Trade Policy and Sectoral Manufacturing Specialization[1]

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Abstract

Trade liberalization leads to significant changes in countries' economic structures. The implied variation in the level and nature of specialization has important consequences for liberalizing economies. Thus, adjustments costs associated with those structural changes may be substantial. Furthermore, the changing specialization profile of countries may affect growth potential, welfare, income distribution, and the macroeconomic environment. It is therefore extremely relevant for those countries pursuing trade liberalization initiatives to know their current specialization profiles and how they would look like under lower trade costs, because this will allow them to anticipate their effects on the potential for development as well as to accordingly define policy strategies. This study examines manufacturing production specialization patterns in ten Latin American countries (Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay and Venezuela) over the period 1990-2001, and explicitly assesses the impact of trade policy and, in particular, the implications of a free trade area with the United States. A theory-consistent measure of specialization is derived from the standard international trade theory: the share of the industry in the country's GDP. The role of trade policy in shaping the distribution of these shares is then investigated using a simultaneous equation approach on sectoral value added and tariff and factor endowment data.

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Trade Policy and Sectoral Manufacturing Specialization

1 Introduction

Trade liberalization leads to significant changes in countries' economic structures. In particular, reducing the degree of protection should be expected to cause relative expansion of those sectors having comparative advantage and relative contraction of those industries suffering comparative disadvantage with respect to the rest of the world.

The implied variation in the level and nature of specialization has important consequences for liberalizing economies. Thus, adjustment costs associated with those structural changes may be substantial and countries should be prepared for minimizing their possible negative impacts. For instance, re-training programs would be very helpful in facilitating re-allocation of labor across industries. Furthermore, the changing specialization profile of countries may affect growth potential and welfare. Opening allows for greater specialization, which could promote productivity growth by learning-by-doing, but it may also induce specialization away from sectors with potential for technological progress, which would result in poorer growth performance and lower levels of welfare.[1] Income distribution is also likely to be influenced. According to the Stolper-Samuelson theorem, opening, by changing production specialization, will tend to shift income towards a country's abundant factor, thus affecting the degree of income inequality.[2] Finally, if as a consequence of trade liberalization countries end up with more dissimilar production structures, they will become more sensitive to specific industry shocks and henceforth more idiosyncratic business cycles. Under these conditions, if (at least one of the) economies use the exchange rate to adjust to those shocks, a higher bilateral exchange rate variability should be expected and this could generate pressures to re-introduce protectionist measures within trade blocs, as the recent experience in MERCOSUR has shown.[3]

[1] See, e.g., Romer (1987), Lucas (1988), Quah and Rauch (1990), Grossman and Helpman (1991), Young (1991), Weinhold and Rauch (1999), and Redding (1999).
[2] See Davis (1996). Leamer et al. (1999) argue that in countries that are abundant in natural resources (such as the Latin American ones) the appearance of manufacturing will tend to be delayed and so the formation of the skills required by the lately emerging human capital intensive sectors. As a consequence, such countries are expected to go through longer periods of higher income inequality than those producing goods demanding gradual skill updating. Further, some economic historians, such as Engerman and Sokoloff (2002), state that the initial concentration of the ownership of natural resources in the Americas favored institutional structures that advantaged certain social sectors thus perpetuating a severely skewed income distribution.
[3] See, e.g., Kenen (1969), Eichengreen (1992), Krugman (1993), and, for MERCOSUR, Fernandez-Arias et al. (2002).

It is therefore extremely relevant for those countries pursuing trade liberalization initiatives to know their current specialization profiles and how would they look like under lower trade costs, because this will allow them to anticipate the effects of their changes on the potential for development and the macroeconomic conditions as well as to accordingly define policy strategies. This is especially important for Latin America, given its disappointing growth performance in the last decades, the already high unemployment rates and inequality levels, and the long history of macroeconomic instability and failed integration attempts.

In the last two decades Latin American countries implemented broad and comprehensive trade reform programs starting from relatively high tariff protection levels (see Figure 1). Removing trade barriers with respect to the rest of the world has proven to have a significant impact on Latin American countries' overall degree of manufacturing specialization. Thus, most of these countries have become increasingly specialized (see Figure 2).[4]

NAFTA, a free trade agreement involving Mexico, the United States, and Canada entered in force in the mid-1990s. Chile and more recently Peru and Colombia have also signed a trade arrangement with the United States, while Ecuador has already advanced negotiations to establish a free trade area with this country. More generally, even though its pace has experienced slowdown in the last time, there is a project to establish a Free Trade Area of the Americas (FTAA) comprising almost all countries in the region. This trade agreement would mean a substantial deepening of Latin American countries' opening to the world which might be expected to accentuate the aforementioned trends. This document aims at assessing how likely this scenario is. More precisely, it analyzes the impact of unilateral trade policy and preferential trade liberalization with the United States, in particular, on sectoral manufacturing specialization of the Latin American countries.

In doing this, this study provides a descriptive picture of specialization patterns in those countries and their evolution over time in terms of the sectors identified by the ISIC Revision 2, two-digit. Second, starting from the standard international trade theory, an expression of the share of each industry in each country's total GDP as a function of relative prices, endowments, and technology is derived and econometrically estimated using data over the period 1990-2001.

This approach has been used by Harrigan (1997) to assess the role of technology and factor supplies in shaping the specialization patterns across developed economies and by

Redding (2002) to quantify the influence of factor endowments in explaining the dynamics of these patterns.[5] Yeaple and Golub (2002) incorporated infrastructure in this setting as a determinant of productivity differences across countries. More recently, Feenstra and Kee (2004) have exploited this framework to analyze the effects of sectoral export variety on country productivity, Hanson and Robertson (2005) to investigate the factor behind countries' export capacities, and Kee et al. (2004) to estimate import demand elasticities and consistent measures of trade restrictiveness.[6]

This paper mainly focuses on the impact of relative prices on sectoral production specialization patterns. One main simplifying assumption is made in assessing this impact. Given that most Latin American countries are small economies, domestic prices will be assumed to be exogenously determined by given unique international prices and sectoral tariffs. Hence, changes in trade policies, by modifying domestic relative prices, will lead to changes in countries' specialization patterns. In this setting, the effects of a trade arrangement with the United States can be simulated by letting the relative prices to converge.

By providing evidence on the expected implications of further opening and a free trade agreement with the United States, this study will give valuable insights on the sectoral adjustments that the Latin American countries should expect and henceforth on the possible policy strategies to deal with them.

The remainder of this paper is organized as follows. Section 2 derives the sectoral specialization measures from the international trade theory and identifies their main determinants thus establishing the estimation equation. Section 3 briefly describes the dataset and reports some descriptive evidence on the manufacturing specialization patterns of the Latin American countries over the sample period. Section 4 presents the estimation results and examines the implications of two main scenarios: further unilateral trade liberalization with respect to the rest of the world and a trade arrangement with the United States. Section 5 concludes.

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[4] Bolivia suffered from a severe hyperinflation episode during the first part of the 1980s. Hence, the behavior of manufacturing specialization might well only reflect a reversion towards a previous equilibrium state. The roughly constant level in the last sample years would support this hypothesis.

[5] Fitzgerald and Hallak (2004) use a slightly approach to estimate the effect of factor proportions on the pattern of manufacturing specialization in a sample of OECD countries, once the fact that factor accumulation responds to productivity has been accounted for.

[6] See, e.g., Anderson and Neary (1992, 1994, 2003) for derivations of alternative theoretically consistent indices of trade restrictiveness.

2 Theory, Empirical Modeling, and Econometric Issues

2.1 Measuring Specialization

To define the estimation equation and thus the appropriate functional forms as well as the relevant variables to be included, the approach proposed by Harrigan (1997) and Redding (2002) will be followed. The idea is to derive theory-consistent measures of specialization from the standard international trade theory.

Assume a set of small countries, each of them endowed with a fixed amount of factors of production. These factors are used to produce final goods under constant returns to scale and perfect competition conditions such that the value of output is maximized. This value is given by:

$$X_{ct} = r(p_{ct}, v_{ct}) \tag{1}$$

where *r()* is the revenue function, *p* is the vector of final goods prices, *v* is the vector of production factors, *c={1,…,C}* indexes countries and *t* time. As long as the revenue function is twice continuously differentiable, the vector of the economy's profit-maximizing net output is given by:[7]

$$x_c(p_{ct}, v_{ct}) = \partial r(p_{ct}, v_{ct}) / \partial p_{ct} \tag{2}$$

Further, Hicks-neutral technology differences will be assumed across countries, industries, and time, so that the production function takes the following form:

$$x_{cjt} = q_{cjt} f_j(v_{cjt}) \tag{3}$$

where q_{cjt} parametrizes technology in industry *j* of country *c* at time *t*. As shown in Dixit and Norman (1980), in this case, the revenue function is given by:

$$r(p_{ct}, v_{ct}) = r(q_{ct} p_{ct}, v_{ct}) \tag{4}$$

where q_{ct} is an *nxn* diagonal matrix of the technology parameters q_{cjt}. This formulation implies that industry-specific neutral technological changes have the same effect on revenue as industry-specific price changes.

