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THREE ESSAYS ON LATIN AMERICAN DEVELOPMENT ISSUES: PRODUCTIVITY GROWTH, INTERNATIONAL TRADE AND VIOLENT CRIME

By

Pablo Fajnzylber

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

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1998

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ABSTRACT

THREE ESSAYS ON LATIN AMERICAN DEVELOPMENT ISSUES: PRODUCTIVITY GROWTH, INTERNATIONAL TRADE AND VIOLENT CRIME

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Pablo Fajnzylber

The first essay studies the influence of openness to international trade on the rates of productivity growth of 18 Latin American countries during the period 1950-1995. After providing some background on the macro and trade policies of the countries involved, and reviewing the theoretical and empirical literature on the link between trade openness and productivity growth, we apply three types of empirical methodologies to examine this relationship: a growth accounting analysis, a study of structural breaks, and the estimation of dynamic panel data regressions of productivity growth on several measures of openness. The data comes from the databases prepared by Nehru and Dareshwar (1993) and Easterly, Loayza and Montiel (1997), which we update and complement. Our main findings are that, on average, the growth of total factor productivity was relatively faster during the periods in which the Latin American countries were open to international trade, but also that the pace of physical capital accumulation was relatively slower during these periods.

The second essay studies the relationship between openness to international trade and productivity growth at the industry level, focusing on five Latin American countries during the period 1970-1994. After describing the economic performance of the industries considered, we estimate the effect of different measures of openness on the

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growth of labor and total factor productivity at the industry level. The data comes from ECLAC/UNIDO's *PADI* database. The results reject the hypothesis of a general positive relationship between openness and productivity growth at the industry level, at least for the Latin American countries considered.

The third essay uses a new data set of crime rates for a large sample of countries for the period 1970-1994, based on information from the United Nations World Crime Surveys, to analyze the determinants of national homicide and robbery rates. A simple model of the incentives to commit crimes is proposed and estimated using both cross-sections and panel data. The results show that increases in income inequality raise crime rates, deterrence effects are significant, crime tends to be counter-cyclical, and criminal inertia is significant even after controlling for other potential determinants of homicide and robbery rates.

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I am most grateful to the Secretariat of Science and Technology of Brazil (CNPq), and to the Federal University of Minas Gerais (Brazil), who sponsored my doctoral studies at Michigan State University. I also would like to express my deepest appreciation to my thesis advisor, Professor Rowena Pecchenino, for her advice and encouragement during the preparation of this dissertation. I am also very grateful to Daniel Lederman and Norman Loayza, with whom I collaborated in a research project conducted at the World Bank on the determinants of criminal behavior worldwide, which led to the third essay of this dissertation. The friendship of Adriana, Anita, Bryan, Carlos, Denise, Doroteia, Heather, Hirokatsu, Joy, Luiz, Nelson, Ramon, Rosane, and Sandro, among others, was a key component of my standard of leaving in East Lansing. Last, but certainly not least, I would like to acknowledge my biggest appreciation to Carmelita, my wife, not only for her love and support, but also for her patience in listening to the oral accounts of the various steps that led to the completion of this dissertation.

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EAP: Economically

ECLAC: Economic

GDP: Gross Domes

GNP: Gross Nation

GMM: Generalized

ISIC: International

NTB: Non-Tariff B

PADI: Program for

TFP: Total Factor

UNCTAD: United

UNIDO: United

LIST OF ABBREVIATIONS

EAP: Economically Active Population.

ECLAC: Economic Commission for Latin America and the Caribbean.

GDP: Gross Domestic Product.

GNP: Gross National Product.

GMM: Generalized Method of Moments.

ISIC: International Standard Industrial Classification.

NTB: Non-Tariff Barrier.

PADI: Program for the Analysis of Industrial Dynamics.

TFP: Total Factor Productivity.

UNCTAD: United Nations Conference on Trade and Development.

UNIDO: United Nations Industrial Development Organization.

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1- Introduction

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Chapter 1:

TRADE LIBERALIZATION AND TOTAL FACTOR PRODUCTIVITY GROWTH IN LATIN AMERICA: 1950-1995

1- Introduction

The impact of trade liberalization on economic growth has long been the subject of theoretical and empirical debate. Recent developments in trade and growth theory have provided stronger analytical foundations for the arguments on the dynamic effects of "opening-up". At the same time, the issue has gained increased attention as the last two decades have witnessed an unprecedented movement towards economic integration among nations. In Latin America, in particular, most countries have engaged in a rapid process of dismantling the protectionist policies that had prevailed, with some interruptions, since the 1930s. The new trade policies have usually been the hallmark of reform packages encompassing a broad range of market-oriented policies and, in many cases, have been implemented in the context of aggressive programs of macroeconomic adjustment.

Partly because of the relatively short period of time that has elapsed since the implementation of the new policies, few studies have dealt with the measurement of their actual effects on economic growth. The present paper attempts to contribute to this research by studying the influence of openness to international trade on the rates of total factor productivity (TFP) growth of 18 Latin American countries during the period 1950-1995. To this end, we perform three types of analysis. The first one is a growth accounting exercise in which the contributions to GDP growth that are associated with the growth of, respe

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the growth of, respectively, TFP, capital stocks and the labor force are calculated. In this context, we examine how the relative importance of TFP growth in the explanation of the overall growth performance of the countries considered has evolved over time and, in particular, how it has changed after the implementation of the trade liberalization reforms. For the categorization and timing of the latter, we follow the criteria suggested by Sachs and Warner (1995) for the characterization of an economy as "open". By these criteria, all 18 countries liberalized their trade regimes in the last decade, while 10 of them had temporary episodes of "openness" in the previous decades (mainly in the 1950s). The data that we use comes from the data base on physical capital stocks, working-age population and output constructed by Nehru and Dareshwar (1993), which we update to 1995.

The second approach that we follow is that of testing for the existence of structural breaks in the series of import-output and export-output ratios and examining whether the rates of TFP growth have increased or decreased after the breaks. We also test for the presence of structural breaks in the series of GDP per worker, capital stocks per worker, and an index of TFP. The econometric procedure that we use is based on the "SupF_t" tests proposed by Vogelsang (1994), as implemented by Ben David and Papell (1997). These tests have the advantage of being general enough to allow for the presence of unit roots, polynomial trends, and serial correlation.

Finally, the third methodology that we adopt is that of estimating dynamic panel data regressions of TFP growth on several indicators of openness to international trade. The econometric technique that we use is based on the Generalized Method of Moments (GMM) estimator proposed by Blundell and Bond (1997), and controls for the existence of joint endogeneity

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The rest of this paper is organized as follows. Section 2 comments on the macroeconomic policy context in which the new trade policies have been put in place and provides some background on the extent and speed of these reforms. Section 3 discusses the theoretical issues involved in the analysis of the trade and growth relationship. Section 4 provides some previous empirical evidence on this issue. In section 5 the data and methodologies used in the paper are described and the results of our empirical exercises are presented. Section 6 offers a summary of results and concluding remarks.

2- Macroeconomic Policy and Trade Liberalization in Latin America

In Latin America and elsewhere, the recent process of trade liberalization has been only one component of a broader movement toward market-oriented reforms encompassing privatization and financial liberalization. Somewhat paradoxically, the new trade policies have been implemented in the context of intense macroeconomic instability, and have often been adopted in conjunction with stabilization packages. Whether the two sets of policies are jointly sustainable is still an open question and the importance of the short-run achievements cannot be underscored. In the words of Rodrik, "the success of reforms will depend less on the direct consequences of the new trade policies than on the resolution of the macroeconomic difficulties in which these countries are presently engulfed" (1992: 102).

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That the trade reforms may contribute, to some extent, to the success of the stabilization packages is not open to discussion. The radical shift in policies involved in the "structural" reforms has played an important role in strengthening the credibility of the stabilization efforts (Rodrik, 1995: 2965). Moreover, the increased foreign competition provided by import liberalization has been considered a potentially useful tool in the battle against inflation. Finally, the gains in technical efficiency that are potentially associated with increased openness can, at some point, improve the competitiveness of the export sector. However, it is clear that in the short run trade liberalization can also complicate the picture of macroeconomic adjustment through its effects on the external balance. As stated by Dornbusch, "one problem for trade reform is political...the other comes from the exchange rate" (1992: 81).

Indeed, the anti-inflationary policies that have been applied in many Latin American countries have rested on the use of the exchange rate as an "anchor" of the domestic price level. This implies the nominal stability of the exchange rate and even its real appreciation. Trade liberalization, on the other hand, invariably has a faster impact on imports than on exports, usually leading, in the absence of a compensating exchange rate depreciation, to the occurrence of large trade deficits. Quoting Dornbusch one more time, "if reserves are not available and depreciation is impractical, the only realistic option for trade policy is to approach liberalization more gradually" (1992: 82).

In practice, Latin American countries have made very rapid advances in the liberalization of their trade regimes[1]. Only a decade ago, Latin America was considered to

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have the most distorted external sector of the world (Edwards, 1995: 115). Since 1985, however, dramatic changes in trade regimes have occurred in the region, which has recently been described by a World Bank study as "rapidly moving toward the level of liberalization found in the East Asian newly industrializing countries" (Dean et al., 1994: 95).

Table 1.1 illustrates the extent of the trade reforms undertaken[2]. The first feature that stands out is the drastic reduction in the average level of nominal protection. This is indicated by the reduction in tariff rates, which now average less than 20 percent in almost all countries. This represents a sharp decrease from the corresponding figures for the years that preceded the reforms, which were usually two or three times higher than the post-reform level. Secondly, even though only one country displays a uniform tariff rate (Chile), the degree of dispersion of the import tariffs has been reduced dramatically, as the reduced tariff ranges illustrate. A third characteristic of the reforms is the abrupt reduction of the coverage of non-tariff barriers, which in some cases have been completely eliminated. Finally, there is evidence that export taxes and restrictions have

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oriented development strategies. Quoting Rodrik, "with regard to liberalizing trade restrictions, for example, it is clear that East Asian countries did not go nearly as far as some Latin American countries have done recently, and that whatever was accomplished took place a lot more gradually" (1995: 2944).

[2] It is worth noting that most of the data in this Table comes from a study by Alam and Rajapatirana (1993), who focus on the trade reforms in Latin America during the 1980s – the exception is the data for the coverage of non-tariff barriers, which was taken mostly from Edwards (1995). The years that Alam and Rajapatirana (1993) assume to have been the first years of the reforms are not always the same as those that we consider below in our estimation exercise. However, they do provide a good indication of the policy changes that occurred in Latin America in the last decade or so. The reform years considered by Alam and Rajapatirana are as follows: 1988 for Argentina, 1985 for Bolivia, 1987 for Brazil, 1985 for Chile, 1985 for Colombia, 1986 for Costa Rica, 1989

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been reduced or eliminated in several countries (Dean et al. 1994: 77, and Edwards, 1995: 125). Consistent with the changes in trade policy, the trade intensity of the Latin American countries – defined as the ratio of real imports plus real exports to real GDP – has increased in all but one country (Honduras)[3].

Regarding the evolution of the exchange rate, Table 1.2 shows that most countries' exchange rates considerably depreciated between 1980 and 1987. In many cases, this was the result of policies aimed at increasing the incentive to export. As shown by Alam and Rajapatirana, in the 1980s "the trade reforms were always preceded by, or associated with, significant depreciation of the real exchange rate (1993: 11)." These depreciations, however, were not always sustained after 1990, as several countries began experiencing a significant real appreciation of their currencies. Not surprisingly, the region has experienced growing trade and current-account deficits[4].

As explained by Edwards, the appreciation of the exchange rates was the result of two factors: "first, many countries used exchange rate policy as an anti-inflationary tool,

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for Ecuador, 1986 for Guatemala, 1986 for Honduras, 1982 for Jamaica, 1985 for Mexico, 1989 for Paraguay, 1989 for Peru, 1987 for Uruguay, and 1989 for Venezuela.

[3] Estimates of the structure-adjusted trade intensity of Latin American countries can be found in Burki and Perry (1997: 30-33). This indicator is obtained by correcting the ratio of trade to GDP for certain structural characteristics that determine a country's volume of trade, such as size and transport costs. As such, it is expected to reflect the level of trade explained by trade policy. The estimates show that "the average (structure-adjusted) trade intensity for the region has risen significantly in the 1990s", allowing Latin America to approach the corresponding average for the OECD, but still lagging far behind the average of the Asian newly industrializing countries (Burki and Perry, 1997: 33).

[4] Figures from ECLAC (1996) show that between 1990-91 and 1992-94 Latin America and the Caribbean's current account deficit increased from 1.1% to 3.2% of GDP. In the latter period, the figures were above 5% in nine countries (Bolivia, Costa Rica, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Paraguay and Peru). In the trade account, the region evolved from a surplus of 1.4% of GDP in 1990-91, to a deficit of 1.4% of GDP in 1992-94 (ECLAC, 1996: 26).

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and, second, massive capital inflows into Latin America made foreign exchange too abundant (1995: 137)." We have already referred to the first factor as a potential source of conflict between stabilization and trade policies. The second factor is to a great extent associated with external conditions, among which are the relatively low interest rates in the U.S. economy.

As the Mexican currency crisis of December 1994 has shown, the combination of real exchange rate appreciation, large current account deficits and strong dependency on foreign portfolio investments can have very explosive consequences, and put in risk the sustainability of the whole process of economic reform[5]. The avoidance of these critical circumstances calls for the very prudent management of the current and capital accounts as well as for the use of some restraint in the utilization of the exchange rate for anti-inflationary purposes. But the Mexican experience also highlights the importance of accelerating the gains in productivity that the reforms can potentially bring about. Edwards, while commenting on the lessons to be drawn from the Mexican crisis, shows that the disappointing performance of aggregate productivity growth during the early years of the reforms in this country made the handling of its external problems more difficult. As Edwards stated, "productivity gains are a fundamentally important element in the way in which the overall external sector develops. Productivity growth is at the heart of export expansion and thus contributes to keeping the current account in balance

[5] As stated by Calvo (1996), "the December 20, 1994, devaluation brought the economy down like a house of cards. Output fell by more than 7 percent in 1995, the current account deficit sharply swung from about 8 percent of GDP in 1994 to zero, and investors turned their noses away from high-yield Mexican public debt even though the international community had plunked about $50 billion in a rescue package (1996: 1)".

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(1995: 302)".[6] Whether trade liberalization is capable of bringing about rapid improvements in productivity – even though it might have failed to so in Mexico before 1994 – is the main question that the following sections attempt to address.

3- Trade Liberalization and Growth: Old and New Theory

The existence of net benefits arising from trade liberalization and, in particular, the potential of the latter to generate growth effects, have long been controversial issues in the economics profession. In a tradition that comes from Ricardo's theory of comparative advantage, economic theorists have usually emphasized the static gains in allocative efficiency arising from freer trade. The theory for these once-and-for-all gains, based on the assumption of perfect competition, has long been understood and tested. The magnitude of the corresponding benefits, however, appears to be relatively small. Quoting Rodrik, "reasonable estimates of the welfare cost of relative-price distortions under usual neoclassical assumptions rarely produce numbers in excess of a couple of percentage points of GNP (1995: 2932)."[7]

The theoretical arguments for the dynamic gains from trade liberalization, on the other hand, have, until recently, been stated in less formal terms. This explains, at least in part, the fact that the issue has remained a controversial one. Probably one of the first to

[6] Edwards (1995: 298) also quotes a World Bank study –*Trends in Developing Economies 1994*—that in September 1994 had pointed out this problem: "productivity growth has so far been insufficient to offset the loss of external competitiveness implied by the peso appreciation…with current account deficits of over $20 billion supported by even higher levels of foreign capital inflows, Mexico is vulnerable to foreign capital volatility" (p. 331).

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defend the existence of a positive link between international trade and growth was Adam Smith. In the *Wealth of Nations*, this author argues that international trade, through its effect on the expansion of markets, opens new possibilities for the division of labor, increases the extent of specialization and promotes improvements in technical efficiency[8]. In other words, in Smith's optimistic view of development, international trade propagates growth in productivity through the exploitation of economies of scale and the creation of incentives for the development of new productive technologies.

