ENDOGENOUS TRADE PROTECTION

UNDER REGIONAL TRADE AGREEMENTS:

THE ANDEAN CASE

A Dissertation

by

GUSTAVO SANCHEZ BIZOT

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2005

Major Subject: Agricultural Economics

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ABSTRACT

Endogenous Trade Protection under Regional Trade Agreements:

The Andean Case.

(May 2005)

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Endogenous tariff formation has been the subject of theoretical studies that attempt to determine the fundamental economic variables that influence the structure of industry protection implemented by international trade policy makers. An empirical analysis of endogenous tariff formation under the framework of a regional trade agreement implemented by the Andean Community Group is offered in this dissertation. Econometric models for the group's common external tariff (CET) and for individual country tariff deviations with respect to the CET are estimated. The analysis is based on cross-sectional industrial and trade data for 1996, collected at four digit level of aggregation. The level of aggregation refers to the specific definition of industrial sectors included in the International Standard Industrial Code (ISIC). While previous studies on another regional integrated group in South America (MERCOSUR) use data at the three digit level, the aggregation used in this research implies a significant increase in the

sample size, and also a more homogeneous specification regarding the composition of the industrial sectors under analysis.

The causal links among the variables are obtained by using the directed acyclical graphs (DAGs) approach. This allows for a refined search for causal relationships. The approach is particularly appealing for the analysis of endogenous trade protection since it allows analyzing economic systems that involve policy intervention.

The empirical analysis supports several of the classic theoretical models on trade protection. The results are consistent with the equity concern model, which suggests that governments tend to protect industrial sectors that employ a significant number of low wage unskilled workers. The estimated models also support the interest group and the adding machine theoretical formulations. However, a rather interesting result derived from the DAG analysis is the feedback interaction that seems to operate between tariffs and policy variables. The current literature restricts the estimation of trade protection by imposing tariffs as the dependent variable with no reverse effect from this variable to the policy variables. Our results challenge this unidirectional causality view, since an effect from tariffs to the policy variables shows up in most of the estimated specifications.

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I would like to dedicate this dissertation to my infinite source of motivation during the time that I have spent studying, my wife Mairen, my son Alejandro, and my daughter Andreina. They made this possible.

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CHAPTER I

INTRODUCTION

The number of regional trade agreements has increased steadily since World War II. However, in the last decade there has been a sharp rise in the number of agreement notifications to the World Trade Organization (WTO). Between January 1995 and April 2004[1], there have been around 160 agreements notified, compared to around 120 notifications during the previous 47 years[2]. With respect to multilateral negotiations, Winters (1996) concludes that regional agreements have the benefit of achieving strong gains from trade de-restriction, and of accomplishing greater liberalization, albeit only within the group members. He argues that "we don't know yet" whether regional trade agreements will encourage or discourage global free trade.

While regional integration between industrialized countries has brought about indisputable benefits, experiments with regional integration in the developing world have been more problematic. The risk of South-South integration, i.e. integration among developing countries, is that the losses due to trade diversion outweigh the gains due to trade creation[3], given member countries' small relative size and limited intraregional trade. Cernat (2003) evaluates seven South-South integration agreements and finds

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This dissertation follows the style and format of the *American Journal of Agricultural Economics*.

[1] A partial list of these agreements includes AFTA, CAN, CEFTA, EC, GCC, MERCOSUR, and NAFTA.
[2] Notifications before 1995 were submitted to the General Agreement on Trade and Tariffs organization (GATT).
[3] See figure 1 in the appendix for an illustration of potential gains and loses from regional integration agreements

evidence of a net trade creation effect for five of the seven regional groups analyzed. The only exceptions were MERCOSUR and the Andean Community, which reduced trade with non-members during the period 1994-98.

A common external tariff (CET) is a fundamental element of a customs union, a regional agreement that not only includes free trade among member states but also a common external trade policy. The Andean Community, whose origins date back to the Cartagena agreement in 1969, initially had counted on forming a customs union by 1980. In reality, a CET was not enacted until 1995, when the Andean Community (CAN) became an "imperfect" customs union, with a large list of exceptions, a member country that doesn't participate (Peru) and another with special treatment (Bolivia). The Andean Community is an interesting case study of integration between developing countries, and in particular, of the process of "open regionalism" currently underway in Latin America.

The object of this study is twofold. Firstly, to apply the results of the theoretical literature on endogenous tariff formation to the Andean Community's Common External Tariff (CET), and to identify the determinants of the CET and its political viability. Secondly, to apply the directed acyclical graph (DAG) approach to policy analysis where causality is a significant issue in determining how different countries' interests can be reflected in the CET. If the Andean CET appears to reflect the underlying political economic variables, one would expect less political challenges and a greater possibility for the CET to survive. If, on the other hand, the CET does not appear to be determined by the political economy in the region, we may not expect the customs union to be politically viable.

The dissertation is offered in five additional chapters. In Chapter II theoretical aspects concerning endogenous trade policy are presented. Also the primary variables that have been identified in the literature as influencing protection levels are discussed. In Chapter III a brief count of the main issues associated with the creation and evolution of the Andean Community is offered. In addition, the major characteristics of the common external tariff (CET) implemented by the group are discussed. Chapter IV presents the econometric tools employed in the empirical analysis, as well as, the formulation of the base model used for estimation. In the first two sections of Chapter IV relevant concepts associated with the directed acyclical graph (DAG) approach are discussed, particularly, the possibility to derive an econometric specification based on the causal flows determined in the DAGs obtained by applying an algorithm that searches for causal connections, the PC algorithm. Chapter V describes the data and the empirical results. The study concludes with a summary and a brief analysis of the implications of the empirical results.

CHAPTER II

ENDOGENOUS TRADE POLICY

In order to support the selection of the variables included in our empirical analysis, theoretical fundamentals related to endogenous trade protection are presented in this chapter. The chapter also offers a discussion on the conceptual approach by Hendry (1995), where the econometric work is considered at four different levels of knowledge about the data generating process. This discussion is relevant to support our hypothesis that causality between the policy variables defined below and the levels of tariffs does not necessarily follow the unidirectional pattern assumed by the standard theoretical models, which do not consider a feedback from tariffs to policy variables.

Literature Review

The basic finding of traditional trade theory, which states that free trade is superior to protectionism, is in sharp contrast to the reality that all countries practice some degree of trade restrictions. According to the political economy of trade policy literature, protectionism is determined by the interaction of different groups of economic agents. This literature is very rich and consists of a variety of different approaches. Six are discussed here:

1) The pressure group framework (see Olson (1965), Pincus (1975) and Stigler (1971)) states that domestic capitalist groups exert political influence demanding trade barriers to protect specific economic sectors. The pressure may be characterized by collective actions, such as financially supporting election campaigns; threatening to have members vote as a block, writing bills and making legislators support the approval of those bills, among others. Olson (1965) suggests that there is an incentive for "free rider" behavior when the collective actions may benefit a sector or group with a significantly large number of members. This situation could lead to less effective functioning of the pressure group. On the contrary, a small number of members as well as geographical concentration would enhance the potential benefits that the pressure group can achieve. This theory reflects an inverse relationship between tariff levels and industrial concentration, since a small number of firms in a particular sector increases the marginal benefit from collective actions and, therefore, fewer firms will have the incentive to adopt a free rider behavior.
2) The adding machine model is based on the assumption that the government will establish a protection structure that maximizes its re-election possibilities. According to Caves (1976), the government not only considers the number of voters represented by a particular sector but also the multiplier effect derived from "the publicity impact, on regional and/or economic neighbors of the sector considered" (see K A Koekkoek, I. Kol and L.B.M. Mennes (1981)). This theory

suggests that the higher the number of employees in an industrial sector, the higher the level of protection set by the government on that sector.

3) The equity concern model (see Baldwin (1984a), Constantopoulos (1974) and Fieleke (1976)) argues that government actions may be directed to protect those industries that hire a significant number of low-income workers, in an attempt to reduce income inequalities. Even though low-income workers may not have enough political power to organize collective actions directed to claim benefits, society expects a non-selfish behavior on public policy issues. However, some criticisms to this approach are related to the fact that it is not necessarily the case that the protected industries transmit the benefits to their low-income unskilled workers, since the skilled workers may get the major gains in those sectors (see Baldwin (1984b)). On the other hand, some of the sectors with higher protection levels have low barriers to entry, which increases the incentive for new incumbents and, therefore, reduces part of the gains derived from government protection. According to this model we would expect wages to be negatively related to tariff levels, since industrial sectors with large numbers of low income workers will be strong potential candidates for higher protection levels.
4) The Status Quo model explains protectionist structures by adopting the conservative social welfare function in Corden (1974). This function is consistent with aversion to drops in income for any established group. The basic idea is that people prefer to maintain current conditions, even if there may be some potential gains from a new structure that would arise after the changes in the levels of

protection. It is easier to identify the losers in the expected new situation, than to identify prospective beneficiaries. According to this model past levels of protection are relevant to explain the current tariff levels. This model is not tested in this study.

5) Recent theoretical work has focused on the development and estimation of structural economic specifications of endogenous trade protection. The median-voter model (see Mayer (1984)) considers a structure based on the fact that governments increase protection in those industries where the median voter owns less capital than the mean ownership; therefore, most people would favor trade policies biased towards protecting labor. Implementing empirical analysis based on the estimation of the median-voter model has been restricted by the lack of data on the median-voters' characteristics. This model is not investigated in the current study.

6) The Grossman and Helpman (1994) model offers an alternative structural specification that is more versatile for empirical testing. The model is motivated by the interest group argument and it is based on microeconomic foundations. The formulation begins with the specification of preferences for a set of uniform individuals. Indirect utility functions are aggregated to generate a welfare function that becomes one of the arguments in the government optimization problem. The second argument of the government objective function corresponds to the contributions provided, through lobbying activities, by the owners of the production factors. The trade policy will result from the maximization of the

government's objective function, which explicitly includes a trade off between the two arguments described above.

It is important to note that most empirical studies on the political economy determinants of trade policy have focused on the case of industrialized countries, in particular the U.S. (for the United States, studies include Pincus (1975), McPherson (1972), and Ray (1981)). In general, developing countries have always been more protectionist than their more developed counterparts, even though this situation has been changing. Latin America, in particular, has undergone a process of trade liberalization over the past quarter century. Empirical studies on developing countries have historically been limited by the lack of data. Olarreaga and Soloaga (1998) consider the political economy determinants of trade policy in the MERCOSUR countries, in particular with respect to the union's common external tariff (CET).

Ray (1981) searched for the empirical determinants of trade protection using four digits aggregation data on U.S. industries. While he didn't find evidence of a significant influence of industrial concentration on the tariff levels, his results supported the equity concerned argument, since tariffs were affected by labor intensity and also by the capital/labor ratio. His results may be summarized by his estimated linear equations of tariff levels as the dependent variable and labor intensity, and the capital labor ratio as independent variables. The signs, as expected, were positive for the former variable and negative for the latter.

Using the same data as Ray (1981), Marvel and Ray (1983) attempted to explain the changes in the interindustry trade restrictions generated after the Kennedy Round of tariff negotiation, which implemented a 50% tariff reduction between 1968 and 1972. These authors found evidence supporting three major effects on tariff levels. The first effect was a positive impact of the level of industry concentration on tariff levels; this result was consistent with the pressure group argument. The second major effect was an inverse impact of the industry growth rate on the levels of protection, supporting the comparative advantage argument that indicates that less protection is demanded by a particular sector as the ratio of exports to imports increases. The third major effect supported the pressure group hypothesis, since as the number of workers belonging to labor unions increased, the protection provided to the sector was higher. Marvel and Ray also found slight evidence supporting the status quo model, as they found that the fifth lag of the tariff turned out to have a positive significant coefficient, implying that current tariff levels were a relevant factor in determining any modification on the pattern of trade protection.

In a study based on U.S. cross-sectional data Baldwin (1985) found an inverse effect of wages and a direct effect of labor per unit of output on tariffs. These results support the equity concern and the status quo models, since the government tends to increase protection in sectors hiring low-income unskilled workers, who would experience severe adjustment conditions if those sectors were less competitive due to protection reduction. Baldwin also found evidence supporting the pressure group theory since the tariff levels were also affected by industrial concentration. On the other hand, the variables related to external commercial trade (e.g. import penetration) were not relevant in his estimation of the tariffs equation.

Different researchers have empirically tested the Grossman-Helpman model. Goldberg and Maggi (1999) using data on U.S. industrial sectors at the three digit aggregation for 1983, found evidence supporting the interest group argument, since import penetration was relevant to explain trade protection in those sectors that tended to be better politically organized. Calfat, Flores and Ganame (2000) tested the Grossman-Helpman model with data for MERCOSUR (Argentina, Brazil, Paraguay and Uruguay). These authors estimated equations for the common external tariff and for deviations from the CET, their results also supported the interest group hypothesis, since a significant effect of import penetration on trade protection was found, for those sectors that were better politically organized.

The analysis performed in this study attempts to look at the different fundamental relationships between tariff levels and policy variables, but leaves open the search for a data generation process, whose causal structure will be explored by a directed acyclical graphs analysis. This leads us to the discussion below concerning levels of knowledge associated to model discovery.

Following Hendry (1995), there are four levels of knowledge available to researchers. The first level (probability theory) corresponds to the unrealistic case where the researcher knows the full theoretical probability distribution of the data generation process (DGP). In the typical random assignment experiment example of flipping a coin, we would know the exact conditions of the coin and that each flip is independent of the others, therefore, we would know the exact probability distribution for the results of the experiment. At the second level (estimation theory) we know that there is a coin that has two sides, and that each flip is independent of the others, but we don't know whether the coin is perfectly balanced and, therefore, we need to perform the experiment a number of times in order to estimate the probability distribution. In the next level of knowledge (modeling theory) the available information is even less, since we only know that there is a coin, but we don't know whether it is perfectly balanced or whether each flip is independent of the others. Thus, in order to estimate the DGP we need to record the results of the random experiments each time we observed that the coin has been flipped. The final level of knowledge (forecasting theory) is related to the fact that once the model has been estimated, interest is focused on the prediction of the next occurrence, but at this point it might be uncertain whether the coin still exists or even if the determinants of the DGP associated with the random experiment remain the same.

It could be said that most of the theoretical and empirical analysis on endogenous trade protection discussed above is located on the borderline between Hendry's second (estimation theory) and third (modeling theory) levels of knowledge. Modeling trade protection is on the second level, because there seems to be consensus about the existence of a relationship that goes from the policy variables to the tariffs levels. However, such modeling is also on the third level of Hendry's structure because it is not completely known what are the right determinants of the tariff levels, since with more than one theory explaining the same causal effects, it is not clear which ones may be supported by the parameter estimates obtained in an empirical exercise.

The plan of this study is also in line with the current econometric approach that searches for the influence of a set of policy variables on the levels of trade protection. In the very early stages of our search on the causal structure associated with the system of variables we observed a strong signal of a feedback or even a reverse causal directionality from tariffs to the policy variables. These results showed up in most of the causal structures estimated throughout the empirical analysis. Therefore, the evidence seems to contrast with the standard assumption of a unidirectional impact in the model estimation of endogenous trade protection. Following Hendry's levels of knowledge approach it may be relevant to focus the discussion on his third level of knowledge about model specification when estimating endogenous trade protection. We can say that, in fact, there is a DGP involving several or all of the policy variables and tariff levels; however, it may not be certain that the standard theoretical connection from the policy variables to the tariff holds. Rather, the association among all the variables may need to be revisited.

Expected Effects of Policy Variables on Trade Protection

In our analysis we will follow the Olarreaga and Soloaga (1998), and present a list of general predictions that follow from the literature. For further discussion of each policy variable (PV), see Rodrik (1995).

In general, the level of protection in a given industry is *higher* when: [4]

1) *Industry concentration (IC) is high.* This result is due to the theory of collective action (or pressure group theory), first developed by Olson (1965) and later by Pincus (1975) and Brock and Magee (1978). According to this theory, even though an action may be in the best interest of a group, it is not necessarily in the best interest of an individual. The incentive to *freeride*, whereby an individual may prefer to let others act and enjoy the benefits for free, reduces the incentive to act, with welfare reducing effects. This collective action problem can be solved when the group is small and/or well organized; in fact in this case each individual receives a significant portion of potential benefits, and therefore, will have a greater incentive to participate.

2) *Import penetration (IMPPEN) is low.* In general, consumer and producer preferences are at odds with respect to import protection for any given good. Whether protection is granted (and the degree of such protection) depends on the

[4] See the appendix for the construction of the variables.

relative weights ascribed to consumers and producers in the government's social welfare function. In the case of low import penetration, the relative weight of consumers will be lower with respect to producers, and it is more likely that protection be granted. However, the pressure group model suggests an opposite direction for the effect of this variable on tariffs. To this respect, Gawande and Khrisna argue that lobbying activities will be developed by those in the domestic import-competing sector, and the government will then increase protection to maintain the income levels of individuals in those industries.

3) *The fraction of industry production used as an input in other industries (INPUT) is low.* This also follows the pressure group model, and is based on the idea of lobbying rivalry: if industry A uses inputs from industry B, industry A will be against any protection in industry B, as it would increase the price of its finished goods. According to this argument, intermediate goods receive less protection than finished goods. Greater protection for finished goods is also a result of Olson's collective action theory, given that, in general, consumers of finished goods constitute a large and badly organized group.

4) *Salaries (WAGES) are low.* According to the equity concern model, the government often takes steps to avoid economic changes that affect low-income workers. This theory has been put forward by Ball (1967), Constantopoulos (1974), Fieleke (1976), and Baldwin (1984a), among others. Furthermore, it is thought that

governments try to minimize labor adjustment costs when deciding to reduce protection levels during multilateral negotiations or to increase protection levels in the face of import threats.

5) *Intra-industry trade (TRADECTA) is low.* Different theories explain this causal relationship. Firstly, according to Cadot et al. (1999), when intra-industry trade is high, import demand elasticity is high for domestically produced goods (given the higher number of substitutes). Following Ramsey's taxation rule, these goods should be taxed at a lower rate. Secondly, Marvel and Ray (1983) argue that intra-industry trade is empirically concentrated in intermediate goods. Therefore, in general, producers are more efficient at lobbying for protection (according to Olsen's collective action theory). Finally, Levy (1997) makes the case that intra-industry trade tends to have less distributive effects than inter-industry trade (intra-industry trade benefits all, while inter-industry trade necessarily creates losers, following the Stolper Samuelson theorem). Therefore, in the case of intra-industry trade there will be relatively less social conflict and lobbying pressures for protectionism.

6) *The ratio of industry labor with respect to total labor (LABUNION) is high.* According to the adding machine model, so named by Caves (1976), a crucial determinant of the level of protection granted to an industry is its voting strength. If elected officials tend to favor industries with the greatest number of voters,

protectionism should be positively correlated with the relative number of workers in the industry. This will be even truer if unions are well organized.

7) *The labor/capital (LABCAP) ratio is high.* This argument is tied, in part, to that of the equity concern model explained in point 4, and, in part, to the adding machine model mentioned in 6. Furthermore, according to the status quo models of protection due to Corden (1974) and Lavergne (1983), governments tend to wish to maintain the status quo, protecting industries that have historically been protected, in part because of their underlying production structure. Lastly, according to the adjustment assistance model elaborated by Cheh (1974), governments wish to avoid large adjustment costs, often tied to the necessity of relocated and retraining large numbers of workers.