Following Woodland (1982), Kohli (1991), and Harrigan (1997), in order to operationalize the model, a translog revenue function will be assumed:[8]

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[7] A sufficient condition is that there are at least as many factors as goods (see Redding, 2002).
[8] The translog model is frequently interpreted as a second order approximation to an unknown function form (see Greene, 1997).

$$lnr(?p,v)=a_{00}+\sum_{j=1}^{n}a_{0j}ln?_j p_j+\frac{1}{2}\sum_{k=1}^{n}\sum_{j=1}^{n}a_{jk}ln(?_j p_j)ln(?_k p_k)+\sum_{i=1}^{m}\text{ß}_{ih}lnv_i+ \\ +\frac{1}{2}\sum_{i=1}^{m}\sum_{h=1}^{m}\text{ß}_{ih}lnv_i lnv_h+\sum_{j=1}^{n}\sum_{i=1}^{m}?_{ji}ln(?_j p_j)ln(v_i) \qquad (5)$$

where j,k index goods and i,h index factors. Symmetry of cross-effects implies:

$$a_{jk}=a_{kj} \quad and \quad b_{ih}=b_{hi} \quad \forall\, h,i,j,k \qquad (6)$$

Further, linear homogeneity in v and p requires:

$$\sum_{j=1}^{n}a_{0j}=1 \quad \sum_{i=1}^{m}b_{0i}=1 \quad \sum_{j=1}^{n}a_{kj}=0 \quad \sum_{i=1}^{m}b_{ih}=0 \quad \sum_{i=1}^{m}g_{ji}=0 \qquad (7)$$

Differentiating the natural logarithm of the revenue function with respect to each p_j, one obtains the share of industry j in country c's GDP at time t, s_{cjt}:

$$s_{cjt}=\frac{p_{cjt}x_{cjt}(q_{ct}p_{ct},v_{ct})}{r(q_{ct}p_{ct},v_{ct})}=a_{0j}+\sum_{k=2}^{n}a_{kj}ln\frac{p_{ckt}}{p_{c1t}}+\sum_{k=2}^{n}a_{kj}ln\frac{q_{ckt}}{q_{c1t}}+\sum_{i=2}^{m}g_{ji}ln\frac{v_{cit}}{v_{c1t}} \qquad (8)$$

The theory-consistent measure of sectoral specialization is then the share of industry j in country c's GDP at time t, s_{cjt}.

Equation (8) relates a theory-consistent measure of sectoral specialization to their underlying economic determinants: relative prices, technology, and factor endowments. The translog specification implies that the coefficients on the variables are constant across countries and over time.

Following Redding (2002), non-traded good prices and technology differences will be assumed as being drawn from an estimable probability function.[9] Further, MFN tariffs will be used to capture cross-country differences in relative prices of traded goods (see Anderson and van Wincoop, 2004).[10] In particular, assuming that goods from industry *1* are freely traded up to transport costs and taking into account that countries face the same relative international prices:[11]

$$\sum_{k=2}^{n_1}a_{kj}ln\frac{p_{ckt}}{p_{c1t}}=\sum_{k=2}^{n_1}a_{kj}ln[(1+t_{ckt})(1+d_{ckt})h_{ck}j_{kt}] \\ =\sum_{k=2}^{n_1}a_{kj}ln[(1+t_{ckt})]+x_{jt}+y_{cj} \qquad (9)$$

where n_1 is the number of traded goods, t_{cjt}^{MFN} is the MFN tariff set by country c on products of industry j at time t, d_{cjt} is a measure of non-tariff barriers on goods from industry j in

[9] Since we do not have a complete set of prices, we do not impose restrictions on the homogeneity in prices in the system.

[10] Prices are inaccurately measured at the level of aggregation used in this paper. In most Latin American countries, trade policy reform primarily took the form of drastic tariff reductions, so here these reforms are exploited as a source of (in principle) exogenous variations in prices (see Goldberg and Pavcnik, 2005). In this exercise, disaggregated statutory MFN rates are used to construct sectoral tariff rates.

country c at time t, h_{cj} measures the pass-through effect from tariffs to domestic prices in industry j in country c (see Feenstra, 1989, and Gonzaga et al., 2005), j_{cjt} denote the international price of goods from industry j relative to that of goods from industry 1, and x_{jt} and y_{ck} are industry-year fixed-effects and country-industry fixed-effects, respectively.[12] These fixed-effects account for the impact of non-tariff trade impediments, changes in relative international prices, and country-specific pass-through.[13]

The estimation equation therefore becomes:

$$s_{cjt} = \sum_{k=2}^{n_1} a_{kj} ln\left[(1+t_{ckt})\right] + \sum_{i=1}^{m} g_{ji}\left[\ln\left(\frac{E_i}{L}\right)_{ct}\right] + p_{cj} + r_{jt} + e_{cjt} \tag{10}$$

where the E_{ct}s are endowments (z=capital stock, population with primary and secondary school, population with post-secondary education, arable land, forest and woodland, mineral stocks, and hydroelectric capacity), of country c at time t, L_{ct} is the size of working age population in country c at time t, p_{cj} are country-industry fixed-effects that control for any permanent country-specific barriers to trade (e.g., remoteness), any permanent country-differences in technology (e.g., associated to social infrastructure, see Hall and Jones, 1999), and r_{jt} are industry-year fixed-effects that capture common changes in relative prices, technologies, and factor endowments across countries.[14]

Equation (10) suggests that, once controlled for forces which are common across countries and years, changes in countries' specialization patterns result from country-specific changes in relative prices and relative factor endowments. According to the theory, the estimated coefficient on the own tariff is the own-price effect and should therefore be nonnegative, while the estimated coefficients on factor supplies will hinge upon the sector.

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[11] Implicit or explicit acceptance of an untaxed *numeraire* is a common practice when addressing questions such as the effects of tax rates on the home and foreign price vectors (see Dixit and Norman, 1980).

[12] When using *ad valorem* tariffs, as it is the case in this analysis, the domestic price can be expressed as one plus tariff times the international price (see Dixit and Norman, 1980; and Feenstra, 2003). Gonzaga et al. (2005) show that the impact of trade liberalization on relative prices additionally depends on the differentiated pass-through coefficients across sectors, which, in turn, hinge upon the sectoral import penetration ratio. In particular, sectors in which the country has comparative advantage are the ones with lower import penetration, hence, with lower pass-through.

[13] Data on non-tariff barriers are rather limited and not perfectly comparable over time (see Goldberg and Pavcnik, 2005). The scarce available information suggests they do not seem to have clear country-specificities over time, but relatively country-specific patterns and common changes across countries over time, so that the fixed-effects are likely to properly control for their influence.

[14] Note that the sectoral shares depend not only in the own tariffs, but also on those of remaining sectors. Kee et al. (2004) work at the tariff line level and propose a method to re-express each n-good economy into n sets of two-good economies using the properties associated with price indices in translog GDP functions to avoid exhausting the degree of freedom (see Caves et al., 1982). They also propose an aggregation method to the industry level. Given the relatively small sample size available and that cross-sectoral effects could provide interesting information, we will pursue here the second strategy.

This theoretical framework is flexible enough to allow for assessing different scenarios. For instance, a general opening to the world economy can be simulated by setting tariffs to zero. Hence, the first term cancels out and then predicted shares are given by:[15]

$$s_{cjt}^{Predicted} = \sum_{i=1}^{m} \hat{g}_{ji} \left[ln\left(\frac{E_i}{L}\right)_{ct} \right] + \hat{p}_{cj} + ?_{jt} \tag{11}$$

A free trade agreement between the Latin American countries and the United States can be assessed by expressing all variables in Equation (10) relative to the US as follows:

$$s_{cjt} - s_{USAjt} = \sum_{k=2}^{n_1} a_{kj} ln\left[\frac{(1+t_{ckt})}{(1+t_{USAkt})}\right] + \sum_{i=1}^{m} g_{ji} \left[\ln\left(\frac{E_{ict}}{L_{ct}} \Big/ \frac{E_{iUSAt}}{L_{USAt}} \right) \right] + p_{cj} + r_{jt} + e_{cjt} \tag{12}$$

A trade arrangement will lead to a convergence of relative prices.[16] In the limit, prices will be equalized. In this case, the following expression holds:

$$s_{cjt}^{\Pr edicted} = \sum_{i=1}^{m} \hat{g}_{ji} \left[\ln\left(\frac{E_{ict}}{L_{ct}} \Big/ \frac{E_{iUSAt}}{L_{USAt}} \right) \right] + \hat{p}_{cj} + \hat{r}_{jt} \tag{13}$$

The distribution of predicted sectoral shares will characterize the countries' specialization patterns in this scenario.

The system of equations implicit in Equations (10) and (12) will be estimated for the Latin American countries over the period 1990-2001 using a simultaneous equation approach. Three econometric issues should be addressed. First, the translog functional form implies that there are cross-equation symmetry restrictions among the systems of output share equations for a group of industries (see Equations (6) and (7)) (see Harrigan, 1997). These theoretical restrictions will be will be imposed yielding a restricted estimator.