Interestingly, dynamic gains were also at the core of the arguments of those that defended "inward-oriented strategies". Quoting Pack (1988), "early proponents of import substitution based their policies partially on infant industry arguments and the rapid growth in productivity they expected during the stage when industrial skills were created and modern technology mastered. Their main assumption was that the period of protection would be utilized to increase technical efficiency and move towards internationally competitive prices" (1988: 348). In fact, as stated by Krueger (1997), "in the 1950's and 1960's, the neoclassical argument for an open trade regime was rejected on the grounds that it was 'static' and ignored 'dynamic considerations'"(1997: 10). Furthermore, as accounted by this author, starting in the late 1960's and 1970's, critics of

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[7] An example is given by Haberger (1959), who estimated the welfare cost of protection in Chile to be 2.5 percent of GNP, as opposed to 10 percent for domestic distortions – see Dornbusch (1992: 74).

[8] When referring to the impact of the discovery of America on the European economy, for example, Adam Smith states: "By opening a new and inexhaustible market to all the commodities of Europe, it gave occasion to new divisions of labour and improvement of art, which, in the narrow circle of the ancient commerce, could never have taken place for want of a market to take off the greater part of their produce. The productive powers of labour were improved, and its produce increased in all different countries of Europe and together with it the real revenue and wealth of its inhabitants (1976: 448)."

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the import-substitution strategies concentrated on static issues, such as the sub-optimality of the use of trade policy for development purposes and the rent-seeking activities generated as a by-product of protection (Krueger, 1997: 5).

There were also writers that, in the tradition of Adam Smith, advocated liberal trade regimes on the basis of dynamic considerations, such as their potential to spur entrepreneurial effort, explore economies of scale and promote the adoption of modern technologies – beside the gains from specialization according to comparative advantage[9]. This type of argument, however, was more prevalent among policy- and empirically-oriented economists. As shown by Rodrik, "this rationale for trade was hidden from the view of academic economists by the intellectual appeal of the Ricardian outlook (1992b: 155)."[10] In the last decade, nonetheless, this situation has changed thanks to the application of new modeling tools to trade and growth issues. Indeed, the formal modeling of international trade in imperfectly competitive markets, and the incorporation of technological change as an endogenous process in models of equilibrium growth have

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[9] Bela Balassa is probably the best exponent of this literature. While commenting on the TFP growth performance of countries with outward- and inward-oriented development strategies, this author asserts that "outward orientation leads to the efficient use not only of existing resources, but also of increments in resources, permits the exploitation of economies of scale, and provides the stick and carrot of competition that gives inducement for technological change" (1993: 47). This vision is already present in a 1970 paper in which the author argues against "the evidence that the static cost of protection would be outweighed by the dynamic benefits of the inward-looking strategy. Rather, the continued sheltering of domestic industry from foreign competition and disincentives to exporting involve a dynamic cost to the national economy in the form of opportunities forgone for improvements in productivity" (1989: 243).

[10] In the same spirit, Edwards asserts that "for a long time it was argued that the theoretical underpinnings of the proposition that freer trade enhances growth were weak. While the theory was clear regarding the *static* gains from free trade, the generalization of these results to a dynamic equilibrium growth setting presented some problems. Only

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provided new insights into the trade and growth relationship. Even with these new tools, however, the literature has been unable to reach unambiguous and general conclusions.

In the neoclassical growth model proposed by Solow (1956), steady-state growth is explained by technological change, which is treated as an exogenous process. As shown by Grossman, in this framework, "long run growth in an open economy proceeds at a rate that is independent of its trade policies or the nature of its international economic relations" (1992: 10). The recent attempts to model growth and technological progress as the outcome of economic forces – either through learning by doing or by investments in research and development (R&D) – have shed light on several channels through which trade can affect growth.

Grossman and Helpman (1991), for example, consider models of R&D-driven growth where technological progress occurs either through the introduction of new differentiated products or through the quality upgrading of existing products. In this context, the authors discuss four different mechanisms underlying the trade growth relationship. Firstly, they assume that trade may facilitate the international diffusion of knowledge, reducing the cost of product development and accelerating growth in all countries. Secondly, trade may favor growth through the reduction in research redundancy that is brought about by the integration of world commodity markets. A third mechanism at work is the increase in the size of the market in which firms operate. This has ambiguous effects on growth, as it causes an increase in sales and profits for a given market structure – and, thus, an incentive for new product development and growth – but

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also an increase in competition that may induce a reduction in the investments in technology. The net effect from these two forces depends on the extent to which research spillovers are national in scope: if international knowledge flows are not perfect, smaller countries can be expected to see their share of the world market decline over time. The same negative effect of trade on growth can occur when a country begins with a disadvantage in R&D and technology spillovers are national in reach. In this setting, as in Krugman (1987), history matters in the determination of dynamic comparative advantage and growth. Finally, when countries are dissimilar in their factor endowments, trade leads to changes in their intersectoral specialization and consequently in their aggregate rates of growth. Specifically, openness to international trade can have positive or negative effects on growth depending on whether it causes a reallocation of resources towards the production of traditional goods, high technology goods or the R&D sector of each economy. A similar decomposition of the growth effects of trade is proposed by Rivera-Batiz and Romer (1991), who also find that "allocation effects can increase or decrease the rate of growth" (p. 973). These effects are expected to be larger when the differences in the trading partners' endowments are bigger – such as in the case of North-South trade.

Lucas (1988, section 5 and 1993) has also emphasized the sectoral composition of output in his explanation of the trade and growth relationship. Lucas proposes a multi-good model where learning-by-doing is the engine of growth. As in Krugman (1987), it is assumed that different goods are associated with different "learning rates", so that the mix of goods produced in a particular country determines its rate of growth. Trade plays the role of determining, through comparative advantage, the sectoral mix of production and hence the aggregate rate of growth. Lucas (1993) also assumes that the sectoral rates of learning are decrea

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learning are decreasing over time, so that growth can only be sustained by the permanent evolution of the economy's production structure. In this context, the occurrence of "growth miracles" – such as Korea's – requires the creation of a gap between the structure of demand and supply in the economy, which can only be possible if the country becomes a large exporter. As stated by the author: "Korea needed to open a large difference between the mix of goods produced and the mix of goods consumed, a difference that could widen over time. Thus, a large volume of trade is essential to a learning-based growth episode" (Lucas, 1993: 269).

As shown by Feenstra (1996), the models proposed by Lucas (1988, section 5, and 1993) belong to a class of learning-by-doing and human capital accumulation models that "stress the unequal growth rates of economies, as motivated by the wide disparity in the growth rates of actual countries" (1996: 229)[11]. However, Feenstra shows that uneven growth rates across countries can also be obtained in models of "endogenous technological change" such as those proposed by Grossman and Helpman (1991), provided that it is assumed that R&D knowledge diffuses freely within borders but does not diffuse internationally[12]. An important point stressed by Feenstra – and one that could have testable implications – is that without this hypothesis, the models of R&D-driven growth predict that trade leads to convergence in growth rates, even when the allocative effects discussed above are involved. In the latter case, however, convergence

[11] Examples of models of this class are Krugman (1987), Young (1991), Azariadis and Drazen (1990), and Stokey (1991).

[12] Evidence against the hypothesis of international diffusion of knowledge can be found in the recent papers by Bowen et al. (1987) and Treffler (1995), who show that the HeckshER-Ohlin model of trade is not supported by empirical evidence due to uniform

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may occur towards a rate that does not necessarily exceed the autarky growth rates of the corresponding countries. In any case, it is worth noting that the concept of convergence to which Feenstra refers is qualitatively different from the one addressed in the recent controversy over convergence[13]. Indeed, as shown by Feenstra, most of this literature has focused on the convergence in the level of output, while "there has been much less exploration of whether the growth rates of countries differ systematically" (Feenstra, 1996: 252).

To summarize the contributions of the new growth literature on the trade and growth relationship, it may be useful to quote Helpman (1992): "The integration of a nation into a world trading system unleashes powerful forces that speed up growth. But it also unleashes forces that are harmful to growth. The former dominate, however, when countries do not differ too much in terms of resource composition, and knowledge flows freely across national borders... When knowledge accumulation is localized, however, history can extract powerful effects on the evolution of trade patterns and growth rates. Under these circumstances small initial differences in knowledge capital can translate into large long-run differences in sectoral structures, trade patterns and growth rates" (1992: 265).

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technological differences across countries – a fact that had already been discussed by Minhas (1962).

[13] For an account of this debate, see Durlauf (1996) and the papers included in the corresponding issue of the Economic Journal.

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4- Trade and Growth: The Empirical Evidence

The relationship between growth and trade liberalization has been the subject of a number of empirical studies. The motivation has been, in many cases, to provide evidence on the dynamic benefits or costs of different strategies of development, usually with an emphasis on the debate over the inward- versus outward-oriented approaches. More recently, after the resurgence in interest in growth theory, and due to the failure of the new models to predict unambiguous effects of trade on growth, the empirical work on the subject has been seen as a way of "to help resolve the debate" (Harrison, 1996: 420). The methodologies vary from the use of growth accounting techniques to the econometric estimation of growth equations. There is also considerable variety of measures of trade openness, ranging from policy indicators to indicators of trade performance. Furthermore, some studies have used cross-sectional analysis while others have concentrated on the time dimension of the series involved. Only a few studies have taken advantage of both sources of variation, using panel data techniques. Finally, a distinction can be made on the basis of whether the units of analysis are firms, industries or countries. Overall, it can be said that even though there is a great variety in conceptual approaches and empirical methodologies, most studies find a positive relationship between growth and openness to trade. Some important methodological problems, however, plague most of the studies. The problem of determining the direction of causality between trade and growth and, more generally, the possible endogeneity of the measures of openness in most econometric studies are probably the best examples.

Case studies carried out at the firm-level in less developed countries have provided some evidence on the type of technical change underlying productivity increases in countı

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increases in countries with inward- and outward oriented development strategies. Especially in Latin America and India, it has been shown that significant indigenous technological change has taken place even in the context of intensive import-substituting strategies. As described by Pack (1992), "rather than simply purchasing foreign equipment and using it according to prevailing norms, an indigenous effort was undertaken, particularly in large firms, that changed the method of production" (p. 22)[14]. It is not clear, however, to what extent to which the learning obtained in this process was generalized to the majority of the firms in the corresponding industries. On the other hand, analogous studies of firms in East Asian newly industrializing countries (NICs) where a more outward-oriented regime has prevailed – although sometimes accompanied by considerable government intervention[15] – show that their approach to industrialization "precluded the need for unique, site- and material-specific innovations that were not purchasable on the world market" (Pack, 1992: 24). In these countries, technology licensing was much more common than indigenous research and their impressive growth performance seems to suggest that this was a winning strategy. However, it is difficult to draw this type of conclusion exclusively from firm case studies, which brings us to review, at least selectively, the cross-industry and cross-country studies on the subject[16].

In a study that covers 21 industries in 17 countries, Nishimizu and Page (1991) regress the average growth of TFP on the growth of exports, imports and domestic

[14] As stressed by this author, "the documentation of this indigenous technical change is intrinsically interesting and provides a good antidote to the view implicit in international trade theory and microeconomics, of a uniform international technology costlessly available to everyone" (Pack, 1992: 22).
[15] See, on this matter, World Bank (1993) and Rodrik (1994).

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demand, controlling for the effect of restrictive trade policies and non-market oriented policy regimes[17]. Their main result is that "[E]xport growth is positively correlated with TFP growth in the industrial sector, but only in economies that follow market-oriented policies in general and that do no resort extensively to quantitative import restrictions in particular" (p. 256). Nevertheless, the authors also find a negative relationship between import penetration and TFP growth in the period following the first oil shock (after 1973). Neither result, it should be stressed, provides insight into the direction of causation: TFP performance could well be the cause and not the effect of the levels of industrial competitiveness, as reflected in the export performance and import penetration indexes. Similar results, however, are obtained by Nishimizu and Robinson (1984) in a study of 4 developing countries, and by Bonelli (1992) who analyzes data on Brazilian industries.

A different approach is adopted by Lee (1996), who focuses on the effect of specific government policies on the productivity performance of 38 Korean industries. Using data from a four-period panel covering the period from 1963 through 1983, the author shows that "trade protections, such as tariffs and import restrictions, are negatively correlated with the growth rates of value added, capital stock, and total factor productivity" (p. 402). Another finding is that industrial policies, as expressed in tax incentives, have a positive effect on output growth but that this occurs through the stimulus of capital accumulation and not TFP growth.

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[16] For more extensive reviews of this literature, see Pack (1988), Havrylyshin (1990), Tybout (1992) and Rodrik (1995).

[17] The study includes countries with different levels of development, over periods that vary somewhat between the late 1950s and early 1980s.

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A few studies have analyzed the industrial productivity performance of Latin American countries after the implementation of market oriented reforms. Agacino et al. (1993), for example, show that in the case of Chile the initial reaction to the reforms (in the period 1976/1981) was a more intense use of the factors of production – both labor and capital had negative growth rates in this period – which was reflected in a positive rate of growth of TFP. This increase in productivity, however, is attributed by the authors to an increase in productive efficiency and not to technological change. In the 1980s, on the other hand, Chilean industry displayed a negative rate of TFP growth, as most industries decreased their capital/labor ratios in a context of relatively low labor costs and previous financial stress.

Oks (1994) looks at the post-reforms productivity performance of Mexican and Chilean industries. The author reviews several studies and points out that, even with striking differences in the figures for productivity, there seems to be agreement on a slight recovery of productivity growth in Mexico after 1987 after having experienced negative growth in 1985/1988. Oks also finds very small rates of TFP growth in the case of Chile. As an explanation for these results, the author suggests that the real depreciation of the capital stock associated with the probable acceleration of the rate of obsolescence – due to modernization – may be underestimated in the data: "productivity just doesn't show up because existing measurements of capital do not capture adequately the real depreciation" (1994: p. 60).

In a recent research project led by James Tybout at the World Bank, the relationships between trade liberalization, technical efficiency, price-cost markups and industry rationalization have been studied for a sample of semi-industrialized countries, using both plan

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using both plant- and industry-level data[18]. In Chile, Mexico and Turkey, this research shows a positive relationship between TFP growth and both the reductions in the sectoral level of protection and the increases in import penetration. Similarly, studies carried-out for Turkey, Côte d'Ivoire and Mexico conclude that price-cost margins were reduced by the trade reforms of the 80s. With regard to the effect of the latter on the exploitation of economies of scale, however, several of the papers produced within the project fail to encounter the expected positive relationship between liberalization and industry rationalization. As summarized by Tybout (1992), "it appears that exposure to increased foreign competition is not closely linked with entry patterns, tends to induce reductions in plant size, and may cause some improvements in technical efficiency" (p. 207).

Helleiner (1994), summarizing 14 country studies on trade policy and industrialization, asserts that "the case studies [...] offer very weak, if any, support for the proposition that either import liberalization or export expansion are particularly associated with overall productivity growth" (p. 30). Furthermore, "the role of trade orientation of individual industries was mixed" (p. 31) as, depending on the country, the studies found either positive or negative relationships between sectoral TFP growth and the corresponding levels of protection against imports and the rates of export growth.

Edwards (1995), on the other hand, presents data on the change in aggregate growth of TFP after the liberalization of the trade regimes in 6 Latin American countries. With the exceptions of Mexico and, to a lesser extent, of Bolivia, considerable increases

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[18] See Tybout (1991, 1992), Roberts and Tybout (1996: chapter 1) and Rodrik (1995: 2970-2971) for a summary of the project's results.

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are encountered[19]. Mexico presents a slight decline in aggregate TFP, a result that is consistent with results presented by Lefort and Solimano (1994). These authors find that the rate of TFP growth was negative in the period 1982-1991 (p. 29). However, they also find signs of a recovery of GDP and TFP growth since 1988 – a result that is consistent with the findings of Oks (1994) at the industry level. In their analysis of the Chilean experience after the reforms initiated in 1974, Lefort and Solimano (1994) find that "all the evidence clearly shows an acceleration in the rate of growth of TFP after the reforms" (p. 18). Nevertheless, this result is contradicted by the evidence presented by Marfán and Bosworth (1994), who find that TFP growth was on average lower in the period 1973-89 than in 1950-73 (respectively 0.21 percent and 1.05 percent). It is possible, however, that these differences in results are due to the use of different methodologies with regard to the treatment of the cyclical changes in growth and the definition of capital.

Another group of studies has been concerned with the econometric estimation of cross-country growth equations in which some measure of trade policy, of trade performance, and/or of price distortions, are used as explanatory variables. As shown by Rodrik (1995), "these studies generally conclude that openness has been conducive to higher growth" (p. 2938). One important problem with this type of work has been uncovered by Pritchett (1996), who analyzes the relationship between different empirical proxies for trade policy stance and finds that "the alternative objective measures of trade policy examined are completely uncorrelated across countries" (p. 308) and produce

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"entirely different country rankings" (p. 329)[20]. These results point to the lack of robustness of the studies that use only some particular measure of trade policy stance.

