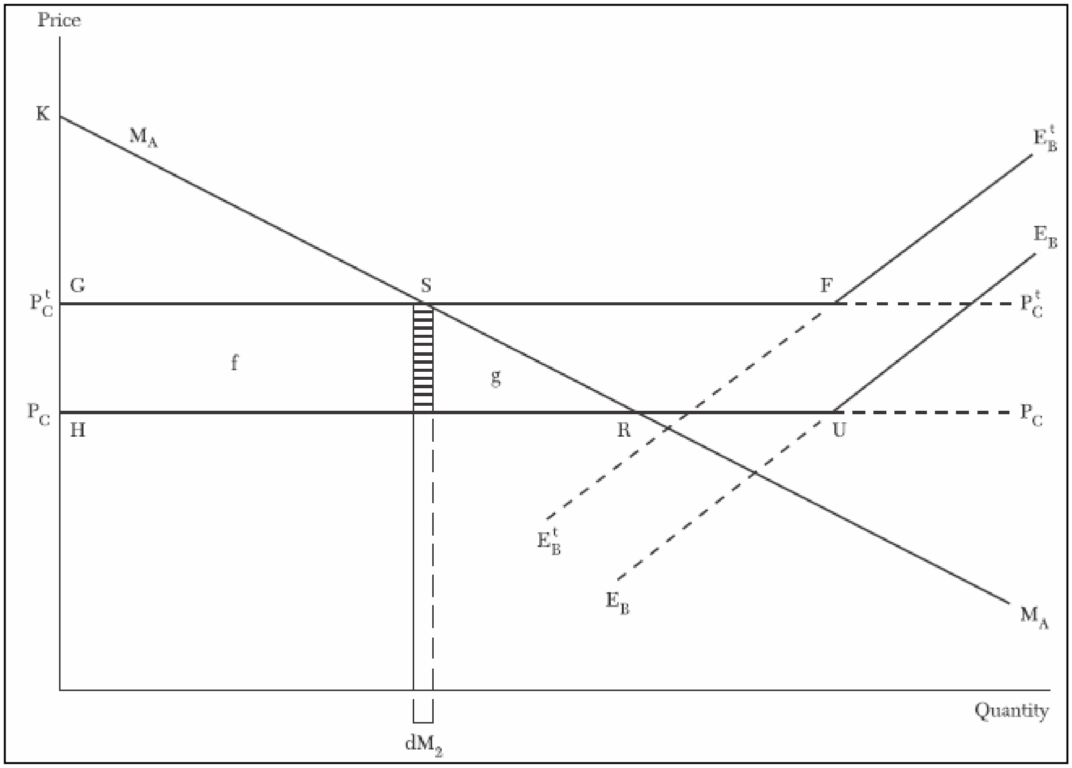
42 This assumes there is an efficient social transfer mechanism for transferring this fiscal revenue to A's consumers.
43 Meade (1955) proposed a three-good model, and he focused on the effects of PTA on world welfare. Lipsey (1958) analyzed the implication of a PTA for the member countries, under the assumption of a small-union case.

Figure 4

THE EFFECT OF PREFERENTIAL REMOVAL OF TARIFF; CASES IN WHICH PREFERENTIAL LIBERALIZATION COINCIDES WITH NON-DISCRIMINATORY LIBERALIZATION



Source: Panagariya (2000).

Consider country A, which initially imposes tariffs $t_2 = t_3 = t$ on goods 2 and 3. Since prices in C are all 1, prices in A are (assuming no transportation costs) 1, $1 + t_2$ and $1 + t_3$, for goods 1, 2 and 3. The PTA involves reducing t_2 without reducing t_3. The effect of this PTA on sector 2 lowers the price of good 2 in A, leading to trade creation in this sector. Assuming the reduction in t_2 is small, the increased imports of good 2 is dM_2, and the welfare gain is represented by t_2dM_2 (shaded rectangle in Figure 4). Since one is now considering general rather than partial equilibrium, assuming that all three goods are substitutes, the reduction in the price of good 2 will lead to a decline in the demand for goods 1 and 3. Imports of good 3 fall, while exports of good 1 rise. With good 3 being imported from C, this is trade diversion; this, in turn, corresponds to a welfare loss, as A's fiscal revenue from this imports falls. For the small change assumed, this can be written as t_3dM_3 , and the net welfare effect depend on whether $t_2dM_2 + t_3dM_3$ is above or below zero. It can be proved that this net effect, for a small decrease in t_2, leads to a net welfare gain. However, deepening the PTA to further reduce t_2 will at some point start decreasing the net contribution to welfare, as t_2 tends to zero and is not able to compensate the welfare loss of the substitution effect on good 3.

This model suffers from several limitations.[44] Panagariya (1999) proposes a model that eliminate these restrictions, demonstrating that a FTA increases or reduces the union joint welfare as it increases or decreases the value of the union-wide production, valued at world prices. Most interestingly, if the production of the numeraire good (produced and exported by both A and B,

44 Limitations include (1) there are no incentives for liberalization coordination between members, (2) no allowance for the same product being imported from two sources; (3) no arbitrage of producer prices within the union; and (4) only applied to infinitesimal changes in tariffs.

which are assumed to be small countries) requires only labor, while the production of all other goods requires also another specific factor, then the FTA necessarily lowers the value of the union output (at world prices), hence reducing the joint union welfare.

The case of large countries PTAs is not reviewed here, as most Latin American economies, and certainly Chile, can be classified as being close to the small country case. Suffice to say that, for large countries, PTA trade diversion may well be welfare increasing, due to the improvement in their terms-of-trade.[45]

[45] Cf. Panagariya (2000), pp. 302 ff.

Appendix 2

Decomposition model to evaluate employment ex-post performance in FTAs

An illustration of the decomposition approach to assess ex – post employment changes is provided here. The illustration is taken from Gutierrez 2004. This illustration does not include the PTA effect decomposition.