Second, the classical LSDV model assumes that the only correlation over time is due to the presence of the same individual across the panel. In particular, the equicorrelation coefficient is the same no matter how far periods are in time. Clearly, this is also a restrictive assumption for the economic relationships under consideration, as an unobserved shock in the current period might affect the specialization patterns for at least some coming periods (see Baltagi, 1995). Ignoring serial correlation when it is present results in consistent but inefficient estimates of the regression coefficients and biased standard errors. In our case, the Baltagi-Li LM test for first

[15] In particular, in those predictions reported in the next section, all remaining variables will be assumed to take their last sample year values, so that these predictions will be conditional on current comparative advantage as determined by relative factor endowments.

[16] Rogers (2002) has found a significant decline in traded goods price dispersion in Europe coincidentally with the completion of the single market. Similarly, using a panel data set of car prices across five European countries, Goldberg and Verboven (2006) find that integration has favored convergence towards both the absolute and relative versions of the Law of One Price.

order serial correlation in a fixed-effects model points out that the null hypothesis of no autocorrelation should be rejected for most industries. An estimation strategy that corrects these non-spherical disturbances is therefore required. Specifically, we remove autocorrelation from the data using the Prais-Winsten transformation (see Greene, 1997).

Finally, endogeneity biases can be expected due to reverse causality and measurement errors, both concerning tariffs and endowments. To address these problems, a three-stage least squares (3SLS) error components estimator will be used on the transformed data. We will compute a fixed-effect estimator, so that only time variation within countries is used to identify the parameters. Given the relative similarity of the Latin American countries, this seems to be the right strategy. There is also a statistical reason for using the fixed-effect instead of the random effect treatment (e.g., Baltagi's (1981) EC3SLS). As shown by Cornwell et al. (1992), when all exogenous variables are correlated with the effects, as *a priori* it is the case in our analysis, consistent estimators reduce to 3SLS after a within transformation of the system.[17]

Tariffs will be instrumented with 10-years lag of sectoral shares in total manufacturing employment, which captures the electoral strength of workers and thus protection for large industries (see Caves, 1976, Finger et al., 1982 and Trefler, 2004), and 10-years lag of (inverse) import penetration ratios, which is related to the stakes from protection in politically organized industries (see Grossman and Helpman, 1994, and Goldberg and Maggi, 1999).[18] Relative endowments will be instrumented with their 10-years lagged values.[19] Note that the systematic measurement errors (e.g., those resulting from differences in measuring procedures and factor quality across countries and over time) will be absorbed into the country and time fixed-effects.[20]

[17] In a random model, the individuals effects would account for factor such as country differences in sectoral pass-through, which are correlated with countries' comparative advantages and thus with their relative endowments (see Gonzaga et al., 2005). Similarly, those effects may capture country differences in average non-tariff barriers, which may be correlated with tariffs (see Anderson and Schmitt, 2003).

[18] Inverse import penetration ratios are measured here as the ratio of exports to imports in the sector in question.

[19] Lagged relative endowments of land for pasture and crop calculated using data from FAO are also used as instruments.

[20] There might be also an omitted variable problem, as Latin American countries have signed sub-regional trade agreements and have experienced non-simultaneous periods of real exchange rate appreciations over the 1990s. We therefore also estimate Equations (10) and (12) including dummy variables for MERCOSUR and CAN to control for the influence of these trade arrangements and the real exchange rate for imports to account for the role that the real exchange rate may have played in shaping sectoral specialization patterns. Estimations results with these additional variables are essentially the same to those reported later and will not be shown. They can be obtained from the authors upon request.

3 Data

The sample includes ten Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, and Venezuela, and the United States of America. Annual data on sectoral value added at the ISIC, Revision 2, are used to characterize manufacturing production specialization in these countries over the period 1990-2001. These data come from the database PADI (Version 5.0) prepared by the United Nation's Economic Commission for Latin America and the Caribbean (ECLAC) and the International Industrial Statistics made available by the United Nations Industrial Development Organization (UNIDO). Table A1 in Appendix A identifies the specific data sources and time coverage.

Table 1 presents these sectoral manufacturing data for the initial and the final year of the sample period, 1990 and 2001. Eight sectors are considered. Table A2 in Appendix A lists these sectors and specifies which 3-digit sectors are included in each of these industries. The first row of Table 1 reports the share of manufacturing value added in each country's total GDP. Each Latin American country, with the exception of Mexico and Ecuador, has experienced a decline in the share of manufacturing in GDP over the last decade. The decrease has been particularly pronounced in Uruguay. By 2001, manufacturing share ranges between 12.04% in the case of Ecuador and 20.48% in the case of Mexico. The remaining eight rows present the share of each industry in total manufacturing value added thus providing information about what these countries produce. In the larger sample countries, Brazil, Mexico, and the United States, Machinery is by far the largest sector and its share has even increased over the 1990s. The larger sectors in the smaller Latin American countries are Chemicals and Food. Except for Chile and Ecuador, the relative importance of Chemicals has decreased, while that of Food has increased in Bolivia, Chile, Mexico y Uruguay. Textiles and Machinery have seen a drop in their shares.[21]

MFN tariffs at the 4 digit level of the ISIC Revision 2 over the period 1990-2001 come from IDB calculations and TRAINS.[22] Table 2 reports a simple average of tariffs at the 2 digit

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[21] It should be noted that the share of Machinery has risen in Venezuela. The main reason is the growing relative importance of Transport Equipment, which can be traced back to the Auto-Regime put in place in 1993 between Colombia, Ecuador, and Venezuela.

[22] Tariff data for most countries come from IDB own estimations. Average sectoral tariffs for Bolivia and the United States have been calculated with data taken from TRAINS. In the case of Bolivia, disaggregated data start to be reported in 1993 onwards. We assume that the sectoral tariffs for 1993 apply also to 1990-1992. Tariff data are aggregated at the 2-digit level of the ISIC Revision 2. The price for this is some risk of aggregation biases. Note that, as long as these are country and/or time specific, they will be captured by the fixed-effects. Further, it should be stressed that, except for Mexico and Venezuela, Latin American countries' simple are very close to the theoretically consistent trade restrictiveness indices calculated by Kee et al. (2004) and the so-called mercantilist index of trade policy as estimated by Anderson and Neary (2003).

level, i.e., we average tariffs across all sub-sectors belonging to a particular industry. Most Latin American countries significantly lowered their tariffs since 1990, but overall these are still substantially higher than those of the United States. Dispersion is, however, lower in Bolivia and especially in Chile, which imposes an almost flat rate. Besides these countries, nominal protection is in general higher for Food and Textiles. The lowest sectoral tariffs are observed for Chemicals and for Basic Metals.

If the revenue function *r()* has a translog functional form and all translog parameters are time invariant, then its exact price index is a Tornqvist price index (Diewert, 1976, Caves et al., 1982, Kee et al., 2004). In logarithm terms:

$$lnP_{ct} = \sum_{z=1}^{Z} \bar{l}_{czt} lnp_{czt} \tag{14}$$

where we define z as a sub-sector at the 4 digit ISIC Revision 2 and $\bar{l}_{czt} = (1/2)(l_{czt} + l_{ROWzt})$ with s_{czt} (s_{usazt}) given by the share of sub-sector z in country c´s (rest of the world's) total imports of industry j in period t. The Tornqvist price index is then a weighted average of the sector' prices. In particular, the price index at the industry level is the weighted average of goods' prices within each industry. We therefore obtain consistent industry-level tariffs as follows:

$$ln(1 + t_{cjt}) = \sum_{z \in j} \bar{l}_{zt} ln(1 + t_{zt}) \tag{15}$$

Sectoral tariffs relative to the United States can be derived symmetrically:

$$ln\left[\frac{(1 + t_{ckt})}{(1 + t_{USAkt})}\right] = \sum_{z \in j} \bar{l}_{zt} ln\left[\frac{(1 + t_{czt})}{(1 + t_{USAzt})}\right] \tag{16}$$

where $\bar{l}_{czt} = (1/2)(l_{czt} + l_{USAzt})$ with s_{USAzt} given by the share of sub-sector z in country US´ total imports of industry j in period t.[23] Industry-level tariffs calculated as previously described are used as explanatory variables in the estimations.

Data on countries endowments include arable, forest and woodland data from the Food and Agriculture Organization (FAO) as well as data on economy-wide labor data (i.e., population over 15 years) and the skill level of population (i.e., population with primary and secondary school, and with post-secondary education) from the database prepared by Barro and Lee (2000)

[23] Since Mexico already entered a FTA with the United States in 1994 and given that a large fraction of its trade is concentrated with that country, average sectoral tariffs for Mexico are estimated as a weighted average of the MFN tariffs and the preferential tariffs to the United States, where the weighting factors are the shares of imports from the rest of the world and those from the United States, respectively. Preferential tariffs are taken from TRAINS. In this case, there are few intermediate years for which data are missing. Figures for those intervening years have been interpolated. Other bilateral trade arrangements with the United States, such as those of Chile, Peru, and Colombia, have not been entered into force during our sample period.

over the period 1960-2000.[24] The perpetual inventory method has been applied as indicated in Jacob et al. (1997) and Kamps (2004) with a depreciation rate of 13.3% (e.g., Schott, 2003) on gross fixed capital formation over the period 1970-2000 as reported by the World Bank´s World Development Indicators to derive countries' capital stocks. Data on oil reserves distributed by the United States' Energy Information Administration (EIA) are used to account for minerals stocks. Accounting for these stocks is especially important for the Andean countries, given their abundant endowments of these resources.