The most natural way to go in measuring trade openness is probably the use of direct administrative measures of trade policy. In aggregate studies, however, this procedure implies the calculation of average indexes of trade policy, which is not a trivial problem. In the case of tariff and non tariff barriers to imports, for example, it is not clear whether the application of a weighting system is a better procedure than the use of simple averages. The latter may bias the measure of the actual restrictions upwards, since in many cases the highest barriers apply to products that are not traded at all. But for the same reason, the use of weights based on trade figures may cause an under-estimation of the barriers to trade, since the products with the highest restrictions are also the least traded exactly because of the government policies. An alternative that has been used, among others, by the World Bank in the *1987 World Development Report*, is to construct subjective indexes of trade orientation. These, however, have been criticized for their lack of international comparability. For these reasons, many cross-country studies have avoided the use of direct policy measures and have made use of indicators of trade performance or price distortions.

One of the first attempts at measuring the effect of outward orientation on growth in a cross-country setting was Michaely (1977), who found a significantly positive

[20] Four types of empirical measures of policy orientation across countries are examined by Pritchett (1996). These are: "(a) the share of trade (or imports) in GDP (adjusted for country structural characteristics or factor endowments), (b) the average tariff and coverage ratio of nontariff barriers (NTBs), (c) measures of the deviation of countries' actual trade pattern from the pattern predicted from a model of resource-based comparative advantage and (d) a measure of price distortions" (p. 308).

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correlation between the rate of growth of export shares of GDP, and output growth. Feder (1983) proposed a model where the export sector generates positive externalities on non-exports sectors, so that its expansion has a positive effect on growth. Feder showed that this result could be empirically tested by regressing output growth on the rate of growth of exports multiplied by the export share in output, and the growth rates of labor and capital. Using a sample of 31 countries, Feder (1983) found evidence supporting his model. As shown by Edwards (1993), many studies followed this line of research, estimating variations of Feder's regression. Among their findings, it is worth mentioning the existence of different relationships between exports and GDP growth depending on the level of income of the countries involved, and the existence of diminishing returns in the contribution of exports to output growth.

As shown by Edwards (1992), the above studies implicitly assume that the growth in exports can be used as an indicator of the type of trade regime in the countries involved. The same assumption underlies the studies that use trade shares, or changes in trade shares, as openness indicators – as do Helliwell and Chung (1991) and Helliwell (1994), for example, who also find a significant positive impact of trade on growth[21]. As stated by Harrison (1996), "one problem with this approach, however, is that trade flows are at best an imperfect proxy for trade policy. Other factors, such as country size or

[21] Helliwell (1994), in a study of 19 industrial countries during the period from 1963 to 1989, regresses TFP growth on both the level and the first diference of the ratio of total trade to GDP. He also uses, as explanatory variables, the log of GDP as a measure of scale, and the ratio of the current level of efficiency in the United States to the preceding year's efficiency level in each country, as a way of testing for convergence in productivity. The author finds evidence that both the level and the rate of change of the trade-output ratio have a positive effect on productivity growth, which he interprets as

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foreign capital inflows, also affect trade". This has led to the use, by some authors, of the deviation of actual from predicted trade flows, based on variables such as country size and transport costs (Syrquin and Chenery, 1989). These measures, however have been criticized for the absence of an underlying theoretical model to predict trade flows.

An alternative that certainly has stronger theoretical foundations has been proposed by Leamer (1988), who constructs measures of openness from the residuals in an empirical Hecksher-Ohlin model estimated to explain trade flows and trade intensity ratios for 53 countries. Edwards (1992), using these measures, finds that the growth in GDP per capita is positively associated with trade openness. A problem with Leamer's measures is that, as shown by Rodrik (1995), it has "serious shortcomings in the way it ranks certain countries" (p. 2939). However, in Edwards' study, the above mentioned result is shown to be robust to the replacement of Leamer's indexes by alternative indicators of trade orientation. In fact, similar findings are reported by the author in a cross-country study that focuses in the growth of TFP and uses 9 different openness indexes (Edwards, 1997).

Harrison (1996) suggests that the ideal measure of the impact of trade policy on the incentives for exporting and import-competing industries would be based on "price comparisons between goods sold in domestic and international markets" (p. 421). These, nevertheless, are not available most of the time. One possibility, pursued by Barro (1991) and Dollar (1991), is to use the deviation of the local price level from purchasing power parity as a measure of outward/inward orientation. Both authors find that these measures

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suggesting "that the level of openness may have effects on both the level and the rate of growth of productivity" (p. 265).

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of openness raise GDP growth per capita. Barro (1991) actually concentrates on the relative domestic prices of the investment goods to international prices. Dollar (1991), on the other hand, uses 10-year averages and controls for the countries' factor endowments by regressing the deviation in price levels on national income. The author finds that his index is "highly correlated with the per capita GDP growth in a large sample of 95 countries" (p. 540). Dollar's methodology, however, has been criticized on the grounds that in many cases it captures "the exchange rate (and therefore macroeconomic) stance of countries, and miss out on micro price distortions when exchange rates are managed well" (Rodrik, 1995: 2940)[22]. Furthermore, as stressed by Harrison (1996), "international price comparisons cannot disentangle the impact of domestic market imperfections (such as oligopolistic marketing channels for imported goods) from trade policy interventions" (p. 425).

The approach adopted by Harisson (1996), in one of the most recent and comprehensive studies on the subject, is to "gather as many different measures of openness as are available for a cross-section of developing countries over time, and test whether these measures generally yield the same results" (p. 425). Indeed, this author defends the use of panel data techniques in order to control for the existence of unobserved country-specific effects and to account for the changes that have occurred over time for the same countries. The seven measures selected – which do not include indicators for which data is not available over time, such as Leamer's indexes and the

[22] Interestingly, Rodrik (1995) gives a very positive evaluation of the relatively similar methodology used by Barro, which focuses in the deviation in the price level of investment goods: "perhaps the most credible of the cross-country regression studies are

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data on trade barriers collected by UNCTAD – include: (a) subjective indexes of trade liberalization from Papageorgiou et al. (1991) and Thomas et al. (1991), (b) the black market premium, (c) trade shares in GDP, (d) measures of relative domestic and international prices, including a modified version of the Dollar (1991) index, and (d), a measure of the indirect bias against agriculture from protection of the industrial sector and overvaluation of the exchange rate[23].

Harrison (1996) regresses GDP growth on the growth of the factors of production – including the labor force, physical and human capital, and arable land – and the different measures of openness (in levels or rates of change, alternatively), which are expected to affect the change in total factor productivity (estimated as the constant in the regression). A first result is that in cross sectional regressions the black market premium is the only measure of openness that presents a significant (and negative) coefficient. When panel data with annual observations and a fixed effects technique is used, however, three out of the seven measures of openness are significant at the 5 percent level and another one is significant at the 10 percent level – all with the expected sign. To deal with short-run cyclical fluctuations, the author also uses a panel of five-year averages. With this approach, also allowing for fixed effects, only three measures of openness are found to exert a positive and significant effect on productivity growth – two at the 5 percent level and one at the 10 percent level. Harrison (1996) also performs a robustness analysis

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those [like Barro (1991) and Easterly (1993)] that find a negative relationship between distortions in capital goods prices and economic growth" (p. 2940).

[23] It is worth noting that the author does not always find significant rank correlations between these alternative measures of openness, a result that is consistent with Pritchett's (1996) findings, and that Harrison (1996) interprets as an indication that "[the openness measures] are not capturing the same aspects of 'openness'" (p. 431).

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in the spirit of Levine and Renelt (1992), introducing additional macro variables in the regressions, and using only the measures of openness that had appeared as significant in her previous exercises. The result is that the statistical significance of the openness measures disappears in half of the cases. Finally, to investigate the direction of causation between openness and growth, the author applies Granger causality tests using vector autoregressions. As stated by Harrison (1996), "[the results] suggest that causality between openness and growth runs in both directions" (p. 443). Overall, Harrison's (1996) study gives support to the hypothesis that greater openness is associated with higher growth: whenever the former is statistically significant, it has the appropriate sign. Nonetheless, this result must be interpreted with caution since the author does not control for the endogeneity problem that, as she shows, affects the openness variables when used to explain output growth. Moreover, as stressed by the author, the results also "suggest that the choice of the time period is critical" (p. 443): the greater support for the above hypothesis is provided by the regressions with annual data, followed by those based on panel data with 5-year-averages, and finally by the cross-sectional regressions. It seems, however, that the best approach is the one based on a panel of 5-year periods. Indeed, as shown in a study by Quah and Rauch (1990) quoted by Harrison (1996: 434), the positive association between openness and growth when using annual data could be mostly explained by short run cyclical fluctuations. Cross-sectional regressions, on the other hand, eliminate the large variation that has occurred over time in the developing countries' trade policies.

To conclude this review of the empirical evidence on the relationship between trade openness and growth with a word of caution, it may useful to quote Helleiner's

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(1994) somewhat pessimistic appraisal of this literature: "The empirical research on the relationship between total factor productivity (TFP) growth and output mix, imports or the trade regime has been inconclusive. Comparisons across countries are often unpersuasive since there are so many other influences for which it is difficult to control... Nor are comparisons within countries over time always easy to interpret, since macroeconomic influences upon capacity utilization typically dominate the effects of changing output mix or incentive structure over the short- and medium-run; long run data are rarely available for developing countries" (p. 28). On the other hand, throwing the towel might not be the right thing to do: as stated by Rodrik (1995), "measurement and conceptual issues aside, it is perhaps reassuring that so many studies using so many different indicators tend to confirm that countries with fewer price distortions, particularly on the trade side, tend to grow faster" (p. 2941).

5 - Methodology and Results

5.1 - Growth Accounting

As explained in the introduction, the first approach that we adopt to measure the effects of trade openness on productivity growth in Latin America, is to perform a growth accounting exercise. We do it by assuming that the production function follows a Cobb-Douglas specification with constant returns to scale:

$$Y_t = A_t K_t^{\alpha} L_t^{(1-\alpha)} \qquad (1)$$

where Y is output, A is an index of total factor productivity, and K and L are the stocks of, respectively, physical capital and labor. Under the assumptions of perfect competition and cost minimi

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and cost minimization, α is the capital share in output (0<α<1). Taking logs and first-differencing yields the standard growth decomposition that relates the rate of change of output to the rates of change of TFP, capital, and the labor force:

$$\ln(Y_t / Y_{t-1}) = \ln(A_t / A_{t-1}) + \alpha \ln(K_t / K_{t-1}) + (1-\alpha)\ln(L_t / L_{t-1}) \qquad (2)$$

Because of the lack of reliable data on factor shares, we adopt a fixed average capital share in output of 0.4 for all countries[24]. We calculate the rates of growth of capital stocks, the labor force, and output using the data base on physical capital stocks, working-age population (aged 15 to 64) and gross domestic product (GDP) constructed by Nehru and Dareshwar (1993). This data base covers the period 1950-1990 but we update it until 1995 using the World Bank's data base on World Development Indicators – the specific procedures that were used in this updating are described in the appendix. The data for capital stocks, it is worth noting, was constructed by applying the perpetual inventory method on the basis of the series of gross domestic fixed investment. We use a sample of 18 Latin American countries, that we choose on the basis of data availability. Together, they account for more than 95 percent of the region's GDP.

Tables 1.3 and 1.4 report growth decompositions based on equation (2). On average, during the period 1950-1995, the countries considered grew at a rate of 3.6 percent, of which 48 percent is explained by capital accumulation, 44 percent by population growth, and only 8 percent by the contribution of productivity growth. Sub-

[24] According to Collins and Bosworth (1996), it is generally thought "that a plausible range for the capital share is 0.3 to 0.4; and there is also considerable evidence that the capital elasticity is higher in developing countries than in industrial economies" (p. 155). A capital share of 0.4 is used by Fisher (1993) in his calculation of "Solow residuals", by Marfan and Bosworth (1994: 169) in their growth accounting analysis of the developing

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period averages show that the contribution of TFP growth was 21.6 percent during the period from 1950 to 1970, but fell significantly during the 1970s and the 1980s. During the 1990s, most countries returned to their historical rates of GDP growth without, however, a corresponding increase in their investment rates. This has been reflected in a considerable increase in the average rate of TFP growth, whose contribution to GDP growth has averaged 35 percent during the first half of the decade.

Worthy of comment is the fact that during the 1980s the region experienced, on average, negative growth in both GDP per worker and TFP. Out of the 18 countries in our sample, 15 had negative rates of TFP growth during this period, while only 7 did so during the 1970s, and 4 during the 1990s (Table 1.4). Negative changes in TFP are difficult to interpret, as it is usually thought that, at the industry level, "true" productivity can only improve (Griliches and Lichtenberg, 1984). One possible explanation for the occurrence of negative rates of TFP growth in the aggregate is that they reflect changes in the sectoral composition of output: if output shifts towards industries characterized by low levels or low rates of growth of productivity, it is possible to find that productivity has declined in the aggregate even though it has not done so at the industry level. It is also possible that low levels of capacity utilization that are not captured in the capital stock series, as well as high unemployment rates not reflected in our measure of the labor

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countries of Latin America and Asia, and by Nehru and Dareshwar (1995: 53) in their estimates of TFP growth.

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In Table 1.6, preliminary evidence on the impact of openness on economic growth is provided. This table reports growth decompositions both for the periods when the Latin American economies were "open", and for those in which they were "closed" to international trade. In order to determine the years in which these economies were "open", we follow the criteria and timing of reforms suggested by Sachs and Warner (1995). These authors define an economy to be "open" in a given year if all the following conditions are simultaneously satisfied: (a) the coverage of nontariff barriers does not exceed 40 percent of foreign trade, (b) the average tariff rate does not exceed 40 percent, (c) The black market premium over the official exchange rate does not exceed 20 percent, (d) the economic system is not socialist, and (e) the state does not have the monopoly on major exports (Sachs and Warner, 1995: 22). As shown in Table 1.5, these criteria lead us to assume that, in the period 1950-1995, the 18 Latin American countries considered were "open", on average, 35 percent of the time. Moreover, as highlighted in Figure 1.1, the subperiods in which a higher fraction of the sample was considered open are the 1950s and the 1990s – almost one hundred percent of the countries were open after 1990.

Our main finding is that 14 out of 18 countries experienced faster TFP growth during the periods of openness. On average, TFP grew at an annual rate of 1.2 percent during the periods of openness, and at a negative rate of 0.2 percent during those of closedness. Among the countries with the best reactions to the opening of their

[25] Similarly, losses of productive capacity not captured in the calculation of capital stocks could arise from civil wars – such as in the case of Nicaragua, for example, during the

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economies is Argentina, whose TFP index has grown at a rate of 4.2 percent since 1991. During the same period, Brazil (which also "opened" in 1991) has had a TFP growth rate of 0.2 percent, while Mexico's TFP growth rate been minus 1.9 percent, since opening-up in 1986. Brazil and Mexico, the two biggest countries of the region, have in fact been the worst performers in terms of the comparison of their rates of TFP growth during periods of openness and closedness. Interestingly, in the two cases TFP growth was relatively fast while the countries in question were closed – respectively 1.1 and 0.9 percent in Brazil and Mexico – which may be interpreted as reflecting some degree of success in their previous development strategies.

Generally speaking, there has been a correlation between the TFP growth of the region's economies and their overall growth performance when this is measured by GDP growth. Indeed, the average rate of GDP growth was 4 percent during the periods of openness, compared to 2.8 percent during those of closedness. All the four countries that experienced slower TFP growth while they were open, also had lower rates of GDP growth during these periods, with Brazil and Mexico experiencing the largest drops – respectively minus 3.0 and minus 4.7 percent.

Growth in capital stocks, however, has not always been correlated with TFP nor with GDP growth. On average, the growth rate of capital stocks has been 0.8 percent lower during the periods of openness. Capital accumulation has been particularly slower in the countries with the worst relative performances during the periods of openness – respectively by 4.3 and 4.5 percent in Brazil and Mexico – but it has also been very slow in countries with particularly good performances in terms of their rates of GDP growth

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during these periods – e.g. Argentina and Guyana, whose growth in capital stocks was, respectively, 4.0 and 3.3 percent lower after they "opened-up". Since in most cases growth in the labor force also has been relatively slower during the periods of openness – 0.5 percent slower, on average – the increases in the rates of TFP growth have been responsible for more than 100 percent of the changes that have been observed in the rates of GDP.