Table A-1

FACTORS RELATED TO EX – POST CHANGES IN PRODUCTION AND EMPLOYMENT

Key	Factor description
A	Overall effect (net addition of factors B to I)
B	Domestic Final Demand scale changes
C	Exports scale changes
D	Domestic Final Demand product mix changes
E	Exports product mix changes
F	Changes in the import / domestic supply to satisfy Final Demand
G	Changes in the import / domestic supply to satisfy Intermediate Demand
H	Techno – organizational changes
I	Changes in inventories (stocks)

Source: The autor.

Notation: Vectors are in lowercase, matrices in uppercase. Subscripts d, e and s refer to domestic demand, exports and changes in stocks.

Table A-2

FINAL DEMAND STRUCTURE AND ALGEBRAIC SYMBOLS

Product Origin	Domestic Demand	Exports	Changes in stocks	Final Demand
Domestic	n_d	n_e	n_s	f_d
Imported	m_d	m_e	m_s	m_{df}
Total	d	e	s	f

Source: The autor.

Accounting identities:

$$f = f_d + m_{df} \quad (1)$$

$$f_d = n_d + n_e + n_s \quad (2)$$

$$m_{df} = m_d + m_e + m_s \quad (3)$$

$$d = n_d + m_d \quad (4)$$

$$e = n_e + m_e \quad (5)$$

$$s = n_s + m_s \qquad (6)$$

$$f = d + e + s \qquad (7)$$

Final demand supplied from imported products (m_d, m_e, y m_s) may be expressed as functions of the ratio matrices,[46] i.e. the imported shares of final demands

$$m_d = M_d \bullet d \qquad (8)$$

$$m_e = M_e \bullet e \qquad (9)$$

$$m_s = M_s \bullet s \qquad (10)$$

Note: The operator • refers to the matrix product.

Substituting (8), (9) y (10) in (4), (5) and (6) final demand supplied by domestic products is given by

$$n_d = d - M_d \bullet d \qquad (11)$$

$$n_e = e - M_e \bullet e \qquad (12)$$

$$n_s = s - M_s \bullet s \qquad (13)$$

Equations (11), (12) y (13) allow expressing final domestic demand (**f_d**) as

$$f_d = N_d \bullet d + N_e \bullet e + N_s \bullet s \qquad (14)$$

where I is the identity matrix and

$$N_d = I - M_d \qquad (15)$$

$$N_e = I - M_e \qquad (16)$$

$$N_s = I - M_s \qquad (17)$$

The change in final domestic demand between two periods (identified as years 0 y 1)[47] is represented by Δf_d, defined by

$$\Delta f_d = f_{d0} - f_{d1} \qquad (18)$$

So, applying (14) to (18) gives

$$\Delta f_d = N_{d1} \bullet d_1 + N_{e1} \bullet e_1 + N_{s1} \bullet s_1 - N_{d0} \bullet d_0 + N_{e0} \bullet e0 + N_{s0} \bullet s_0 \qquad (19)$$

Which, grouping related elements, can be expressed as

46 All elements of these matrices, except the main diagonal, are zero.

47 The notation 0 and 1 does not imply the intervening interval is one year.

$$\Delta f_d \;=\; (N_{d1} \bullet d_1 - N_{d0} \bullet d_0) + (N_{e1} \bullet e_1 - N_{e0} \bullet e0) + (N_{s1} \bullet s_1 - N_{s0} \bullet s_0) \quad (20)$$

Considering the change in domestic demand in (20) gives

$$N_{d1} \bullet d_1 - N_{d0} \bullet d_0 \;=\; (N_{d1} \bullet d_1 - N_{d1} \bullet d_0) + (N_{d1} \bullet d_0 - N_{d0} \bullet d_0) \quad (21)$$

Which can be expressed as

$$N_{d1} \bullet d_1 - N_{d0} \bullet d_0 \;=\; N_{d1} (d_1 - d_0) + (N_{d1} - N_{d0}) d_0 \quad (22)$$

Corresponding to changes in demand (**Δd**) and in the coefficients of the national output ratios (**ΔN**), i.e.

$$N_{d1} \bullet d_1 - N_{d0} \bullet d_0 \;=\; N_{d1} \bullet \Delta d + \Delta N_d \bullet d_0 \quad (23)$$

In a similar vein, the change in exports[48] is given by

$$N_{e1} \bullet e_1 - N_{e0} \bullet e_0 \;=\; N_{e1} \bullet \Delta e + \Delta N_e \bullet e_0 \quad (24)$$

so the change in domestic final demand becomes

$$\Delta f_d \;=\; (N_{d1} \bullet \Delta d + \Delta N_d \bullet d_0) + (N_{e1} \bullet \Delta e + \Delta N_e \bullet e_0) + (N_{s1} \bullet s_1 - N_{s0} \bullet s_0) \quad (25)$$

Considering that changes in the coefficients of domestic production (ΔN) correspond to changes in the penetration of imports for final use, the terms of (25) may be rearranged to highlight the changes arising from the domestic and external demand (Δd and Δe) and changes in the coefficients

$$\Delta f_d \;=\; (N_{d1} \bullet \Delta d + N_{e1} \bullet \Delta e) + (\Delta N_d \bullet d_0 + \Delta N_e \bullet e_0) + (N_{s1} \bullet s_1 - N_{s0} \bullet s_0) \quad (26)$$