Factor endowments data for 1992 and 2001 are shown in Table 3. The United States is relatively abundant in capital and college-educated workers, whereas most Latin American countries have large relative endowments of workers with lower qualification levels. Argentina is relatively abundant in arable land. Bolivia, Brazil, and Peru are relatively well endowed with forest and woodland, and Ecuador and mainly Venezuela, with oil reserves. Most economies witnessed declines in workers with primary education, arable land, and forest and woodland over the period, while the share of workers with post-secondary education grew in all countries.

4 Econometric Results

Table 4 presents standardized estimates of Equation (10).[25] As mentioned before, the estimated coefficient on tariffs corresponds to the own price-output effects and hence should be nonnegative. This effect is positive and significant in the cases of Paper and Printing and Publishing and Chemical Products and not significantly different from zero in the remaining sectors.[26] The cross-price effects are mostly non-significant, but, as the theory suggests, when significant, they alternate positive and negative signs. Thus, for example, higher tariffs on Wood and Furniture, Non-Metallic Minerals, and Basic Metals are associated with larger shares of Food Products in GDP, whereas the opposite holds for tariffs on Machinery and Chemical Products.

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[24] Data on skill levels for 2001 are obtained by projecting the trend from the previous five-year period.

[25] Standardized coefficients are obtained by multiplying the regression slope by the standard deviation of the explanatory variable and dividing by the standard deviation of the dependent variable. Restrictions imposed have been tested by computing the Wald statistic, which has a X^2 distribution with degrees of freedom equal to the numbers of restrictions being evaluated. The null hypotheses of homogeneity (i.e., the sum of the estimated coefficients on factor endowments is equal to zero) and symmetry of cross-price effects cannot be rejected. These results are not reported but available from the authors upon request. The average R^2 of the regressions of the share equations is 0.97. The smallest R^2 is 0.91 and corresponds to Wood and Furniture, while the R^2 for Basic Metal Industries is 0.95. This suggests that other factors than those considered here (e.g., specific public sectoral policies) may have played an important role in explaining specialization, especially in the former sector. Predictions regarding this industry will therefore be relatively less precise and should accordingly be taken with caution. The R^2 of the remaining regressions is above 0.96.

[26] The cutoff used to determine statistical significance is $t>1.64$ ($t<-1.64$), which corresponds to the 10% significance level.

Factor endowments have different impacts depending on the sector, as expected from the theory. Relative abundance of capital has a positive influence on the share of Food Products, Non-Metallic Minerals, and Machinery in GDP. Abundance of workers with primary education has a positive effect on the output share of Food Products, Textiles, Chemicals, and Machinery, and a negative one on that of Non-Metallic Minerals and Paper and Printing and Publishing. Abundance of oil negatively affects the relative importance of Textiles, Non-Metallic Minerals, and Machinery in the Latin American countries' GDP.

The estimates obtained from this model can be used to simulate the impact of unilateral opening on the specialization patterns as indicated in Equation (11). Results are shown in Figure 3. The first picture displays the share of each industry in GDP in 2001 and the second one how would these shares be in the long-run in case that tariff barriers with respect to the rest of the world were completely removed. The share of Basic Metals in GDP is predicted to increase in all countries. The same is also true for Wood and Furniture in most countries. Chemical Products would become relatively larger in Bolivia, Colombia, and Venezuela. This is exactly what one would expect according to the theory given the comparative advantage of many Latin American economies, in those industries that intensively use their relatively abundant oil and gas, wood, and metal endowments. In contrast, the shares of Machinery, Non-Metallic Minerals, and Textiles are expected to contract relatively. Food Products would slightly lose relative importance in some countries. Summarizing, unilateral opening would reinforce the current patterns of specialization based on static comparative advantage along specific sectoral dimensions.

Table 5 presents estimates of Equation (12), i.e., when the United States are adopted as a benchmark.[27] Larger relative endowments of capital relative to the United States imply larger relative shares of Food Products and Machinery in GDP. Similarly, higher tariffs on Machinery relative to the United States are associated with larger relative output shares of this sector.[28] The relative share of workers with primary education is positively related to the relative shares of Food Products, Chemicals, and Basic Metals in GDP, while that of workers with secondary education with the shares of Basic Metals and Machinery. Finally, relative oil abundance has a

[27] The average R^2 is 0.90. However, there is a significant variation across sectors. Food Products and Machinery have the largest R^2, 0.99. The smallest R^2 is 0.78 corresponding to Wood and Furniture, whereas the R^2 for Textiles and Non-Metallic Minerals is 0.84 and that for Basic Metal Industries is 0.90. The same considerations concerning the goodness of fit and the accuracy of the predictions made for the first set of estimations also hold for these regressions.

[28] Remaining relative sectoral tariffs are not significantly different from zero with the exception of that on Basic Metal Products, which is negative. This might be due to the lack of explicit control for countries' relative metal endowments. These endowments may have been important in explaining relative specialization patterns in this sector. Discoveries of metal reserves and starting of processing activities of these metals took place over the 1990s in Latin America. A well known example is Peru.

positive effect on the share of Chemical Products and a negative effect on the shares of Textiles and Machinery in total output.

We now turn to the analysis of the impact of a free trade agreement between the Latin American countries and the United States. The third graph of Figure 3 shows for each country the share of each industry in GDP in the long-run under the assumption that relative prices were equalized as a result of tariff removal. We observe a relative expansion of Basic Metals and Chemicals may be expected for most countries. The share of Food Products is predicted to rise in Argentina and Brazil. Similarly, Wood and Furniture is expected to become relatively more important in the production structures of Bolivia, Brazil, Chile, Colombia, and Mexico. In contrast, Machinery would experience a relative contraction. This is far from being surprising given the evident comparative advantage of the United States in this sector relative to the Latin American countries. In general, these results are similar to those previously discussed, which might suggest that the United States is a reasonable approximation of the rest of the world for Latin American countries.

Summarizing, a free trade agreement between the Latin American countries and the United States will benefit those industries intensive in natural resources relatively abundant in those countries, mainly Basic Metals, Chemicals, and Wood Products, and will be associated with a relative shrinking of those sectors intensive in workers with higher qualification, mainly Machinery.

5 Concluding Remarks

Trade liberalization induces changes in countries' specialization patterns and thus to sectoral adjustments governed by the logic of comparative advantage. Sectors in which countries enjoy comparative advantage are expected to expand, while sectors in which the countries suffer from comparative disadvantage are predicted to contract. The reallocation of resources across sectors is not automatic and, at least in the short run, unemployment problems might arise or accentuate. Changing specialization patterns may also affect the growth potential, income distribution, and macroeconomic volatility.

Integration into the world economy is the right strategy, but this strategy is associated with costs that should be neither overlooked nor underestimated. The same holds for those developing countries seeking a free trade arrangement with developed economies. Gaining insights about the adjustments to be expected is relevant from an economic policy point of view.

Using the standard neoclassical trade theory as a framework, this paper has analyzed the interplay of trade policy and factor endowments in shaping sectoral specialization of the Latin American countries over the period 1990-2001 and has generated consistent predictions of how would this specialization look like if these countries implemented a complete unilateral trade liberalization and signed a free trade agreement with the United States. This deepening of trade liberalization will be associated with a relative expansion of those industries intensive in natural resources relatively abundant in those countries, Basic Metals, Chemicals, and Wood Products, and with a relative contraction of those sectors intensive in more skilled workers, mainly Machinery. Further opening will therefore reinforce the preexisting patterns of specialization based on static comparative advantage.

However, comparative advantage is not static and, over time, is partially determined by public policies, as is the case of supply of educated workers. Policies facilitating resource reallocation and skill upgrading are then called for. These policies will allow involved countries to ameliorate the short-run costs and properly shape intra- and inter-sectoral specialization to face the challenges imposed by the lowering of trade barriers.