Fundamental theoretical models on endogenous trade protection were briefly outlined in this chapter. The policy variables described above correspond to the most common factors that affect tariffs levels, according to that literature. Other variables, such as foreign tax credit and the number of firms have also been used in empirical applications. Also, the two main branches of the current literature have incorporated additional variables in their structural specification, income inequality in the case of the median-voter model, and a dummy indicator to account for sectors organized into a lobby in the case of the interest group model. In the following chapter we offer a brief description of the Andean Community Trade Association.

CHAPTER III

THE ANDEAN COMMUNITY[5]

This chapter briefly summarizes the main aspects related to the historical evolution of the Andean Community. Some of the major decisions are presented, and important figures related to the CAN members' international commercial trade are presented.

The Andean Community's origin dates back to the Cartagena agreement in 1969, which set the basis for the conformation of a regional economic group with the objective of promoting balanced development under fair conditions, through cooperation in social and economic areas. The initial members were Bolivia, Colombia, Ecuador, Peru and Chile. In 1973 Venezuela joined the group, while in 1976 Chile opted out. The agreement attempted to develop a regional integration for a group of countries with an almost non-existent intra-community commercial trade (approximately 2% of the total international CAN members' commercial trade)[6].

Among other prospective policies, a regional financial institution was created in1968, the Andean Development Corporation (CAF). The institution was created in order to promote integration by moving economic resources to the public and private sectors of the country members. In 1980, the implementation of a common external tariff (CET)

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[5] This summary is based on the official document by The Andean Community General Secretariat "35 años de Integración Económica y Comercial: Un Balance para los Países Andinos". May 2004

[6] The European Union began the regional integration with 30% intra-community trade, and MERCOSUR with 10%.

was established. However, the excessive protectionist policies (including imports substitution and several trade barriers) during the years preceding and following the agreement did not allow the custom union to effectively begin its operations.

After a period where unilateral liberalization trade policy was adopted by most of the countries in Latin America, the members of the Andean group regained interest in the formation of the customs union and the CET. In 1991 it was decided that a free trade area and a CET would be adopted in January, 1992. However, it was not until February 1993 that the free trade area began to operate (with the exception that Peru joined the free trade area in July 1997), and November 1994 that the CET began to operate (with preferential treatment for Bolivia and, again, with the exception that Peru did not subscribe to the agreement).

The CET was adopted with a tiered structure of tariffs at four basic levels: 5%, 10%, 15% and 20%. In general, protection levels increase with the degree of processing of a product. For some products in the agricultural sector, an ad valorem tariff is changed depending on the volatility of the international prices. The tariff (a band system) is augmented whenever the international price is below an established price floor. It is reduced to zero when the international price is over an established price ceiling.

The current CET includes several exceptions. Peru and Bolivia have only two levels of tariffs (12% and 20% for the former; 5% and 10% for the latter). Ecuador is allowed to deviate by 5% with respect to the basic structure for around 900 products. In addition, a "zero list" grants exemptions to 34 tariff lines[7]. These are primarily related to education and health goods. With respect to goods not produced in the region the members can reduce the tariff up to 55% in the case of primary and capital goods; these exceptions represent 34% of tariff lines (2227 tariff lines).

In January 2002 the Andean Group presidents established December 31, 2003 as the new date for the implementation of a recent modification of the CET. The new CET attempts to reduce the dispersion in the tariff system, although it still would keep the same five levels of tariff considered in the previous CET. The preferential treatment for Bolivia would remain in place, as well as the exceptions for the automobile industry and the band system for agricultural product prices. However, the new CET implied the participation of all of the five members[8], which in conjunction with the lower dispersion would reduce the triangulation problem[9] generated by the implementation of different individual country tariffs for imports from nonmember countries. The date for implementation of the new conditions has been moved on three occasions and currently it is set for May 2005.

[7] Tariffs lines are referred to the specific level at which the tariff is defined. Most tariff lines are defined at the lowest aggregation level of the industrial classification, which corresponds to the product level .
[8] Peru would be partially incorporated with a consensus of around 62% of the universe of tariffs and 96% of the total intra-community exports.
[9] Triangulation occurs when two members of a regional free trade area assign different tariff levels to a specific product. Non-member exporters sell the products to the country with the higher tariff, but ship the goods via the country with the lower tariff.

It is important to notice that the CET has made progress toward trade reform, which the individual Andean countries begun in the mid 1980s. In the 60s and 70s, inspired by models of import substitution, high levels of protection and government intervention characterized trade policy in Latin America. As in other Latin American countries, tariffs in the Andean countries were high, with high rates of dispersion; further, and non-tariff barriers abounded. Beginning in the mid 80s, Latin American countries reduced their tariffs, eliminated most non tariff barriers and in general liberalized markets[10]. On average, regional tariffs fell from approximately 80% in 1972 to 13.5% in 2000, while maximum tariffs decreased from an average of more than 80% in 1985 to around 30% in 2000. Non-tariff barriers, which affected approximately 40% of imports, were almost completely eliminated by 2000. The evolution of the individual countries' tariffs is shown in figure 2.

In terms of commercial trade, the regional integration has achieved an important increase on the intra-community trade; by 1976 it was around (4%) twice as much as before the initial agreement. During the 1980s an external debt crisis significantly affected Latin-America. Trade among the CAN members stayed around 4% during the entire decade. However, the implementation of the free trade area in 1993 and the common external tariff in 1995 help to increase the intra-community trade to levels above 10% by the mid 1990s (see figures 3 and 4 for the evolution of exports by destiny and imports by origin during the 1990s). These changes in trade patterns among the CAN members can also be

[10] Examples of non-tariffs barriers include: quotas on the number of goods imported, customs or administrative procedures, safety standards, among others.

observed in figures 5 and 6 where the average annual growth of exports and imports shows high levels during the 1970s (right after the initial implementation in 1968); then, a period of almost zero growth during the eighties (due to the external debt crisis) followed by a significant increase to levels around 10% in the 1990s. This 10% level has remained during the current decade, while the increase in trade with the rest of the world has risen at a around 6% after the 1980s.

An additional issue concerning future actions and perspectives for the Andean Community corresponds to a free trade agreement signed in December 2003[11], between the CAN group and the other important integrated trade group in the region, MERCOSUR (Argentina, Brazil, Uruguay and Paraguay). With respect to this potential future integration, the ability to identify endogenous characteristics corresponding to each of the two blocks would be of significant relevance. Although some empirical studies have been performed for the MERCOSUR group, we have found no evidence of empirical analysis for the Andean Community. Scandizzo and Arcos (2003) assessed the political viability of the Common External Tariff of the Andean Community by computing and evaluating the industrial and commercial indices associated to the variables formulated in II. This last study did not include any empirical estimation connecting the policy variables and the tariff levels.

[11] In May 2004 there was a meeting between the CAN members and the European Union. The meeting established the initial steps for an association agreement that would include a free trade area between the two blocks.

Summing up, three main stages are observed in the evolution of the regional integration of the Andean Group. The first period began immediately after the initial agreement signed in 1969, there was a quick, although small, increase in the intra-regional trade but excessive tariffs and non-tariff barriers did not allow an effective integration beyond the timid increase in trade. During the late 70s and the 1980s, there was no apparent progress on the community integration. Nevertheless, unilateral reductions of trade barriers implemented by each of the CAN countries began to set the conditions for an increase in the potential benefits to be obtained from more coordinated actions by the members of the group. During the 1990s, the third important period began with the effective implementation of the free trade area and common external tariffs. The intra-regional trade has increased at a higher rate than in the previous period. New potential benefits are expected from the possibility to negotiate trade agreements as a block with other regional groups.

CHAPTER IV

THEORETICAL ECONOMETRIC APPROACH

The main theoretical aspects related to the empirical implementation in this study, are considered in this chapter. The first issue corresponds to an analytical device, directed acyclical graph (DAG), designed to search for causal relationships among a set of variables. The general approach and the specific algorithm used here, PC-algorithm, are presented in the next section. Then, the following section discusses the cases where the causal graph suggests the use of instrumental variables to account for simultaneous determination, or omitted variables, in the causal connection between a pair of variables. The final section of this chapter presents the two basic equations that relate tariffs to the policy variables involved in the determination of endogenous trade protection.

Directed Acyclical Graphs (DAGs)

A theoretical formulation attempts to explain relationships related to a particular sector of the economy with a set of equations. An accompanying narrative is offered in terms of social and economic behavioral explanations. While building their analysis economists explicitly postulate hypothetical causal relations that policy makers expect to use in order to affect the variables that would allow them to achieve certain economic goals.

Pearl (2000) criticizes the recent year's econometric textbooks tendency to concentrate on algebraic and statistical properties of the structural equation modeling (SEM), leaving aside the explicit causal interpretation that he attributes to the SEM founders. Pearl writes of the early econometricians: "qualitative cause-effect information could be combined with statistical data to provide quantitative assessment of cause-effect relationships among variables of interest" (Pearl, 2000, p.135).

Directed acyclical graphs (DAG) provide a communication device that allowed Pearl to elaborate on his interpretation about the fact that the equality sign ("=") originally used by SEM founders was expected to express a structural causal association rather than a simple algebraic equation. Particularly, it is considered that the linear equation $y = \beta * x + \varepsilon$ expresses an "ideal experiment" where the parameter β is obtained by externally controlling x. This situation implies an asymmetric treatment of each side of the equation, which differs from a regular algebraic equality sign.

The present study attempts to determine a set of model specifications consistent with directed acyclical graphs. Here causal flows are established among the variables corresponding to the general formulation explaining the CET, and to the analysis of each of the individual country tariff deviations from the CET. The construction of the DAGs is based on conditional and unconditional correlations that will be used to determine edges graphically connecting those pair of variables. The actual search procedure, PC algorithm, was developed by Spirtes et al. (1991).

The PC algorithm is a development of computer science oriented to produce a graphical device that represents a causal structure among a set of variables. In recent years the approach has been introduced in the economic area with particular emphasis on the search for contemporaneous causality to determine the structure of the Bernanke decomposition used for structural VAR (SVAR) analysis (See Bessler and Lee (2002) and Yang and Bessler (2004)). In a Monte Carlo simulation analysis, Demiralp and Hoover (2003) evaluated the effectiveness of the PC algorithm as "an effective data-based tool in selecting (or at least narrowing the equivalence class of) the contemporaneous causal order of SVARs". Their findings were particularly promising when the true data generating process have causal links that are moderately or significantly strong.

The PC algorithm begins with a diagram connecting each variable to all other variables with no directed edges. The algorithm continues in two stages. In the first stage correlations between each pair of variables are evaluated and edges corresponding to zero correlation coefficients are removed. An iterative edge elimination process based on vanishing partial correlations of order i (i=1 to n-2) results in a diagram where a subset of variables remain connected but no direction is defined. In the second stage every triple of three connected variables is analyzed in an attempt to assign direction of causal flow. The criterion for the directionality is stated as follows: for every three variables connected X – Z – Y, if the first order conditional correlation $r_{XY.Z} \neq 0$ then the right orientation is X → Z ← Y. The algorithm investigates all such triples. Once all have been evaluated, then if a triple remains such that X → Z – Y, X and Y are not connected and there is not arrowhead at Z, then orient X → Z → Y. The last step of the second stage consists in orienting any two variables X – Y as X → Y if in addition to the directed edge between X and Y, there is a path from X to Y through a set of intermediate connections where all the arrowheads consistently point in direction to Y until this last variable is reached by the path.

The entire analysis for determining edge orientation rests on the idea that inverted causal forks (X→Y←Z) imply a different correlation structure than do causal chains (X→Y→Z) or causal forks (X←Y→Z). In particular, for causal inverted forks (X→Y←Z) the unconditional correlation between the outside variables (X,Z) will be zero, while the conditional correlation between the outside variables given information about the middle variables (ρ(x,z/y)) will be non-zero. For causal forks and causal chains these conditions are reversed.

Three assumptions are required to support the use of PC algorithm to find DAG structures among a set of variables. First, we assume causal sufficiency. That is, there is no omitted variable, say z, that causes at least two included variables in the study. This assumption does not require that we include all causal variables associated with every variable in the study, but only that we do not omit a variable that causes two or more variables in the study. If, for example, we find a causal path running from variable X to

Y, X → Y, but we erroneously omitted variable Z, which in fact is responsible for the observed error. So the true causal structure X ←Z→Y, is masked by not observing Z.

The second assumption upon which PC algorithm sits is the causal Markov condition. Here we assume that the underling probability distribution generating the observed data can be factored by conditioning each variable on just (and only just) its causal parents. So for example, if the underlying causal structure is X→Y←Z→W, the joint probability distribution on X, Y, Z, W is given as:

$$P(X,Y,Z,W)=P(X)*P(Z)*P(Y|X,Z)*P(W|Z)$$

Here exogenous variables X and Z are represented by their marginal distributions P(X) and P(Z). Variables Y and W, require conditioning on their immediate parents, P(Y|X,Z) and P(W|Z) and not grandparents or other genealogical relatives (here there are not grandparents)

The final assumption to support PC algorithm is faithfulness. Here we assume deep parameters do not cancel out, thus giving false signals in correlations between variables. Consider the case in figure 7: X causes both Y and Z with coefficients β_1 and β_2, and Z causes Y with coefficient β_3. If β_1= -$\beta_2\beta_3$ faithfulness is violated. Here if β_1= -$\beta_2\beta_3$, correlation between X and Y will be zero and PC algorithm will remove the edge between X and Y, even though in the true model X causes Y.

The DAG structure can be helpful in model specification as illustrated below. Figure 8 shows a DAG where wages and industrial concentration are both affecting individual country tariffs deviations from the common regional tariff, and wages affect industrial concentration salaries. The diagram in figure 8 allows us to explain the concepts involved in the identification of the causal structure that form the basis for the specification. This diagram describes the data generating process that fundamentally determines the behavior of the dependent variable. Let's assume that we are interested in knowing the effect of industrial concentration on the individual countries deviations from the common tariff. Based on the DAG in figure 8, if we regress tariff deviations (X_4) on both industrial concentration (X_1) and the firms' average size (X_3) we would be blocking the effect of the first variable (X_1) by including the latter (X_3). This situation describes the front door path criterion according to which we should not include descendants of the X variable to estimate its effect on Y (Pearl (2000), p.82).[12]

In addition to the front door path, there might be a set of arrows that connect the included explanatory variable X to the dependent variable Y, through a different indirect path that also leads to Y. This case is illustrated by wages (X_2), which leads to the common tariff through the firms' average size and is actually connected to industrial concentration. Thus, if we want to measure the effect of industrial concentration (X_1) on deviations from the tariff (X_4), our final regression should include wages (X_2) to block

[12] However, if there is not a priori theoretical restriction on the explanatory variables, then, the DAG would indicate that firms' average size is the parent of X4 and any relevant information from X1 would be contained in X3.

the back door path, as well as industrial concentration (X_1) and not firms average size (in order to satisfy the front door path criterion). The recommendation is thus, do not block the front door path, but do block the back door path in specifying variables to include in a linear regression model.

Instrumental Variables and Directed Acyclical Graphs

The instrumental variable estimator is widely used for models where the assumption of independence between the explanatory variable and the error term is not satisfied. Three cases can be distinguished where OLS is no longer unbiased because of the violation of the assumption above.

i. When there is a lag of the dependent variable on the right hand side of the equation and the error term turns out to be serially correlated, the IV method allows for a consistent estimator by using an instrument for the lag of the dependent variable.

ii. An alternative situation corresponds to the case when we are aware of an unmeasured omitted variable that might be correlated to one or more of the other regressors. If there is not an available proxy for the unmeasured variable, its effect will be contained in the error term, and, therefore, instruments would be needed for the explanatory variables correlated with the omitted variable.

iii. The simultaneous equation models represent another relevant case. The interaction among some of the variables in the system links the stochastic behavior of the dependent variable Y1 in one equation, to the stochastic term corresponding to another endogenous variable Y2, which has been included as a regressor in the equation for Y1. The IV estimator is performed based on the information contained in each single equation; it contrasts with full information methods, such as three stage least square or full information maximum likelihood, which take into account the correlation across the error terms of all of the equations in the system.

The literature on directed acyclical graphs illustrates the situation where instrumental variable is the adequate estimation method. The definition is based on the DAG in figure 9 (Pearl and Brito 2003): Variable Z is an instrumental variable for X in a regression on Y if:

1. Z is independent of all error terms that have an influence on Y that is not mediated by X;

   and

2. Z is not independent of X

The "bow pattern" from X to Y indicates that they have correlated errors because of the omission of a relevant variable, and, therefore, OLS regression of Y on X would produce biased estimators. In this situation, Z can be used as an instrument for X because it satisfies the two conditions above.

The use of an instrumental variable estimator is also required when the PC-algorithm produces a graph as the one in figure 10. The double arrows between Wages and Tariffs indicate an omitted variable connecting those two variables. Two different models can be estimated. The first model should have tariffs as the dependent variable and labor capital, import penetration, and wages, as the explanatory variables. However, given the bi-directed edge between tariffs and wages, OLS will be biased and, therefore, based on the DAG structure; input should be used as an instrumental variable for wages in the equation for tariffs. The second model should consider wages as a function of input, import penetration, and tariff. Similar to the previous case an instrumental variable estimator will be required, and according to the DAG structure labor capital will be the adequate instrument for tariffs. Several of the equations estimated in the empirical analysis presented in Chapter V are illustrative of the situation described above.

Model Formulation

The empirical analysis is based on the partial equilibrium model estimated by Olarreaga and Soloaga (1998). The first equation (1) explains the common external tariff by a linear combination of the aggregated policy variables corresponding to the Andean group members:

$$(CET_i) = \beta_0 + \sum_{j=1}^{n} \beta_j \left(\sum_{k=1}^{5} \omega_i^k X_{i,j}^k \right) + \varepsilon_i \quad . \qquad (1)$$

where: CET_i: Common External Tariff for group i

$X_{i,j}^{k}$: Policy variable j for group i, country k

ω_i^k : Weight for group i, country k..

n : Number of policy variables

ε_i ~ iid(0, σ^2I)

The second equation explains individual country tariff deviations from the CET, as a function of the deviation of the individual country policy variables with respect to the weighted average policy variables.

$$\left(ET_i^k - CET_i\right) = \alpha_0 + \sum_j^n \alpha_j^k \left[X_{i,j}^k - \left(\sum_{k=1}^5 \omega_i^k X_{i,j}^k \right) \right] + \mu_i^k \quad . \qquad (2)$$

where: ET_i^k : External tariff for group i, country k.

μ_i^k ~ (0,σ^2 x Ω): error term that allows contemporaneous correlation across countries

Both equations are estimated based on the results of the directed acyclical graphs derived from the PC algorithm. OLS may be used to estimate equation (1) given that the policy variables have been considered exogenous for CET, according to the current literature.

However, some contrasting results from the DAG analysis challenge this unidirectional effect view; more comments on this are presented in the empirical results analysis.

Equation (2) represents a more complex case and, therefore, a more detailed empirical analysis is required. The first aspect to be considered is whether the estimation should be carried out separately for each country or, should, the data be pooled to estimate the model at the regional level. This issue is analyzed by comparing the out of sample forecast performance of the two alternative strategies.

In the case of the regional pooled data the model could be estimated using seemingly unrelated regression estimation, this would account for the potential contemporaneous correlation associated with the regional economic interaction that influence the group of Andean countries. A second alternative would be to take advantage of the two dimensions of the data (country and industry) and perform panel data estimation. Olarreaga and Soloaga actually combined the two strategies, since they had time series data for each of the countries (although at three digit aggregation level). The data available for this study is restricted to one year (but for a four digit aggregation level), therefore, only one of the two alternatives, SUR or panel data, could be used.