The reduction in the rates of capital accumulation during the episodes of openness can be interpreted in two different ways. On one hand, it could be argued that a new sectoral pattern of growth should develop in a context of openness to international trade. This new pattern should benefit the growth of the sectors and industries where the region has a comparative advantage, in detriment of the import-competing sectors and industries that had previously been promoted in the context of inward-oriented strategies of development. Since in many cases the latter industries are more capital intensive than the former, it would be possible to observe lower rates of capital accumulation in the aggregate even if this is not necessarily the case at the industry level.

An alternative interpretation is that capital investment has not responded to the new government policies because of the lack of confidence of private agents in the sustainability of the reforms. Indeed, in a context of irreversibility of investment costs it is natural to think that the business sector should initially adopt a "wait-and-see" attitude, until there is enough evidence on the lasting power of the reforms. This idea has been formalized by Rodrik (1991), who proposes a simple model that links policy uncertainty to the private investment response, and reviews the empirical work on the subject. The author shows that "even moderate amounts of policy uncertainty can act as a hefty tax on investment, and

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investment, and that otherwise sensible reforms may prove damaging if they induce doubts as to their permanence (p. 229)."

As previously mentioned, it could be argued that our results are driven by the failure of our data on capital stocks and the labor force to capture the changes in the rates of capacity utilization and employment. In particular, our proxy for the labor force – the working-age population – could be overestimating the actual number of people employed during recessions and underestimating them during recoveries, thus leading to predict TFP growth rates that are too low and too high, respectively, during recessions and recoveries[26].

In order to test the robustness of our results, we collected data on unemployment rates – available for 15 of the countries of our sample over the period 1980-1995[27] – and used it to adjust the rates of growth of the labor force. In most cases the available data refers only to "open urban unemployment", measured as the total number of urban unemployed as a percentage of the corresponding economically active population (EAP). The data on the ratio of the EAP to the working age population – the so-called "rates of participation", available only for a few countries and periods – indicated that the changes in this ratio have been rather small in the sampled countries. In practice, we assumed constant rates of participation and proxied the national unemployment rates by the rates

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[26] A similar reasoning would apply to the non-consideration of changes in the rates of capacity utilization: it would lead to overestimate the use of capital services during recessions and to underestimate it during recoveries, thus leading to, respectively, underestimate and overestimate the growth of TFP during recessions and recoveries.

[27] The data was extracted from several issues of ECLAC's *Economic Survey of Latin America* and *Statistical Yearbook of Latin America*. The series were constructed for each country by combining these two sources in a manner that led to the use of consistent criteria for the measurement of unemployment rates over time.

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of urban unemployment. We then calculated the annual percentage change in the rate of employment and added the result to the rate of growth of the working age population, to obtain a proxy of the rate of change in the *employed* work force. The rates of TFP growth resulting from this adjustment are presented in Table 1.7. On average, the changes are very small when one compares these results with those previously obtained without adjusting for unemployment: TFP growth was 0.01 percent faster with the adjustment during the 1980s, and 0.1 percent faster during the 1990s. The latter result is in fact contrary to expectations, and shows that during the first half of the present decade a recovery took place in the rates of GDP growth that was not reflected in the rates of unemployment – which increased in most countries. Taking this into account, the recovery in the rates of TFP growth was even bigger than what had been suggested by our previous results. Argentina, in particular, stands out as the most impressive example of a recovery with increasing unemployment – the latter averaged 5.8 percent during the period 1981-1990, and 10.4 percent during the period 1991-95.

A second test of the robustness of our results is performed by examining their sensitivity to an adjustment made to account for changes in the rates of capacity utilization. Since we do not have access to any direct measure of the fraction of the capital stock that has been actually used in each stage of the business cycle, we followed Harrigan (1996) in the calculation of a proxy for capacity output, that we then used as a substitute for actual output in the calculation of the rates of TFP growth. Harrigan (1996) estimates potential GDP "as the log-linear 20 year trend of actual GDP" (p.9); instead, we estimate capacity output as the fitted values of a regression of GDP on both a linear and a quadratic trend, as well as on lagged values of GDP (included to account for serial correlation). W

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correlation). We also allowed for trend-breaks, when their presence was suggested by the application of Vogelsang (1994) "SupF_t" tests[28]. In practice, breaks were detected in 16 of the 18 countries considered. In more than 80 percent of the cases, these breaks were found to have occurred between 1978 and 1982 (Table 1.8).

The results of the calculation of TFP growth rates using capacity output instead of actual output are presented in Table 1.9. As expected, the new results showed larger rates of TFP growth during the 1980s – minus 1.3 instead of minus 1.5 percent – and lower rates during the 1990s – 1.1 instead of 1.4 percent. However, on average the difference between the TFP growth rates observed during periods of openness and closedness of the countries considered did not change considerably: it fell from 1.57 percent without adjusting for capacity utilization, to 1.44 percent after the adjustment. The results for Brazil and Mexico were still the most disappointing, while Argentina still ranked first in terms of its TFP performance after opening-up.

We also adjusted the rates of capital accumulation by multiplying the capital stocks by the ratio of actual to capacity output. The results, reported in Table 1.10, showed no difference in the average change of the rates of growth of capital stocks from the periods of closedness to those of openness: this difference was equal to minus 0.73 percent, with and without adjustments for capacity utilization. As before, the largest countries of the region were also those with the worst performance in terms of their investment response to more liberal trade policies

[28] The exact procedure that was used to determine the break years is detailed in the next section, where we apply it to the series of import- and export-output ratios, TFP indexes,

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5.2 - Structural Breaks

As mentioned in the review of the empirical literature on openness and growth, two types of measures of openness have been most commonly used: policy-based and outcome-based. In the previous section we used the first type of criteria for defining an economy as open, and compared the corresponding performance of the Latin American countries with the one observed during the periods in which the openness criteria did not apply. In the present section we focus on the second type of criteria for defining openness. In particular, we examine the series of import- and export-output shares in order to determine whether and when statistically significant structural breaks have taken place. Thus, we search for structural changes in the degrees of openness of the economies of our sample that are revealed endogenously by the data. We then compare the TFP performance of the countries in question before and after the breaks. Similarly, we follow the reverse procedure and test for the existence of breaks in the TFP series, and compare the countries' degrees of openness before and after the breaks.

The methodology that we use to determine the existence of trend breaks is the same that Ben-David and Papell (1997) applied to a sample of 48 countries, on the basis of the Vogelsang (1994) Sup Wald (or SupF_t) tests. Their study, however, covered only 5 of the 18 countries of our sample. The data that we use for calculating trade shares was extracted from the World Bank data bases[29]. The time spans for the data are as long as 1951 through 1995, and no smaller than 1965 through 1995. As before, we rely on an updated version of the Nehru and Dareshwar (1993) data base for the TFP series.

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The "SupF_t" tests proposed by Vogelsang (1994) are based on the estimation of a univariate time series model under the alternative hypothesis of a one-time break in the parameters of the trend function. The model allows for serial correlation in the errors and the tests are valid regardless of whether the errors are stationary or have a unit root. Using the notation of Ben-David and Papell (1997), we refer to the year in which the trend break takes place as T_B and define the following trend-break dummy variables: $DU_t = 1$ if $t > T_B$, 0 otherwise; $DT_t = t - T_B$ if $t > T_B$, 0 otherwise; and $DT2_t = (t - T_B)^2$ if $t > T_B$, 0 otherwise. The estimating equation can then be written:

$$R_t = \mu + \beta_1 t + \beta_2 t^2 + \theta DU_t + \gamma_1 DT_t + \gamma_2 DT2_t + \sum_{j=1}^{k} c_j R_{t-j} + \varepsilon_t \qquad (3)$$

where R_t represents the variable whose series are being analyzed – e.g. the import-output or the export-output ratios. The above equation assumes that the data contains a linear and a quadratic trend, a specification that we call model I. Two other specifications are considered: only a linear trend (model II), and no trend at all (model III), which corresponds, respectively, to imposing the restrictions $\beta_2 = \gamma_2 = 0$, and the restrictions $\beta_1 = \gamma_1 = \beta_2 = \gamma_2 = 0$.

Regression (3) is estimated for all possible breaks years T_B such that: $0.15T < T_B < 0.85T$, where T is the number of observations[30]. The number of lags included in the regressions ("k") is determined in the following manner. Equation (3) is estimated with

[29] Data were available for 17 of the 18 countries of our sample: only Nicaragua had to be excluded because of the lack of consistent data.

[30] This corresponds to 15 percent trimming, which we use because of the relatively short time spans of our data. We also performed the tests using 1 percent trimming – for which Vogelsang (1994) also provides critical values – and found almost no changes in the results.

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For model I, the SupF_t statistic proposed by Vogelsang (1994) is given by the maximum, over all possible trend breaks, of three times the standard F-statistic for testing $\theta = \gamma_1 = \gamma_2 = 0$. Similarly, for model II, SupF_t is the maximum of two times the standard F-statistic for testing $\theta = \gamma_1 = 0$ and, for model III, SupF_t is the standard F-statistic for testing $\theta = 0$. Vogelsang (1994) provides critical values for the SupF_t statistic in both the assumption of stationarity and of unit root series – the latter critical values being always larger than the former. We adopt a conservative approach and reject the null hypothesis of no trend-break only if the statistic exceeds the unit root critical value[31]. As for the selection of the relevant model, we use the following model selection algorithm proposed by Ben-David and Papell (1997). We first estimate the least restrictive model I. If the no-trend-break null hypothesis can be rejected at a level of 10 percent or higher, we report the results. If this is not the case, we estimate model II and, again, we report the results only if the no-trend-break is rejected. If model II leads to the acceptance of the null hypothesis, we estimate model III and report the results if they indicate a trend-break.

[31] This is the "conservative" approach proposed by Vogelsang (1994), who also suggests "to not reject the null hypothesis when the statistic is smaller than the stationary critical value" (p.11): the test would be inconclusive for values in between the stationary and the non-stationary critical values. In our case, we only use the unit root critical values because the application of Augmented Dickey Fuller tests to our series of trade shares resulted in the acceptance, in the majority of the countries, of the null hypothesis of a unit root. The same was true for the series of GDP and capital stocks per worker but not for the TFP index. We opted, however, for the use of a uniform conservative criteria.

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When no model leads to the rejection of the no-trend-break null, we report the results of model I.

Tables 1.11 and 1.12 report the results of the SupF_t tests applied to the series of import-output and export-output ratios. Significant trend-breaks were detected in 13 out of 17 countries in the case of import shares, and in 14 out of 17 countries in the case of export shares. Comparing the average trade shares in output before and after the breaks, we found that they increased in 11 out of 13 countries for the case of imports, and in 9 out of 14 countries for exports. The median change in import-output shares after the breaks was an increase of 20 percent, while for the export-output shares it was an increase of 23 percent. Most trend-breaks took place during the late 1970s and early 1980s: the median trend-break year was 1979 for imports and 1983 for exports.

The comparison of the rates of TFP growth before and after the breaks in trade shares reveals no correlation between the changes in these growth rates and those observed in the import- and export-output ratios. In less than 50 percent of the countries did the changes in the rates of growth of TFP occur in the same direction of the changes in trade shares. With regard to the changes in the rates of growth of GDP per worker and capital per worker, we found that in 80 percent of the cases these rates changed in a direction opposite to that of the changes in import ratios – this was true in 57 percent of the cases for the breaks in export-output ratios.

We also estimated structural breaks in the series of TFP (Table 1.13). To this end we constructed an index that takes the value 100 in 1950 and grows according to the TFP growth rates calculated in our growth accounting exercise. Statistically significant breaks were found in 13 out of 17 countries. The median trend-break year was 1979 and the median change

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median change in the rate of TFP growth after the break was minus 1.8 percent. In all countries where significant breaks were detected, the after-break rate of TFP growth was lower than before. As for the trade shares, we typically found larger import- and export-output ratios after the breaks: the median changes in these ratios were, respectively, 22 and 14 percent.

We also found significant trend-breaks in GDP per worker and capital per worker for 16 out of 17 countries (Table 1.14). In 90 percent of the cases, the growth rates of these variables were lower after the breaks. As in the case of TFP, most trend-breaks took place in the late 1970s and early 1980s. In 11 out of 13 countries, the breaks in GDP per worker occurred within two years of the breaks in TFP.

Overall, it is important to highlight the fact that the trend breaks in trade-output ratios do not coincide with the dates of opening of the Latin American economies, as determined by policy-based criteria. Indeed, the latter suggest that, except for some temporary episodes of openness during the 1950s and 1960s, most countries remained "closed" until the late 1980s and early 1990s. The dates for most trend breaks (both for trade and for output variables), on the other hand, are concentrated in the late 1970s and early 1980s, and seem to reflect the effects of the external shocks that hit the region during these periods. These terms of trade and interest rate shocks led to the implementation of contractionary policies that resulted in the very low (and even negative) rates of growth of the 1980s – the so-called "lost decade" for Latin America. Even though the poor performance of this period contributed to the emergence of a new policy stance that favored the re-orientation of the region's trade policies, the latter only occurred several years latter.

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5.3 - Regression Analysis

A problem with the comparison of growth rates before and after the adoption of liberal trade policies, or before and after the occurrence of trend-breaks in the ratios of trade flows to GDP, is that they do not provide a basis for establishing a causality relationship between openness and productivity growth. Changes in both types of variables could in fact be the result of a third factor – an external shock, for example – or it could be the case that observed increases (or declines) in openness are the consequence, and not the cause, of improvements (or declines) in the productivity performance of countries. It is important to keep this in mind when interpreting the results of the two previous sections.

In the present section, we use regression analysis to address the problem of establishing a relationship of causality between openness and growth. We do this by estimating panel regressions of the rate of growth of GDP per worker on several variables representative of levels and rates of changes of the degree of openness of the economies considered. In order to isolate the effect of openness on TFP growth, we include the rate of growth of capital stocks per worker in the above regressions. We also run separate regressions with the growth of per worker capital stocks as the dependent variable. We use several control variables, intended to capture scale effects, convergence processes, external shocks, and other government policies. The basic estimating equation can thus be written:

$$GR_{it} = \alpha + \beta X_{it} + \eta_i + \varepsilon_{it} \quad (4)$$

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where GR_{it} represents either the growth in per worker GDP (GY_{it}) or the growth in per worker capital stock (GK_{it}) of country i at time t; X_{it} represents the set of variables representative of the openness of country i at time t, as well as the corresponding control variables; η_i is a country-specific effect potentially correlated with the explanatory variables; and ε_{it} is a serially uncorrelated error.

The specific variables that we use as measures of the countries' openness are: a dummy variable activated when the Sachs and Warner (1995) criteria for openness apply (*DREF*), the share of real total trade in real GDP (*TI*), the growth rates of exports (*GX*) and imports (*GM*), and the log of one plus the premium in the black market for foreign exchange (*BLACK*). We use variables representative of both levels and rates of change of the degree of openness of the economies considered in order to determine the relative importance of static and dynamic gains from trade[32]. Most of these variables are expected to have positive coefficients in the hypothesis that openness has a beneficial effect on the levels and rates of growth of productivity. The only exception is *BLACK*, which is supposed to capture government restrictions on the access to foreign exchange, and is expected to have a negative coefficient – a higher *BLACK* being associated with lower openness.

As previously mentioned, in the regressions where the dependent variable is the growth in GDP per worker, the growth in per worker capital stock (*GK*) is included as an

[32] If, for example, productivity growth is affected only by the changes and not by the levels of openness of an economy, it can be argued that static gains from trade are more prevalent than dynamic gains: openness affects the level of efficiency but not (directly) its rates of change. This argument is made by Helliwell (1994: 265).

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explanatory variable[33]. Two other control variables are included in all regressions: the log of the countries' total population (*POP*), and the log of the initial GDP per worker (*INI*) – the second variable being substituted by the log of the initial capital per worker in the regressions where *GK* is the dependent variable. The variable *POP* is intended to capture the positive influence of scale on the rates of growth, predicted by several models of endogenous growth. Its inclusion is also important, in order to isolate the policy-determinants of the share of total trade in output (*TI*), from the (negative) effect that the size of a country is usually believed to exert on this variable. The variable *INI*, on the other hand, has been a standard feature of the empirical estimation of growth models. It attempts to capture the existence of a convergence or "mean reversion" process, by which relatively poor countries would show faster rates of growth[34]. As emphasized by Easterly et al. (1997), who are also concerned with the growth effects of economic reforms, "controlling for 'mean reversion' is especially important… because reforms tend to be implemented in periods of poor growth performance, and, thus, their effect on growth could otherwise be confused with the simple dynamics of growth recovery" (p. 294).