It is interesting to highlight that the effects of **ΔN** may be positive (imports substitution) o negative (imports penetration). Now, the change in demand (**Δd**) arises from combining two different effects: changes in the scale of demand and changes in the product mix within each sector. The first effect may be detected by a vector whose elements vary in the same proportion as the corresponding aggregate variation. If a scalar $\boldsymbol{\alpha_d}$ is defined by

$$\alpha_d \;=\; \sum d_0 / \sum d_1 \quad (26)$$

then vector δ, whose elements vary in the same proportion than the corresponding aggregate variation, may be given by

$$\delta \;=\; \alpha_d\, d_1 \quad (27)$$

In the same way, for exports a scalar $\boldsymbol{\alpha_e}$ is defined by

$$\alpha_e \;=\; \sum e_0 / \sum e_1 \quad (28)$$

which allows obtaining a vector $\bar{\mathbf{e}}$, whose elements vary in the same proportion than the corresponding aggregate variation, given by

48 No significant re-exporting is considered

$$\bar{e} = \alpha_e e_1 \qquad (29)$$

Using (27) to express $\mathbf{\Delta d}$ gives

$$\Delta d = (d_1 - \delta) + (\delta - d_0) \qquad (30)$$

Where the first term represents the scale effect and the second the product mix change. In a similar manner, for exports one has

$$\Delta e = (e_1 - \bar{e}) + (\bar{e} - e_0) \qquad (31)$$

So, considering the labels of Table A-1, equation (26) may be expressed by

$$\Delta f_d = \text{Effect B} + \text{Effect C} + \text{Effect D} + \text{Effect E} + \text{Effect I} \qquad (32)$$

where

$$\text{Effect B} = N_{d1} \bullet (d_1 - \delta) \qquad (33)$$

$$\text{Effect C} = N_{e1} \bullet (e_1 - \bar{e}) \qquad (34)$$

$$\text{Effect D} = N_{d1} \bullet (\delta - d_0) \qquad (35)$$

$$\text{Effect E} = N_{e1} \bullet (\bar{e} - e_0) \qquad (36)$$

$$\text{Effect F} = \Delta N_d \bullet d_0 + \Delta N_e \bullet e_0 \qquad (37)$$

$$\text{Effect I} = N_{s1} \bullet s_1 - N_{s0} \bullet s_0 \qquad (38)$$

Analyzing now intermediate consumption, there are two effects affecting employment, as indicated in Table A-1: Effect G (import penetration) and Effect H (techno – organizational change). Disentangling these requires considering the structure of supply, represented by the Leontief technology. The matrix of total intermediate consumption coefficients (A) is given by the addition of the matrix of domestic inputs (A_d) plus the matrix of imported inputs[49] (A_m):

$$A = A_d + A_m \qquad (39)$$

Changes in the A matrix arise from the combined interaction between strictly technological changes, coupled to organizational changes.[50] A measure of these techno – organizational changes between years 0 and 1 is provided by matrix T for the ratios for the total coefficients, so the element i,j of T is defined by

$$T_{ij} = A_{ij\,0} / A_{ij\,1} \quad (\text{if } A_{ij\,1} > 0) \qquad (40)$$
$$T_{ij} = 1 \quad (\text{if } A_{ij\,1} \equiv 0)^{51}$$

49 Please note this is an accounting approach. No behavioral assumption is assumed, although it can be argued that adding them up implies that both types of inputs are perfect substitutes. If desired, a matrix of substitution coefficients could be included later into the analysis.

50 An important force behind these changes are changes in relative prices. However, the **A** matrices are estimated at constant relative prices within the national accounts. Thus this unobserved effect is submersed within the techno –organizational effect.

51 A negative value is possible if a method such as negative transfer valuation is used for secondary products. (cf. United Nations 1993).

Now comes a behavioral assumption: assume that the change in the use of an input for a particular purpose is not dependent upon the input origin, so it is applied for both domestic and imported inputs.[52] In such a case the change in the use of imported inputs can be decomposed into two components, namely those arising from the techno – organizational change and those arising from the imports / domestic substitution. The first element is given by the matrix $\tilde{A}_m$, defined by

$$\tilde{A}_{m\,1} = T \times A_{m\,1} \tag{41}$$

where x is a product operator.[53] Applying (41) to (39) the matrix of domestic inputs for year 1 may be represented by

$$A_{d1} = A_1 - A_{m\,1} = (A_1 - \tilde{A}_{m\,1}) + (\tilde{A}_{m\,1} - A_{m\,1}) \tag{42}$$

For year 0 the relationship is obviously given by

$$A_{d0} = A_0 - A_{m0} \tag{43}$$

The total (direct plus indirect) requirements matrix R for each of these two years is given by

$$R_0 = (I - A_{d0})^{-1} = (I - A_0 - A_{m0})^{-1} \tag{44}$$

$$R_1 = (I - A_{d1})^{-1} = (I - (A_1 - A_{m\,1}))^{-1} - (I - (A_1 - \tilde{A}_{m\,1}))^{-1} + (I - (A_1 - \tilde{A}_{m\,1}))^{-1} \tag{45}$$

and it is clear that (45) explicits the incorporation of techno – organizational change.

In order to link changes in production with changes in employment, consider the direct employment required by one production unit, represented by vector *l*. Define the corresponding diagonal matrix by L.[54] Calling Λ the matrix of total coefficients (direct and indirect labor requirements for each unit of final demand) the following relationship holds:

$$\Lambda = L \bullet R \tag{46}$$

So the level of employment by sector is given by

$$\lambda = \Lambda \bullet f_d \tag{47}$$

Applying (47) to years 0 and 1, the vector of change in employment, Δl, is given by

$$\Delta l = l_1 - l_0 = \Lambda_1 \bullet f_{d1} - \Lambda_0 \bullet f_{d0} \tag{48}$$

Now this relationship can be reshaped to make explicit the change in final demand, Δf_d, and the change in the matrix of labor requirements, $\Delta\Lambda$.

$$\Delta l = \Lambda_1 \bullet f_{d1} - \Lambda_1 \bullet f_{d0} + \Lambda_1 \bullet f_{d0} - \Lambda_0 \bullet f_{d0} \tag{49}$$

$$\Delta l = \Lambda_1 \bullet \Lambda f_d + \Delta\Lambda \bullet f_{d0} \tag{50}$$

[52] This assumption holds if the country can freely import the new technology, which certainly was the case with Chile within the period.
[53] Meaning product X = Y x Z implies that Xij = Yij Zij for element ij, with X, Y, Z being three matrices of the same size.
[54] The matrix **L** has zeros in all elements off the main diagonal.