The panel data estimation was chosen for two reasons. First, given the cross-sectional characteristic of the data the countries' unobserved effects seem to be more relevant for explaining a set of domestic industrial economic indicators, in comparison to choosing the efficiency gains generated by the correlation of the residuals across the equations estimated using SUR. The second reason that led to the choice of the panel data estimation was a recurrent result arising from the directed acyclical graphs analysis, which showed a different causality structure in comparison to the one represented by equation (2). This causality structure implied that more than one equation should be estimated for each country and for the region. In some cases it was actually needed to use SUR to account for the correlation across the equations for the policy variables.[13]

This section has presented the econometric specification that includes the fundamental variables involved in the empirical implementation reported in the next chapter. The causal connection among those variables can be identified by PC-algorithm as explained in the previous section. Once causal links are found, the resulting directed acyclical graphs, discussed in the first section of this chapter, suggest the appropriate modeling strategy that will produce the parameter estimates of the underlying data generating process. Having presented the theoretical aspects related to the model specification and the tools used in the search for causal connections associated to the jointly determination of the policy variables and tariffs, we now turn to the empirical implementation in the following chapter.

[13] This is developed in more detail in Chapter V.

CHAPTER V

EMPIRICAL RESULTS

This chapter is divided in four sections. The first section describes the industrial data used for the model estimation and discusses issues concerning measurement errors frequently present in economic statistics. Notice that, even though panel estimators are used in the empirical analysis, the data are cross-sectional. In fact, all of the models reported in this chapter were estimated for data corresponding to 1996. However, panel estimation was feasible due to the two dimensional characteristics of the data; there are around 60 industrial sectors common to the five countries, thus, the unobserved country effect was modeled as fixed or random effect.

The next three sections correspond to the estimation of the causal relationships among the policy variables and tariff levels. The three sections are similarly structured; the causal diagrams from the DAG analysis are presented first, followed by the model estimation and the interpretation of the results. The second section shows the estimation of the model for the common external tariff in equation (1). In the third section an empirical experiment is performed on sub-regional data, in order to select the appropriate estimation strategy for the data generating process that involves the variables included in equation (2). The final section is devoted to the estimation of the data generating process for the complete regional data; this estimation is based on the strategy suggested by the analysis performed in the third section of this chapter.

Data

The empirical analysis is concentrated on cross-sectional estimation due to restrictions on the availability of data.[14] However, rather than using a three digit aggregation level (as in the recent studies for the Latin-American case) that only allows studying a sample size of 27 sectors for a particular year, the present study is performed at a four digit aggregation level, which increases the sample to around 60 sectors in all of the regressions.[15] The larger sample, not only represents an improvement due to the large number of observations, but also a refinement regarding the composition of the industrial sectors under analysis. This concern emanates from the possibility that some connections among the policy variables, as well as their impact on the CET, could be misrepresented, given the aggregation of some sub-sectors with different or opposite characteristics.

The estimation of the regional and individual country models are performed on data for 1996 (one year after the implementation of the common external tariff); however, sub-regional data for Bolivia, Colombia, and Ecuador is used for the forecast evaluation in the third section of this chapter[16]. The original sources of the industrial data correspond to the national statistic institutes of each of the countries; however, most of the

[14] Olarreaga and Soloaga estimate a panel for the MERCOSUR country members. Specifically they study 27 groups for 1987 to 1992. In this study the data correspond to a lower aggregation level (4 digits), which generates 81 groups.

[15] For example, at three digits aggregation the ISIC code identifies the beverage industries with the code 313, while at four digits this industry include the codes 3131-34 corresponding to the four sub-sectors: distilling blending spirits, wine industries, malt liquors, and soft drinks respectively

[16] The data for 1997 is not readily available at four digits aggregation level, in the cases of Peru and Venezuela.

information has been obtained through the industrial statistics yearbook produced by the United Nations Industrial Development Organization (UNIDO), which gathers data from its country members. The Common External Tariffs were obtained from decision number 370 issued by the Andean group, and the data for the individual country tariffs come from the Latin-American Integration Association (ALADI) and from the Interamerican Development Bank. The imports and exports figures were also provided by ALADI.

The industrial data at the four digit aggregation level are reported based on more than one homogeneous industrial classification for all of the CAN countries. Therefore, conversion tables among three different industrial classification codes were required in order to build the dataset used for the empirical estimation.[17]. In addition, data for imports, exports and tariffs were constructed from raw databases containing information at the ten digits aggregation of the NALADISA classification code[18].

Not only does the data availability represents a factor that affects an empirical exercise as the one performed in the present study, it is also important to consider potential measurement problems derived from the data itself, particularly, when the measurement involves explicit firms' confidential information as well as figures that are associated with policy makers' performance.

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[17] See Appendix B for the conversion tables among the three industrial classifications. (International Standard Industrial Classification (ISIC) revisions 2 and 3; and the NALADISA classification (used for the Latin American Integration Association ALADI)

[18] The ten digits aggregation corresponds to the industrial data at the product level.

Nerlove (1958) discusses in detail four main classes of measurement errors. The first corresponds to the difference between the conceptual nature of the variable included in the theoretical model with respect to the variable that is available for the empirical analysis, an example could be the financial credit to the private sector in an equation for investment, it is normally the case that this explanatory variable is not directly available, rather it has to be constructed as the difference between the stock of financial credit at the end and at the beginning of the relevant period. The second source of measurement error is the voluntary misrepresentation that could be present due to information provided by the observed (maybe due to fears of government intervention) or generated by the observer (probably due to political pressures). The third factor corresponds to sources of inadvertent misrepresentation that could arise even if the data collection is implemented through a well structured sample survey design; some examples include non-responses, errors in coverage, and errors in coding or tabulating. The final common factor is simply the lack of data availability, frequently present in the data collection stage. This implies that statistic adjustments such as interpolation, extrapolation and others should be implemented to complete the raw data used for the reports generated from surveys.

In the present case all four sources of measurement error may be present in the analysis. The first and fourth sources basically affect the construction of some of the proxies used as policy variables. Labor unions represent an illustrative example. There is no information on the number of workers enrolled in unions and, therefore, the policy variable has to be approximated by the ratio of industry labor with respect to total labor. The use of that proxy variable assumes that a large number of workers increases the probability of the conformation of unions.

While the second of Nerlove's sources of measurement error doesn't seem to be significantly affecting the accuracy of the industrial surveys for the CAN countries[19], his third source seems to be important, particularly at the processing stage, since, even though industrial surveys are conducted most of the years in all of the countries, there is a significant lag between the actual data collection and the availability of public reports. This situation implies that low priority is assigned to processing the surveys and producing reports, and, therefore, few resources are allocated to that purpose.[20]

The Aggregate Common External Tariff (CET)

This section presents the estimation of equation (1). In the next sub-section the causal diagrams obtained from the directed acyclical graph analysis are presented. The causal structure and its implication for the model specification are discussed. The second sub-section shows the results for the parameter estimates of the underlying data generating process. Also, non-nested tests are performed to determine whether the data supports the

[19] On the one hand, political pressures are more concentrated on frequently reported data such as inflation or GDP; on the other hand, fears of government intervention may be more relevant at the commercialization level than at the production level, since governments in the region tend to support and protect the manufacture sector.

[20] In the case of Venezuela, industrial data for the 1997 survey has not been fully processed and, therefore, there is no publicly available data at the four digits aggregation level.

hypothesis that one or more countries are significantly more influential in the determination of the CET.

Directed Acyclical Graphs Analysis for the CET

Figure 11 gives five DAG structures, estimated on 1996 data for the interaction of the common external tariff with the aggregated and individual country policy variables. The first causal diagram (figure 11.A) shows the structure associated with the specification in equation (1), where the CET is assumed to be endogenously determined by the set of aggregated policy variables (i.e. CET cannot cause any of the policy variables). On the other hand, the DAG structure in figure 11.B was obtained from the same data used for the previous diagram, but no restriction was imposed on the causality direction. The other three graphs in figure 11 correspond to the evaluation of the causal links when the CET is examined jointly with each of the individual country policy variables[21]. Notice that Bolivia and Ecuador are not included because there were no causal links between their corresponding policy variables and the CET. As indicated above, PC algorithm is used to generate these graphs at a significance level of .10 (as suggested by the Monte Carlo experiments of Spirtes, Glymour and Scheines 2000, p.116).

In general, there seems to be a connection among all of the variables included in the analysis. In figures 11.A and 11.B the estimation with the aggregated policy variables

[21] Although not reported here, the DAG analysis also showed an effect from the CET to the individual country policy variables when no causality restriction was imposed

shows causal diagrams where no variable or subset of variables are isolated; they are all connected to one or more variables in the system, and five out of the nine edges in figure 11.B show a possibility of an omitted variable between the corresponding two variables. The DAGs for Colombia (figure 11.C) and Venezuela (figure 11.E) also show a significant number of causal links among the variables, whereas in the case of Peru, only few connections were determined by the PC-algorithm.

According to the causal structures in figures 11.A and 11.B, wages and intra-industry trade are the significant policy variables in determining the CET, although, in the case of the intra-industry trade, the causal link with the CET is not present in any of the graphs corresponding to the individual countries. In the case of wages, the causal link with the CET is also present in the graphs for Colombia and Venezuela but not in the graph for Peru. In fact, for the latter country it is the industrial concentration variable that is connected to the CET.

Given that the causal diagrams for the other two countries (Bolivia and Ecuador) did not show any connection between the policy variables and the CET, the set of results in figure 11 provide some evidence that favors the hypothesis that the two largest countries in the Andean Community group may be the most influential in determining the CET. The fact that the causal link between wages and the CET is only relevant for Colombia and Venezuela, may be a reason for the current state of no participation of Peru (since the CET may not be consistent yet with its economic structure) and the significant number of exceptions still present in the implementation of the common external tariff for the Andean group.

The next sub-section offers a set of non-nested tests for the hypothesis that the policy variables of one of the individual countries contain enough information to explain the CET. Olarreaga and Soloaga (1998) for the case of MERCOSUR, found evidence supporting the hypothesis that Brazil (the largest country in that regionally integrated group) was the most influential country in the determination of that group's common external tariff.

A rather interesting result is obtained when the analysis is not restricted to the theoretical causal structure that imposes the policy variables as exogenous determinants of the CET (as in equation 1). In that case (figure 11.B), there seems to be an omitted variable. This edge direction from the CET to the policy variables is also present when the individual country deviations from the CET is jointly analyzed with the deviations of the individual country policy variables with respect to the aggregate policy variables. In this sub-section we only conduct the estimation based on the restriction imposed by the specification in equation (1), which implies that the relevant policy variables will be the exogenous explanatory covariates in the equation for the CET.

Another result deserves a comment when comparing figure 11.A[22] with the causal graphs corresponding to Colombia, Peru and Venezuela (figures 11.C, 11.D, and 11.E). The edges between input and wages, input and labor union, and labor union and industrial concentration seem to be robust in the sense that they appear in all of the DAG structures. The last two edges are also relevant in most of the specifications estimated in the next section. This set of robust connections may imply some overlap among the different theories that attempt to explain trade protection. Input, labor union, and industrial concentration are all found in the literature as factors related to the interest group hypothesis. The last two are assumed to have a direct effect on tariffs; whereas input is supposed to have an inverse impact. Also, industrial concentration and labor unions are factors related to the status quo model, although the sign of the effects are opposite (as explained in Chapter II). Gawande and Khrisna (2003) comment that “this promiscuous relation between variables and theories and the inability of the literature to identify variables that would separate models more sharply has precluded the precise determination of the relative validity of the different models.”

Model Estimation for the CET

Based on the results in the previous section, four models are presented in table 1. The dependent variables in all of the models are the common external tariffs, but the

[22] No comparison with figure 11.B is commented here, since the estimation of the causal graphs using the individual country policy variables were executed imposing the causality direction from the policy variables to the CET (as it is the case in figure 11.A).

regressors correspond to the relevant aggregate policy variables in the first equation, and the individual country policy variables for Colombia, Peru and Venezuela, respectively, in the other three equations.

The results in table 1 show that the explanatory power of the policy variables appears low (32%) in comparison to the results obtained by Olarreaga and Soloaga (1998) for MERCOSUR. This could be an indication of a fundamental weakness of the Andean CET: if the tariff structure is not representative of the community political economy, it might not be politically viable.

Wages appears to be the most important policy variable affecting the CET. According to the social change literature, most governments are dedicated to reducing the degree of income inequality in the economy by attempting to raise the living standards of the lowest income groups, i.e. most protection will be granted to sectors that employ low income, unskilled workers. This would appear to be applicable in Latin America, where trade liberalization has brought about an increase in income inequality and in particular with respect to the gap between skilled and unskilled workers. Low wage sectors across the Andean Community are textiles, clothing, shoes, wood products, ceramic and leather products, among others; sectors that in fact benefit from relatively high levels of protection.

The importance of wages in determining protection across the Andean Community is consistent with other empirical studies on the determinants of trade policy. Not only do Olarreaga and Soloaga (1998) find a similar result for MERCOSUR, but Baldwin (1995) finds that wages (together with the labor/capital ratio) are the most important variable in determining tariff levels in the United States.

Intra-industry trade is a more problematic policy variable. As seen above, most of the literature seems to point to a negative relationship between intra-industry trade and protection, while our results point to a positive (albeit small) relationship. Olarreaga and Soloaga (1998) also find a similar result for MERCOSUR. The explanation may be in the type of goods for which intra-industry trade is present among the Andean countries. In general, one tends to identify intra-industry trade with intermediate goods, whereby producers' collective actions would be sufficient to push down protection. In the Andean Community, intra-industry trade is relevant in a series of industries that historically have been strongly protected: textiles, clothing, shoes, wood products, ceramics, and glass products, among others. On the one hand, this represents intra-industry trade in finished goods, for which the intermediate good argument does not apply. Secondly, many of these goods are crafts goods. Furthermore, some of these sectors, such as textiles, clothing and shoes, are subject to high levels of protection in developed countries as well, possibly implying a retaliation effect.

Non-nested tests[23] were performed in order to evaluate whether one or more countries were more relevant in the determination of the CET. According to the results in table 2, in no case did it appear that the policy variables of a specific country were a more appropriate set of regressors compared to the aggregate community variables, with the exception of Venezuela, for which the results were ambiguous, although only at the 15% level of significance. This result may appear slightly surprising, given that Colombia and Venezuela are considered the “core” countries of the Andean Community, and Bolivia’s production is a mere 10% of Venezuela’s. Furthermore, regressions using data only on Colombia, Ecuador and Venezuela (the three countries to apply the CET) did not yield significantly different results than regressions using data on all five countries.

Our major finding from the aggregate of the common external tariff is that wages are the most consistent causal variables for the CET. Results for the entire group (CAN) and for Venezuela, and Colombia, indicate wages are the most likely direct cause of the CET. However, if we relax the restriction that CET can only be an effect and not a cause, we find some evidence that an omitted variable may be missing in the link between wages and CET.

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[23] The J-Test contrast two rival non-nested models. For example, assume two competing models:

$$H_0: Y = \alpha_0 + \alpha_1 X + \varepsilon$$
$$H_1: Y = \beta_0 + \beta_1 Z + \mu \ .$$

The test consists in contrasting H_0 vs. H_1 by estimating the model in H_0 adding the fitted values ($\hat{Y}$) obtained from the model in H_1, if $\hat{Y}$ is significant H_0 is rejected because there is information in the second model (H_1) that is relevant in the explanation of Y, and that information is not contained in the first model (H_0). The models are reversed and the test is performed again. When both models are rejected or accepted the test is inconclusive. One might as well compare Schwarz loss metrics of Ho and H1 as both have the same left-hand-side variable

Given these initial results we now turn to an analysis of deviations present from the CET and aggregate policy variables.

Deviations with Respect to the CET, and the Aggregated Policy Variables (Sub-Regional Forecast Evaluation)

In the third section of Chapter IV a brief outline was offered on the set of alternative estimation strategies considered for models involving the individual country tariff deviations from the CET, and the difference between the country and aggregated policy variables. The following sub-sections present an evaluation of those alternatives using a sub-regional model for Bolivia, Colombia and Ecuador. The results are presented for the data corresponding to both three and four digits aggregation levels. This allows comparing whether the relationships found at three digit aggregation remain approximately the same when the model is estimated with a lower level of aggregation.[24]

The evaluation is basically carried out by comparing the mean squared errors (MSE), the minimum absolute percentage errors (MAPE), and other statistics generally used to check forecasting performance. Also, the statistical significance of the difference between the MSEs of each pair of models is tested by using the Diebold-Mariano (1995)

[24] The interest here is to get some indication about a potential weakness some the studies performed for Latin-American, which use data on three digits aggregation.

test. On the other hand, in the case of the pooled data, a Hausman test is performed to choose between random and fixed effects estimator.[25]

Based on the results for the sub-regional data, the model for the full set of countries is estimated in final section of this chapter

Sub-Regional Data Estimation

In order to decide about the best alternative for modeling the individual country tariff deviations with respect to the CET and the associated policy variables, the forecast performance of four different modeling strategies are compared in this section. The lack of data available for all of the countries did not allow performing the analysis with all of the five CAN members. The base period for the full model is 1996, but the forecast evaluation for 1997 was carried out with only three of the five country members (Bolivia, Colombia and Ecuador).

Three of the four modeling strategies presented in this section are based on the empirical relationships resulting from the directed acyclical graph analysis; the last estimation corresponds to what is commonly known as a "straw man" model, which is constructed without any structured strategy and it is supposed to be beaten by any systematic

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[25] Hausman (1978) proposed a specification test is based on the difference between the two estimators ($q = \widehat{\beta}_{re} - \widehat{\beta}_{fe}$). Under the null hypothesis (Ho: the error term in the re model is uncorrelated to the regressors) $\widehat{\beta}_{re}$ is Blue, consistent and asymptotically efficient, whereas $\widehat{\beta}_{fe}$ is consistent, but if Ho is false the random effects estimator is inconsistent while the fixed effects estimator is still consistent.

modeling methodology. The first modeling strategy consists of estimating individual models for each of the three countries in the sample. In the second case the data for all of the countries are pooled and the estimation is performed on the regional data. The third model is also estimated at the regional level but taking into consideration the longitudinal[26] feature of the data.

All of the papers analyzing tariff determination and deviations from CETs in the South American region are based on a three digit aggregation of the industrial sectors. This aggregation generates 27 observations for each country for each year. Two main weaknesses motivated the use in this analysis of an aggregation that allows having more observations in the sample.

1) On the one hand, there is the standard statistical concern about the small sample size. This issue has been managed in previous analysis by pooling the individual countries and collecting data for some years, in order to perform panel data estimation (see for example Olareaga and Soloaga (1998) and Calfat et al. (2000))

2) On the other hand, the three digits aggregation may mislead the search for the structural association between the country tariffs deviations and the group of policy variables. There might be highly different economic structures for the variety of sectors aggregated in one code at the three digits level. For example the

[26] Even though we don't have a cross-sectional time-series data, we refer here to panel data or longitudinal estimation since we have two dimensions for the industrial data (countries and industrial sectors)

case of grain mills, with a typical economic structure close to perfect competition, being in the same group with canning and preserving of fruits and vegetables, which is closer to an oligopoly economic structure.

The first aspect is examined in this section by comparing the estimation and forecasting results obtained at both 3 and 4 digits aggregation. The second aspect is analyzed by comparing the structural specification resulting from the DAGs. Differences related to the existence and direction of causality would support the hypothesis that analyses performed at three digits aggregation may be misleading in the search for the economic structure underlying the data generating process.

Directed Acyclical Graphs Analysis for Sub-Regional Data

The individual country deviations and the group of policy variables are all incorporated into the DAG analysis without any predetermined relationship structure. All of the models from previous studies are estimated with a predetermined structural effect from the policy variables to the country tariffs deviations. In this study, there is not preconception on the way the variables are linked, rather the connections among the variables are determined by the DAGs.