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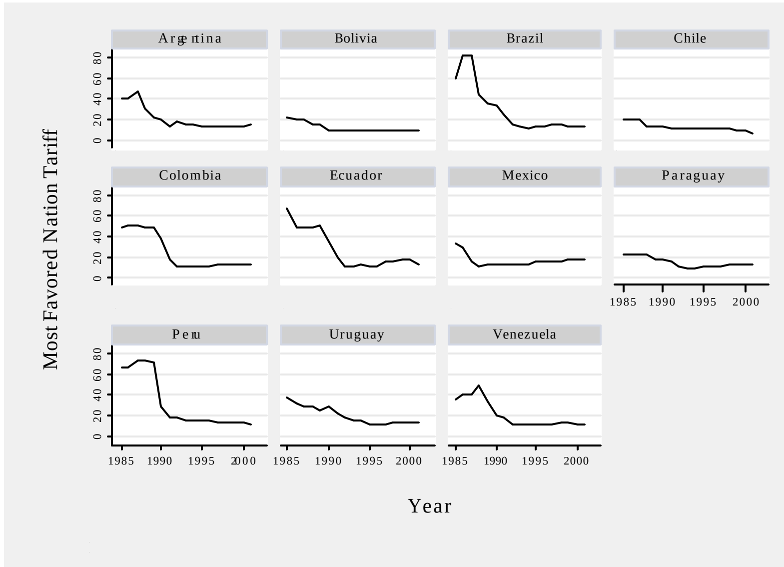
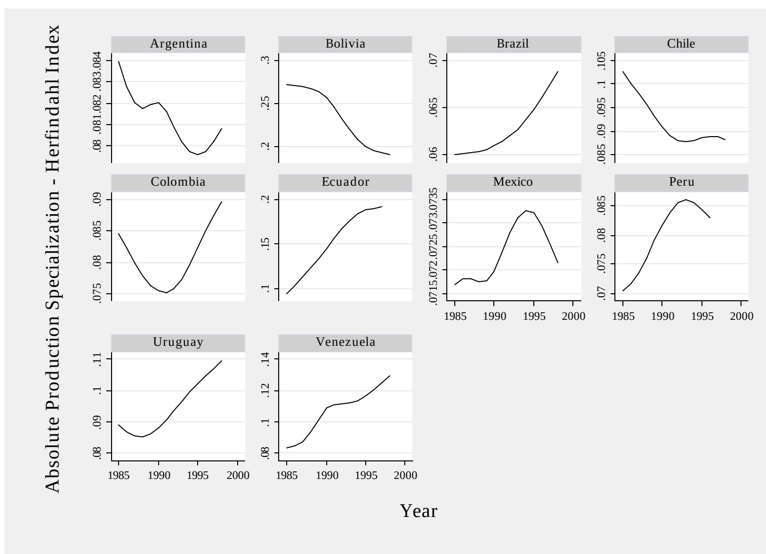
Figure 1



The figure shows the evolution of MFN tariffs over the period 1985-2001. Source: Estevadeordal and Volpe Martincus (2005).

Figure 2



The figure shows the HP trends of the Herfindahl Index calculated using sectoral manufacturing value added over the period 1985-1998. Source: Estevadeordal and Volpe Martincus (2005).

Table 1

Share of Manufacturing in GDP and Shares of Industries in Total Manufacturing in 1990 and 2001 (Percentage)												
	Year	**Argentina**	**Bolivia**	**Brazil**	**Chile**	**Colombia**	**Ecuador**	**Mexico**	**Peru**	**Uruguay**	**Venezuela**	**US**
Total Manufacturing Industry	**1990**	18.22	16.69	21.64	18.59	17.27	11.87	19.41	15.18	25.82	17.48	19.41
	2001	15.46	16.31	19.64	15.78	14.05	12.04	20.48	14.58	17.42	13.97	15.16
Food, Beverages, and Tobacco	**1990**	6.83	4.18	3.28	4.84	5.46	2.61	4.35	4.34	8.07	2.97	2.06
	2001	6.45	6.56	2.92	4.87	4.15	2.58	4.50	3.63	8.85	2.41	1.22
Textiles, Wearing Apparel, and Leather	**1990**	1.82	0.87	2.61	1.50	2.43	1.13	2.03	1.90	4.70	0.83	1.00
	2001	0.85	0.59	1.46	0.56	1.79	0.43	1.74	1.36	1.28	0.38	0.47
Wood and Furniture	**1990**	0.21	0.31	0.32	0.76	0.22	0.25	0.65	0.90	0.35	0.14	0.54
	2001	0.19	0.21	0.23	0.47	0.06	0.18	0.51	1.90	0.17	0.15	0.31
Paper, Printing, and Publishing	**1990**	0.69	0.34	1.41	1.56	1.27	0.61	0.99	0.72	1.43	0.66	2.07
	2001	0.72	0.46	1.50	1.16	1.29	0.32	0.88	0.83	1.08	0.57	1.05
Chemicals, Petroleum, Rubber, and Plastics	**1990**	3.75	9.40	5.05	3.56	3.76	5.26	3.44	2.60	6.43	8.92	3.11
	2001	3.38	6.72	4.48	3.97	3.36	7.48	3.12	2.33	3.71	7.37	1.96
Non-Metallic Mineral Products	**1990**	0.46	0.83	0.56	0.57	1.03	0.74	1.25	1.35	0.92	0.60	0.60
	2001	0.30	0.65	0.45	0.83	0.58	0.37	1.15	1.79	0.50	0.66	0.35
Basic Metal Industries	**1990**	1.85	0.27	1.93	3.85	0.72	0.21	1.26	1.21	0.37	1.85	0.69
	2001	1.51	0.18	1.99	2.02	0.68	0.12	1.27	1.45	0.15	0.54	0.43
Fabricated Metals, Machinery and Equipment	**1990**	2.57	0.28	6.02	1.89	2.22	1.03	5.10	1.57	3.39	1.43	9.06
	2001	2.03	0.16	6.42	1.88	2.02	0.52	7.00	0.76	1.61	1.82	9.16

The table reports the share manufacturing in GDP and shares of each industry in total manufacturing value added.

Source: Own Elaboration on PADI (ECLAC), Industrial Statistics Database (UNIDO), Annual Statistical Yearbook (ECLAC), World Development Indicators (World Bank), INE (Statistical Bureau of Venezuela)

Table 2

Average Sectoral Tariffs in 1990 and 2001 (Percentage)	Year	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Mexico	Peru	Uruguay	Venezuela	US
Food, Beverages, and Tobacco	**1990**	16.88	10.00	47.82	15.00	47.71	41.72	15.23	33.32	32.85	28.24	6.22
	2001	21.47	9.89	17.12	8.34	17.58	17.82	34.13	16.00	17.02	17.60	9.02
Textiles, Wearing Apparel, and Leather	**1990**	26.36	10.00	41.15	15.08	52.91	55.51	16.68	42.90	33.58	34.19	11.51
	2001	23.31	9.96	19.21	8.00	17.09	17.09	42.90	15.49	19.11	16.68	9.09
Wood and Furniture	**1990**	25.58	10.00	25.88	15.00	48.94	53.72	17.27	36.53	36.72	38.37	3.99
	2001	17.78	10.00	14.10	8.00	14.92	15.75	19.99	11.53	14.08	15.23	1.47
Paper, Printing, and Publishing	**1990**	21.92	10.00	25.04	14.55	44.84	44.43	9.93	39.36	31.72	24.93	1.85
	2001	19.14	9.66	14.82	7.77	14.08	14.30	13.74	11.05	14.38	14.05	0.55
Chemicals, Petroleum, Rubber, and Plastics	**1990**	20.69	10.00	34.94	15.05	31.93	29.93	13.20	22.44	28.22	17.96	4.94
	2001	13.83	9.88	11.73	8.00	11.05	10.73	14.34	9.23	12.21	11.03	3.36
Non-Metallic Mineral Products	**1990**	21.59	10.00	26.39	15.00	37.97	38.74	13.68	25.12	30.46	26.21	5.80
	2001	14.26	9.94	12.61	8.00	12.76	12.12	17.06	11.25	12.59	12.94	3.35
Basic Metal Industries	**1990**	21.10	9.94	17.92	15.00	25.49	22.05	11.12	19.81	25.11	7.95	4.47
	2001	12.58	9.86	12.56	8.00	8.14	7.68	13.89	9.01	12.38	8.34	1.95
Fabricated Metals, Machinery and Equipment	**1990**	22.38	9.32	38.12	14.62	30.95	29.88	14.20	26.62	28.39	17.34	4.13
	2001	13.78	7.70	15.78	7.79	10.81	11.28	16.58	11.96	12.69	11.38	1.85

Source: IDB and TRAINS.

Table 3

Factor Endowments	Year	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Mexico	Peru	Uruguay	Venezuela	US
Labor Force	**1990**	22587	3864	97393	9195	20901	6266	52347	13440	2296	12061	195685
	2001	26988	5153	124680	11121	26891	8584	69620	17959	2509	16346	217190
Capital Stock per Worker	**1990**	10.47	1.29	7.97	3.95	3.34	3.99	8.77	3.52	5.64	13.73	34.85
	2001	11.83	1.76	7.12	8.54	3.43	3.11	10.01	4.04	7.52	11.46	50.50
Share of Workers with Primary School	**1990**	51.20	41.40	63.90	50.10	49.70	48.20	42.80	44.60	49.60	56.40	8.60
	2001	44.62	45.08	61.84	43.78	42.32	45.84	41.66	31.48	44.38	44.06	8.22
Share of Workers with Secondary Education	**1990**	30.70	18.40	11.30	33.70	22.90	22.20	35.00	25.30	35.60	14.90	47.30
	2001	31.00	14.44	14.96	34.16	27.56	23.92	38.20	34.42	35.44	31.34	42.06
Share of Workers with Post-Secondary Education	**1990**	13.20	8.80	6.10	10.10	7.10	12.30	8.50	15.10	10.20	10.50	42.90
	2001	20.90	13.42	7.66	14.94	10.10	15.42	10.80	22.62	15.08	14.42	48.88
Arable Land per Worker	**1990**	1.28	0.54	0.52	0.30	0.16	0.26	0.46	0.26	0.55	0.23	0.95
	2001	1.25	0.56	0.47	0.18	0.09	0.19	0.36	0.21	0.52	0.16	0.81
Forest and Woodland per Worker	**1990**	2.26	15.00	5.79	1.80	2.60	2.49	0.93	6.31	0.41	3.86	1.51
	2001	1.89	11.25	4.45	1.48	1.97	1.82	0.70	4.72	0.37	2.72	1.36
Oil Reserves per Worker	**1990**	0.13	0.07	0.05	0.05	0.18	0.46	2.01	0.06	0.00	10.15	0.18
	2001	0.15	0.12	0.10	0.02	0.12	0.44	0.70	0.03	0.00	8.39	0.12

Sources:

Data on labor force (population older than 15 years) come from Barro and Lee (2000) and are expressed in thousands of persons.
Intervening years are interpolated as in Harrigan (1997).