Considering that equations (32) to (38) provide the formulation for Δf_d, what is required is the expression for **ΔΛ**. To this end, (46) can be applied, giving

$$\Delta\Lambda \quad = \quad L_1 \bullet R_1 - L_0 \bullet R_0 \qquad (51)$$

Replacing (44) and (45) in (51), y rearranging terms gives

$$\Delta\Lambda \quad = \quad L_1 \bullet (I - A_1 + A_{m\,1})\,)^{-1} - L_1 \bullet (I - A_1 + \tilde{A}_{m\,1}))^{-1} \quad + \quad L_1 \bullet (I - A_1 + \tilde{A}_{m\,1}))^{-1} - L_0 \bullet \quad (I - A_0 - A_{m0})^{-1} \qquad (52)$$

Finally, substituting (32) to (38), (52), and (14) in (50) and rearranging gives the expression for the change in employment

$$\Delta l = \Lambda_1 \bullet \left[N_{d1} \bullet (d_1 - \delta) + N_{e1} \bullet (e_1 - \bar{e}\,) + N_{d1} \bullet (\delta - d_0) + N_{e1} \bullet (\bar{e} - e_0)\right] + \Lambda_1 \bullet (\Delta N_d \bullet d_0 + \Delta N_e \bullet e_0\,) + \left[\Lambda_1 - L_1 \bullet (I - A_1 + A_{m\,1})\,)^{-1}\right] \bullet (N_{d0} \bullet d_0 + N_{e0} \bullet e_0\,) + \left[L_1 \bullet (I - A_1 + \tilde{A}_{m\,1}))^{-1} - \Lambda_0\right] \bullet (N_{d0} \bullet d_0 + N_{e0} \bullet e_0\,) + \Lambda_1 \bullet (\,N_{s1} \bullet s_1 - N_{s0} \bullet s_0\,) + \Delta\Lambda \bullet N_{s0} \bullet s_0 \qquad (53)$$

To facilitate understanding, this equation is presented in Table A-3.

Table A-3

COMPONENTS OF EQUATION (53) AND FACTORS RELATED TO PRODUCTION AND EMPLOYMENT CHANGES

Factor	Component of (53)
B	$\Lambda_1 \bullet \left[N_{d1} \bullet (d_1 - \delta)\right]$
C	$\Lambda_1 \bullet \left[N_{e1} \bullet (e_1 - \bar{e}\,)\right]$
D	$\Lambda_1 \bullet \left[N_{d1} \bullet (\delta - d_0)\right]$
E	$\Lambda_1 \bullet \left[N_{e1} \bullet (\bar{e} - e_0)\right]$
F	$\Lambda_1 \bullet (\Delta N_d \bullet d_0 + \Delta N_e \bullet e_0\,)$
G	$\left[\Lambda_1 - L_1 \bullet (I - A_1 + A_{m\,1})\,)^{-1}\right] \bullet (N_{d0} \bullet d_0 + N_{e0} \bullet e_0\,)$
H	$\left[L_1 \bullet (I - A_1 + \tilde{A}_{m\,1}))^{-1} - \Lambda_0\right] \bullet (N_{d0} \bullet d_0 + N_{e0} \bullet e_0\,)$
I	$\Lambda_1 \bullet (\,N_{s1} \bullet s_1 - N_{s0} \bullet s_0\,) + \Delta\Lambda \bullet N_{s0} \bullet s_0$

Source: The autor.