Directed Acyclical Graphs for Individual Countries (for Sub-Regional Data)

The DAGs in figure 12 are presented country-by-country comparing the resulting DAGs for the data at three and four digit aggregation levels. In both cases the significance level for the tests on the simple and partial correlation coefficients is at around 20%. Monte Carlo Simulations performed by Spirtes, Glymour and Scheines (2000 p.116) suggest a 20% significance level for samples with less than 100 observations.

It can be observed that, even though some connections among the variables are common to the two aggregation levels, the resulting DAGs produce significantly different structural relationships among the variables. This seems to be consistent with the hypothesis that working at a three digits aggregation level might be misleading the search for causal relationships among the variables.

Directed Acyclical Graphs for Pooled Data (for Sub-Regional Data)

Similar results are obtained when the variables are pooled (figure 13). However, the connections among the variables at three and four digits aggregation seem to be more compatible in this case in comparison to the results obtained for the individual country analysis. The significance level for the three digits aggregation was also 20% since the pooled data has 81 observations. However, for the four digits aggregation the DAG is consistent with a significance level around 10%, which agrees with the level suggested by the Monte Carlo analysis referred above. In this last case the sample has 180 observations.

Model Estimation for Sub-Regional Data

The models estimated in this section correspond to the specifications suggested by the DAGs reported above. In general, all of the equations corresponding to a particular country or to the regional data are estimated using seemingly unrelated regression when there are not double arrows in the DAG, which imply that there is no evidence of an omitted variable relationship. When double arrows are present, instrumental variables were used based on our discussion in the second section of Chapter IV.

Estimation for Individual Countries (for Sub-Regional Data)

In order to perform the forecast evaluation in the next section, only those equations corresponding to endogenous variables resulting from the DAGs for the regional data were estimated. In tables 3-5, the models are presented at three and four digits aggregation levels for each country, however, no direct comparison can be established since the scale of the policy variables are different due to the aggregation.

In general, it is observed that the relationships derived from the DAG analysis produce specifications where the suggested explanatory variables are significantly relevant in the equation for the corresponding dependent variable. However, an interesting result in the set of estimated equations presented in this and the following sections, is that whenever the DAGs suggested the use of instrumental variables, it was always observed that even though the instruments were relevant in the first stage of the IV method (not reported here), the instrumented variable was never relevant in the final equation. This result does not change whether only the exogenous variables derived from the DAG analysis, or all the exogenous variables in the model, are included in the first stage of the instrumental variable estimation.

Estimation for Pooled Data (for Sub-Regional Data)

Two specifications are reported in table 6; both models correspond to the estimation of the pooled data, but the first was estimated for the data at three digits aggregation, while the second was estimated for the data at four digits aggregation. It can be observed that with only one exception, all of the explanatory variables suggested by the DAG analysis are statistically relevant at 10% (and most at 5%) in their corresponding equation. It is also interesting to observe that the two explanatory variables with lower significance in the equations for wages correspond to the ones that are not common for the two specifications (tariff for 4 digits and input for 3 digits).

Notice that in the case of three digit aggregation the connection between labor union and industrial concentration was not determined, but the model reported in table 6a shows labor union as a function of industrial concentration. Previous studies have used Schwarz loss (see for example Yang and Bessler (2004)) in order to determine the causality direction in those cases; however, in this case it was found that the difference between the Schwarz loss functions computed for the models with labor union and industrial concentration interchanged (as dependent and explanatory variable) was so small (0.00004) that it was decided to use the causal direction obtained for the four digits aggregation in figure 13.

The next estimators to be reported correspond to the longitudinal data model. The Hausman test was performed in order to determine whether a fixed or random effects specification was the appropriate in each case. Table 7 clearly shows that while wages seems to be better estimated with fixed effects, labor union is better estimated with random effects. In fact, the coefficients for random and fixed effects are pretty close for the labor union equations, but not for the wages equation. Moreover, the joint significance of the dummy variables in the fixed effects specification (not reported here) turned out to be different than zero only in the case of wages. Baltagi (2003) explains that random effects are more adequate in those cases where the number of panels is significantly high and, therefore, using the fixed effects estimator would produce an excessively high loss of degrees of freedom.

The panel data models at three and four digits in tables 8 and 9 show the fixed effects estimator for wages, and the random effects estimator for labor union, at three and four digits aggregation level. While the explanatory variables in the models for labor union seem to explain a significant portion of the total variation of the dependent variable that is not the case for the fixed effects model for wages.

The results for wages look particularly interesting since the regional estimation for labor union are pretty similar whether the unobserved individual effects are included or not in the specification. In contrast, it can be observed that the significance of the coefficients for the wages equation at three digits aggregation differ substantially between the fixed effects and the simple regional estimation. While input was not significant in the regional estimation, it is highly relevant in the fixed effects model, and the reverse happens to two of the other regressors (trade quota and labor capital). At four digits level there are similar results, three of the four explanatory variables experienced an important reduction in the significance level, actually two of them (tariff and trade quota) are not relevant anymore.

Different factors may be influencing the poor results obtained for the fixed effects estimation for wages (compared to the simple regional estimation), one plausible argument is the fact that the DAG analysis was performed at the regional level without taking into consideration the longitudinal features of the data[27]. In order to contrast these particular results, a parsimonious fixed effects model for wages departing from the whole set of variables was estimated. This strategy partially follows Hendry's

[27] No reference was found for applications of the directed acyclical graph approach to longitudinal data.

parsimoniously encompassing approach, from general to specific. The estimation in this last case (not reported here) did not offer much explanation other than dropping the irrelevant variables at the four digits case. For the three digits aggregation case, in addition to dropping the irrelevant variables already found in the fixed effects model, tariff was found to be relevant. Curiously, this last variable was identified as relevant for wages in the DAG analysis at the four digits aggregation; however, tariffs had the weakest influence in wages in the DAG[28]

Forecast Evaluation for Sub-Regional Data

In order to evaluate the different models estimated at individual and regional levels, a group of statistic measures are presented in tables 11 and 12. In addition to the three models reported above, a "straw man model" estimated without any systematic or structural methodology (just including all possible explanatory variables) was incorporated in the analysis. This last model was expected to be beaten by most of the models constructed with the analytical tools described above.

In terms of specification the "straw man model" was significantly weak when compared to the models suggested by the DAG analysis. Most of the variables not included in the specifications suggested by the DAGs were not relevant in this naive model (see table 10); in fact, for pooled data models (regional, longitudinal and straw man) at the three

[28] It was relevant only at 12% whereas all the other connections found among the variables were relevant at 5%

digits aggregation the relevant variables at approximately a 5% significance level are almost the same for the two equations that are used for the forecast evaluation analysis (wages and labor-union). Only import penetration (for the wages equation) was significantly different from zero for the regional estimation, but not for the straw man model. At the 5% statistical significance the additional variables included in the straw man models were redundant. At the four digits aggregation the results are similar. The only relevant variables in the straw man specification are those suggested by the DAGs. All other variables are redundant. These results seem to justify the DAG analysis proposed by Pearl (2000) as a previous step to model estimation, in order to detect the causality structure suggested by the data.

In general, based on the mean absolute percentage error, the longitudinal model seems to dominate in terms forecasting performance. At the three digit aggregation level, the longitudinal model and the individual country model, each has the best out of sample forecasting performance for two of the five dependent variables predicted. It is also observed that the forecasting performance of the regional estimation is pretty close to the longitudinal model, but the latter does better in four of the five analyzed cases. On the other hand, the “straw man model” has a forecasting performance that is pretty bad for the two equations for Bolivia, it is similar to the longitudinal model in the case of wages for Ecuador, and has reasonable good results for the other two variables analyzed (wages for Colombia and labor union for Ecuador). The results are shown in table 11.

At the four digits levels the individual model has a poor performance for all of the models except in the case of labor union for Ecuador. The longitudinal estimation has the best performance for two of the four variables modeled. The simple regional estimation is again close to the performance of this model. Forecasts from the straw man model are better in this case than at the three digits level; its outcomes are also close to the longitudinal model in most of the cases. The results at the four digits levels are shown in table 12.

Table 13 shows a summary of the models chosen based on the mean absolute percentage error for each of the variables estimated. The longitudinal model seems to be the most stable specification in terms of forecast performance; although the simple regional estimation and the straw man model have similar forecasts performance as the longitudinal model. However, the straw man model is in general parsimoniously encompassed by the other two models since, as commented above; most of the additional variables contained in the straw man model are not significantly different from zero.

An additional analysis on the forecasting performance was carried out by conducting a series of Diebold-Mariano tests (1995)[29] between each pair of forecasted series. A total of six tests statistics were computed for each model, and the results are shown in tables

[29] The Diebold-Mariano test statistic is based on the difference between the results of the computation of a loss function for each of the two competing predictions. The loss function used here was the mean square error.

14 and 15. The Diebold-Mariano tests are more conclusive regarding the comments above related to the better results obtained from the pooled data; the individual country estimation turns out to be better only in the case of wages for Colombia at the three digits aggregation level. In general, the other three models perform better than the individual country models but, as was also already commented, there is not clear distinction on the accuracy of the forecasts obtained from the regional model, the straw man and the longitudinal models.

Pooling the data and estimating regional models looks as an appropriate alternative for the search on the connection among the policy variables analyzed in this study. It is interesting to notice that in the case of labor union for Ecuador at four digits aggregation, the individual country model has the best performance, but in the other three cases its performance is rather poor.

The comparison between pooled and non-pooled data estimators has been extensively discussed in the literature; Baltagi et.at. (2000) compare a group of models with homogeneous parameters across panels (pooled data estimators) with respect to the alternative heterogeneous parameters estimator proposed by Pesaram and Smith (1995), which estimates individual models by panel and averages the parameter estimates. The comparison in the model of demand for cigarette estimated by Baltagi et. al. clearly favors the pooled data estimators. In a previous study, Baltagi and Griffin (1997) performed an empirical analysis for data on gasoline for the OECD countries. They found evidence for a dynamic model that also supports the use of pooled estimators. The forecast evaluation showed that, even though, pooling the data imposes the constraint that the parameters are homogeneous across panels, individual panel estimation produced inferior results in terms of forecast performance for the OECD data on gasoline.

In the search for the possible reasons that generated the poor forecasting results from the individual models, it was found that on average the forecast from regional models is better, but it could be far away from the actual levels for the whole set of values corresponding to one or few variables. This can be seen in Figure 14 where the forecast from the simple regional model at three and four digits levels are shown. It can be observed that the forecast for the middle observations (which correspond to Colombia) are significantly distant from the actual values

Deviations with Respect to the Common External Tariff, and the Aggregated Policy Variables (Estimation for All CAN Members)

The results in the previous section led us to consider that the pooled data provides significantly better parameter estimates compared to the individual country estimation. The DAG analysis for the country tariff deviation will still be presented for the two alternatives in order to study the similarities between the individual and the regional relationship structure, however, the estimation is going to be carried out at the regional level only.

When individual country tariffs deviate from the CET, what is the cause? That was the original issue to be analyzed in this study, since all of the papers in the literature attempt to develop an empirical estimation departing from the theoretical fundamentals presented in Chapter II. In fact, Sanchez et al. (2004) performed the DAG analysis imposing the causality direction from the policy variables to the tariff deviations. They found that, as in the case of the CET, wages and intra-industry trade seem to be the most immediate causes for a dependent variable involving tariff levels. However, they also reported that when no restriction is imposed on the causality direction, there is a feedback or even an opposite direction for the causality structure.

The weak evidence of causality from the policy variables to the country tariffs deviations found by Sanchez et al. (2004) may imply that those countries determine their individual levels of protection based on considerations outside of the political economy variables, and not reflecting industrial structure; rather, this could be the result of powerful lobbying forces that succeed in achieving protection for their industry depending instead on historical power distributions, for example.

Directed Acyclical Graphs Analysis for Full Regional Data

Due to the weak evidence of causality commented on above, the DAG analysis for the data corresponding to the full set of CAN members was performed without imposing any causality direction. Thus, all of the variables were included without any pre-conception regarding the structural relationship.

The directed acyclical graphs in figure 15 show the causal links among the country tariff deviations and the policy variables. It is observed that some connections are common to all or almost all of the countries. Tariff deviations are mainly connected to trade quota and wages, whereas input and industrial concentration are the main source of explanation for labor union. Those two relationships are also observed at the regional level in figure 15.F. On the other hand, although labor capital and import penetration are connected for three of the five countries the causality direction is ambiguous since for Bolivia and Colombia the directions are opposite, whereas for Venezuela there is a connection between those two variables, but without a specific direction. The regional analysis also agrees with the individual analysis by showing an undirected connection between labor capital and import penetration. The only slightly incompatible result at the regional level with respect to the individual country findings is the connection between trade quota and input, which is only observed for Ecuador.

At this point it is also interesting to contrast the results in figure 15 with the DAGs obtained for the CAN members when the analysis is performed at three digits. It can be observed in figure 16, that at the three digits aggregation, there are significant discrepancies between the causality structures obtained for the individual countries and the one obtained at the regional level. It is also noticeable that at the regional level the DAGs for the three and four digits aggregation only differ in the edge connecting trade quota and wages, which is present in the former case. This last result may be suggesting that those studies that have reported estimated models at three digits aggregation would have produce more robust results had the relationships been estimated with the countries pooled.

Model Estimation for Full Regional Data

As it was already stated, the results obtained for the sub-regional data led us to conduct the regression estimation at the regional level using fixed or random effects to account for the unobserved individual country component common to all the industry sectors.

The estimation for wages is performed using fixed effects since the Hausman test in table 16 suggests that there is a systematic difference between the fixed and the random effects estimators.

On the other hand, according to the theory on instrumental variables estimation based on directed acyclical graphs briefly outlined in section two of Chapter IV, the DAGs in figure 15.F suggest that two equations should be estimated using the IV estimator. One equation would be for labor union using trade quota as an instrument for input, and the other equation would be for input using industrial concentration as an instrument for labor union. However, similar to the previous experience with the IV estimator for the sub-regional data, the results for the two equations were significantly poor. The first stage produced reasonable results in the sense that the instruments were relevant as regressors for the instrumented variable, but the latter was completely irrelevant for the dependent variable in the second stage equation. Therefore, it was decided to estimate the relationship considering the causality only from input to labor union, based on the fact that for the five countries the edge connecting input with labor union shows a causality direction from the former to the latter. The random effects model was chosen since the Hausman test suggested that there was not a significant systematic difference between the coefficients of that model and those from the fixed effects model.

Interpretation of the Results for the Full Regional Data

The negative coefficient for tariffs in the wages equation (table 17) supports the theoretical view of an inverse relationship between these two variables, this result agrees with the equity concern model where protection is expected to be higher in those sectors with low income unskilled workers. The equation in table 17 also reflects an inverse effect of the labor-capital ratio on wages, this could be explained by the fact that labor intensive sectors require a higher number of less skilled workers, which leads to lower wages on average; this situation can be expected in sectors such as textiles, clothing, ceramic and leather products among others. The coefficient for the last regressor in the wages equation (import penetration) implies that the higher the levels of imports for a particular industry the lower the domestic wages for that sector, this may be showing that more internal competition due to external supply, forces the sector to be more competitive and, therefore, the cost of the domestic input factors should be lower.

Table 18 shows that industrial concentration has a direct impact on labor union. The first effect implies that the lower the number of industries in a particular sector (higher IC) the greater the number of employees[30]. This may be particularly true for the CAN countries where few groups dominate important economic sectors and, therefore, a few number of firms employ a significant amount of workers. This situation favors the creation of more organized labor unions, since workers are normally concentrated in few companies and, in many cases in few geographical areas.

The remaining coefficient in the equation in table 18 shows a positive sign on the effect that input has on labor union. This suggests that the higher the value added of a particular sector (relative to the total industrial output), the higher the number of workers in that industry. This result may be expected given the fact that greater value added

[30] Remember that LABUNION is defined as the ratio of industry labor with respect to total labor: (Number of employees in sector i) / (total number of employees)

should be generated in sectors with higher number of workers, unless the sector corresponds to a high technology industry, which is not the case on average for the CAN members.

The empirical findings reported in this chapter have been derived from the combination of the directed acyclical graph approach proposed by Pearl (1995) and the use of the econometric tools consistent with the model specifications suggested by the DAG structures obtained for the tariffs and the policy variables of the Andean Community group. After considering some issues related to the data used for the empirical analysis, this chapter showed the estimation results for the equation corresponding to the levels of the CET as a function of the statistically significant policy variables. The last two sections were devoted to the search for the causal structure and the econometric specification of the data generating process underlying the jointly determination of the individual country tariff deviations from the CET, and the deviations of the individual country policy variables with respect to the aggregated policy variables.

CHAPTER VI

CONCLUSIONS

As stated in the introduction two main issues motivated this study: an analysis of the determinants of endogenous trade protection and the use of directed acyclical graphs to analyze an economic system that involves policy intervention. The first aspect was changed to a related problem because, contrary to the standard literature on endogenous trade protection, some of the policy variables that are normally postulated as exogenous in the data generating process for tariff levels, where in turn affected by tariffs. It was still possible to find evidence supporting some of the theoretical models outlined in Chapter I, but the empirical connections found were not directly implied from an equation for tariffs. The second aspect not only allowed for the determination of causal flows amongst variables, but also to contrast the connections among all of the variables for two basic experiments, estimation on three versus four digits aggregated data, and regional versus individual countries estimation.

The comparison of the results at three versus four digits aggregation confirmed the hypothesis that significantly different economic structures could arise as the relevant model in each case. These different structures not only affect the parameter estimates but also the causal connections found among the variables. The differences found in the empirical exercises performed here were stronger when the models were estimated separately for each country. When the data for all of the countries were pooled the causality structures were much more alike. This is perhaps a result, consistent with earlier literature, indicating benefits from aggregation (Grunfeld and Griliches 1960). These results indicate that if it is the case no data are available at four digits aggregation the estimation at three digits should be performed on pooled data.

In reference to the findings related to the endogenous trade protection and policy variables, the evidence from the equation for the common external tariff supports the equity concern model, since tariffs are negatively affected by wages. This suggests that governments tend to favor those sectors that employ a significant number of low income unskilled workers as a policy to reduce income inequality. The intra-industry trade was also relevant to explain equation (1) but the sign was opposite to the theoretical argument that less social conflict and lobbying pressures for protectionism is expected when this variable increases. A potential explanation for this result is the fact that a significant amount of intra-industry trade among the CAN members is carried out for finished rather than intermediate goods.

The results for the models involving individual country tariff deviations from the CET, and the deviations of the individual country policy variables with respect to the aggregated policy variables, also support the equity concern model. Even though the relevant relationship estimated in section four of Chapter V had wages as the dependent variable, it was still the case of an inverse causality connection between wages and tariffs.

On the other hand, it was observed that: first, the labor-capital ratio entered into the wages equation with the same sign as tariffs, and second, the graph in figure 15.F shows that the connection among those three variables form an inverted causal fork (tariffs→wage ←labcap) implying that a correlation between tariffs and the labor capital ratio conditional on wages would be different than zero. Those two facts taken together could be thought of as supporting the adding machine model since a positive conditional correlation between tariffs and labcap would be an argument favoring the hypothesis that governments implement higher protection levels to those sectors that employ a significant number of workers. A similar analysis applies to import penetration since this variable also forms a causal inverted fork with tariffs and wages (tariffs → wages ← impen). The conditional correlation in this case supports the pressure group hypothesis since the government will increase protection in response to demands from those in the domestic import competing sector.