Five other control variables are included in the regressions: the rate of change of the terms of trade (*TOT*) as a measure of external shocks, the average years of secondary

[33] This is justified by the growth accounting equation (2). This equation implies that per worker GDP growth can be expressed as the sum of TFP growth and the growth in per capita capital stocks multiplied by the share of capital in output.

[34] An extensive literature exists on the issue of convergence. Initially, this literature was motivated by the fact that convergence is expected to occur as a result of transitional dynamics in the context of neoclassical growth models. Some studies have also related the existence of convergence to the international diffusion of technology, which would lead to the faster growth of initially lagging countries. A review of the recent controversies on the subject can be found in Durlauf (1996), as well as in the other papers included in the corresponding issue of the *Economic Journal*.

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schooling of the population aged 15 and over (*EDU*) as a measure of the stock of human capital available in each country[35], the ratio of broad money to GDP (*M2*), the ratio of government consumption to GDP (*GOV*), and the rate of inflation (*INF*). The last two variables are expected to capture the effects of policies of macroeconomic stabilization, while *M2* is an indicator of financial reform that measures the extent of financial deepening attained in each country. These three variables are included because the policies for which they proxy have been shown to have significant effects on growth. Since in many cases these policies have been implemented simultaneously with trade policy reforms, it is important to include variables that control for them: not doing it could create doubts about whether our openness variables are capturing the effect of trade policies alone, or that of the complete policy packages.

The data that we use is constituted by a panel of 16 countries over the period 1960-1995[36]. The source of the data is as follows: *GY*, *GK*, *POP*, and *INI* were constructed from the updated Nehru and Dareshwar (1993) database; *DREF* was constructed on the basis of Sachs and Warner (1995); *GX* and *GM* were calculated on the basis of data from the World Bank data bases; *TI*, *TOT*, *BLACK*, *EDU*, *GOV*, *INF* and *M2* were taken from Easterly et al. (1997). All variables are (mostly) five-year averages, except for *INI* and *EDU* which are referred to the first year of each period, and *DREF*,

[35] According to Benhabib and Spiegel (1994), the empirical evidence from cross-country regressions favors the idea that the stocks and not the rates of growth of human capital "play a role in determining the growth of per capita income" (p. 166). The authors suggest that human capital influences growth, not as another factor of production, but through its effect on the rates of innovation and technology adoption. This is the approach hereby adopted as a motivation for including the stock and not the rate of growth of human capital in our growth regressions.

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which takes the value 1 when the corresponding country was "open" in the majority of the years in a given period[37]. The use of five-year averages instead of annual data is motivated by the objective of concentrating on long-run effects, and is thus intended to eliminate short-run fluctuations associated with the business cycle.[38]

In order to deal with the problems of simultaneity, reverse causality, and possible correlation between country-specific effects and the explanatory variables, we make use of a GMM estimator proposed by Blundell and Bond (1997). This estimator is based on the stacking of equation (4) with its first difference, and on the use of lagged levels and first-differences as instruments for, respectively, the first-differences and the levels of the potentially endogenous explanatory variables[39]. The specific moment conditions that justify the use of these instruments are:

$$E\,[X_{i(t-s)} \bullet (\varepsilon_{it} - \varepsilon_{i(t-1)})] = 0 \qquad \text{for } s \geq 2 \text{ and } t \geq 3 \qquad (5)$$

$$E\,[(X_{i(t-1)} - X_{i(t-2)}) \bullet \varepsilon_{it}] = 0 \qquad \text{for } t \geq 3 \qquad (6)$$

$$E\,[(X_{i(t-1)} - X_{i(t-2)}) \bullet \eta_{i}] = 0 \qquad \text{for } t \geq 3 \qquad (7)$$

Equations (5) and (6) are implied by the assumption that the X_{it} variables are weakly exogenous[40], in the sense that they are potentially correlated with past and

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[36] Of the 18 countries considered in the previous sections, only Guyana and Nicaragua had to be excluded because of the lack of consistent data.
[37] The only additional exceptions are given by the variables taken from Easterly et al. (1997), for which the last period averages do not include the years 1994 and 1995.
[38] This is also the procedure adopted in the cross-country studies of income convergence that use panel data – see Loayza (1994), Islam (1995) and Caselli, et al. (1996).
[39] A more detailed presentation of the Blundell and Bond (1997) estimator that we use is presented in the next chapter of this dissertation (section 5)
[40] In the case of the variable *INI*, equation (5) can be assumed to be valid for s≥1on the basis of the assumption of no serial correlation in the residuals. This can be seen by recognizing that the dependent variable can be rewritten as the lead of the first difference of *INI*, so that the model can be rearranged with *INI* as the lagged dependent variable.

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contemporaneous values of the dependent variable but not with its future values – e.g. openness being potentially "caused" by present and past growth but not by future growth:

$$E\,[X_{it} \bullet \varepsilon_{is}] = 0 \qquad \text{for } t < s \qquad (8)$$

Equation (7) is implied by the assumption that the country-specific effects are potentially correlated with the level of some of the explanatory variables, but not with their rate of change. Thus, for example, we assume that country-specific characteristics are potentially correlated with levels of openness but not with changes in those levels[41].

The estimation of equation (4) using the above described method is performed using the Gauss-based program "DPD96", whose original version is described in Arellano and Bond (1988). This program reports two types of specification tests. The first is a Sargan test for overidentifying restrictions proposed by Arellano and Bond (1991), which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. The second type of test is a test of serial autocorrelation (of first and second-order) in the residuals. By construction, first-order serial correlation is likely to be found due to the use of first differences, but this is not the case for second-order serial correlation. Under both types of specification tests, failure to reject the null hypothesis gives support to the model.

Tables 1.15 reports estimation results of the regressions of growth in GDP per worker on the various openness variables, including the control variables *GK*, *INI*, *POP*

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[41] For this same reason, we assume that the variables *GX* and *GM* are not correlated with country-specific effects. In the case of the variable *INI* (interpreted as a lagged dependent variable), Blundell and Bond (1997: 12) show that the validity of an assumption such as (7) depends on whether the difference between the initial level of *INI* (at time t=0) and its convergent level is uncorrelated with the country-specific effect itself. Since the first

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and *TOT*. The latter variable (*TOT*) does not appear to be significant in these regressions – (5) is the only exception – which suggests that the effects of external shocks on TFP growth have not been significant in the region, or, alternatively, that they have been entirely captured by the openness variables[42]. The other control variables are always significant and have the expected signs. The coefficients on *INI* and *POP*, in particular, respectively indicate the existence of convergence in productivity growth and scale effects: faster growth of countries with relatively low initial GDP per worker, and of larger countries.

With regard to the openness variables, we find that they are all significant and have the expected signs when separately included in the basic regression. However, *DREF* looses its significance when the rest of the openness variables are also taken into consideration – regression (6) – which suggests that the latter variables account for the faster rates of TFP growth observed during periods of openness. Similarly, *TI* loses its significance when included simultaneously with the other variables representative of openness – regressions (4) and (6) – which could be interpreted as suggesting that trade intensity, as measured by the ratio of trade-flows to output, affects productivity mainly through changes in the *levels* of efficiency rather than by affecting directly the *rates of change* of productivity: that static gains from trade are more prevalent than dynamic ones.

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year of our series can here be treated as random, we assume that the first difference of *INI* is uncorrelated with η_i.

[42] We also run a regression (not reported) excluding all openness variables and found that *TOT* has a positive but not statistically significant coefficient (with a p-value of 0.96). The negative and significant coefficient of *TOT* in regression (5), on the other hand, suggests that for a given black market premium on the exchange rate (which has a bivariate correlation with *TOT* of minus 0.23) improvements in external conditions act as

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Indeed, both *GX* and *GM* appear to have a positive and significant effect on TFP growth, regardless of the other openness variables that are included in the regressions. The negative coefficients on *BLACK*, on the other hand, confirm that lower restrictions on the availability of foreign exchange promote faster TFP growth.

The regression results reported in Table 1.16 are based on the estimation of equation (6) – which includes all the openness variables – but with the addition of other control variables – namely *EDU*, *GOV*, *INF*, and *M2*. Due to the limited size of our sample, we have been forced to include these control variables one by one. For the same reason, we have excluded *TOT*, whose effect on TFP growth was shown to be not significant, and whose exclusion does not appear to affect the coefficients of the other variables – as can be seen by comparing regression (6) of Table 1.15 with regression (1) of Table 1.16. Two main findings are derived from the results in Table 1.16. The first is that *DREF*, *GX*, *GM*, and *BLACK* maintain their signs and significance (or non-significance in the case of *DREF*) after the inclusion of variables that control for the stocks of human capital as well as for other government policies. The second finding is that *TI* regains its significance when either *EDU*, *GOV*, or *M2* are controlled for. This constitutes evidence in favor of the existence of dynamics gains from trade, but it also suggests that these are dependent on the countries' degree of financial development, on their macroeconomic stability, and on their stock of human capital. None of the new control variables, it is worth noting, has a significant coefficient, with the exception of *EDU*, whose coefficient is negative and has a p-value of 11 percent. This is a puzzling

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a disincentive for TFP growth. This result is not robust, however, to the inclusion of other openness variables, as is shown by the non-significance of *TOT* in regression (6).

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result since, after controlling for initial per worker GDP, we expected the countries with larger human capital stocks to grow faster: as suggested by Benhabib and Spiegel (1994), for a given technology gap, countries with more human capital should be more able "to adapt and implement technologies developed elsewhere"(p.156). One possible interpretation for the negative coefficient on *EDU* is that this variable is capturing the same technology gap effect that causes *INI* to have a negative coefficient. However, the issue certainly merits further investigation.

Tables 1.17 and 1.18 report the results of regressions with the rate of growth of capital stocks per worker as dependent variable. They indicate that both *TI* and *GX* have a positive and statistically significant effect on capital accumulation, but that once these variables are controlled for, neither *GM* nor *BLACK* have a significant effect on the growth of capital stocks[43]. The dummy variable *DREF*, on the other hand, has a negative and significant coefficient when it is included together with the rest of the openness variables. The latter result suggests that even though a larger trade intensity and faster export growth have promoted investment in the region, the latter has responded negatively to the implementation of more liberal trade policies. A possible interpretation for this is that, as argued by Rodrik (1991), the private sector could be reluctant to commit itself to the new policies until there is enough evidence that they will not be reversed. This is an issue that should motivate great concern, as a negative investment response to changes in economic policy can be, in itself, a factor that conspires against

[43] It is important to note that regressions (1), (2) and (5) are not supported by the specification test of second-order serial correlation. Thus, their results should, at best, be interpreted with great caution.

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As for the control variables, we found that, as in the case of TFP growth, capital investment is affected by both convergence and scale effects. We also found that improvements in the terms of trade do not have a significant effect on capital accumulation once all openness variables are taken into consideration. Overall, the main findings on the effects of openness on capital accumulation are not affected by the inclusion of additional control variables[44].

6- Summary and Conclusions

It is not clear, from a theoretical point of view, whether openness to international trade leads to faster or slower productivity growth. In recent models of trade and (endogenous) growth, this depends on the extent to which openness to trade facilitates the international diffusion of knowledge, as well as on the initial stock of technological capabilities of nations and the degree to which their comparative advantage lies in sectors with a dynamic potential.

On the empirical side, a large number of studies have found that a positive relationship seems to exist between the degree of trade openness of industries and countries and their growth performance. Many of these studies, however, suffer from methodological problems that lead one to question the validity of their results. Examples of these problems are the sensitivity of the results to the specific measures of openness

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used in each case, the possible endogeneity of some of the trade variables used in the econometric studies and, in particular, the difficulties in establishing the direction of causality between trade and growth.

Latin America constitutes an interesting case for the study of the dynamic effects of "opening up". Indeed, for decades this region has been characterized by having some of the most restrictive trade policies in the world. However, in recent years most of the Latin American countries have liberalized their trade regimes at a speed that is seldom found elsewhere in the developing world. Whether this has had noticeable effects on their productivity performance is the question that we have intended to address in this paper.

In the first approach that we have adopted, productivity growth appears as the unexplained residual in a growth accounting framework with two factors of production – labor and capital. In this context, we have compared the average rate of growth of TFP in the periods in which the Latin American economies were, respectively, open and closed to international trade. The criteria that we have used for defining openness – proposed by Sachs and Warner (1995) – are mostly policy-based, taking into account the levels of the average tariff rates, the average nontariff barriers to imports and the premium on the black market exchange rate. The main finding from this exercise is that, on average, the growth of TFP was faster during the periods in which the Latin American countries were "open". This result seems to apply to almost all the countries here considered, the main exceptions being Brazil and Mexico.

Since the larger rates of TFP growth found during the periods of openness could be explained by higher degrees of capacity utilization – not captured by our data on capital stocks – we adjusted these rates by using, in the calculation of TFP growth, a proxy of cap

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proxy of capacity output instead of actual output. To this end, we estimated, for each country, a regression of GDP on both a linear and a quadratic trend, as well as on lagged values of GDP. In most of the countries, these regressions involved a trend-break in a year that was determined by the application of Vogelsang (1994) "SupF_t" tests to the series of GDP. The fitted values of the above regressions were assumed to proxy for capacity output. Comparing the unadjusted rates of TFP growth with the adjusted ones, we found that the results of the growth accounting exercise are not driven by changes in capacity utilization. Indeed, the difference between the periods of openness and those of closedness remains considerable, although it is slightly lower when TFP growth is adjusted for capacity utilization – 1.44 instead of 1.57 percent, on average. Similarly, we find, as before, that there are only four countries in which TFP growth was slower during the periods of openness, with Brazil and Mexico still showing the most disappointing performances.

Also with the objective of testing the robustness of our growth accounting results, we adjusted the rates of growth of the labor force by using data on employment for the period 1980-95, available for 15 countries. We then compared the resulting rates of TFP growth with those previously obtained using the working-age population as a proxy for the work force. Although the consideration of the changes in unemployment rates resulted in some changes in the rates of TFP growth of individual countries, there were no significant changes in the average rates of the 15 countries considered – 0.01 percent during the 1980s, and 0.1 percent during the first half of the 1990s. Thus, it appears that the rates of TFP growth calculated in this paper are not sensitive to the adjustment of the data on capita

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A second important finding is that in the majority of the Latin American countries the pace of capital accumulation has been relatively slower during the periods of openness. This is also true when the capital stocks are adjusted for capacity utilization, by multiplying them by the ratio of actual to capacity output (calculated with the above-described procedure). A possible explanation for this result could be that the beneficial effects of the trade reforms – and of the other macroeconomic and structural reforms to which they have often been associated – are more than offset by the uncertainty regarding the sustainability of the new government policies, thus leading to an economy-wide reduction in the rates of investment. Alternatively, another explanation could be that the greater exposure to foreign competition that is caused by the opening of the region's economies should cause a reallocation of output away from import-substituting industries and toward export-oriented ones. Since in the region the former are often more capital-intensive than the latter, a reduction in the overall rate of capital accumulation could occur even if individual industries are in fact accelerating their investment plans.

As an alternative to the use of the Sachs and Warner (1995) policy-based criteria for defining an economy as open, we performed an analysis of trend breaks in trade-output shares. Thus, we searched for structural changes in openness revealed endogenously by the data. To this end, we applied the Vogelsang (1994) "SupF_t" tests, as they were implemented by Ben-David and Papell (1997). The results showed that most countries experienced breaks in their series of import-output and/or export-output ratios (76 percent in the case of imports and 82 percent for exports) and that in the majority of the cases (7

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the cases (74 percent) the trade shares increased after the breaks. Comparing the rates of TFP growth before and after the trend-breaks, we found that in more than 50 percent of the countries the changes in trade-output shares were not associated with changes in the same direction in the average rates of TFP growth: no correlation between the changes openness and TFP growth can be extracted from this analysis.

We also estimated structural breaks in the series of TFP, and found that in all 13 countries for which these breaks were significant, TFP growth was slower after than before the breaks. Moreover, in the majority of the cases, the after-TFP-breaks periods were characterized by relatively larger levels of trade openness and slower TFP growth. We also found that in 11 of the 13 countries that experienced significant breaks in TFP, (downward) breaks in GDP per worker were found to have occurred within two years of the break in the TFP index, most commonly during the 1978-1982 period.