Appendix 3

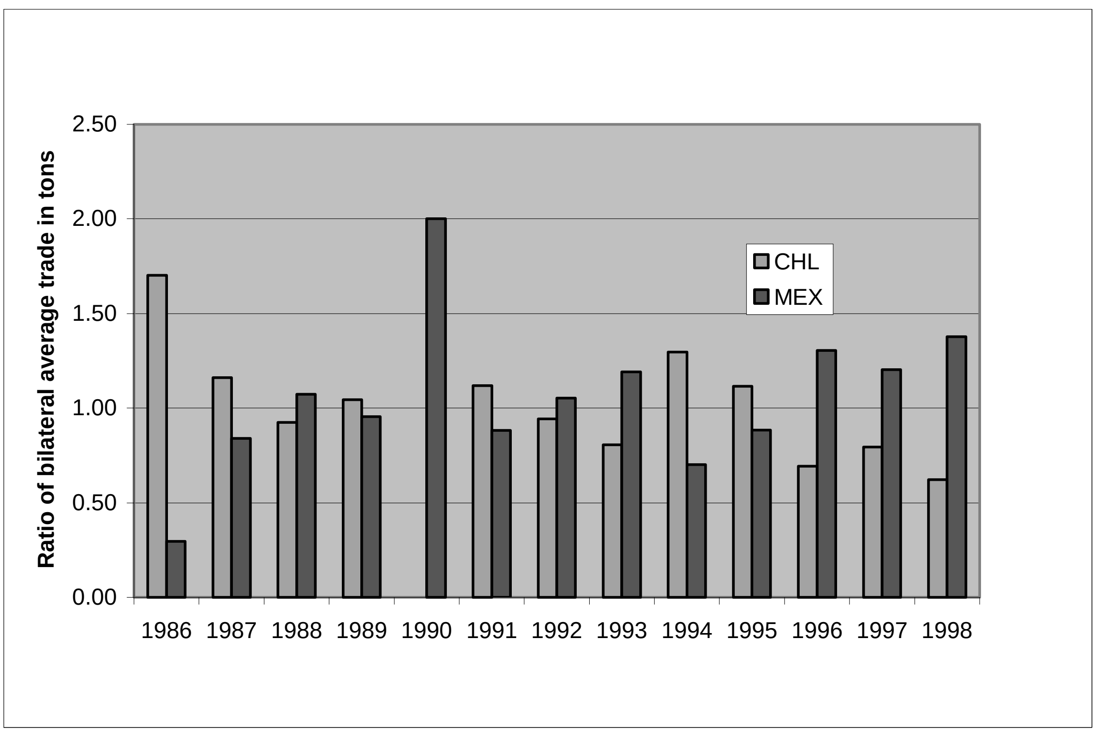
Bilateral trade data issues

1. Bilateral trade data discrepancies

Before proceeding to discuss how to deal with the decomposition of PTAs on trade, investment and employment, the issue of bilateral trade flows data discrepancies must be faced, as trade flows are the main channel through which PTAs may affect a country. Graph 1 illustrates this issue, displaying Chilean exports to Mexico (in tons /year) and the corresponding Mexican imports for a specific commodity, as reported by both countries to Comtrade. Since flows vary much, both data for a single year are displayed as the average of both reported volumes for that year. Thus, if both reports were fully consistent, they would be equal to 1.00. In fact, this method implies that the value for one of the reporting countries will take any value between zero and 2, while the sum for both reporters must add up to 2. This graph clearly shows there are significant reporting discrepancies, with Chile apparently over-reporting in the eighties and Mexico in the nineties, but no readily visible pattern emerges. The graph also shows that for some years there are no reported data (Chile in 1990 did not report volume data to Comtrade, and it has not reported volume data since 2001). These discrepancies are not restricted to the example shown, being a well known feature of international trade data.[55]

Graph 1

BILATERAL TRADE REPORTING - SITC REV.2 CODE 1121



Source: Author, based on Comtrade data.

55 Gehlar et al. (1997, pp.74) mentions several studies on trade data discrepancies, such as De Wulff (1981), Hiemstra & Mackie (1986), and Tsigas, Hertel & Blinkley (1992).

From a practical viewpoint, trade data for two countries (trading partners) is considered consistent if $X_{ij} = M_{ij}$, with X_{ij} being the volume of exports of a particular product (or an aggregate of products) from country i imported by country j, and with M_{ij} being the volume of the same product (or aggregate) imported by country j from country i. Thus, Graph 1 displays the two ratios $X_{ij} / (0.5\{X_{ij} + M_{ij}\})$ and $M_{ji} / (0.5\{X_{ij} + M_{ij}\})$, for Chile ($X_{ij}$) and Mexico ($M_{jj}$).

In the process of preparing the databases for the GTAP project, Gehlhar et al. (1997, pp. 76 ff) faced this issue. The UN has made significant efforts to estimate missing data, with the Statistics Division using the methodology known as TESSY (Trade Estimation System) to provide estimates of unreported trade. An alternative methodology was developed by the U.S. Department of Agriculture (USDA) Economic Research Service, but it requires time series, so is applicable only to countries reporting on a regular basis.

2. A trade data reconciliation procedure

There are a number of arguments made to prefer imports data to exports data, and also the other way around (Gehlhar et al. 1997, pp. 77). Following the GTAP tradition, no presumption is made that one data set is inherently better than the other. Thus, assume that the true (unobserved) volume of exports from country i to country j is X^*_{ij}, while the reported volume is X_{ij}. Assuming a multiplicative error term e_i for country ‘i’ reports, then:

$$X_{ij} = \beta_i X^*_{ij} e_i \qquad (3\text{-}1)$$

In a similar vein, country ‘j’ imports from country ‘i’ are given by:

$$M_{ij} = \alpha_j M^*_{ji} e_j \qquad (3\text{-}2)$$

with M^*_{ij} being the unknown trade volume, and e_j the error term. If there is a systematic reporting bias of the exporter, then β_i will differ from 1; the same applies to α_j if there is systematic reporting bias in the importing country.

It can be readily verified, by taking logarithms of the ratio of imports to exports, that:

$$\ln (M_{ij} / X_{ij}) = \ln (\alpha_j / \beta_i) + \ln e_j - \ln e_i \qquad (3\text{-}3)$$

Please note that, since trade flows are measured in tons/year, there is no price effect to be considered. If trade flows (X and M) referred to trade values (in current dollars / year), then the cif / fob ratio would have to be included in the analysis.

Thus, expression (3-3) allows an estimate of the (α_j / β_i) ratio to be obtained, and tested to see whether it differs significantly from 1. The result can then be used to adjust the reported data, achieving bilateral data consistency.

As an illustration of a data discrepancy analysis, consider the results of applying (3-3) for Chilean exports to Mexico and other Latin American countries, for 1986-2001,[56] as provided in Table 1 to Table 6. The constant (C) is used to isolate the general effect of a potential reporting bias by Chile, while dummies are used to isolate potential reporting biases of specific partners.

Table 1

DATA DISCREPANCY FOR CHILEAN EXPORTS 1986 - 2001

LS // Dependent Variable is LN_MX_CHL				
Sample: 1 64 Included observations: 59 Excluded observations: 5				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.0440	0.0977	0.4507	0.6539
DUM_ARG	-0.0933	0.1732	-0.5389	0.5921
DUM_MEX	-0.0926	0.1692	-0.5472	0.5864
R-squared	0.0079	Mean dependent var		-0.0017
Adjusted R-squared	-0.0276	S.D. dependent var		0.5279
S.E. of regression	0.5351	Akaike info criterion		-1.2010
Sum squared resid	16.0357	Schwartz criterion		-1.0954
Log likelihood	-45.2872	F-statistic		0.2225
Durbin-Watson stat	1.8462	Prob(F-statistic)		0.8012

Source: Author estimates, over Comtrade data, for products included in the first digit 0 of SITC Rev.2.