The lack of industrial data available for some countries for the years after 1996 was an important restriction to the possibility of performing the model estimation exercise on cross-sectional time-series data. The re-estimation of the models as more data become available would be a natural extension of the present study. Also, an unbalanced cross-sectional time-series analysis could be performed with the data currently available, however, this alternative was not considered here since no data at the four digits aggregation after 1996 was available for Venezuela whose total output represents around 33% of the total output of the Andean Community Group.

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APPENDIX A

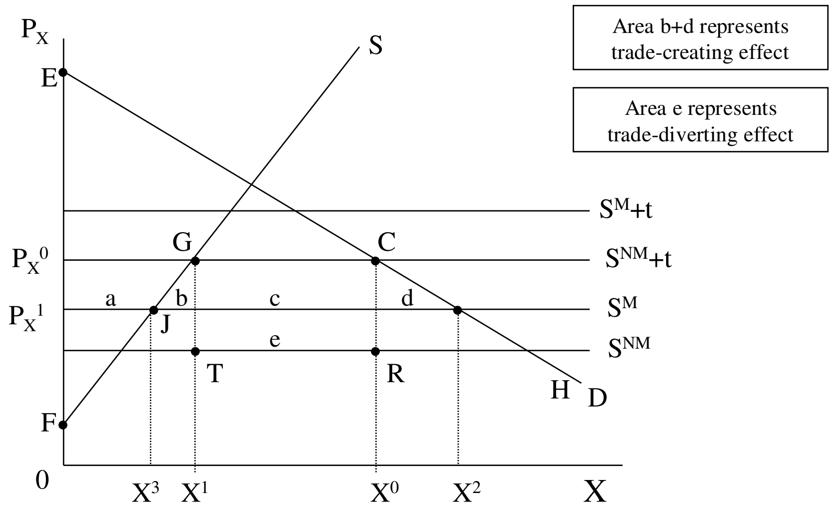
POLICY VARIABLES DEFINITION, FIGURES AND TABLES

Policy Variables

1) Industry concentration *(IC)*:
   (number of firms in whole economy) / (number of firms in sector i)
2) Import penetration *(IMPPEN)*:
   (Imports – exports) / total output
3) The fraction of industry production used as an input in other industries *(INPUT)*:
   (value added) / (total output)
4) Salaries *(WAGES)*
   (Cost of labor) / (number of employees)
5) Intra-industry trade *(TRADECTA)*:
   [1- |exports – imports| / (exports + imports)]*100
6) Ratio of industry labor with respect to total labor *(LABUNION)*:
   (Number of employees in sector i) / (total number of employees)
7) Labor/capital ratio *(LABCAP)*:
   (Number of employees) / (value added –labor costs)

The variables for the individual countries are denoted by adding the first letter of the name of the country as a prefix to the name of the variable (e.g. P_Wages: wages for Peru). In the case of the aggregated variables the prefix is CAN (e.g. CAN_IMPPEN: aggregated import penetration for the CAN members).

The variables in deviation form are denoted by adding the prefix DEV to the name of the variable (e.g. B_DEV_Tariff: Deviation of the Bolivia tariff with respect to the CET).

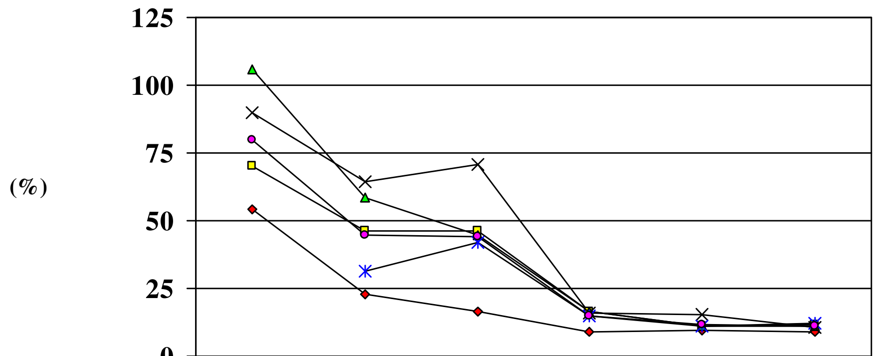


Source: Yarbrough and Yarbrough (1997)

Figure 1. Welfare Effect of Economic Integration: Formation of a Free Trade Area in Good X

Departing from an original situation where a small open economy faces lower prices of good X in the international market, the potential gains and loses from regional integration are depicted in figure 1[31]. Before the formation of a free trade area the situation may be illustrated by the horizontal supply curves that are shifted upwards due to the tariff imposed by the country that imports good X. The good is bought from non-member countries since the level S^{NM}+t (where t corresponds to the tariff implemented by the importer country) represents the less expensive price per unit (P_X^0) for the importer country. . Even though, once the free trade area is formed the importer country sees a reduction in the price per unit charged on good X (from P_X^0 to P_X^1), the new price is higher than the one corresponding to the complete elimination of the tariff. This situation leads to an increase in welfare related to the creation of trade among member countries, which is represented by area (b+d), but it also generates a welfare loss (area e) since the potential trade with non-member countries will be diverted to trade with member countries.

[31] D and S represent the domestic demand and supply curves, while S^M and S^{NM} represent the international supply curves from members and non-members of the free trade area regional agreement

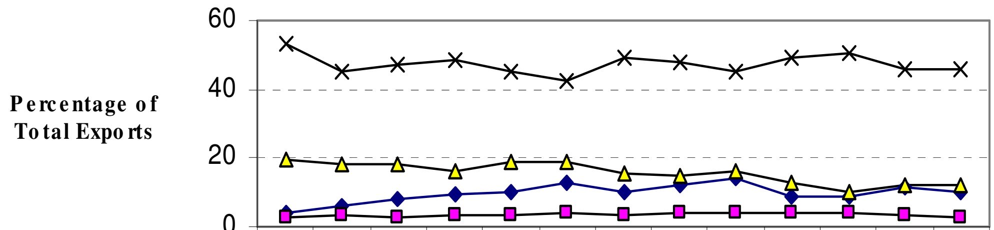


	1972	1985	1988	1991	1994	2002
Bolivia	54	22.7	16.6	9.2	9.7	9.3
Colombia	70	46.5	46.3	16.4	11.3	11.7
Ecuador	106	58.7	44.5	16.6	11	11.4
Perú	90	64.4	70.5	16.2	15.6	10.6
Venezuela	NA	31.6	42.2	15.1	11.3	12.1
Prom. CAN	80	44.8	44	14.7	11.8	11

Years

Source: The Andean Community General Seretariat

Figure 2. Average Tariff of The Andean Community Group (1972-2002)

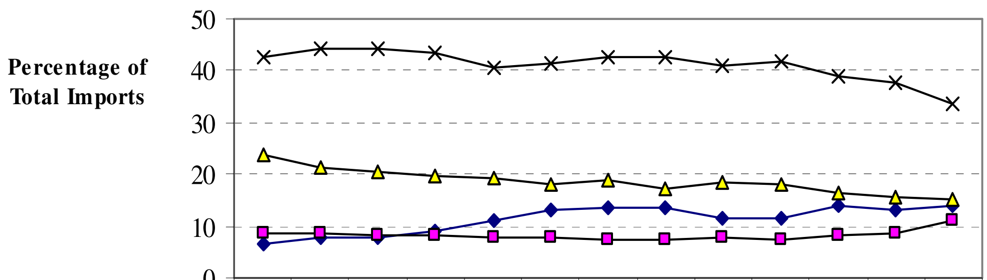


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CAN	4.2	6.1	7.8	9.6	10	12.7	10.3	11.8	13.9	9.1	9	11.2	10.3
MERCOSUR	2.8	3.3	3	3.1	3.6	3.9	3.6	4.2	3.9	3.9	4	3.6	2.8
European Union	19.3	18.2	17.9	16.3	18.7	18.9	15.7	14.6	16	12.9	9.9	12	12.3
NAFTA	53.3	45	47.4	48.5	44.9	42.8	49.4	47.8	45.2	49.4	50.7	46.1	45.9

Years

Source: The Andean Community General Secretariat

Figure 3. Exports (by Destiny) of The Andean Community Group (1990-2002)

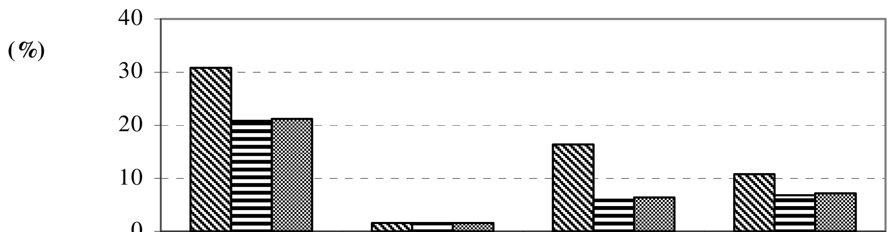


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CAN	6.7	7.7	7.8	9.2	10.9	13	13.4	13.5	11.5	11.6	13.8	13.2	13.9
MERCOSUR	8.7	8.8	8.2	8	7.9	7.8	7.3	7.5	7.6	7.4	8.4	8.8	11.2
European Union	23.7	21.5	20.6	19.7	19.2	18.1	18.7	17.1	18.3	18.1	16.3	15.4	15.1
NAFTA	42.8	44.1	44.1	43.6	40.5	41.4	42.5	42.5	40.8	41.9	38.8	37.8	33.8

Years

Source: The Andean Community General Secretariat

Figure 4. Imports (by Origin) of The Andean Community Group (1990-2002)

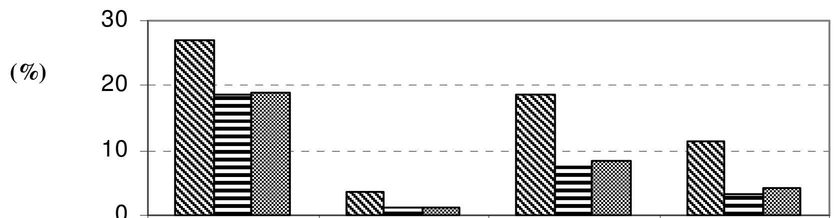


	1970-79	1980-89	1990-99	2000-02
Intra-Community	30.8	1.6	16.3	11
Rest of the world	20.9	1.7	5.9	7
Total	21.1	1.7	6.3	7.3

Years

Source: The Andean Community General Secretariat

Figure 5. Average Exports Growth of The Andean Community Group(1970-2002)



	1970-79	1980-89	1990-99	2000-02
Intra-Community	27	3.6	18.5	11.5
Rest of the world	18.5	1.1	7.6	3.2
Total	18.8	1.2	8.4	4.1

Years

Source: The Andean Community General Secretariat

Figure 6. Average Imports Growth of The Andean Community Group (1970-2002)

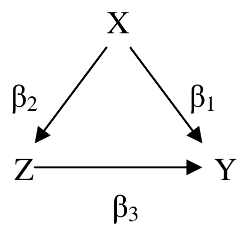


Figure 7. Faithfulness[32]

[32] Faithfulness would be violated if $\beta1 = -\beta2\beta3$

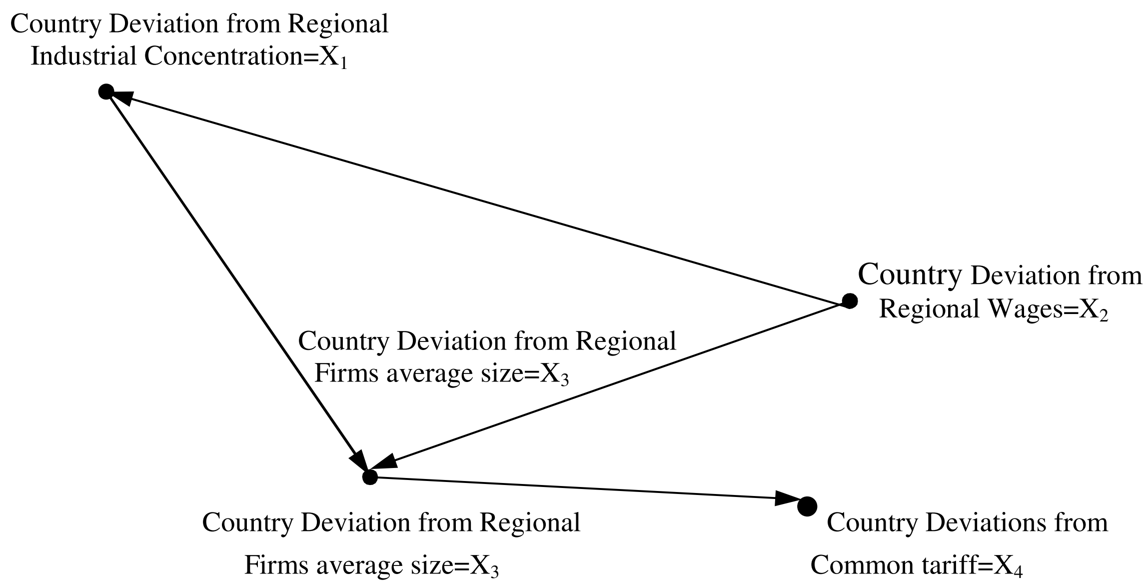


Figure 8. Industrial Concentration and Wages Meet the Front Door and Back Door Criterion to Be Included in a Regression for the Common Tariff

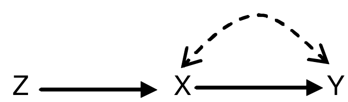


Figure 9. Directed Acyclical Graphs Representing an Omitted Variable Case

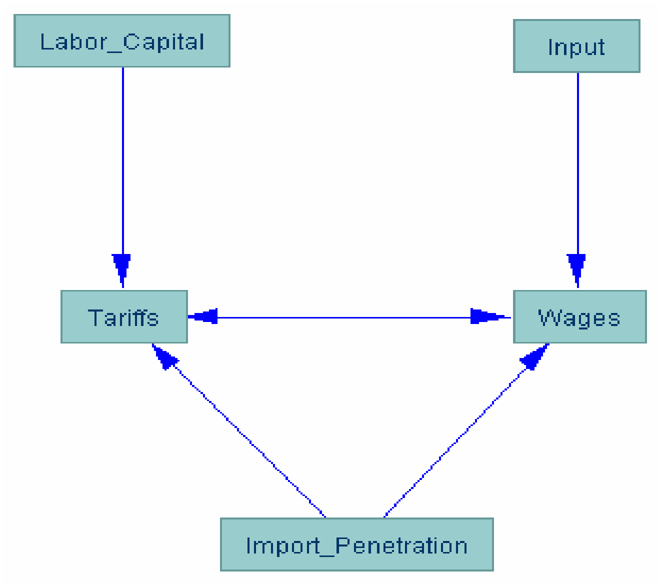
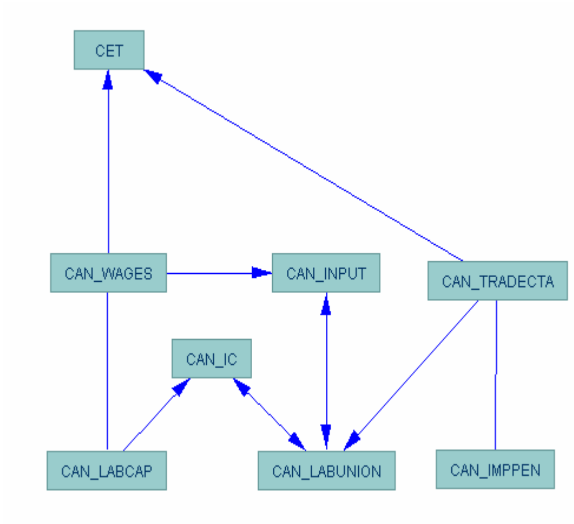
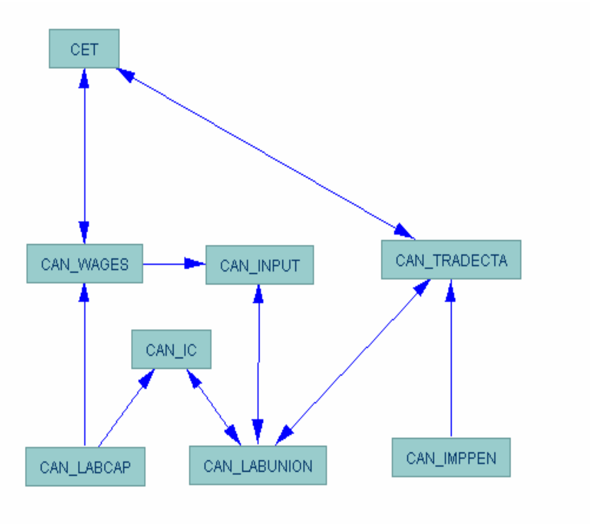


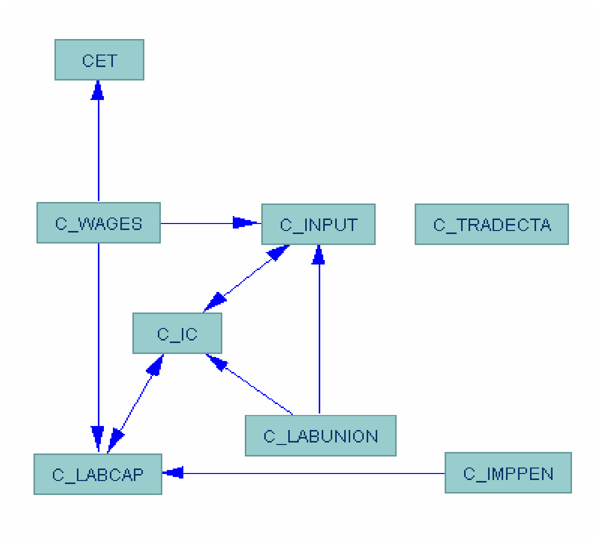
Figure 10. Instrumental Variable Case from PC-Algorithm



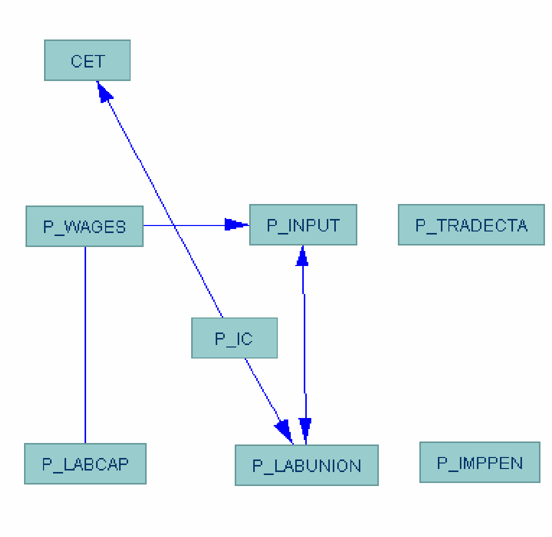
A. CAN aggregate policy variables imposing imposing causality direction from the policy variables to the CET



B. CAN aggregate policy variables without imposing causality direction



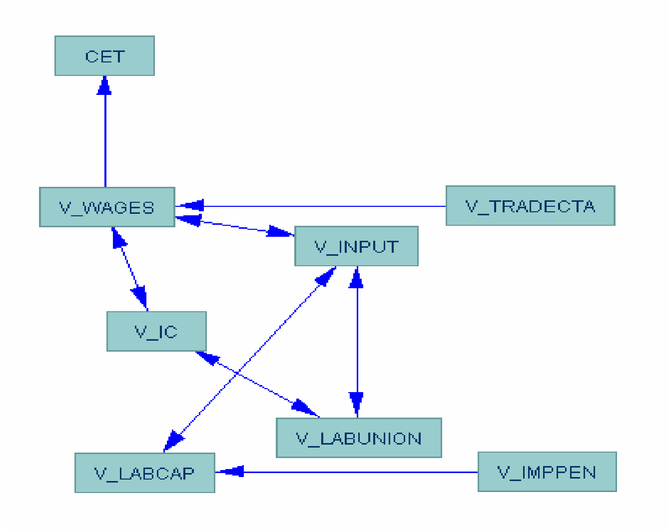
C. Colombia policy variables imposing causality direction