A problem with the comparison of the rates of TFP growth observed during periods of lower and higher openness – regardless of whether these periods are defined using policy-based criteria or on the basis of statistical tests of trend breaks – is that it is not possible to infer the existence of a relationship of causality from openness to productivity growth. Indeed, changes in these variables could be determined simultaneously by a third type of variable – an external shock, for example – or it could be the case that faster growth is propitiated by greater openness rather than the other way around. To uncover the existence of a causality link from openness to productivity growth in the case of Latin America, we performed a regression analysis of a panel of 16 countries over the period 1960-1995. In order to purge from the data the effect of short run fluctuations, we used five-year averages instead of annual data. The endogeneity problems wer

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The regression analysis allowed us to test (and confirm) the main above-mentioned finding from the growth accounting exercise: that a higher rate of TFP growth was observed during the periods of openness – as defined by Sachs and Warner (1995) – of the Latin American economies. Indeed, a dummy variable that is activated during the periods of openness (*DREF*) appeared positive and significant in a regression of the growth in output per worker on the rate of growth of capital per worker. With regard to the effect of other measures of openness on productivity growth, our regression results indicated that larger rates of growth in both imports and exports, as well as lower black market premiums have led to faster TFP growth in Latin America. We also found that *DREF* ceases to be significant when the above-mentioned variables are introduced into the regressions, which suggests that these variables account for the larger rates of TFP growth that are observed during the periods of openness of the Latin American economies.

We also ran regressions with the rate of growth of capital per worker as a dependent variable and found that it is positively affected by larger export growth and larger trade-output shares, but it is not significantly affected by import growth, nor by lower black market premiums. We also found that when the dummy variable *DREF* was included in the regressions together with the rest of the openness variables, its coefficient was negative and significant. Thus, the rates of capital accumulation observed in the Latin American countries during the periods of openness were lower than what should be expecte

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Interestingly, the regression analysis showed that, when the growth rates of exports and imports are controlled for, the level of the trade-output ratio is not a significant determinant of the growth of TFP. The significance of the *rates of change* and not of the *levels* of the trade flows-based openness variables could be interpreted as suggesting that these variables affect productivity mainly through changes in the *levels* of efficiency rather than by affecting directly the *rates of change* of productivity. However, the coefficient of the trade-output share becomes significant when the level of government consumption to GDP, the ratio of broad money (M2) to GDP, or the level of educational attainment of the adult population are controlled for. Thus, it appears that, at least in the aggregate and in the context of cross-country regressions, static gains from trade have applied equally to most Latin America countries, but dynamics gains from trade have been dependent on the countries' degree of financial development, on their macroeconomic stability, and on their stock of human capital. The latter, in particular, has had a surprisingly negative effect on the growth of TFP and capital per worker. This effect, however, could be interpreted as reflecting a convergence mechanism by which the greater international flows of knowledge that are associated with greater openness benefit more the countries that lag further behind in terms of their knowledge stock. The existence of convergence among the Latin American countries was also suggested by the negative and significant coefficients of the initial levels of GDP per worker and capital per worker, re

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We also included, in all regressions, the total population of the countries involved. The motivation for this was twofold. On one hand, since larger countries are normally less open to international trade, it is important to control for the size of the countries considered in order to isolate the component of the trade-output shares that is associated with trade policies. On the other hand, total population is expected to capture the positive influence of scale on growth, predicted by several models of endogenous growth. Although the empirical verification of "scale effects" has been controversial in studies of industrial countries – e.g. Jones (1995) – our regression results show that they have been relevant in the explanation of the rates of TFP growth and capital accumulation of the Latin American economies: *ceteris paribus*, larger countries have in fact grown faster.

It is important to highlight the fact that in Latin America and elsewhere trade policy reforms have been implemented in conjunction with other major policy changes, such as the privatization of public enterprises, the liberalization of financial markets, and the implementation of aggressive programs of macroeconomic stabilization. Thus, it could be argued that in our regressions the variables representative of trade openness are in fact capturing the effects on productivity growth of the complete packages of policy reform. To deal with this possible criticism, we have included in our main regressions some additional control variables that are expected to capture at least the effect of financial reforms and stabilization policies – respectively, through the rate of broad money to GDP, and the inflation rate together with the ratio of government consumption to GDP. Even if it is not enough to disentangle the growth consequences of the various types of polic

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types of policies implemented simultaneously in the region – a task that certainly goes beyond the reach of the present paper – this exercise has allowed us to conclude that most of the above presented findings, concerning the effects of trade policies on growth, are robust to the inclusion of variables representative of other government policies. Moreover, as it was previously mentioned, it appears that one particular finding – the positive effect of the trade-output share on TFP growth – only stands when other government policies are controlled for.

Also worthy of comment is the fact that the results from the analysis of structural breaks in the trade and productivity series may be considered to be in conflict with the other findings of this paper. Indeed, the drop in the rates of TFP growth observed in most countries after the trend-breaks that took place during the early 1980s, in a context of increasing trade-output ratios, can be interpreted as contradicting the result, from the regression analysis, that changes in the degree of openness of the Latin American economies – as measured by the growth of their trade flows – have had, over the past four and half decades, a positive effect on the productivity growth performance of these countries. However, it can also be argued that the potentially positive effects of the increases in the levels of openness that occurred during this period were offset by the negative incentives to all types of investment, both in physical and in knowledge capital, that were provided by the context of high macroeconomic instability in which the region was engulfed. This hypothesis is in fact supported by the coincidence in time of the breaks in TFP and GDP per worker, and by the fact that in the TFP regressions the significance of the trade-output share increases considerably when measures of stability are included.

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A complementary argument is that the breaks in trade shares that we uncovered took place mostly as a result of external shocks and in the context of the same inward-oriented policies that had prevailed in the region since the 1930s. Thus, the breaks in import shares were usually associated with the oil shocks of the 1970s, while the actual opening of the Latin American economies in terms of their trade policies only happened a few years latter, most commonly in the late 1980s and the early 1990s. The breaks in export shares also preceded the advent of outward-oriented policies and were often associated with sharp contractions in domestic demand and highly depreciated currencies, both a result of macroeconomic policies aimed at the generation of balance of payments surpluses in a context of high external indebtedness of the countries in question.

During the 1990s, our growth accounting exercise showed that a considerable recovery in the rates of growth of TFP and GDP per worker has been taking place in most countries. In this period, most Latin American economies have reencountered positive rates of growth in GDP per worker and, as suggested by our regression results, may have started to reap the potential benefits from both their new trade policies and the changes that occurred in their trade shares during the previous decade. In terms of capital investment, however, the performance of most countries has been quite poor during the periods of openness of the Latin American economies. Advancing the understanding of this phenomena is, we believe, an issue that merits further research.

Finally, it is worth noting that, from a theoretical point of view, we should expect different dynamic responses to the opening of an economy to international trade, depending on its specific structural characteristics. This is especially the case if countries do not have access to same stock of "blueprints" or, in other words, if technology spillovers ar

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spillovers are not instantaneous nor global in reach. It is difficult, however, to uncover evidence on this subject in the context of a cross-country analysis. Thus, to further our understanding of the trade-productivity link in the region, it would be useful to perform country studies, if possible using data at the industry level. It is what we attempt to do in the next chapter of this dissertation.

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APPENDIX A

TABLES AND FIGURES

Table 1.1: Indicators of Trade Regimes Before and After Reform

Country (pre-reform year, post-reform year)	Unweighted Average of Legal Tariff Rates (%)		Tariff Range (%)		Unweighted Average Coverage of Non-Tariff Barriers (%)		Trade (Imports + Exports) as Percentage of GDP, 1980 Prices	
	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform	Pre-Reform (1985-1987)	Post-Reform (1991-1992)	Pre-Reform	Post-Reform
Argentina (1987, 1991)	42 (a)	15	15-115	5-22	31.9	8.0	38.57	54.32
Bolivia (1985, 1991-1992)	20 (a)	8 (a)	0-20	5-10	25.0	0.0	57.51	83.97
Brazil (1987, 1992)	51	21	0-105	0-65	35.3	10.0	21.17	25.27
Chile (1984, 1991)	35	11	35	11	10.1	0.0	44.96	56.34
Colombia (1984, 1992)	61	12	0-220	5-20	73.2	1.0	28.23	32.66
Costa Rica (1985, 1992)	53 (a)	15 (a)	0-1400 (a)	5-20	0.8	0.0	58.66	78.97
Ecuador (1989, 1992)	37 (a)	18	0-338 (a)	2-25 (c)	59.3	--	48.73	50.84
El Salvador (1987, 1995)	--	10.2	--	1-30 (i)	--	19.2 (d)	--	--
Guatemala (1985, 1992)	50 (a)	15 (a)	5-90	5-20	7.4	6.0	31.31	35.56
Guyana (1987, 1995)	--	15	--	--	--	--	--	--
Honduras (1985, 1992)	41 (a)	15 (b, a)	5-90	5-20	--	--	62.82	61.76
Jamaica (1981, 1991)	--	20	--	0-45	--	6.6 (d)	105.51	163.49
Mexico (1985, 1990)	24 (b)	13 (b)	0-100	0-20	12.7	20.0	22.63	34.31
Nicaragua (1985, 1990)	54 (a)	10.7 (d)	1-100 (e)	0-10	27.8	--	--	--
Paraguay (1985, 1991-1992)	71.7 (a)	16 (a)	0-44 (f)	3-86	9.9	0.0	51.01 (g)	63.14
Peru (1985, 1992)	64 (a)	15 (a) (h)	0-120 (g)	5-25	53.4	0.0	30.37 (g)	41.58
Uruguay (1987, 1992)	32	18	10-55	12-24	14.1	0.0	38.04	45. 10
Venezuela (1989, 1991)	37	19	0-135	0-50	44.1	5.0	49.25	53.29

Notes: -- Not available; (a) Including tariff surcharges; (b) Production-weighted average tariff; (c) Ecuador also has a specific tariff of 40 % on automobiles; (d) 1990-1993; (e) 1986; (f) 1984; (g) 1988; (h) 1991-1992; (i) 1994.
Source: Alam and Rajapatirana (1993), Burki and Perry (1997), Edwards (1995), IDB (1996).

Table 1.2: Bilateral Real Exchange Rate Relative to the U.S. Dollar in Selected Countries, 1980/1993 (1985=100)

Country	1980	1983	1987	1992	1993[a]
Argentina	35.08	96.4	80.8	36.9	34.0
Bolivia	88.1	84.6	107.9	109.6	113.3
Brazil	70.7	88.7	78.0	51.7	45.7
Chile	55.3	75.3	94.8	75.1	75.2
Colombia	79.2	78.3	115.9	119.9	102.6
Costa Rica	65.8	103.0	94.9	88.2	82.9
Ecuador	105.6	104.5	153.3	165.7	153.9
El Salvador	172.6	133.9	121.0	103.7	--
Guatemala	124.9	120.5	162	149.5	--
Honduras	121.6	106.2	93.2	141.5	152.3
Jamaica	60.1	54.8	80.1	94.5	70.7
Mexico	83.3	119.8	123.9	68.72	63.8
Paraguay	74.4	60.7	111.4	113.0	--
Peru	77.3	80.6	46.2	21.7	23.6
Uruguay	49.7	89.4	77.2	55.5	40.5
Venezuela	84.2	70.3	134.8	122.3	119.1

Note: Increases indicate currency depreciation against the dollar; -- not available;
(a) Preliminary.
Source: Edwards (1995).

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Table 1.3: Growth Decomposition: 1950/1995 (in percent)

Country	GDP growth (1)	Capital[*] (2)	Labor (3)	Productivity (4)	(4)/(1) (in percent) (5)
Argentina	2.38	1.22	0.83	0.33	13.94
Bolivia	2.43	1.17	1.43	-0.17	-7.07
Brazil	5.15	2.41	1.72	1.03	19.96
Chile	3.67	1.33	1.37	0.97	26.37
Colombia	4.55	1.77	1.82	0.96	21.06
Costa Rica	5.08	2.54	2.16	0.38	7.55
Ecuador	4.91	1.93	1.85	1.14	23.13
El Salvador	3.57	2.08	1.45	0.04	1.03
Guatemala	3.82	1.84	1.76	0.23	5.96
Guyana	1.16	0.76	1.37	-0.97	-83.16
Honduras	3.86	1.88	1.72	0.26	6.73
Jamaica	2.85	1.26	0.83	0.76	26.61
Mexico	4.69	2.62	1.77	0.31	6.57
Nicaragua	2.65	2.05	1.93	-1.33	-50.06
Paraguay	4.27	2.69	1.95	-0.37	-8.71
Peru	3.61	1.51	1.49	0.61	16.82
Uruguay	1.93	0.42	0.43	1.08	55.68
Venezuela	3.45	1.44	2.22	-0.20	-5.88
Average	3.56	1.72	1.56	0.28	7.87
Av.50-70	4.50	2.01	1.52	0.97	21.61
Av.70-80	4.19	2.27	1.70	0.22	5.16
Av.80-90	0.92	0.90	1.53	-1.52	-165.46
Av.90-95	3.88	1.03	1.49	1.36	34.96

Source: see text. [*] A capital share of 0.4 is assumed.

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Table 1.4: Total Factor Productivity Growth by Sub-periods: 1950/1995 (in percent)

Country/Period	1950-1970	1970-1980	1980-1990	1990-1995	1950-1995
Argentina	0.77	-0.03	-2.13	4.21	0.33
Bolivia	-0.60	0.16	-0.97	2.46	-0.17
Brazil	1.69	2.66	-1.52	0.21	1.03
Chile	0.73	0.28	0.61	4.00	0.97
Colombia	1.05	1.61	0.02	1.19	0.96
Costa Rica	1.07	-0.19	-0.71	0.99	0.38
Ecuador	0.88	4.07	-0.93	0.41	1.14
El Salvador	0.82	-1.04	-1.50	2.12	0.04
Guatemala	0.51	1.41	-1.71	0.74	0.23
Guyana	-1.14	-1.31	-3.93	6.51	-0.97
Honduras	0.78	1.11	-1.29	-0.44	0.26
Jamaica	3.29	-3.54	0.82	0.01	0.76
Mexico	1.62	1.05	-1.85	-2.11	0.31
Nicaragua	1.54	-3.54	-4.61	-0.98	-1.33
Paraguay	-0.60	1.83	-1.96	-0.54	-0.37
Peru	2.30	0.00	-3.21	2.85	0.61
Uruguay	1.28	1.78	-0.65	2.31	1.08
Venezuela	1.52	-2.42	-1.76	0.47	-0.20
Average	1.0	0.2	-1.5	1.4	0.28

Source: see text. (*) A capital share of 0.4 is assumed.

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Table 1.5: Periods of Openness: 1950/1995

Country	Openness Periods	Openness Periods / Total Period (percent)
Argentina	Since 1991	11
Bolivia	1956-79 and since 1991	74
Brazil	Since 1991	11
Chile	Since 1976	43
Colombia	Since 1986	22
Costa Rica	1952-61 and since 1986	43
Ecuador	1950-80 and since 1991	78
El Salvador	1950-61 and since 1991	37
Guatemala	1950-61 and since 1988	43
Guyana	Since 1988	17
Honduras	1950-61 and since 1991	37
Jamaica	1962-73 and since 1989	41
Mexico	Since 1986	22
Nicaragua	1950-60 and since 1991	35
Paraguay	Since 1989	15
Peru	1948-67 and since 1991	50
Uruguay	Since 1990	13
Venezuela	1950-59 and 1989-93	33
Average	--	35

Source: see text.