Arable land and forest and woodland data come from FAO are expressed as herctares per worker.

Capital stocks are estimated using the perpetual inventory method on country series of gross fixed capital formation taken from WDI (Worldbank) as suggested by Jacobs et al. (1997) and Kamps (2004).
Data are expressed in thousands of 2000 US Dollars per worker.

The distribution of economically active population is taken from Barro and Lee (2000). Data correspond to 1990, 1995, 2000.
Intervening years (2001) are interpolated (extrapolated) as in Harrigan (1997). Data are expressed in percentages.

Data on oil reserves are taken from the database maintained by the US Energy Information Administration and are expressed in thousands of barrels per worker.

Table 4

Trade Policy, Factor Endowments, and Specialization Patterns - Estimates of Equation (10)								
	Sector 31	**Sector 32**	**Sector 33**	**Sector 34**	**Sector 35**	**Sector 36**	**Sector 37**	**Sector 38**
Tariff Sector 31	0.117	0.040	-0.055	0.508	-0.322	0.318	0.444	-0.135
	1.231	*0.336*	*-0.237*	*1.907*	*-1.874*	*1.785*	*2.478*	*-2.164*
Tariff Sector 32	0.019	-0.150	0.315	-0.499	0.360	-0.264	-0.350	0.081
	0.336	*-0.942*	*1.135*	*-1.385*	*2.299*	*-1.016*	*-1.671*	*1.336*
Tariff Sector 33	-0.014	0.169	0.306	-0.817	-0.095	0.298	-0.023	-0.032
	-0.237	*1.135*	*0.524*	*-1.397*	*-0.468*	*0.781*	*-0.084*	*-0.421*
Tariff Sector 34	0.104	-0.219	-0.674	1.637	-0.512	-0.120	0.196	0.163
	1.907	*-1.385*	*-1.397*	*2.270*	*-2.557*	*-0.291*	*0.736*	*2.227*
Tariff Sector 35	-0.186	0.465	-0.237	-1.515	0.715	-0.835	-0.597	0.231
	-1.874	*2.299*	*-0.468*	*-2.557*	*2.041*	*-2.027*	*-1.489*	*2.095*
Tariff Sector 36	0.058	-0.105	0.227	-0.109	-0.256	0.080	0.662	-0.041
	1.785	*-1.016*	*0.781*	*-0.291*	*-2.027*	*0.225*	*3.881*	*-0.881*
Tariff Sector 37	0.131	-0.219	-0.027	0.279	-0.287	1.035	-0.291	-0.111
	2.478	*-1.671*	*-0.084*	*0.736*	*-1.489*	*3.881*	*-0.920*	*-1.699*
Tariff Sector 38	-0.117	0.152	-0.113	0.695	0.336	-0.193	-0.331	-0.085
	-2.164	*1.336*	*-0.421*	*2.227*	*2.095*	*-0.881*	*-1.699*	*-0.947*
Capital	0.386	-0.169	-0.129	0.051	-0.389	0.478	-0.301	0.187
	2.465	*-0.952*	*-0.563*	*0.182*	*-1.617*	*2.065*	*-1.508*	*2.019*
Primary Education	0.149	0.373	0.351	-0.590	0.351	-0.657	0.024	0.116
	2.064	*2.779*	*1.530*	*-2.096*	*2.108*	*-3.377*	*0.128*	*1.889*
Secondary Education	-0.095	0.260	0.357	0.000	-0.036	0.012	0.225	0.102
	-0.971	*1.631*	*1.371*	*0.001*	*-0.173*	*0.049*	*1.004*	*1.324*
Post-Secondary Education	-0.504	-0.223	-1.052	0.645	-0.328	0.507	-0.260	-0.380
	-2.375	*-0.546*	*-1.433*	*0.760*	*-0.662*	*0.856*	*-0.464*	*-2.054*
Arable Land	0.259	-0.087	0.336	1.280	-0.839	1.378	0.711	0.285
	0.886	*-0.187*	*0.496*	*1.687*	*-1.428*	*2.264*	*1.275*	*1.232*
Forest and Woodland	-0.398	-1.487	-0.705	-0.141	0.282	0.769	-0.755	-0.437
	-0.788	*-4.433*	*-1.913*	*-0.244*	*0.571*	*1.677*	*-1.859*	*-2.247*
Oil Reserves	0.412	-0.998	-0.647	0.641	0.455	-1.290	0.177	-0.539
	1.457	*-3.393*	*-1.467*	*0.982*	*1.056*	*-2.689*	*0.463*	*-3.244*
Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	120	120	120	120	120	120	120	120

Notes:

The table reports standardized 3SLS estimates.

Standardized coefficients are obtained by multiplying the slope by the standard deviation of the explanatory variable and dividing by the standard deviation of the GDP share.

Tariff Sector k = ln(1+Tariff Sector k), calculated according to Equation (15).

Tariffs are instrumented by 10 years-lagged sectoral shares in total manufacturing employment and 10 years-lagged inverse import penetration ratios.

All endowments are expressed as log of share of labor (i.e., economically active population)

Relative endowments are instrumented by their 10 years-lagged values

t-statistics in below coefficients in *bold*

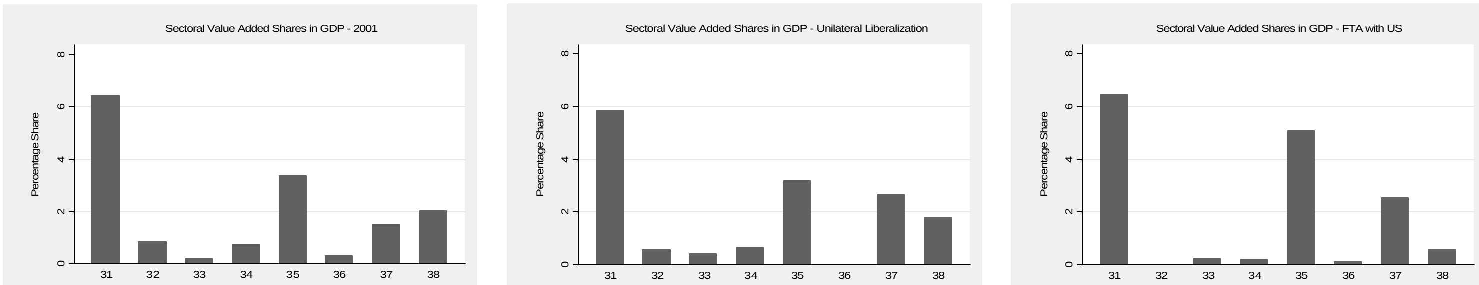
Table 5

Trade Policy, Factor Endowments, and Specialization Patterns - Estimates of Equation (12)								
	Sector 31	**Sector 32**	**Sector 33**	**Sector 34**	**Sector 35**	**Sector 36**	**Sector 37**	**Sector 38**
Tariff Sector 31	-0.052	0.133	0.260	-0.432	0.679	-0.100	-0.008	-0.329
	-0.534	*0.952*	*0.937*	*-1.982*	*3.925*	*-0.271*	*-0.050*	*-4.168*
Tariff Sector 32	0.075	-0.205	0.141	0.386	-0.234	-0.017	0.130	0.185
	0.952	*-0.952*	*0.420*	*1.437*	*-1.263*	*-0.037*	*0.676*	*2.201*
Tariff Sector 33	0.076	0.081	-0.156	0.147	-0.460	0.209	0.167	0.068
	0.937	*0.420*	*-0.221*	*0.387*	*-2.393*	*0.295*	*0.675*	*0.685*
Tariff Sector 34	-0.118	0.209	0.143	0.247	-0.024	-0.493	-0.157	0.153
	-1.982	*1.437*	*0.387*	*0.671*	*-0.151*	*-1.061*	*-0.935*	*2.024*
Tariff Sector 35	0.420	-0.286	-1.054	-0.057	-0.162	0.170	0.142	-0.094
	3.925	*-1.263*	*-2.393*	*-0.151*	*-0.485*	*0.275*	*0.521*	*-0.698*
Tariff Sector 36	-0.020	-0.007	0.146	-0.354	0.052	0.443	0.250	-0.067
	-0.271	*-0.037*	*0.295*	*-1.061*	*0.275*	*0.626*	*1.201*	*-0.730*
Tariff Sector 37	-0.003	0.079	0.180	-0.176	0.069	0.389	-0.657	-0.043
	-0.050	*0.676*	*0.675*	*-0.935*	*0.521*	*1.201*	*-3.314*	*-0.679*
Tariff Sector 38	-0.329	0.351	0.238	0.558	-0.147	-0.335	-0.137	0.320
	-4.168	*2.201*	*0.685*	*2.024*	*-0.698*	*-0.730*	*-0.679*	*2.332*
Capital	0.475	-0.065	-0.123	0.071	-0.709	0.458	-0.090	0.270
	3.115	*-0.309*	*-0.451*	*0.276*	*-2.336*	*1.176*	*-0.472*	*2.102*
Primary Education	0.221	0.378	0.062	-0.218	0.351	-0.721	0.541	0.090
	2.960	*1.132*	*0.155*	*-0.827*	*1.982*	*-1.526*	*2.280*	*0.927*
Secondary Education	-0.156	0.012	0.371	0.294	-0.245	0.055	0.529	0.269
	-1.592	*0.066*	*1.365*	*1.314*	*-1.124*	*0.156*	*2.970*	*2.751*
Post-Secondary Education	-0.654	-0.407	-0.290	-1.023	1.389	-0.456	-1.184	-0.891
	-3.245	*-0.934*	*-0.401*	*-1.898*	*3.130*	*-0.513*	*-2.861*	*-3.872*
Arable Land	0.301	0.954	0.467	2.227	-2.853	2.112	0.495	0.950
	1.050	*1.328*	*0.385*	*2.616*	*-4.442*	*1.425*	*0.743*	*2.752*
Forest and Woodland	-0.280	-0.888	-0.734	-0.189	-0.850	0.541	-1.039	0.072
	-0.494	*-3.201*	*-1.582*	*-0.365*	*-0.934*	*0.785*	*-3.130*	*0.235*
Oil Reserves	0.483	-1.036	-0.271	-0.113	0.936	-0.837	0.519	-0.698
	1.924	*-3.750*	*-0.517*	*-0.242*	*1.858*	*-1.219*	*1.685*	*-3.343*
Country Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed-Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	119	119	119	119	119	119	119	119