D Peru policy variables imposing causality direction

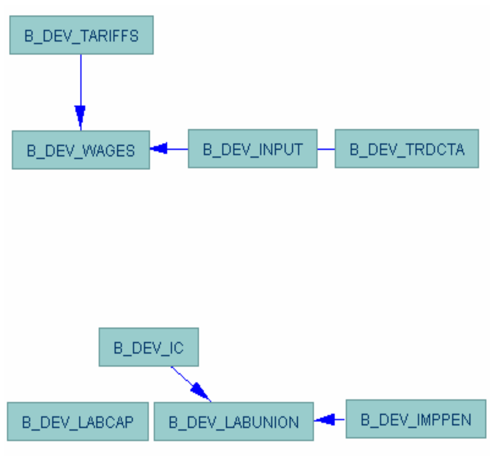
Figure 11. Directed Acyclical Graphs for Common External Tariffs (Sub-Regional Data) [33]

[33] See variables' definition on the first page of this appendix

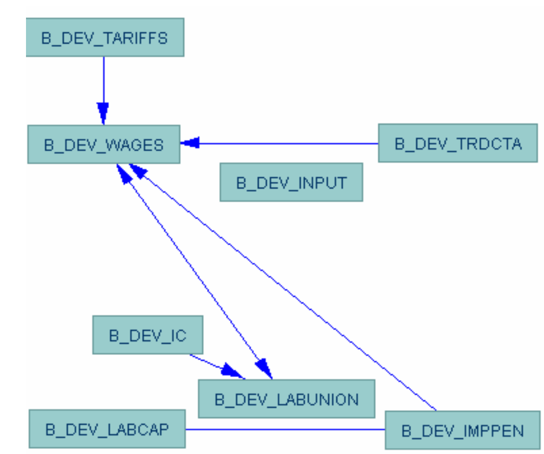


E. Venezuela policy variables imposing causality direction

Figure 11. (Continued)

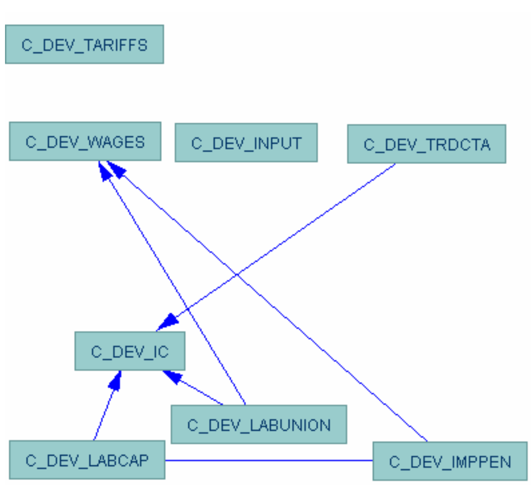


Three Digit Aggregation

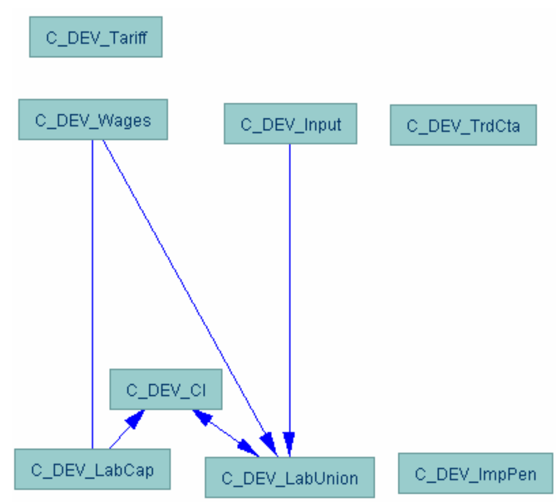


Four Digit Aggregation

A. Bolivia



Three Digit Aggregation



Four Digit Aggregation

B. Colombia

Figure 12.[34] **Directed Acyclical Graphs for Individual Countries Data (Sub-Regional Data)**

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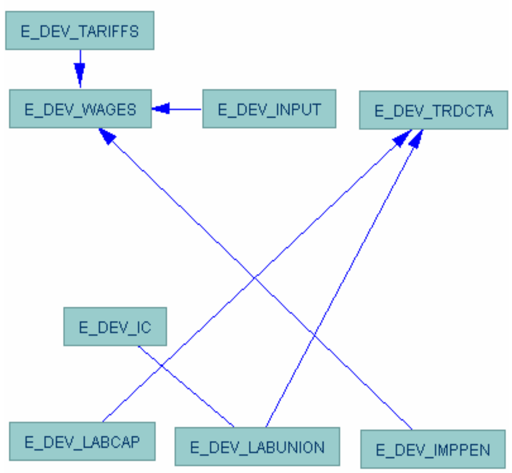
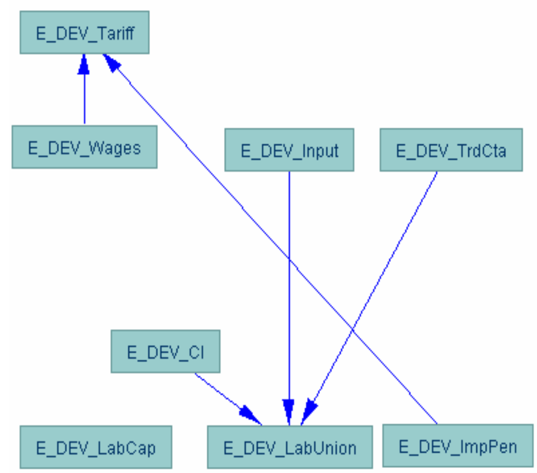
[34] See variables' definition on the first page of this appendix

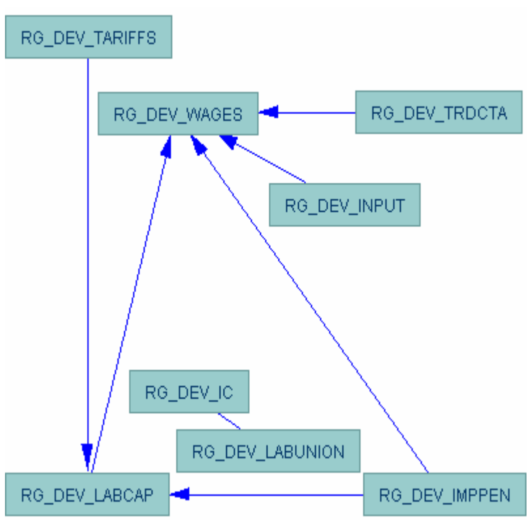




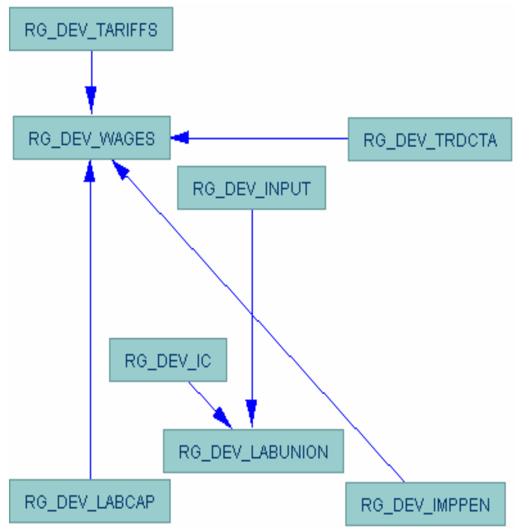
Three Digit Aggregation **Four Digit Aggregation**

C. Ecuador

Figure 12. (Continued)



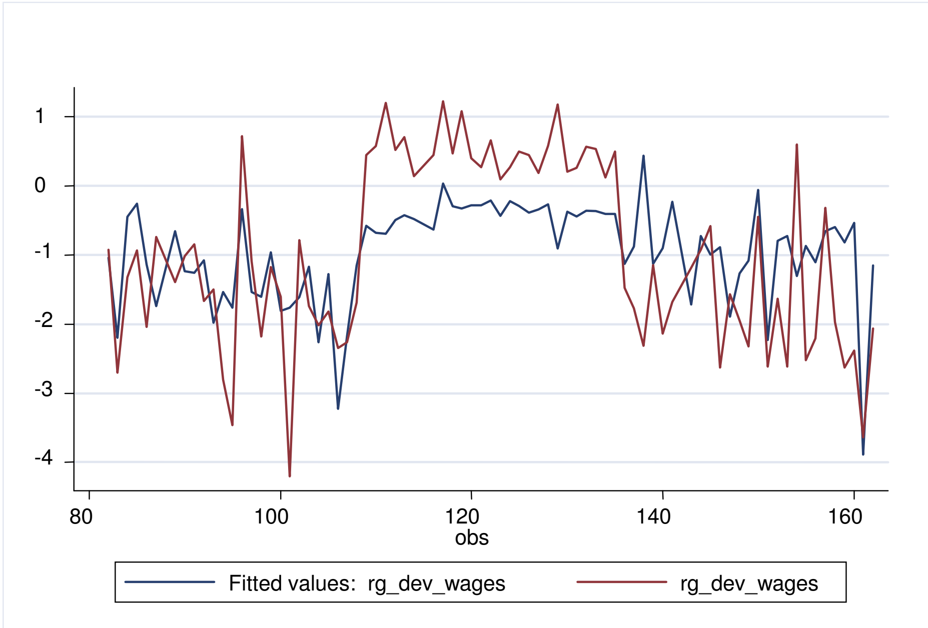
Three Digit Aggregation



Four Digit Aggregation

Figure 13.[35] Directed Acyclical Graphs for Pooled Data (Sub-Regional Data)

[35] See variables' definition on the first page of this appendix



A. Regional Estimation for Wages (Three Digits)

B. Regional Estimation for Wages (Four Digits)

Figure 14.[36] Current and Fitted Values for Wages[37]

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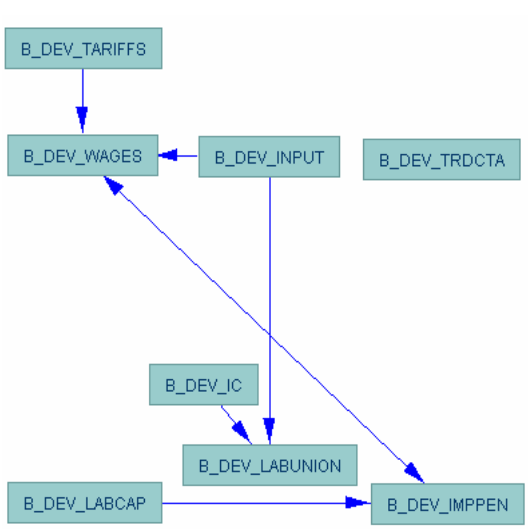
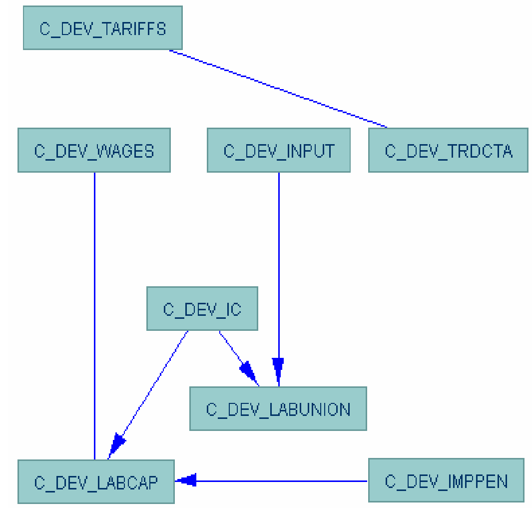
[36] The range of the x axis corresponds to the 1997 observations for the three countries, the middle observations (where the forecast is far from the actual values) correspond to wages for Colombia

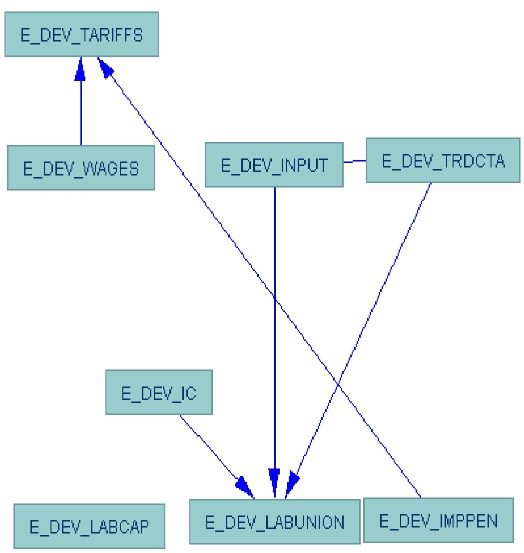
[37] See variables' definition on the first page of this appendix



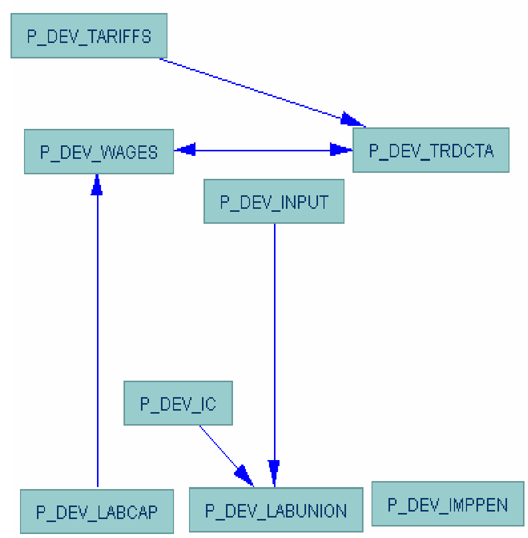
A. Bolivia



B. Colombia



C. Ecuador



D. Peru

Figure 15. [38] **Directed Acyclical Graphs for Individual Country Tariff Deviation (Regional Data)**

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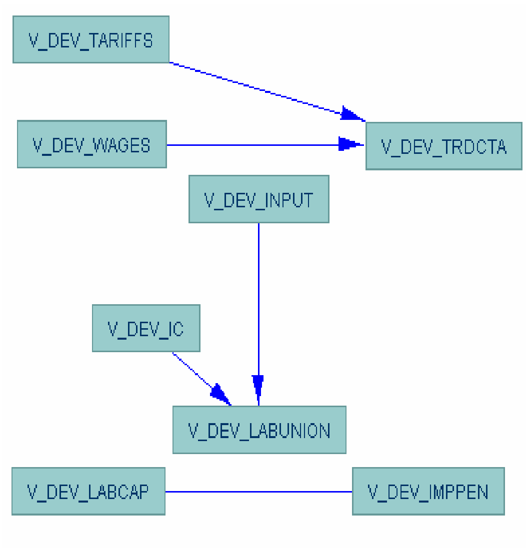
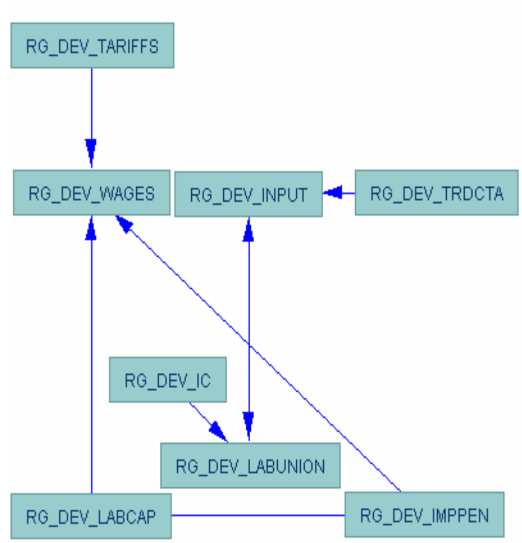
[38] See variables' definition on the first page of this appendix



E. Venezuela



F. Pooled Data

Figure 15. (Continued)

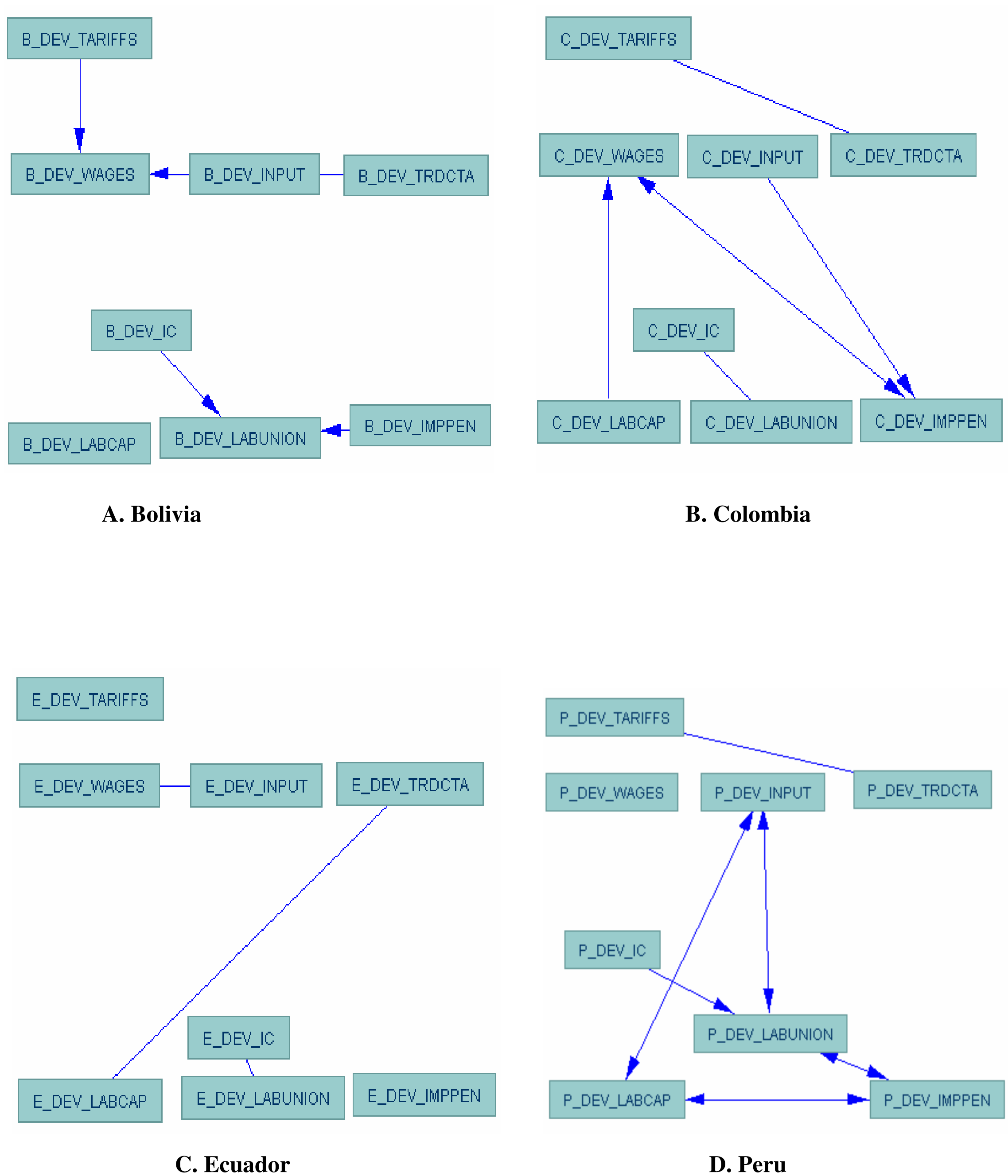
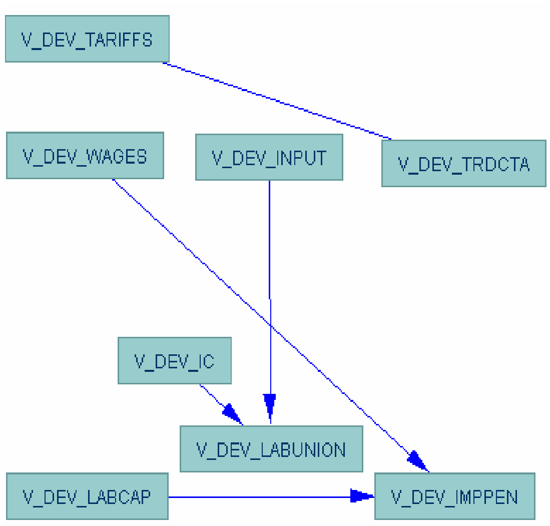
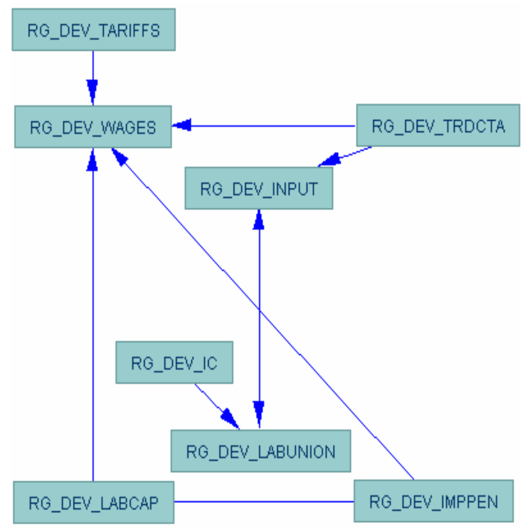