Table 2

DATA DISCREPANCY FOR CHILEAN EXPORTS 1986 - 2001

LS // Dependent Variable is LN_MX_CHL				
Sample: 1 64 Included observations: 59 Excluded observations: 5				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-0.0562	0.0442	-1.2724	0.2086
DUM_ARG	0.0069	0.0777	0.0887	0.9296
DUM_MEX	0.1716	0.0776	2.2110	0.0312
DUM_OUTLIERS	0.2733	0.0182	15.0191	0.0000
R-squared	0.8055	Mean dependent var		-0.0017
Adjusted R-squared	0.7949	S.D. dependent var		0.5279
S.E. of regression	0.2391	Akaike info criterion		-2.7966
Sum squared resid	3.1434	Schwartz criterion		-2.6558
Log likelihood	2.7831	F-statistic		75.9340
Durbin-Watson stat	1.3336	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the first digit 0 of SITC Rev.2.

56 Due to Chile lack of reporting to Comtrade, 2002 and 2003 could not be included in the database. The commodity classification used was SITC Rev. 2, as the HS spans a significantly shorter period.

Table 3

DATA DISCREPANCY FOR CHILEAN EXPORTS 1986 – 2001

LS // Dependent Variable is LN_MX_CHL				
Sample: 1 64 Included observations: 59 Excluded observations: 5				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.1177	0.0968	1.2158	0.2292
DUM_BOL	-0.3031	0.1658	-1.8285	0.0728
DUM_MEX	-0.1662	0.1658	-1.0028	0.3203
R-squared	0.0589	Mean dependent var		-0.0017
Adjusted R-squared	0.0253	S.D. dependent var		0.5279
S.E. of regression	0.5212	Akaike info criterion		-1.2538
Sum squared resid	15.2108	Schwartz criterion		-1.1482
Log likelihood	-43.7291	F-statistic		1.7532
Durbin-Watson stat	1.9423	Prob(F-statistic)		0.1826

Source: Author estimates, over Comtrade data, for products included in the first digit 0 of SITC Rev.2.

Table 4

DATA DISCREPANCY FOR CHILEAN EXPORTS 1986 – 2001

LS // Dependent Variable is LN_MX_CHL				
Sample: 1 64 Included observations: 59 Excluded observations: 5				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.0247	0.0410	0.6022	0.5495
DUM_BOL	-0.2281	0.0697	-3.2713	0.0019
DUM_MEX	0.0885	0.0713	1.2406	0.2200
DUM_OUTLIERS	0.2696	0.0166	16.2134	0.0000
R-squared	0.8372	Mean dependent var		-0.0017
Adjusted R-squared	0.8283	S.D. dependent var		0.5279
S.E. of regression	0.2187	Akaike info criterion		-2.9743
Sum squared resid	2.6318	Schwartz criterion		-2.8334
Log likelihood	8.0236	F-statistic		94.2596
Durbin-Watson stat	1.5436	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the first digit 0 of SITC Rev.2.

Table 5

DATA DISCREPANCY FOR CHILEAN EXPORTS 1986 – 2001

LS // Dependent Variable is LN_MX_CHL				
Sample: 1 64 Included observations: 59 Excluded observations: 5				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-0.1197	0.0948	-1.2629	0.2119
DUM_BRA	0.3932	0.1623	2.4220	0.0187
DUM_MEX	0.0711	0.1623	0.4382	0.6629
R-squared	0.0973	Mean dependent var		-0.0017
Adjusted R-squared	0.0651	S.D. dependent var		0.5279
S.E. of regression	0.5104	Akaike info criterion		-1.2955
Sum squared resid	14.5905	Schwartz criterion		-1.1898
Log likelihood	-42.5009	F-statistic		3.0181
Durbin-Watson stat	2.0288	Prob(F-statistic)		0.0569

Source: Author estimates, over Comtrade data, for products included in the first digit 0 of SITC Rev.2.

Table 6

DATA DISCREPANCY FOR CHILEAN EXPORTS 1986 – 2001

LS // Dependent Variable is LN_MX_CHL				
Sample: 1 64 Included observations: 59 Excluded observations: 5				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-0.1288	0.0408	-3.1593	0.0026
DUM_BRA	0.2256	0.0706	3.1935	0.0023
DUM_MEX	0.2393	0.0707	3.3874	0.0013
DUM_OUTLIERS	0.2651	0.0168	15.7347	0.0000
R-squared	0.8359	Mean dependent var		-0.0017
Adjusted R-squared	0.8270	S.D. dependent var		0.5279
S.E. of regression	0.2196	Akaike info criterion		-2.9666
Sum squared resid	2.6521	Schwartz criterion		-2.8257
Log likelihood	7.7969	F-statistic		93.3979
Durbin-Watson stat	1.5549	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the first digit 0 of SITC Rev.2.

First, in five out of the six cases the estimate for C is not significantly different from 0, suggesting that the reporting of Chilean exports, for this product group, was not significantly biased. Second, out of the 59 observations, three were actually very far away from unity, suggesting severe recording errors for those particular observations; this was accounted for including a dummy for these three outliers (DUM_OUTLIERS). This procedure allows for comparing the results with and without the very large influence of those three observations. Third, once the data are controlled for these outliers, the estimates for Mexico seems significantly different from zero (t = 2.21 in Table 2, and t = 3.39 in Table 6), suggesting an $\alpha_j > 1$. If this procedure is applied to a larger panel, it would be feasible to have the required data conciliation estimates for all product categories.