Table 1.6: Changes in Growth Rates: Periods of Openness and Closedness of the Economy, 1950/1995 (in percent)

Country / Variable	Total Factor Productivity Growth			Gross Domestic Product Growth			Capital Stock(*)	Labor Force(*)	(3)/(6) (in percent)
Status	Closed (1)	Open (2)	Open - Closed (3)	Closed (4)	Open (5)	Open - Closed (6)	Open - Closed (7)	Open - Closed (8)	Open - Closed (9)
Argentina	-0.2	4.2	4.4	2.1	5.0	2.9	-1.6	0.2	149
Bolivia	-2.4	0.5	2.9	-0.2	3.2	3.3	0.2	0.2	88
Brazil	1.1	0.2	-0.9	5.5	2.5	-3.0	-1.7	-0.3	31
Chile	-0.3	2.6	2.9	2.6	5.0	2.5	-0.2	-0.3	117
Colombia	0.9	1.3	0.5	4.6	4.4	-0.1	-0.2	-0.4	-343
Costa Rica	0.0	0.9	0.9	4.7	5.5	0.8	-0.2	0.1	115
Ecuador	-0.7	1.5	2.3	2.0	5.5	3.6	1.2	0.1	64
El Salvador	-0.6	0.9	1.5	2.9	4.5	1.6	0.0	0.1	95
Guatemala	0.3	0.1	-0.2	3.9	3.7	-0.3	-0.2	0.2	87
Guyana	-1.7	2.5	4.2	0.8	2.8	2.0	-1.3	-0.9	206
Honduras	0.3	0.2	-0.1	4.2	3.3	-0.9	-0.3	-0.6	9
Jamaica	-0.1	1.8	1.9	1.8	4.2	2.4	0.9	-0.4	79
Mexico	0.9	-1.9	-2.8	5.7	1.0	-4.7	-1.8	-0.2	59
Nicaragua	-2.2	0.4	2.6	1.8	4.4	2.6	0.1	-0.1	101
Paraguay	-0.4	-0.2	0.1	4.4	3.5	-0.9	-0.8	-0.3	-15
Peru	-1.3	2.6	4.0	1.7	5.6	3.8	0.5	-0.6	104
Uruguay	0.9	2.0	1.1	1.8	2.9	1.1	0.0	0.1	96
Venezuela	-1.2	2.0	3.2	2.4	5.8	3.3	0.1	0.1	94
Average	-0.4	1.2	1.6	2.9	4.0	1.1	-0.3	-0.2	142

Source: see text. (*) Contribution to GDP growth, assuming a capital share of 0.4.

Table 1.7: Total Factor Productivity Growth(*) Adjusting for Employment, 1980/1995 (in percent)

Country/ Period	1980-1990 Adjusted	1980-1990 Non-Adjusted	1990-1995 Adjusted	1990-1995 Non-Adjusted	1980-1995 Adjusted	1980-1995 Non-Adjusted
Argentina	-1.82	-2.13	5.59	4.21	0.65	-0.01
Bolivia	-0.96	-0.97	1.99	2.46	0.03	0.17
Brazil	-1.64	-1.52	0.25	0.21	-1.01	-0.94
Chile	0.27	0.61	4.11	4.00	1.55	1.74
Colombia	0.07	0.02	0.76	1.19	0.27	0.31
Costa Rica	-0.75	-0.71	1.03	0.99	-0.16	-0.14
Ecuador(**)	-0.15	-0.10	0.61	0.41	0.11	0.11
Guatemala	-1.44	-1.71	0.84	0.74	-0.79	-0.92
Honduras	-1.36	-1.29	-0.85	-0.44	-1.19	-1.01
Mexico	-1.96	-1.85	-1.66	-2.11	-1.86	-1.94
Nicaragua	-5.12	-4.61	0.34	-0.98	-3.86	-4.06
Paraguay	-1.80	-1.96	-1.18	-0.54	-1.62	-1.64
Peru	-3.13	-3.21	2.48	2.85	-1.53	-1.61
Uruguay	-0.54	-0.65	2.53	2.31	0.49	0.34
Venezuela	-1.47	-1.76	0.45	0.47	-0.83	-1.02
Average	-1.45	-1.46	1.15	1.05	-0.65	-0.71

Source: see text. (*) A capital share of 0.4 is assumed. (**) Data available for 1983-1995.

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Table 1.8: Structural Trend Breaks in GDP, 1950/1995

Country	Break in GDP		
	Break Year	Model	SupF_t
Argentina	80	I	30.40$^{(***)}$
Bolivia	78	I	47.28$^{(*)}$
Brazil	81	I	48.76$^{(*)}$
Chile	83	I	14.08
Colombia	80	I	30.58$^{(***)}$
Costa Rica	80	I	79.38$^{(*)}$
Ecuador	73	I	40.52$^{(*)}$
El Salvador	79	I	117.06$^{(*)}$
Guatemala	81	I	127.37$^{(*)}$
Guyana	82	I	20.01
Honduras	78	I	55.93$^{(*)}$
Jamaica	72	I	34.41$^{(**)}$
Mexico	81	I	49.51$^{(*)}$
Nicaragua	78	I	48.21$^{(*)}$
Paraguay	82	I	53.00$^{(*)}$
Peru	88	I	32.69$^{(**)}$
Uruguay	82	I	37.16$^{(**)}$
Venezuela	81	I	47.49$^{(*)}$

Source: see text. $^{(*)}$, $^{(**)}$ and $^{(***)}$ stand for statistical significance at the 1, 5, and 10 percent level, respectively, using unit root critical values. For model I, these are 38.35, 31.29, 27.99, respectively. For model II, the critical values are 30.36, 25.10, and 22.29, while for model III they are 22.48, 17.88, and 15.78.

Table 1.9: Growth Rates of Total Factor Productivity Adjusting for Capacity Utilization, 1950/1995 (in percent)

Country/ Period	1950-70	1970-80	1980-90	1990-95	1950-95	Closed	Open	Open - Closed
Argentina	0.70	0.40	-1.90	4.00	0.42	-0.02	4.00	4.02
Bolivia	-0.43	-0.21	-1.00	2.60	-0.17	-2.65	0.54	3.19
Brazil	1.99	1.58	-0.61	-0.64	1.03	1.24	-0.64	-1.88
Chile	0.60	0.06	1.29	3.34	0.94	0.27	1.78	1.51
Colombia	1.11	1.64	-0.22	1.11	0.93	0.87	1.16	0.29
Costa Rica	1.11	0.03	-1.00	1.11	0.40	0.11	0.77	0.66
Ecuador	1.26	3.26	-0.77	0.51	1.15	-0.74	1.56	2.30
El Salvador	0.87	-1.09	-1.55	2.01	0.02	-0.78	1.22	2.00
Guatemala	0.54	1.30	-1.55	0.65	0.25	0.34	0.11	-0.23
Guyana	-1.16	-1.73	-2.98	4.68	-1.17	-1.52	0.68	2.20
Honduras	0.77	1.19	-1.13	-1.10	0.23	0.22	0.24	0.02
Jamaica	3.08	-2.76	0.07	2.04	0.72	-0.20	2.14	2.34
Mexico	1.59	1.00	-1.66	-1.74	0.36	0.87	-1.40	-2.27
Nicaragua	1.56	-3.89	-3.64	-3.26	-1.26	-2.36	1.30	3.66
Paraguay	-0.55	1.20	-1.39	-0.70	-0.36	-0.34	-0.48	-0.14
Peru	2.36	-0.12	-3.36	1.86	0.45	-1.48	2.56	4.04
Uruguay	1.21	1.39	-0.03	2.81	1.15	0.93	2.57	1.64
Venezuela	1.44	-2.07	-1.98	0.37	-0.22	-0.99	1.51	2.50
Average	1.00	0.07	-1.30	1.09	0.27	-0.35	1.09	1.44

Source: see text. (*) Contribution to GDP growth, assuming a capital share of 0.4.

Table 1.10: Changes in Growth Rates of Capital Stocks, Adjusting for Capacity Utilization: Periods of Openness and Closedness of the Economy, 1950/1995 (in percent)

Country	Growth in Adjusted Capital Stocks			Growth in Non-Adjusted Capital Stocks		
Status	Closed	Open	Open - Closed	Closed	Open	Open - Closed
Argentina	3.33	-0.39	-3.72	3.49	-0.60	-4.09
Bolivia	1.16	2.84	1.68	2.58	3.02	0.44
Brazil	6.51	3.00	-3.51	6.50	2.15	-4.35
Chile	2.95	4.51	1.56	3.52	3.08	-0.43
Colombia	4.47	4.06	-0.41	4.53	3.96	-0.57
Costa Rica	6.49	5.71	-0.78	6.59	6.04	-0.55
Ecuador	2.32	5.61	3.29	2.32	5.35	3.03
El Salvador	5.38	4.54	-0.84	5.17	5.25	0.08
Guatemala	4.77	3.54	-1.23	4.78	4.31	-0.47
Guyana	2.16	2.48	0.32	2.41	-0.76	-3.16
Honduras	5.00	3.56	-1.44	4.93	4.29	-0.64
Jamaica	2.23	4.56	2.34	2.26	4.54	2.29
Mexico	7.66	2.69	-4.98	7.52	3.15	-4.38
Nicaragua	5.21	2.28	-2.93	5.05	5.28	0.23
Paraguay	7.60	5.10	-2.50	6.99	4.99	-2.01
Peru	3.36	3.62	0.26	3.22	4.40	1.18
Uruguay	1.24	0.45	-0.79	1.07	1.03	-0.04
Venezuela	3.31	3.88	0.57	3.50	3.81	0.32
Average	4.18	3.45	-0.73	4.25	3.52	-0.73

Source: see text.

Table 1.11: Structural Trend Break Tests in Import-Output Ratios

Country	Period	Import-Output Ratios				Changes in Growth Rates (percent)		
		Break Year	Model	SupF_t	Change in Import Share (%)	TFP	GDP per worker (p.w.)	Capital Stock (p.w.)
Argentina	1959/95	1974	I	30.3$^{(***)}$	-15.3	-0.8	-2.3	-3.7
Bolivia	1951/95	1988	I	24.5	15.9	3.0	1.2	-4.6
Brasil	1951/95	1974	I	29.6$^{(***)}$	-7.9	-2.7	-3.4	-1.7
Chile	1951/95	1973	I	51.9$^{(*)}$	99.3	0.8	0.6	-0.4
Colombia	1958/95	1980	I	27.9	29.9	-1.2	-1.0	0.4
Costa Rica	1951/95	1982	I	107.6$^{(*)}$	19.3	0.6	-0.1	-1.6
Ecuador	1951/95	1985	I	28.4$^{(***)}$	31.6	-1.6	-3.0	-3.4
El Salvador	1958/95	1973	I	35.6$^{(**)}$	17.8	-1.5	-2.0	-1.4
Guatemala	1951/95	1981	I	74.6$^{(*)}$	19.7	-1.6	-3.1	-3.9
Guyana	1952/93	1975	I	26.8	44.7	-0.6	-1.3	-1.7
Honduras	1958/95	1973	I	28.4$^{(***)}$	19.9	-1.6	-2.1	-1.4
Jamaica	1951/94	1984	I	48.4$^{(*)}$	39.2	0.2	-0.6	-3.2
Mexico	1957/95	1980	I	43.6$^{(*)}$	44.3	-3.3	-4.7	-3.7
Paraguay	1951/95	1987	I	34.8$^{(**)}$	106.4	0.5	-0.1	-1.7
Peru	1951/95	1973	I	22.5	-28.3	-3.3	-4.0	-2.4
Uruguay	1965/95	1979	I	38.0$^{(**)}$	48.4	-0.8	-1.0	-0.4
Venezuela	1957/95	1976	I	50.2$^{(*)}$	10.5	-1.5	-1.7	-0.4

Source: see text. $^{(*)}$, $^{(**)}$ and $^{(***)}$ stand for statistical significance at the 1, 5, and 10 percent level, respectively, using unit root critical values. For model I, these are 38.35, 31.29, 27.99, respectively. For model II, the critical values are 30.36, 25.10, and 22.29, while for model III they are 22.48, 17.88, and 15.78.

Table 1.12: Structural Trend Break Tests in Export-Output Ratios

Country	Period	Export-Output Ratios				Changes in Growth Rates (percent)		
		Break Year	Model	SupF_t	Change in Export Share (%)	TFP	GDP per worker (p.w.)	Capital Stock (p.w.)
Argentina	1959/95	1979	I	23.1	-6.8	-0.2	-2.1	-4.7
Bolivia	1951/95	1988	I	32.9$^{(**)}$	-6.4	3.0	1.2	-4.6
Brasil	1951/95	1982	I	50.3$^{(*)}$	14.4	-1.9	-3.5	-3.9
Chile	1951/95	1987	I	31.5$^{(**)}$	87.9	3.7	4.8	2.9
Colombia	1958/95	1980	I	24.6	16.3	-1.2	-1.0	0.4
Costa Rica	1951/95	1980	I	83.8$^{(*)}$	32.1	-1.0	-1.7	-1.9
Ecuador	1951/95	1971	II	25.2$^{(**)}$	47.8	0.4	0.01	-1.1
El Salvador	1958/95	1977	I	83.2$^{(*)}$	-32.9	-1.7	-2.7	-2.5
Guatemala	1951/95	1978	I	38.3$^{(**)}$	-0.6	-1.6	-2.8	-3.0
Guyana	1952/93	1986	III	22.3$^{(**)}$	41.6	2.4	1.7	-1.7
Honduras	1958/95	1989	I	37.4$^{(**)}$	2.6	-1.3	-1.9	-1.4
Jamaica	1951/94	1978	I	18.1	35.2	-1.8	-3.4	-5.5
Mexico	1957/95	1988	I	35.8$^{(**)}$	46.3	-1.7	-2.9	-3.0
Paraguay	1951/95	1988	I	46.1$^{(*)}$	41.1	0.1	-0.4	-1.6
Peru	1951/95	1976	I	30.0$^{(***)}$	-29.0	-3.5	-4.4	-3.0
Uruguay	1965/95	1982	II	30.4$^{(***)}$	51.3	-0.1	-0.9	-2.0
Venezuela	1957/95	1984	III	17.8$^{(***)}$	-7.6	1.4	0.6	-2.2

Source: see text. $^{(*)}$, $^{(**)}$ and $^{(***)}$ stand for statistical significance at the 1, 5, and 10 percent level, respectively, using unit root critical values. For model I, these are 38.35, 31.29, 27.99, respectively. For model II, the critical values are 30.36, 25.10, and 22.29, while for model III they are 22.48, 17.88, and 15.78.

Table 1.13: Structural Trend Breaks in Total Factor Productivity, 1950/1995

Country	Break in Total Factor Productivity Index			Changes in Growth Rates (percent)			Changes in Trade-Output Shares (percent)		
	Break Year	Model	SupF_t	TFP	GDP per worker (p.w.)	Capital Stock (p.w.)	Period[a]	Imports	Exports
Argentina	1988	I	20.2	1.94	-0.03	-4.9	1959/95	-2.9	-0.2
Bolivia	1970	II	15.9	0.6	-0.5	-2.9	1965/95	-14.6	-17.6
Brazil	1980	I	32.7[**]	-2.9	-4.4	-3.6	1950/95	-18.9	13.7
Chile	1970	I	19.5	0.3	0.1	-0.6	1950/95	85.8	88.6
Colombia	1977	I	61.9[*]	-0.6	-0.3	0.4	1958/95	28.4	19.3
Costa Rica	1981	I	39.6[*]	-0.4	-1.2	-1.9	1950/95	22.1	29.2
Ecuador	1972	I	76.9[*]	-0.3	-0.5	-1.1	1950/95	32.1	50.1
El Salvador	1979	I	73.2[*]	-1.8	-3.2	-3.5	1958/95	-6.3	-42.4
Guatemala	1981	I	48.0[*]	-1.6	-3.1	-3.9	1950/95	19.8	-9.2
Guyana	1963	I	26.2	2.82	3.0	0.05	1952/93	37.1	30.6
Honduras	1981	II	28.3[**]	-1.8	-3.1	-3.2	1958/95	-8.6	-11.7
Jamaica	1973	I	43.3[*]	-4.9	-6.7	-6.3	1950/94	40.7	41.7
Mexico	1981	I	40.3[*]	-3.7	-5.4	-4.3	1957/95	43.2	116.4
Paraguay	1979	I	91.8[*]	-1.3	-0.9	0.8	1950/95	51.6	-11.5
Peru	1987	II	22.3[***]	-2.8	-4.1	-3.0	1950/95	-25.5	-46.8
Uruguay	1979	I	50.2[*]	-0.8	-0.7	0.1	1965/95	48.3	41.2
Venezuela	1978	III	18.5[**]	-2.5	-3.1	-1.6	1957/95	-2.0	-7.2

Source: see text. [a] Period for which data on trade-output shares is available. [*], [**] and [***] stand for statistical significance at the 1, 5, and 10 percent level, respectively, using unit root critical values. For model I, these are 38.35, 31.29, 27.99, respectively. For model II, the critical values are 30.36, 25.10, and 22.29, while for model III they are 22.48, 17.88, and 15.78.