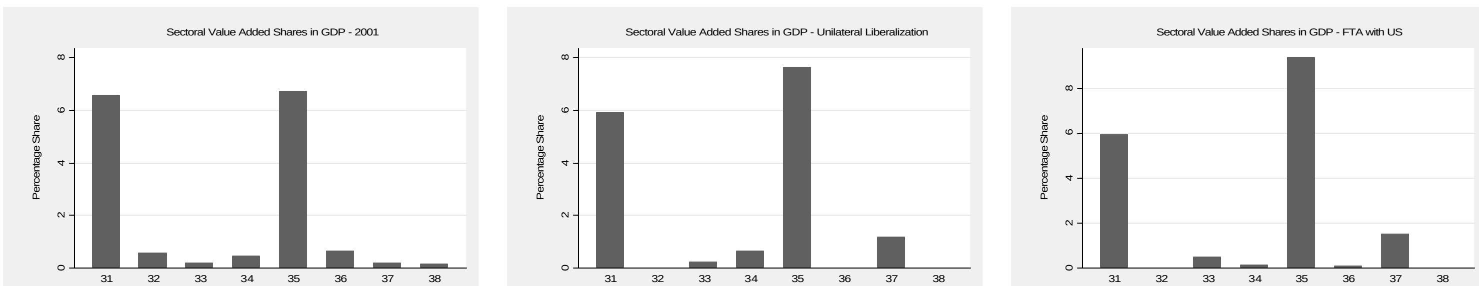
Notes:
The table reports standardized 3SLS estimates.
Standardized coefficients are obtained by multiplying the slope by the standard deviation of the explanatory variable and dividing by the standard deviation of the the GDP share.
Tariff Sector k = ln[(1+Latin American Country Tariff Sector k) / (1+ US Tariff Sector k)], calculated according Equation (16)
Tariffs are instrumented by 10 years-lagged sectoral shares in total manufacturing employment and 10 years-lagged inverse import penetration ratios.
All endowments are expressed as log of share of labor (i.e., economically active population)
Relative endowments are instrumented by their 10 years-lagged values
t-statistics in below coefficients in *bold*