Appendix 4

Gravity models for Chile: a brief exploratory analysis

It must be recognized that the empirical application of the gravity model faces the problem of properly defining the distance between countries. This is a complex subject, which has recently become a focus of renewed research interest. Head & Mayer (2002) show how distance mismeasurement (since a single point is used to represent the location of a whole country) is an important source of bias in gravity models. Although they provide alternative distance measures, in a preliminary application of gravity models it was felt that using the simplest distance would provide a benchmark against which more sophisticated alternatives could be assessed afterwards.

Also, usually the gravity model has been applied to the aggregate trade flows, taking a cross-sectional sample. But the effects of distance on the trade of goods should be observable even at the single product level. To test this notion, a sample of several cases was estimated for Chile, thus being microgravity equations rather than the usual macro aggregates. This type of approach is required if it is desired to disentangle the PTAs effects at a disaggregate level.

The simplified approach used here is not meant to provide a strictly specified gravity model, as the trade data reconciliation involved into such exercise exceeds by a large margin the time allocated for this study. Thus, in this exercise, bilateral trade is measured from the point of view of the importing country, Chile. The data are not reconciled with those reported by the trading partners.

The specific form of the gravity model used for imports is:

$$\ln M_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln D + \beta_3 \ln Y_j + e \qquad (4\text{-}1)$$

where Y_i is Chile's GDP per capita, D is distance from Chile to the trading partner j, and Y_j is the partner's GDP per capita, while e is the error term with the assumed usual properties.[57] M is measured in tons / year. The GDP variables are proxies for size, with the importing country GDP representing the size of demand, and the exporting country GDP standing for the capacity of supply. In applied gravity models, when controlling for GDP, then population tends to present a negative coefficient, reflecting the fact that larger countries tend to be more inward-looking (and smaller countries to be more open to trade). Hence, the use of GDP per capita is an attempt to capture both effects at once.[58]

This specification, although very simple, allows some testing of the significance of D. One expects from theory that $\beta_2 < 0$, as the increased distance should imply increased cost of transport. Since there are omitted variables in (4-1), such as price effects (here including tariffs and the exchange rate), it should come as no surprise that the estimates usually require an AR(1) correction term.

The names used for the computer variables are CHL_GDP_PC for Chile GDP per capita, DISTKM for the distance in kilometers, and OTH_GDP_PC for the trading partner GDP per capita. Distance is the variable dist, taken from the CEPII database. The results of estimating (4-1) for some product categories are displayed in Table 7 through Table 13. Interestingly, the estimates of

[57] In a full study, these assumed properties would have to be tested. But the gravity function in such a case will be different from the illustration. For a detailed review of trade determinants used in gravity model studies, cf. Adams et al. (2003, pp. 34 ff).

[58] In some studies both total and per capita GDP are used, for both importer and exporter.

β_2 come out as expected, even under this very simplified model, for the five product groups considered.

Table 7

ESTIMATE OF A SIMPLIFIED GRAVITY MODEL FOR CHILE

Product: SITC Rev2 00				
LS // Dependent Variable is LN_TONS				
Sample: 2 506				
Included observations: 330				
Excluded observations: 175 after adjusting endpoints				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	23.3671	4.5524	5.1329	0.0000
LN_CHL_GDP_PC	-1.9481	0.5498	-3.5433	0.0005
LN_DISTKM	-1.3609	0.2725	-4.9939	0.0000
LN_OTH_GDP_PC	0.4453	0.1838	2.4226	0.0160
R-squared	0.1099	Mean dependent var		0.1829
Adjusted R-squared	0.1017	S.D. dependent var		2.7201
S.E. of regression	2.5781	Akaike info criterion		1.9062
Sum squared resid	2 166.8350	Schwartz criterion		1.9522
Log likelihood	-778.7682	F-statistic		13.4136
Durbin-Watson stat	0.7996	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the second digit (00) of SITC Rev.2.

Table 8

ESTIMATE OF A SIMPLIFIED GRAVITY MODEL FOR CHILE

SITC Rev2 00				
LS // Dependent Variable is LN_TONS				
Sample: 3 506				
Included observations: 243				
Excluded observations: 261 after adjusting endpoints				
Convergence achieved after 6 iterations				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	1 610.4160	453.1943	3.5535	0.0005
LN_CHL_GDP_PC	16.7297	5.7112	2.9293	0.0037
LN_DISTKM	-1.3273	0.2995	-4.4310	0.0000
LN_OTH_GDP_PC	0.5091	0.1567	3.2487	0.0013
YEAR	-0.8708	0.2495	-3.4898	0.0006
AR(1)	0.5488	0.0601	9.1386	0.0000
R-squared	0.4316	Mean dependent var		-0.1402
Adjusted R-squared	0.4196	S.D. dependent var		2.7388
S.E. of regression	2.0866	Akaike info criterion		1.4954
Sum squared resid	1 031.8510	Schwartz criterion		1.5817
Log likelihood	-520.4970	F-statistic		35.9898
Durbin-Watson stat	2.0922	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the second digit (00) of SITC Rev.2.

Table 9

ESTIMATE OF A SIMPLIFIED GRAVITY MODEL FOR CHILE

SITC Rev2 01				
LS // Dependent Variable is LN_TONS				
Sample: 3 998				
Included observations: 410				
Excluded observations: 586 after adjusting endpoints				
Convergence achieved after 3 iterations				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	10.5638	6.5063	1.6236	0.1052
LN_CHL_GDP_PC	0.4571	0.7933	0.5762	0.5648
LN_DISTKM	-1.0835	0.2071	-5.2313	0.0000
LN_OTH_GDP_PC	-0.2305	0.1304	-1.7680	0.0778
AR(1)	0.3479	0.0444	7.8318	0.0000
R-squared	0.2595	Mean dependent var		2.4644
Adjusted R-squared	0.2521	S.D. dependent var		3.0878
S.E. of regression	2.6703	Akaike info criterion		1.9765
Sum squared resid	2 887.8170	Schwartz criterion		2.0255
Log likelihood	-981.9451	F-statistic		35.4743
Durbin-Watson stat	2.1385	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the second digit (01) of SITC Rev.2.