Figure 16. [39] **Directed Acyclical Graphs for Individual Country Tariff Deviation (Regional Data) Three Digits Aggregation Level**

[39] See variables' definition on the first page of this appendix



E. Venezuela



F. Pooled Data

Figure 16. (Continued)

Table 1. Estimation Results for CET on Policy Variables Based on the Directed Acyclical Graphs Analysis

	CET on CAN Policy Variables		CET on Colombia Policy Variables		CET on Peru Policy Variables		CET on Venezuela Policy Variables	
Variables	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
Constant	18.286	0.000	20.388	0.000	14.383	0.000	18.807	0.000
CAN_Wages	-1.030	0.000						
CAN_TrdCta	0.036	0.020						
C_Wages			-1.063	0.000				
P_IC					49.102	0.027		
V_Wages							-0.97362	0.000
R_Squared	0.3405		0.2172		0.0816		0.2878	
Adj R-Squared	0.3174		0.2037		0.0658		0.2755	
Prob >F	0.0000		0.0002		0.0269		0.0000	
Number of Obs	60		60		60		60	

* See variables' definition on the first page of this appendix

Table 2. Davidson and Mackinnon J-Test for CET on Aggregate Policy Variables versus CET on Individual Country Policy Variables

	P-Value		Decision
	Ho: Aggregate	H1: Country	
Colombia vs. Aggregate	0.8250	0.0020	Colombia Rejected
Ecuador vs. Aggregate	0.8320	0.0000	Ecuador Rejected
Peru vs. Aggregate	0.6420	0.0000	Peru Rejected
Venezuela vs. Aggregate	0.1530	0.0170	Inconclusive at 15.3%

* None of the individual country policy variables were more appropriate regressors compared to the aggregate community variables. The only exception is the case of Venezuela, for which the results were ambiguous, although only at the 15% level of significance

Table 3a. Individual Country Estimation for Bolivia (Sub-Regional Data - Three Digits)

	Seemingly Unrrelated Estimation			
	B_DEV_Wages		B_DEV_LabUnion	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	-2.2848	0.0000	0.0011	0.0031
B_DEV_Tariff	-0.1221	0.0040		
B_DEV_Input	16.6198	0.0080		
B_DEV_IC			0.8269	0.1390
B_DEV_ImpPen			-0.0002	0.0003
R_Squared	0.306		0.6160	
Prob >chi2	0.0028		0.0000	
Number of Obs	27		27	

* See variables' definition on the first page of this appendix

Table 3b. Individual Country Estimation for Bolivia (Sub-Regional Data - Four Digits)

	Instrumental Variables			
	B_DEV_Wages		B_DEV_LabUnion	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	-2.1197	0.0000	0.0033	0.3120
B_DEV_LabUnion	11.4988	0.3220		
B_DEV_Tariff	-0.1002	0.0080		
B_DEV_TrdCta	0.0080	0.0410		
B_DEV_ImpPen	-0.0104	0.0010		
B_DEV_Wages			0.0017	0.2790
B_DEV_CI			0.8559	0.0000
Instrumented	*B_DEV_LabUnion*		*B_DEV_Wages*	
Instruments	B_DEV_Tariff B_DEV_TrdCta B_DEV_ImpPen B_DEV_CI		B_DEV_CI B_DEV_Tariff B_DEV_TrdCta B_DEV_ImpPen	
R_Squared	0.37		0.6579	
Adj R-squared	0.3242		0.6459	
Prob >F	0.0001		0.0000	
Number of Obs	60		60	

* See variables' definition on the first page of this appendix

Table 4a. Individual Country Estimation for Colombia (Sub-Regional Data - Three Digits)

	Seemingly Unrrelated Estimation			
	C_DEV_Wages		C_DEV_CI	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	0.4355	0.0000	0.0016	0.0000
C_DEV_LabUnion	-26.1999	0.0020		
C_DEV_ImpPen	0.2598	0.0240		
C_DEV_LabCap			0.1943	0.0040
C_DEV_LabUnion			0.8894	0.0000
C_DEV_TrdCta			-0.0002	0.0000
R_Squared	0.4282		0.7897	
Prob >chi2	0.0000		0.0000	
Number of Obs	27		27	

* See variables' definition on the first page of this appendix

Table 4b. Individual Country Estimation for Colombia (Sub-Regional Data - Four Digits)

	Instrumental Variables			
	C_DEV_CI		C_DEV_LabUnion	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	0.0007	0.1240	0.0009	0.0680
C_DEV_LabUnion	0.6478165	0.0050		
C_DEV_LabCap	0.1057732	0.0510		
C_DEV_CI			0.4404	0.0840
C_DEV_Wages			-0.0021	0.0310
C_DEV_Input			0.1787	0.0280
Instrumented	*C_DEV_LabUnion*		*C_DEV_CI*	
Instruments	C_DEV_LabCap C_DEV_Wages C_DEV_Input		C_DEV_Wages C_DEV_Input C_DEV_LabCap	
R_Squared	0.646		0.7106	
Adj R-squared	0.6335		0.6951	
Prob >F	0.0000		0.0000	
Number of Obs	60		60	

* See variables' definition on the first page of this appendix

Table 5a. Individual Country Estimation for Ecuador (Sub-Regional Data - Three Digits)

	Seemingly Unrrelated Estimation					
	E_DEV_Wages		E_DEV_TrdCta		E_DEV_LU	
Variables	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
Constant	-1.0962	0.0000	-18.3804	0.0010	-0.0002	0.9150
E_DEV_Tariff	0.2187	0.0080				
E_DEV_Input	16.0698	0.0130				
E_DEV_ImpPen	-0.0217	0.0250				
E_DEV_LabCap			67.83715	0.1460		
E_DEV_LabUnion			-688.5813	0.0190		
E_DEV_IC					1.1542	0.0000
R_Squared	0.4256		0.3038		0.5475	
Prob >chi2	0.0002		0.0071		0	
Number of Obs	26		26		26	

* See variables' definition on the first page of this appendix

Table 5b. Individual Country Estimation for Ecuador (Sub-Regional Data - Four Digits)

	Seemingly Unrrelated Estimation			
	E_DEV_Tariff		E_DEV_LabUnion	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	-1.0327	0.0000	-0.0011	0.2800
E_DEV_Wages	0.1381842	0.0800		
E_DEV_ImpPen	-0.0138657	0.0010		
E_DEV_CI			0.9417	0.0000
E_DEV_TrdCta			-0.0001	0.0200
R_Squared	0		0.0000	
Adj R-squared	0		0.0000	
Prob >F	0.0037		0.0000	
Number of Obs	60		60	

* See variables' definition on the first page of this appendix

Table 6a. Pooled Data Estimation (Sub-Regional Data - Three Digits)

	Seemingly Unrrelated Estimation					
	rg_dev_wages		rg_dev_labcap		rg_dev_labunion	
Variables	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
Constant	-0.4503	0.0010	0.0360	0.0140	0.0000	1.0000
rg_dev_labcap	-3.9988	0.0000				
rg_dev_input	8.1614	0.2030				
rg_dev_trdqta	0.0135	0.0020				
rg_dev_imppen	-0.0251	0.0540				
rg_dev_tariff			-0.0071	0.0420		
rg_dev_imppen			0.0041	0.0010		
rg_dev_ci					0.9326701	0.0000
R_Squared	0.3345		0.1775		0.5830	
Prob >chi2	0.0000		0.0002		0	
Number of Obs	81		81		81	

* See variables' definition on the first page of this appendix

Table 6b. Pooled Data Estimation (Sub-Regional Data - Four Digits)

	Seemingly Unrrelated Estimation			
	Eq_Wages		Eq_LabUnion	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	-0.4423	0.0090	0.0001	0.8650
rg_dev_tariff	0.0639	0.0990		
rg_dev_labcap	-0.6942	0.0040		
rg_dev_trdqta	0.0119	0.0060		
rg_dev_imppen	-0.0114	0.0010		
rg_dev_ci			0.8653	0.0000
rg_dev_input			0.1406	0.0010
R_Squared	0.1727		0.6061	
Prob >chi2	0.0000		0.0000	
Number of Obs	180		180	

* See variables' definition on the first page of this appendix

Table 7. Hausman Test for Random vs. Fixed Effects Models for Wages and Labor Union (Sub-Regional Pooled Data)

			Estimator		Hausman		Model
Aggregation	Model	Explanatory Variable	Random Effects	Fixed Effects	Statistic	P-value	Chosen
3 Digits							
	Wages						
		rg_dev_labcap	-3.97076	0.40360			Fixed
		rg_dev_imppen	-0.02646	-0.02281	98.790	0.000	Effects
		rg_dev_trdcta	0.01346	0.00024			
		rg_dev_input	9.00359	12.97484			
	Labor Union						Random
		rg_dev_ci	0.93403	0.93403	0.000	1.000	Effects
4 Digits							
	Wages						
		rg_dev_labcap	-0.38760	-0.69820			
		rg_dev_imppen	-0.00898	-0.01146	44.960	0.000	Fixed
		rg_dev_trdcta	0.00513	0.01189			Effects
		rg_dev_tariff	-0.03871	0.06293			
	Labor Union						
		rg_dev_ci	0.86473	0.86483	0.020	0.991	Random
		rg_dev_input	0.14337	0.14258			Effects

* See variables' definition on the first page of this appendix

Table 8. Panel Data Estimation (Sub-Regional Data - Three Digits)

	Fixed Effect Model		Random Effects Model	
	rg_dev_wages		rg_dev_labunion	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	-0.8760	0.0000	0.0000	1.0000
rg_dev_lacap	0.4036	0.6560		
rg_dev_input	12.9748	0.0060		
rg_dev_trdqta	0.0002	0.9430		
rg_dev_imppen	-0.0228	0.0150		
rg_dev_ci			0.9340	0.0000
R_Squared				
Within	0.1731		0.5830	
Between	0.9109		0.5694	
Overall	0.1267		0.5830	
Prob >F	0.0065			
Prob > chi2			0.0000	
F test that all u_i=0:				
Prob > F = 0.0000	0.0065			
Number of Obs	81		81	
Number of groups	3		3	
Obs per group	27		27	

* See variables' definition on the first page of this appendix

Table 9. Panel Data Estimation (Sub-Regional Data - Four Digits)

	Fixed Effect Model		Random Effects Model	
	rg_dev_wages		rg_dev_labunion	
Variables	Coefficient	Prob	Coefficient	Prob
Constant	-0.8720	0.0000	0.0001	0.8650
rg_dev_tariff	-0.0387	0.3600		
rg_dev_labcap	-0.3876	0.0860		
rg_dev_trdqta	0.0051	0.2000		
rg_dev_imppen	-0.0090	0.0040		
rg_dev_ci			0.8648	0.0000
rg_dev_input			0.1426	0.0010
R_Squared				
Within	0.081		0.6062	
Between	0.731		0.5595	
Overall	0.1186		0.6061	
Prob >F	0.0054		-	
Prob > chi2	-		0.0000	
F test that all u_i=0:				
Prob > F = 0.0000	0.0000		-	
Number of Obs	180		180	
Number of groups	3		3	
Obs per group	60		60	

* See variables' definition on the first page of this appendix

Table 10a. Straw Man Model Estimation (Sub-Regional Data - Three Digits)

	Straw Man Model					
	rg_dev_wages		rg_dev_labcap		rg_dev_labunion	
Variables	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
Constant	-0.3343	0.0310	0.0049	0.7420	0.0014	0.4310
rg_dev_tariff	-0.0139	0.7080				
rg_dev_labcap	-6.6770	0.0000				
rg_dev_ci	-17.7143	0.1630				
rg_dev_input	5.3341	0.4140				
rg_dev_labunion	17.8196	0.0850				
rg_dev_trdqta	0.0146	0.0010				
rg_dev_imppen	-0.0133	0.3130				
rg_dev_tariff			-0.0053	0.1140		
rg_dev_wages			-0.0577	0.0000		
rg_dev_ci			0.6479	0.5850		
rg_dev_input			0.0124	0.9840		
rg_dev_labunion			-0.7938	0.4130		
rg_dev_trdqta			0.0011	0.0140		
rg_dev_imppen			0.0016	0.1970		
rg_dev_tariff					-0.0003	0.3780
rg_dev_wages					0.0020	0.0850
rg_dev_labcap					-0.0103	0.4130
rg_dev_ci					0.9136	0.0000
rg_dev_input					0.0642	0.3540
rg_dev_trdqta					0.0000	0.5480
rg_dev_imppen					0.0000	0.9930
R_Squared	0.2833		0.2508		0.6055	
Prob >chi2	0.0000		0.0000		0.0000	
Number of Obs	81		81		81	

* See variables' definition on the first page of this appendix

Table 10b. Straw Man Model Estimation (Sub-Regional Data - Four Digits)

	Straw Man Model					
Variables	rg_dev_wages		rg_dev_labcap		rg_dev_labunion	
	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
Constant	-0.3820	0.0250	0.0463	0.3680	0.0001	0.8400
rg_dev_tariff	0.0555	0.1550				
rg_dev_labcap	-1.3142	0.0000				
rg_dev_ci	-23.8989	0.2550				
rg_dev_input	5.3428	0.6400				
rg_dev_labunion	24.1798	0.1900				
rg_dev_trdcta	0.0113	0.0090				
rg_dev_imppen	-0.0099	0.0040				
rg_dev_tariff			-0.0030	0.8010		
rg_dev_wages			-0.1175	0.0000		
rg_dev_ci			0.0636	0.9920		
rg_dev_input			-0.1735	0.9600		
rg_dev_labunion			-1.0885	0.8440		
rg_dev_trdcta			0.0011	0.3960		
rg_dev_imppen			0.0008	0.4510		
rg_dev_tariff					-0.0001	0.5000
rg_dev_wages					0.0004	0.1900
rg_dev_labcap					-0.0002	0.8440
rg_dev_ci					0.8657	0.0000
rg_dev_input					0.1400	0.0020
rg_dev_trdcta					0.0000	0.7710
rg_dev_imppen					0.0000	0.9610
R_Squared	0.1462		0.0448		0.6074	
Prob >chi2	0.0000		0.0000		0	
Number of Obs	180		180		180	

* See variables' definition on the first page of this appendix

Table 11. Forecast Evaluation (Sub-Regional Data - Three Digits)

Estimation	Dep. Variable	MSE	RMSE	MAE	MAPE	WAPE
		Forecast Evaluation Measures				
Individual Country						
	Bol_Wages	4.3529	2.0864	1.8455	107.0011	1.1116
	Bol_LabUnion	0.0005	0.0230	0.0163	1428.9805	-21971096
	Col_Wages	0.3039	0.5513	0.4476	81.1777	0.8850
	Ecu_Wages	5.1881	2.2777	2.1053	119.5419	1.1589
	Ecu_LabUnion	0.0003	0.0161	0.0095	213.4720	55123104
Pooled Data - SUR						
	Bol_Wages	0.7136	0.8447	0.6700	44.0135	0.3566
	Bol_LabUnion	0.0002	0.0143	0.0103	1524.2269	8909286
	Col_Wages	0.9742	0.9870	0.8925	214.1488	1.7647
	Ecu_Wages	1.4600	1.2083	0.9819	62.3884	0.4706
	Ecu_LabUnion	0.0001	0.0104	0.0071	235.1285	-17984478
Pooled Data - Panel						
	Bol_Wages	1.0024	1.0012	0.7051	33.3781	0.4197
	Bol_LabUnion	0.0002	0.0140	0.0097	1483.0941	5402145
	Col_Wages	1.9904	1.4108	1.3448	360.1383	2.6591
	Ecu_Wages	1.3144	1.1465	0.9493	60.6843	0.4649
	Ecu_LabUnion	0.0001	0.0103	0.0068	228.0132	-11958737
Pooled Data - Straw Man						
	Bol_Wages	71.1653	8.4359	2.4954	194.2606	1.4452
	Bol_LabUnion	0.0004	0.0193	0.0118	2781.3178	-499465
	Col_Wages	0.7657	0.8750	0.7723	186.9048	1.5271
	Ecu_Wages	1.5282	1.2362	1.0393	64.2263	0.5020
	Ecu_LabUnion	0.0001	0.0102	0.0071	168.2868	-16606889

* See variables' definition on the first page of this appendix

Table 12. Forecast Evaluation (Sub-Regional Data - Four Digits)

		Forecast Evaluation Measures				
Estimation	Dep. Variable	MSE	RMSE	MAE	MAPE	WAPE
Individual Country						
	Bol_Wages	11.01357	3.31867	2.97593	182.2517	1.5588
	Bol_LabUnion	0.00030	0.01737	0.01427	513.4796	-36385528
	Col_LabUnion	0.00001	0.00384	0.00262	347.1427	-55826580
	Ecu_LabUnion	0.00014	0.01162	0.00641	185.9593	-12354432
Pooled Data - SUR						
	Bol_Wages	2.42537	1.55736	1.15302	94.3798	0.4434
	Bol_LabUnion	0.00008	0.00912	0.00627	149.0126	7079587
	Col_LabUnion	0.00000	0.00199	0.00147	156.5959	-12401479
	Ecu_LabUnion	0.00006	0.00771	0.00498	338.6476	4186758
Pooled Data - Panel						
	Bol_Wages	2.55529	1.59853	1.24977	75.6815	0.5203
	Bol_LabUnion	0.00008	0.00912	0.00627	149.0726	7110289
	Col_LabUnion	0.00000	0.00199	0.00147	156.3624	-12488522
	Ecu_LabUnion	0.00006	0.00772	0.00498	340.0092	4200740
Pooled Data - Straw Man						
	Bol_Wages	2.265259	1.50508	1.11909	83.7580	0.4547
	Bol_LabUnion	0.000082	0.00904	0.00618	151.3334	7256244
	Col_LabUnion	0.000004	0.00207	0.00154	150.8058	-13779952
	Ecu_LabUnion	0.000058	0.00762	0.00481	323.3804	5729130