Figure 3

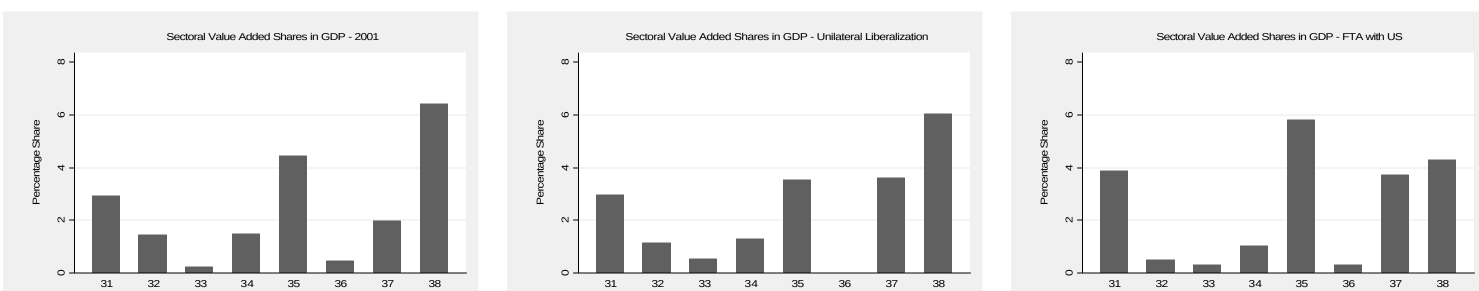
Argentina



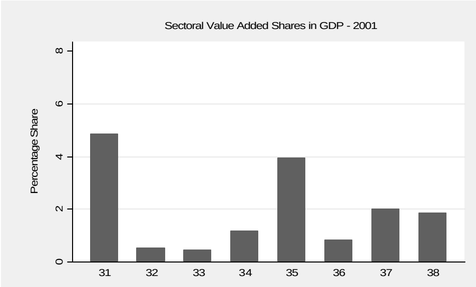
Bolivia

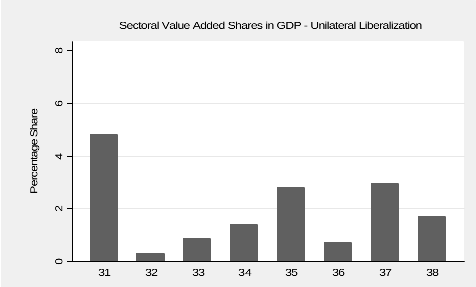


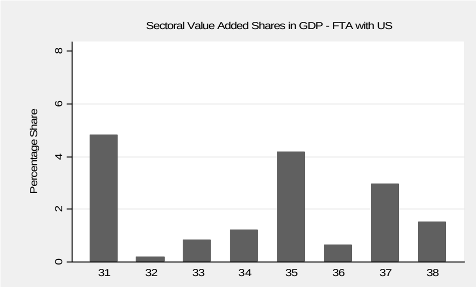
Brazil



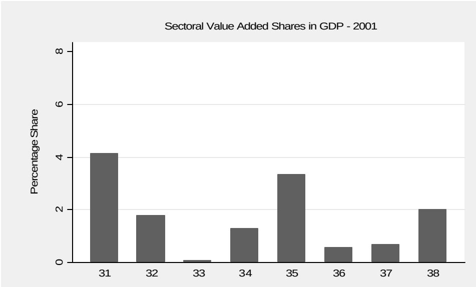
Chile

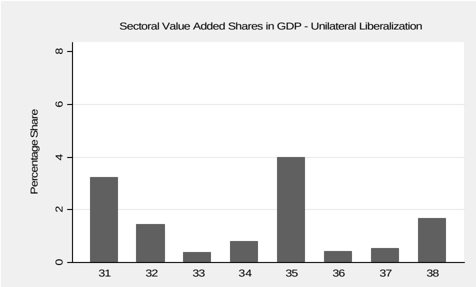


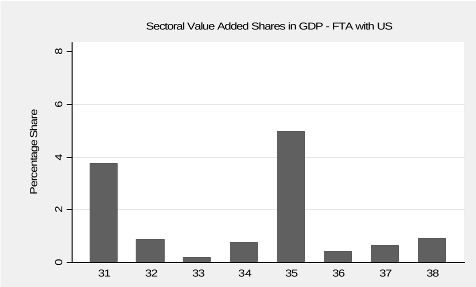




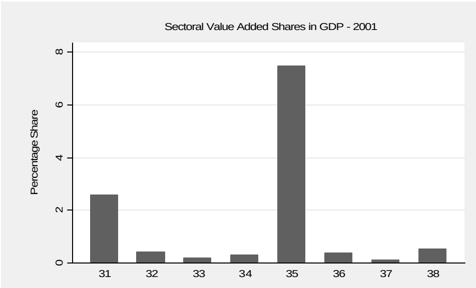
Colombia

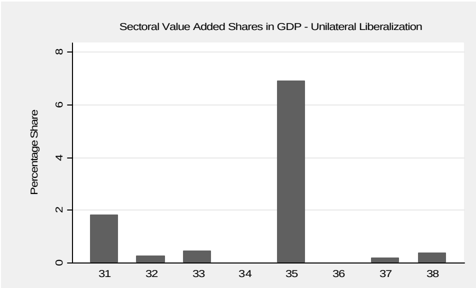


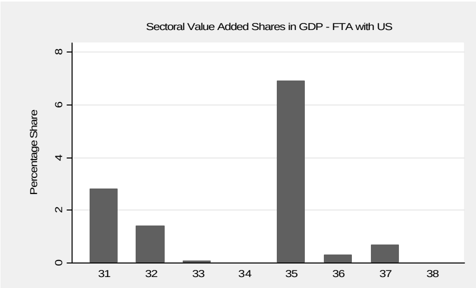




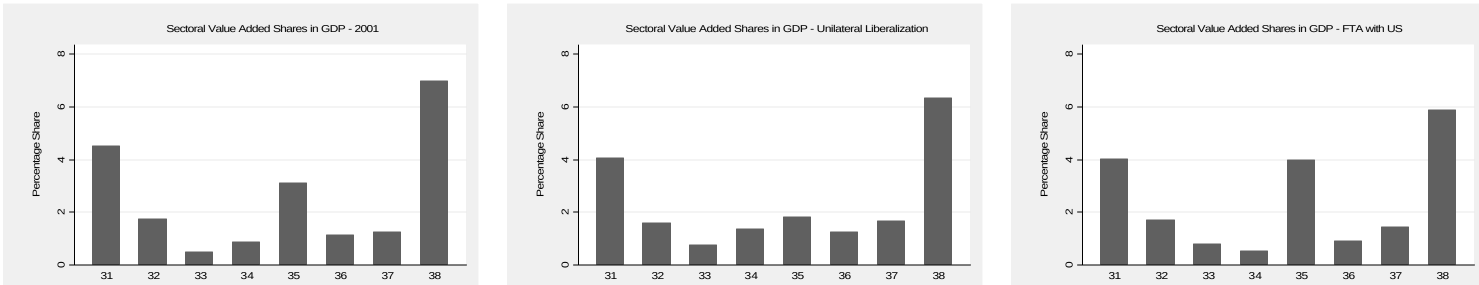
Ecuador



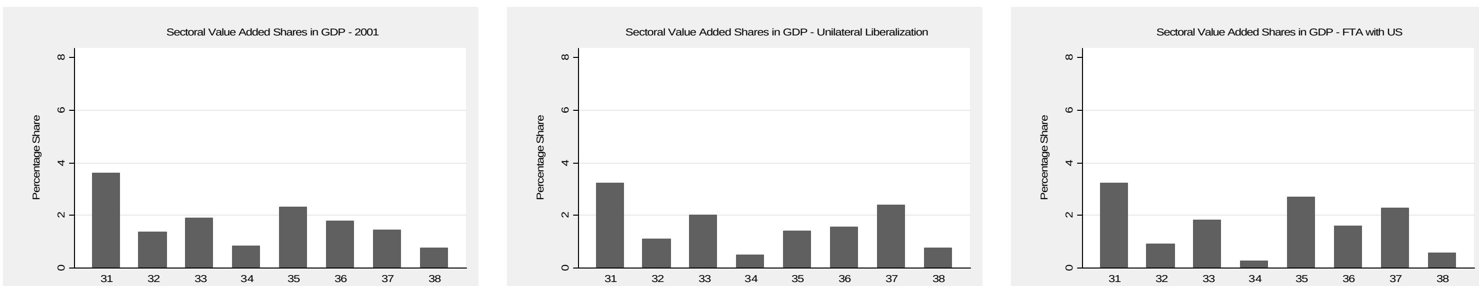




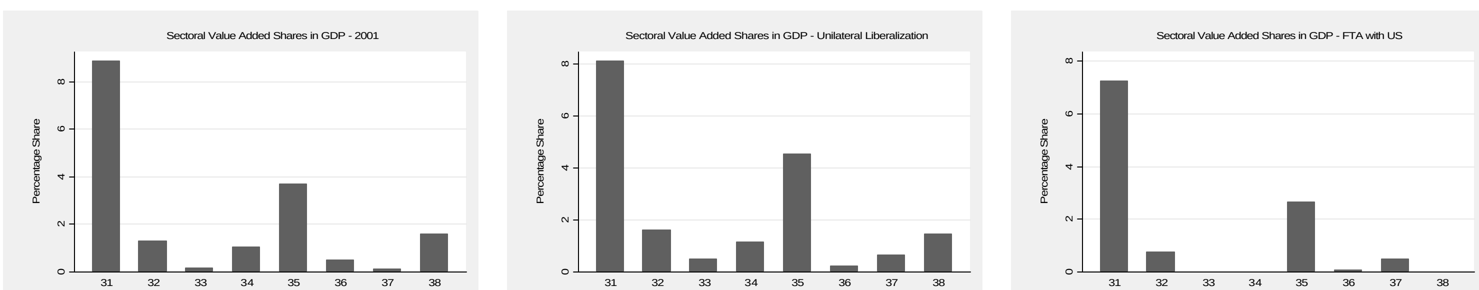
Mexico



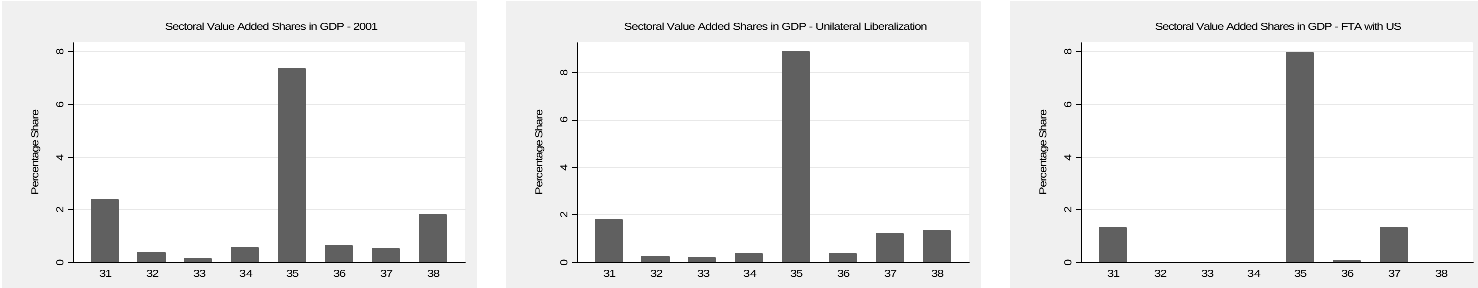
Peru



Uruguay



Venezuela



Sectoral Value Added Shares in GDP - 2001
Sectoral Value Added Shares in GDP - Unilateral Liberalization
Sectoral Value Added Shares in GDP - FTA with US
Percentage Share
0
2
4
6
8
31
32
33
34
35
36
37
38

Appendix A

Table A1

Value Added: Countries, Sectors, Time Coverage, and Sources				
Country	**Sectoral Coverage**	**Number of Sectors**	**Time Coverage**	**Source**
Argentina	Manufacturing	8	1990-2001	PADI (ECLAC)
Bolivia	Manufacturing	8	1990-2001	PADI (ECLAC)
Brazil	Manufacturing	8	1990-2001	PADI (ECLAC)
Chile	Manufacturing	8	1990-2001	PADI (ECLAC)
Colombia	Manufacturing	8	1990-2001	PADI (ECLAC)
Ecuador	Manufacturing	8	1990-2001	IIS (UNIDO)
Mexico	Manufacturing	8	1990-2001	PADI (ECLAC)
Peru	Manufacturing	8	1990-2001	PADI (ECLAC)
Uruguay	Manufacturing	8	1990-2001	PADI (ECLAC)
Venezuela	Manufacturing	8	1990-2001	PADI (ECLAC)/INE
United States	Manufacturing	8	1990-2001	PADI (ECLAC)

Table A2

International Standard Industrial Classification (ISIC), Revision 2, 2 digits	
Code	**Description**
31	**Manufacture of Food, Beverages, and Tobacco**
	Food products (311), Beverages (313), Tobacco (314)
32	**Textiles, Wearing Apparel, and Leather Industries**
	Textiles (321), Wearing Apparel (322), Leather Products (323), Footwear (324)
33	**Manufacture of Wood and Furniture**
	Wood Products (331), Furniture (332)
34	**Manufacture Paper Products, Printing and Publishing**
	Paper (341), Printing and Publishing (342)
35	**Manufacture of Chemicals and Chemical, Petroleum, Coal, Rubber, and Plastic Products**
	Industrial Chemicals (351), Other Chemicals (352), Petroleum Refineries (353),
	Miscellaneous Products of Petroleum and Coal (354), Rubber Products (355),
	Plastic products not elsewhere classified (356)
36	**Manufacture of Non-Metallic Mineral Products, except Products of Petroleum and Coal**
	Pottery, China, and Earthenware (361), Glass Products (362),
	Other Non-Metallic Mineral Products (369)
37	**Basic Metal Industries**
	Iron and Steel (371), Non-Ferrous Metals (372)
38	**Manufacture of Fabricated Metal Products, Machinery and Equipment**
	Fabricated Metal Products (381), Machinery (382), Electrical Machinery (383)
	Transport Equipment (384), Professional, Scientific and Measuring Equipment (385)

Note:

Other Manufacturing Industries (390) are a residual sector and thus not considered