Table 10

ESTIMATE OF A SIMPLIFIED GRAVITY MODEL FOR CHILE

SITC Rev2 02				
LS // Dependent Variable is LN_TONS				
Sample: 3 1106				
Included observations: 591				
Excluded observations: 513 after adjusting endpoints				
Convergence achieved after 3 iterations				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	1.8434	5.8112	0.3172	0.7512
LN_CHL_GDP_PC	0.3760	0.6958	0.5404	0.5891
LN_DISTKM	-0.2176	0.2503	-0.8693	0.3850
LN_OTH_GDP_PC	0.1094	0.1682	0.6506	0.5156
AR(1)	0.3662	0.0380	9.6483	0.0000
R-squared	0.1395	Mean dependent var		3.8886
Adjusted R-squared	0.1336	S.D. dependent var		2.8353
S.E. of regression	2.6392	Akaike info criterion		1.9493
Sum squared resid	4 081.5640	Schwartz criterion		1.9864
Log likelihood	-1 409.6230	F-statistic		23.7425
Durbin-Watson stat	2.3148	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the second digit (02) of SITC Rev.2.

Table 11

ESTIMATE OF A SIMPLIFIED GRAVITY MODEL FOR CHILE

SITC Rev2 03				
LS // Dependent Variable is LN_TONS				
Sample: 3 1273				
Included observations: 657				
Excluded observations: 614 after adjusting endpoints				
Convergence achieved after 3 iterations				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	7.3536	4.5169	1.6280	0.1040
LN_CHL_GDP_PC	0.6485	0.5295	1.2246	0.2212
LN_DISTKM	-0.5724	0.1707	-3.3534	0.0008
LN_OTH_GDP_PC	-0.6774	0.0845	-8.0187	0.0000
AR(1)	0.1849	0.0374	4.9427	0.0000
R-squared	0.2116	Mean dependent var		1.1806
Adjusted R-squared	0.2067	S.D. dependent var		2.9442
S.E. of regression	2.6223	Akaike info criterion		1.9357
Sum squared resid	4 483.4280	Schwartz criterion		1.9698
Log likelihood	-1 563.1130	F-statistic		43.7363
Durbin-Watson stat	2.1566	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the second digit (03) of SITC Rev.2.

Table 12

ESTIMATE OF A SIMPLIFIED GRAVITY MODEL FOR CHILE

SITC Rev2 04				
LS // Dependent Variable is LN_TONS				
Sample: 3 2341				
Included observations: 1087				
Excluded observations: 1252 after adjusting endpoints				
Convergence achieved after 3 iterations				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	7.5207	4.2128	1.7852	0.0745
LN_CHL_GDP_PC	0.9640	0.4930	1.9555	0.0508
LN_DISTKM	-1.7603	0.1773	-9.9255	0.0000
LN_OTH_GDP_PC	0.4052	0.0937	4.3243	0.0000
AR(1)	0.1462	0.0322	4.5369	0.0000
R-squared	0.1176	Mean dependent var		2.9536
Adjusted R-squared	0.1143	S.D. dependent var		3.4944
S.E. of regression	3.2886	Akaike info criterion		2.3855
Sum squared resid	11 701.6800	Schwartz criterion		2.4085
Log likelihood	-2 833.9110	F-statistic		36.0508
Durbin-Watson stat	1.7943	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the second digit (04) of SITC Rev.2.

Table 13

ESTIMATE OF A SIMPLIFIED GRAVITY MODEL FOR CHILE

SITC Rev2 04				
LS // Dependent Variable is LN_TONS Sample: 3 2341 Included observations: 1087 Excluded observations: 1252 after adjusting endpoints Convergence achieved after 4 iterations				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	7.4908	4.2237	1.7735	0.0764
LN_CHL_GDP_PC	0.9709	0.4960	1.9575	0.0506
LN_DISTKM	-1.7618	0.1778	-9.9107	0.0000
LN_OTH_GDP_PC	0.4043	0.0940	4.3000	0.0000
PTA_MEX	-0.0901	0.6023	-0.1496	0.8811
AR(1)	0.1459	0.0323	4.5157	0.0000
R-squared	0.1176	Mean dependent var		2.9536
Adjusted R-squared	0.1135	S.D. dependent var		3.4944
S.E. of regression	3.2901	Akaike info criterion		2.3873
Sum squared resid	11 701.4400	Schwartz criterion		2.4149
Log likelihood	-2 833.9000	F-statistic		28.8191
Durbin-Watson stat	1.7946	Prob(F-statistic)		0.0000

Source: Author estimates, over Comtrade data, for products included in the second digit (04) of SITC Rev.2.

The possible effects of the Chile-Mexico PTAs on Chilean imports of product group 04 are estimated in the variable PTA_MEX. The coefficient turns out not to be significant. This seems very reasonable, as this product group includes imports of grains, such as Durum wheat (which Chile imports mostly from Canada), other wheat, rice, barley, maize, rye, oats, buckwheat, other cereals and products thereof, such as macaroni and malt. Of these, imports from Mexico include only maize, other cereals, and malt. Please note that in this particular illustration the coefficients for the GDP and distance turn out to be quite sensible.

A last point to emphasize is that the gravity model, as a true workhorse of the ex – post assessment literature, is able to pinpoint many effects, once it is properly formulated and estimated, that is including price, geographical variables (areas, if the country is an island, if it is landlocked, if it shares a common border with the partner, if it shares the same cultural milieu), a common currency, and different institutional and political indicators, which may be particularly relevant in the case of applying the gravity model to foreign direct investment flows.

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