* See variables' definition on the first page of this appendix

Table 13. Model Chosen Based on the Mean Absolute Percentage Error (Sub-Regional Data)

		Model					
Agregation	Estimation	Bol_Wages	Bol_LabUnion	Col_Wages	Col_LabUnion	Ecu_Wages	Ecu_LabUnion
Three Digits	Individual		V	V	NA		
	Region				NA		
	Longitudinal	V			NA	V	
	Straw Man				NA		V
Four Digits	Individual			NA		NA	V
	Region		V	NA		NA	
	Longitudinal	V	V	NA		NA	
	Straw Man			NA	V	NA	

* See variables' definition on the first page of this appendix

Table 14 . Diebold Mariano Tests for Forecasting Evaluation (Sub-Regional Data - Three Digits)

Model	Estimation	MSE Difference	S(1) Statistic	p-value	Model Chosen
Bol_Wages					
	I vs R	3.779325	5.572574	0.000000	Region
	I vs P	3.479434	6.714834	0.000000	Panel
	I vs S	3.395358	4.349449	0.000014	Straw Man
	R vs P	-0.299891	-1.520761	0.128320	None
	R vs S	-45.599144	-1.027697	0.304092	None
	S vs P	0.084076	0.262831	0.792680	None
Bol_LabUnion					
	I vs R	0.000323	1.670010	0.094917	Region
	I vs P	0.000346	1.731374	0.083385	Panel
	I vs S	0.000155	0.570117	0.568598	None
	R vs P	0.000000	-0.733422	0.463301	None
	R vs S	-0.000168	-0.928883	0.352950	None
	S vs P	0.000178	0.944208	0.345063	None
Col_Wages					
	I vs R	-0.686597	-5.401831	0.000000	Individual
	I vs P	-1.751661	-12.283724	0.000000	Individual
	I vs S	-0.461708	-3.820936	0.000133	Individual
	R vs P	-1.055317	-9.765901	0.000000	Region
	R vs S	0.224889	7.936408	0.000000	Straw Man
	S vs P	-1.285904	-10.194627	0.000000	Straw Man
Ecu_Wages					
	I vs R	3.718799	4.599630	0.000004	Region
	I vs P	3.765582	4.680715	0.000003	Panel
	I vs S	3.659890	4.720934	0.000002	Straw Man
	R vs P	0.151208	1.098713	0.271893	None
	R vs S	-0.058909	-0.600272	0.548325	None
	S vs P	0.153122	1.058979	0.289609	None
Ecu_LabUnion					
	I vs R	0.000152	1.004201	0.315282	None
	I vs P	0.000160	1.016504	0.309389	None
	I vs S	0.000157	0.965763	0.334163	None
	R vs P	0.000000	0.283634	0.776691	None
	R vs S	0.000005	0.320726	0.748418	None
	S vs P	-0.000005	-0.293897	0.768837	None

*(H0: difference is not significant)

* See variables' definition on the first page of this appendix

Table 15. Diebold Mariano Tests for Forecasting Evaluation (Sub-Regional Data - Four Digits)

Model	Estimation	MSE Difference	S(1) Statistic	p-value	Model Chosen
Bol_Wages					
	I vs R	8.5882036	6.0918320	0.0000000	Region
	I vs P	8.4582880	6.7438339	0.0000000	Panel
	I vs S	8.7483153	6.1936282	0.0000000	StrawMan
	R vs P	-0.1299155	-0.4056497	0.6850000	None
	R vs S	0.1601117	2.3480431	0.0188723	StrawMan
	S vs P	-0.2900272	-0.9255664	0.3546714	None
Bol_LabUnion					
	I vs R	0.0002185	2.3385779	0.0193573	Region
	I vs P	0.0002185	2.3382935	0.0193720	Panel
	I vs S	0.0002199	2.3604597	0.0182523	StrawMan
	R vs P	0.0000000	-0.1895654	0.8496497	None
	R vs S	0.0000014	0.9068534	0.3644843	None
	S vs P	-0.0000015	-0.9268132	0.3540235	None
Col_Wages					
	I vs R	0.0000108	2.5858780	0.0097131	Region
	I vs P	0.0000108	2.5862248	0.0097034	Panel
	I vs S	0.0000105	2.5400509	0.0110836	StrawMan
	R vs P	0.0000000	-0.0127228	0.9898490	None
	R vs S	-0.0000003	-1.7010448	0.0889346	Region
	S vs P	0.0000003	1.7173303	0.0859188	Panel
Ecu_LabUnion					
	I vs R	0.0000108	1.1135427	0.2654754	None
	I vs P	0.0000107	1.0985419	0.2719679	None
	I vs S	0.0000767	1.1748971	0.2400359	None
	R vs P	-0.0000001	-0.8539945	0.3931080	None
	R vs S	0.0000007	0.8755802	0.3812583	None
	S vs P	-0.0000008	-1.0346311	0.3008412	None

*(H0: difference is not significant)

* See variables' definition on the first page of this appendix

Table 16. Hausman Test for Random vs. Fixed Effects Models for Wages and Labor Union (Regional Pooled Data)

Model	Explanatory Variable	Estimator: Random Effects	Estimator: Fixed Effects	Hausman statistic	p-value	Model chosen
Wages						
	rg_dev_labcap	-0.52326	-0.44503			
	rg_dev_imppen	-0.00774	-0.00719	51.8200	0.0000	Fixed Effects
	rg_dev_tariffs	-0.04168	-0.07056			
Labor Union						
	rg_dev_ci	0.43248	0.43220			
	rg_dev_input	0.28330	0.28743	0.3300	0.8469	Random Effects

* See variables' definition on the first page of this appendix

Table 17. Panel Data Estimation for Wages (Regional Data - Four Digits)

	Fixed Effects Model Estimation for Wages	
Variables	Coefficient	Prob
Constant	-0.4637	0.0000
rg_dev_tariff	-0.0706	0.0660
rg_dev_labcap	-0.4450	0.1000
rg_dev_imppen	-0.0072	0.0440
R_Squared		
Within	0.0362	
Between	0.1273	
Overall	0.0085	
Prob >F	0.0129	
F test that all u_i=0:		
Prob > F = 0.0000	0.0000	
Number of Obs	300	
Number of groups	5	
Obs per group	60	

* See variables' definition on the first page of this appendix

Table 18. Panel Data Estimation for Labor Union (Regional Data - Four Digits)

	Random-Effects Model Estimation for Labor Union	
Variables	Coefficient	Prob
Constant	0.0001	0.7180
rg_dev_ic	0.4325	0.0000
rg_dev_input	0.2833	0.0000
R_Squared		
Within	0.4408	
Between	0.0575	
Overall	0.4397	
Prob > chi2	0	
Number of Obs	300	
Number of groups	5	
Obs per group	60	

* See variables' definition on the first page of this appendix

APPENDIX B

CONVERSION TABLES FOR DIFFERENT INTERNATIONAL INDUSTRIAL CLASSIFICATIONS

Table 19. International Standard Industrial Classification of All Economic Activities (ISIC)

4-digit level of Revision 2 CODE	INDUSTRY	4-digit level of Revision 3 CODE
3111	Slaughtering, preparing and preserving meat	1511
3112	Manufacture of dairy products	1520
3113	Canning and preserving of fruits and vegetables	1513
3114	Canning, preserving and processing of fish, crustaceans and similar foods	1512
3115	Manufacture of vegetable and animal oils and fats	1514
3116	Grain mill products	1531
3117	Manufacture of bakery products	1541
3118	Sugar factories and refineries	1542
3119	Manufacture of cocoa, chocolate and sugar confectionery	1543
3121	Manufacture of food products not classified elsewhere	1532+1544+1549
3122	Manufacture of prepared animal feeds	1533
3131	Distilling, rectifying and blending spirits	1551
3132	Wine industries	1552
3133	Malt liquors and malt	1553
3134	Soft drinks and carbonated waters industries	1554
3140	Tobacco manufactures	1600
3211	Spinning, weaving and finishing textiles	1711+1712
3212	Manufacture of made-up textile goods except wearing apparel	1721
3213	Knitting mills	1730
3214	Manufacture of carpets and rugs	1722
3215	Cordage, rope and twine industries	1723
3219*	Manufacture of textiles not classified elsewhere	1729
3220	Manufacture of wearing apparel, except footwear	1810
3231	Tanneries and leather finishing	1911
3232	Fur dressing and dyeing industries	1820
3233	Manufacture of products of leather and leather substitutes, except footwear and wearing apparel	1912
3240	Manufacture of footwear, except vulcanized or moulded rubber or plastic footwear	1920

Table 19. (Continued)

4-digit level of Revision 2 CODE	INDUSTRY	4-digit level of Revision 3 CODE
3311	Sawmills, planing and other wood mills	2010+2021+2022
3312	Manufacture of wooden and cane containers and small cane ware	2023
3319*	Manufacture of wood and cork products not classified elsewhere	2029
3320+3812	Manufacture of furniture and fixtures, except primarily of metal	3610
3411	Manufacture of pulp, paper and paperboard	2101
3412	Manufacture of containers and boxes of paper and paperboard	2102
3419*	Manufacture of pulp, paper and paperboard articles not classified elsewhere	2109
3420	Printing, publishing and allied industries	2211..2219+2221..2222
3511	Manufacture of basic industrial chemicals except fertilizers	2411+2330
3512	Manufacture of fertilizers and pesticides	2412+2421
3513	Manufacture of synthetic resins, plastic materials and man-made fibres except glass	2413+2430
3521	Manufacture of paints, varnishes and lacquers	2422
3522	Manufacture of drugs and medicines	2423
3523	Manufacture of soap and cleaning, preparations, perfumes, cosmetics and other toilet preparations	2424
3529*	Manufacture of chemical products not classified elsewhere	2429
3530	Petroleum refineries	2320
3540	Manufacture of miscellaneous products of petroleum and coal	2310
3551	Tyre and tube industries	2511
3559	Manufacture of rubber products not classified elsewhere	2519
3560	Manufacture of plastic products not classified elsewhere	2520
3610	Manufacture of pottery, china and earthenware	2691
3620	Manufacture of glass and glass products	2610
3691	Manufacture of structural clay products	2693
3692	Manufacture of cement, lime and plaster	2694
3699*	Manufacture of non-metallic mineral products not classified elsewhere	2692+2695..2699
3710	Iron and steel basic industries	2710+2731
3720	Non-ferrous metal basic industries	2720+2732

Table 19. (Continued)

4-digit level of Revision 2 CODE	INDUSTRY	4-digit level of Revision 3 CODE
3811	Manufacture of cutlery, hand tools and general hardware	2893
3812+3320	Manufacture of furniture and fixtures primarily of metal	3610
3813	Manufacture of structural metal products	2811
3819*	Manufacture of fabricated metal products except machinery and equipment not classified elsewhere	2891+2892+2899+2812
3821	Manufacture of engines and turbines	2911
3822	Manufacture of agricultural machinery and equipment	2921
3823	Manufacture of metal and wood-working machinery	2923
3824	Manufacture of special industrial machinery and equipment except metal and wood-working machinery	2813+2922+2924..2926
3825	Manufacture of office, computing and accounting machinery	3000
3829	Machinery and equipment except electrical not classified elsewhere	2912..2919+2927+2929
3831	Manufacture of electrical industrial machinery and apparatus	3110..3120+3210
3832	Manufacture of radio, television and communication equipment and apparatus	3220+3230+2230
3833	Manufacture of electrical appliances and household goods	2930
3839	Manufacture of electrical apparatus and supplies not classified elsewhere	3130..3190
3841	Shipbuilding and repairing	3511+3512
3842	Manufacture of railroad equipment	3520
3843	Manufacture of motor vehicles	3410..3430
3844	Manufacture of motorcycles and bicycles	3591+3592
3845	Manufacture of aircraft	3530
3849	Manufacture of transport equipment not classified elsewhere	3599
3851	Manufacture of professional and scientific, and measuring and controlling equipment, not classified elsewhere	3311+3312+3313
3852	Manufacture of photographic and optical goods	3320
3853	Manufacture of watches and clocks	3330
3901	Manufacture of jewellery and related articles	3691
3902	Manufacture of musical instruments	3692
3903	Manufacture of sporting and athletic goods	3693
3909	Manufacturing industries not classified elsewhere	3694+3699

Source: United Nations, Statistics Division. Methods and Classifications(Correspondences)
Own derivations.

Table 20. Conversion Table for the ISIC (Revision 2) and NALADISA Classifications

4-digit level of Revision 2 CODE	INDUSTRY	4-digit level of NALADISA CODE
3111	Slaughtering, preparing and preserving meat	1601+1602
3112	Manufacture of dairy products	0401..0406
3113	Canning and preserving of fruits and vegetables	2001..2105
3114	Canning, preserving and processing of fish, crustaceans and similar foods	1603..1605
3115	Manufacture of vegetable and animal oils and fats	1501..1522
3116	Grain mill products	1901..1904
3117	Manufacture of bakery products	1905
3118	Sugar factories and refineries	1701..1703
3119	Manufacture of cocoa, chocolate and sugar confectionery	1704..1806
3121	Manufacture of food products not classified elsewhere	2106+2209+2501
3122	Manufacture of prepared animal feeds	2308+2309
3131	Distilling, rectifying and blending spirits	2207+2208
3132	Wine industries	2204+2205
3133	Malt liquors and malt	2203
3134	Soft drinks and carbonated waters industries	2201+2202+2206
3140	Tobacco manufactures	2401..2403
3211	Spinning, weaving and finishing textiles	5001..5007+5101..5113+5201..5212+5301..5313+ 5401..5408+5501..5516+5601..5603+5801..5807+ 5901..5907
3212	Manufacture of made-up textile goods except wearing apparel	6301..6309
3213	Knitting mills	6001..6006+6107..6117
3214	Manufacture of carpets and rugs	5701..5705
3215	Cordage, rope and twine industries	5604..5609+5908+5808+6310
3219*	Manufacture of textiles not classified elsewhere	5809..5811+5909..5911
3220	Manufacture of wearing apparel, except footwear	4203+4303+6101..6106+6201..6217+6501..6507
3231	Tanneries and leather finishing	4101..4103
3232	Fur dressing and dyeing industries	4104..4115
3233	Manufacture of products of leather and leather substitutes, except footwear and wearing apparel	4201..4202+4204..4205+4301..4302+4304

Table 20. (Continued)

4-digit level of Revision 2 CODE	INDUSTRY	4-digit level of NALADISA CODE
3240	Manufacture of footwear, except vulcanized or moulded rubber or plastic footwear	6403..6406
3311	Sawmills, planing and other wood mills	4401..4413
3312	Manufacture of wooden and cane containers and small cane ware	4414..4420+4601..4602
3319*	Manufacture of wood and cork products not classified elsewhere	4421+4501..4504
3320+3812	Manufacture of furniture and fixtures, except primarily of metal	9401..9403
3411	Manufacture of pulp, paper and paperboard	4701..4707+4801..4816
3412	Manufacture of containers and boxes of paper and paperboard	4819
3419*	Manufacture of pulp, paper and paperboard articles not classified elsewhere	4817..4818+4820..4823
3420	Printing, publishing and allied industries	4901..4911
3511	Manufacture of basic industrial chemicals except fertilizers	2801..2851+2901..2935+2942+3507
3512	Manufacture of fertilizers and pesticides	3101..3105+3808
3513	Manufacture of synthetic resins, plastic materials and man-made fibres except glass	3901..3916
3521	Manufacture of paints, varnishes and lacquers	3201..3215+3809
3522	Manufacture of drugs and medicines	2936..2941+3001..3006
3523	Manufacture of soap and cleaning, preparations, perfumes, cosmetics and other toilet preparations	3301..3307+3401
3529*	Manufacture of chemical products not classified elsewhere	3402..3407+3501..3506+3601..3606+3803..3807+ 3810..3815+3817..3825
3530	Petroleum refineries	2709..2713
3540	Manufacture of miscellaneous products of petroleum and coal	2701..2708+2714..2715+3801..3802
3551	Tyre and tube industries	4009+4011..4013
3559	Manufacture of rubber products not classified elsewhere	4001..4008+4010+4014..4017+6401..6402
3560	Manufacture of plastic products not classified elsewhere	3917..3926
3610	Manufacture of pottery, china and earthenware	6911..6914
3620	Manufacture of glass and glass products	7001..7020
3691	Manufacture of structural clay products	6901..6910
3692	Manufacture of cement, lime and plaster	2520..2523+3816+6809..6810
3699*	Manufacture of non-metallic mineral products not classified elsewhere	2502..2519+2524..2530+6701..6704+6801..6808+ 6811..6815

Table 20. (Continued)

4-digit level of Revision 2 CODE	INDUSTRY	4-digit level of NALADISA CODE
3710	Iron and steel basic industries	2601+7201..7229+7301..7307
3720	Non-ferrous metal basic industries	2602..2621+7401..7407+7501..7507+7601..7609+ 7801..7805+7901..7906+8001..8006+8101..8112
3811	Manufacture of cutlery, hand tools and general hardware	8201..8215
3812+3320	Manufacture of furniture and fixtures primarily of metal	9401..9403
3813	Manufacture of structural metal products	7308..7310+7610..7612
3819*	Manufacture of fabricated metal products except machinery and equipment not classified elsewhere	7311..7326+7408..7419+7508+7613..7616+7806+ 7907+8007+8301..8311+ 8481
3821	Manufacture of engines and turbines	8401..8412
3822	Manufacture of agricultural machinery and equipment	8432..8438
3823	Manufacture of metal and wood-working machinery	8454..8463+8465
3824	Manufacture of special industrial machinery and equipment except metal and wood-working machinery	8413..8431+ 8444..8453+8464+ 8466..8468+8474..8475+8477..8478
3825	Manufacture of office, computing and accounting machinery	8439..8443+8469..8473
3829	Machinery and equipment except electrical not classified elsewhere	8476+8479..8485+9302..9305+9307
3831	Manufacture of electrical industrial machinery and apparatus	8501..8508+8514..8515
3832	Manufacture of radio, television and communication equipment and apparatus	8517..8531
3833	Manufacture of electrical appliances and household goods	8509..8510+8516
3839	Manufacture of electrical apparatus and supplies not classified elsewhere	8511..8513+8532..8548
3841	Shipbuilding and repairing	8901..8908
3842	Manufacture of railroad equipment	8601..8608
3843	Manufacture of motor vehicles	8701..8710
3844	Manufacture of motorcycles and bicycles	8711..8712
3845	Manufacture of aircraft	8801+8805
3849	Manufacture of transport equipment not classified elsewhere	8609+8713..8716
3851	Manufacture of professional and scientific, and measuring and controlling equipment, not classified elsewhere	9014..9033
3852	Manufacture of photographic and optical goods	3701..3707+9001..9013
3853	Manufacture of watches and clocks	9101..9114
3901	Manufacture of jewellery and related articles	7101..7117
3902	Manufacture of musical instruments	9201..9209
3903	Manufacture of sporting and athletic goods	9506..9507
3909	Manufacturing industries not classified elsewhere	6601..6603+6701..6702+9301+9306+9404..9406+ 9501..9505+9508+9601..9618+9701..9705

Source: United Nations, Statistics Division. Methods and Classifications(Correspondences)
Asociación Latinoamericana de Integración
Own derivations.

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