Table 1.14: Structural Trend Breaks in GDP and Capital Stock per Worker, 1950/1995

Country	Break in GDP per Worker				Break in Capital Stock per Worker			
	Break Year	Model	SupF_t	Change in Growth Rate (%)	Break Year	Model	SupF_t	Change in Growth Rate (%)
Argentina	1980	I	28.8(***)	-2.5	1981	II	36.5(*)	-5.0
Bolivia	1977	I	40.9(*)	-2.2	1979	I	38.1(**)	-5.7
Brazil	1981	I	43.7(*)	-4.0	1972	I	37.4(**)	-0.9
Chile	1982	II	17.5	3.0	1980	I	30.5(***)	1.0
Colombia	1978	I	85.9(*)	-0.5	1973	II	20.7	0.6
Costa Rica	1979	I	36.9(**)	-1.9	1979	I	55.3(*)	-1.7
Ecuador	1973	I	62.1(*)	-1.9	1972	I	44.8(*)	-1.1
El Salvador	1979	I	55.4(*)	-3.2	1987	I	29.0(***)	-2.5
Guatemala	1980	I	90.0(*)	-3.2	1974	I	50.6(*)	-1.9
Guyana	1982	III	16.2(***)	1.1	1979	I	28.3(***)	-1.9
Honduras	1982	I	51.3(*)	-2.5	1971	I	35.6(**)	-2.0
Jamaica	1970	I	37.8(**)	-6.2	1971	II	28.3(**)	-6.2
Mexico	1982	I	46.6(*)	-5.3	1981	I	49.9(*)	-4.3
Paraguay	1980	I	53.4(*)	-1.7	1980	I	57.9(*)	-0.2
Peru	1988	II	24.3(***)	-2.9	1971	I	31.5(**)	-2.7
Uruguay	1982	I	55.6(*)	-0.5	1979	I	30.3(***)	0.1
Venezuela	1980	III	25.1(*)	-2.4	1975	II	24.6(***)	-0.3

Source: see text. (*), (**) and (***) stand for statistical significance at the 1, 5, and 10 percent level, respectively, using unit root critical values. For model I, these are 38.35, 31.29, 27.99, respectively. For model II, the critical values are 30.36, 25.10, and 22.29, while for model III they are 22.48, 17.88, and 15.78.

Table 1.15: GMM Estimates of Growth in GDP per Worker
(p-values in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)
Regression Specification	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.
Instruments (*)	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.
Growth in Capital per Worker	0.887 (0.00)	0.850 (0.00)	0.464 (0.00)	0.384 (0.00)	0.665 (0.00)	0.329 (0.00)
Initial GDP per Worker (log)	-0.019 (0.01)	-0.055 (0.00)	-0.025 (0.00)	-0.036 (0.00)	-0.026 (0.00)	-0.027 (0.03)
Total Population (log)	0.009 (0.02)	0.018 (0.00)	0.011 (0.01)	0.016 (0.01)	0.013 (0.00)	0.009 (0.06)
Changes in Terms of Trade	-0.021 (0.53)	-0.024 (0.43)	-0.028 (0.55)	-0.005 (0.86)	-0.076 (0.04)	-0.032 (0.38)
Reforms Dummy	0.017 (0.00)					-0.003 (0.55)
Trade-GDP Ratio (log)		0.035 (0.01)		0.002 (0.88)		0.015 (0.32)
Export Growth			0.053 (0.12)	0.073 (0.00)		0.068 (0.05)
Import Growth			0.092 (0.00)	0.079 (0.00)		0.075 (0.01)
Black Market Premium (log of one plus the premium)					-0.044 (0.00)	-0.027 (0.02)
Wald Test of Joint Significance: p-value	0.000	0.000	0.000	0.000	0.000	0.000
Sargan Test of Overidentifying Restrictions: p-value	1.000	1.000	1.000	1.000	1.000	1.000
Test for First-Order Serial Correlation: p-value	0.068	0.096	0.090	0.109	0.026	0.060
Test for Second-Order Serial Correlation: p-value	0.577	0.614	0.880	0.839	0.650	0.421
Number of Observations	92	92	92	92	92	92

Notes: (*) See text.

Table 1.16: GMM Estimates of Growth in GDP per Worker
Including Control Variables
(p-values in parenthesis)

	(1)	(2)	(3)	(4)	(5)
Regression Specification	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.
Instruments (*)	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.
Growth in Capital per Worker	0.328 (0.00)	0.238 (0.08)	0.249 (0.17)	0.237 (0.00)	0.369 (0.01)
Initial GDP per Worker (log)	-0.027 (0.03)	-0.033 (0.03)	-0.034 (0.09)	-0.017 (0.11)	-0.035 (0.05)
Total Population (log)	0.009 (0.06)	0.010 (0.09)	0.012 (0.13)	0.006 (0.13)	0.012 (0.05)
Reforms Dummy	-0.003 (0.59)	0.0004 (0.95)	-0.005 (0.29)	-0.004 (0.52)	-0.006 (0.20)
Trade-GDP Ratio (log)	0.016 (0.30)	0.030 (0.11)	0.023 (0.01)	0.008 (0.22)	0.020 (0.08)
Export Growth	0.061 (0.09)	0.075 (0.07)	0.066 (0.18)	0.052 (0.13)	0.065 (0.08)
Import Growth	0.081 (0.00)	0.058 (0.07)	0.074 (0.02)	0.111 (0.00)	0.082 (0.00)
Black Market Premium (log of one plus the premium)	-0.026 (0.03)	-0.022 (0.08)	-0.024 (0.19)	-0.020 (0.06)	-0.024 (0.12)
Educational Achievement		-0.015 (0.11)			
Government Consumption / GDP			-0.002 (0.27)		
Inflation				-0.00002 (0.39)	
M2 / GDP					0.0002 (0.40)
Wald Test of Joint Significance: p-value	0.000	0.000	0.000	0.000	0.000
Sargan Test of Overidentifying Restrictions: p-value	1.000	1.000	1.000	1.000	1.000
Test for First-Order Serial Correlation: p-value	0.082	0.026	0.033	0.110	0.128
Test for Second-Order Serial Correlation: p-value	0.411	0.543	0.505	0.384	0.302
Number of Observations	92	92	92	92	92

Notes: (*) See text.

Table 1.17: GMM Estimates of Growth in Capital per Worker
(p-values in parenthesis)

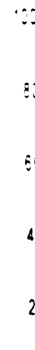
	(1)	(2)	(3)	(4)	(5)	(6)
Regression Specification	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.
Instruments (*)	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.
Initial Capital per Worker (log)	-0.014 (0.00)	-0.034 (0.00)	-0.012 (0.06)	-0.024 (0.00)	-0.026 (0.00)	-0.027 (0.03)
Total Population (log)	0.009 (0.00)	0.015 (0.00)	0.007 (0.05)	0.013 (0.01)	0.015 (0.00)	0.009 (0.05)
Changes in Terms of Trade	0.083 (0.00)	0.083 (0.00)	0.075 (0.00)	0.047 (0.22)	0.059 (0.03)	0.024 (0.62)
Reforms Dummy	0.001 (0.46)					-0.012 (0.09)
Trade-GDP Ratio (log)		0.019 (0.03)		0.001 (0.94)		0.026 (0.13)
Export Growth			0.126 (0.02)	0.169 (0.00)		0.150 (0.01)
Import Growth			-0.019 (0.57)	-0.051 (0.06)		-0.037 (0.39)
Black Market Premium (log of one plus the premium)					-0.020 (0.00)	-0.002 (0.91)
Wald Test of Joint Significance: p-value	0.000	0.000	0.000	0.000	0.000	0.000
Sargan Test of Overidentifying Restrictions: p-value	0.997	0.999	1.000	1.000	0.998	1.000
Test for First-Order Serial Correlation: p-value	0.767	0.368	0.011	0.002	0.753	0.003
Test for Second-Order Serial Correlation: p-value	0.023	0.053	0.740	0.769	0.051	0.691
Number of Observations	92	92	92	92	92	92

Notes: (*) See text.

Table 1.18: GMM Estimates of Growth in Capital per Worker
Including Control Variables
(p-values in parenthesis)

	(1)	(2)	(3)	(4)	(5)
Regression Specification	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.	Dif.-Lev.
Instruments (*)	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.	Lev.-Dif.
Initial Capital per Worker (log)	-0.028 (0.00)	-0.022 (0.07)	-0.020 (0.09)	-0.017 (0.01)	-0.021 (0.07)
Total Population (log)	0.008 (0.09)	0.005 (0.46)	0.007 (0.10)	0.008 (0.00)	0.007 (0.16)
Reforms Dummy	-0.010 (0.14)	-0.002 (0.80)	-0.014 (0.10)	-0.010 (0.00)	-0.016 (0.06)
Trade-GDP Ratio (log)	0.034 (0.02)	0.039 (0.13)	0.024 (0.04)	0.007 (0.05)	0.023 (0.04)
Export Growth	0.158 (0.02)	0.129 (0.07)	0.147 (0.04)	0.149 (0.00)	0.087 (0.08)
Import Growth	-0.046 (0.34)	-0.046 (0.37)	-0.035 (0.49)	-0.030 (0.29)	0.005 (0.88)
Black Market Premium (log of one plus the premium)	-0.001 (0.92)	0.008 (0.71)	-0.014 (0.55)	-0.001 (0.91)	-0.019 (0.27)
Educational Achievement		-0.020 (0.00)			
Government Consumption / GDP			-0.001 (0.34)		
Inflation				-0.00005 (0.00)	
M2 / GDP					0.00006 (0.90)
Wald Test of Joint Significance: p-value	0.000	0.000	0.000	0.000	0.000
Sargan Test of Overidentifying Restrictions: p-value	1.000	1.000	1.000	1.000	1.000
Test for First-Order Serial Correlation: p-value	0.005	0.036	0.001	0.000	0.019
Test for Second-Order Serial Correlation: p-value	0.624	0.420	0.773	0.248	0.531
Number of Observations	92	92	92	92	92

Notes: (*) See text.



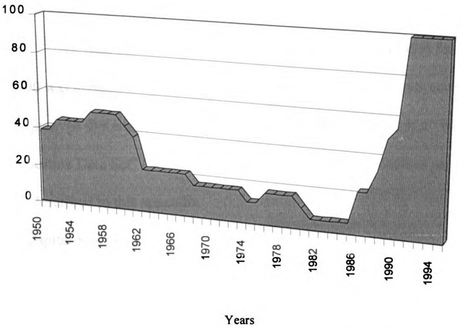


Figure 1.1: Open Countries as Percent of Total, 1950/1995

APPENDIX B

UPDATING THE NEHRU AND DARESHWAR (1993) DATA BASE

The data base constructed by Nehru and Dareshwar (1993) for the period 1950-1990 was updated until 1995 for the 18 Latin American countries considered in this chapter. To this end, we used information from the World Bank's "World Development Indicators Data Set" (WDI). A brief description of the procedures used in this updating are described in this appendix.

1) Capital Stocks

This series was calculated using the perpetual inventory method, which is based on the following accumulation equation:

$$K_t = (1-d)^t K(0) + S(1-d)^i\ I_{t-i} \qquad (1)$$

where K_t is the capital stock at time t (in 1987 prices), K(0) is the initial capital stock (in period 0), I_{t-i} is the Gross Domestic Fixed Investment in period t-i, and d is the depreciation rate. Nehru and Dareshwar (1993) estimate K(0) by a modification of a technique proposed by Harberger(1978). The procedure is based on the assumption that in steady state the rate of growth of output *(g)* is equal to the rate of growth of capital stock. By re-arranging (1), this rate can be written:

$$(K_t - K_{t-1})/K_{t-1} = -d + (I_t/K_{t-1}) \qquad (2)$$

which, by the above assumption, implies

$$K_{t-1} = I_t/(g+d) \qquad (3)$$

Thus, in period 0, the capital stock can be calculated as:

$K(0) = I_1/(g+d)$

Nehru and Dareshwar (1993) calculate I_1 as the fitted value of a log-linear trend of I_t, adjusting for trend-breaks when appropriate. The depreciation rate is assumed to be 4 percent, and g is derived from the series of real GDP at market prices. Equation (1) is then applied to calculate the rest of the values of K_t. To continue this procedure for the post-1989 values, we used data on Gross Domestic Fixed Investment (GDFI), available for all countries except for Argentina. For this country, only the data on Gross Domestic Investment (GDI) was available. To solve this problem, we regressed the log of the ratio of GDFI to GDI on a linear and a quadratic trend, using the years for which both variables were available (from 1970 to 1990). The estimates were then used to extrapolate the figures of GDFI from 1990 through 1995.

2) Gross Domestic Product

While comparing the WDI data for this series with the data from Nehru and Dareshwar (1993), we found considerable discrepancies in the levels but not in growth rates of the series. Thus, we performed the updating by multiplying the 1988 levels from the original source by the subsequent years' rates of growth, as derived from the WDI data base.

3) Labor Force

Nehru and Dareshwar (1993) use the population aged 15-64 years as a proxy for the labor force. Their data covers the period from 1960 to 1988. We updated this series with WDI data for the period 1989-1995. For the period 1950-1959, however, we only had access to data on total population. Thus, we regressed the log of the ratio of the wo

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working-age population to the total population on a linear and a quadratic trend, with data on the period 1960-1995. We then used the fitted values of this regression to extrapolate the figures for the working-age population from 1950 through 1959.

Chapter 2:

OPENNESS TO TRADE AND PRODUCTIVITY GROWTH IN LATIN AMERICAN INDUSTRIES: 1970-1994

1 - Introduction

Most of the industrial base in Latin America was developed in a context of heavy protectionism and strong government interventionism. It was generally thought that this was the best – and indeed the only – way of achieving rapid output and productivity growth. This situation has changed drastically in the last decade or so. Most governments have engaged in ambitious programs of market-oriented reforms in which trade liberalization features prominently. Interestingly, it is now a widely accepted belief among the region's policy makers that the increased exposure of Latin American industries to international trade has the potential of promoting rapid productivity growth. This dramatic change in policy stance stems from many sources, among which can be cited the collapse of the statist economies of Eastern Europe, the rapid export-oriented growth of the East Asian economies, the poor economic performance of most Latin American countries during the 1980s, and the increased influence of the multilateral financial institutions during this period.

What have been the results of the new policies? So far, the answers to this question have been mixed. Mexico, for example, has experienced relatively low productivity growth in the early years after the "opening" of its economy[1]. The Mexican currency crisis of December 1994, partially attributed to this poor performance, has been a reminder of the difficulties and the lack of automaticity associated with the potential growth effects of the trade reforms[2]. Considering the region as a whole, however, Easterly et al. (1997) have recently argued that its return to the historic growth rate of 2 percent per capita in 1991-93, in the midst of a global slowdown, cannot be interpreted as a disappointment[3]. Also at the aggregate level, we showed, in the first chapter of this dissertation, that during the period from 1950 to 1995 the Latin American economies experienced, on average, relatively faster productivity growth during the periods in which they were open to international trade. In a country by country growth accounting analysis, however, we found that in a few important cases – e.g. Brazil and Mexico – this result did not apply as total factor productivity was found to be relatively slower during periods of openness.

From a theoretical point of view, it is not surprising that different countries have responded in different ways to the opening of their economies to international trade. Even the "new" models of endogenous growth, which have greatly contributed to the understanding of the trade and growth relationship, do not provide unambiguous and general conclusions on the growth effects of opening-up: trade "unleashes powerful forces that speed up growth" but also "forces that are harmful to growth" (Helpman, 1992: 265). Indeed, the net growth effects from increased integration into the world trading system can be shown to depend on the countries' initial stocks of technological

[1] See Edwards (1995: 131) and the references therein.
[2] See, for example, Burki and Edwards (1997).
[3] The authors show that "Latin American growth has responded to changes in policy variables as would have been predicted by the experience of other times and places, as sumarized by a panel regression spanning a large number of countries and (mostly) 5-year periods from 1960 to 1993" (Easterly et al. 1997: 304).

capabilities, and on the type of changes that trade causes in the countries' sectoral composition of output[4].

It is thus possible that the empirical studies that have focused on the effects of the trade reforms on aggregate productivity growth have missed the actual responses to the new policies at the sectoral level. Indeed, as stressed by the above-mentioned models of trade and endogenous growth, it may well happen that in the high-technology sectors of the economy the productivity gains provided by the increased access to the global stock of blueprints and intermediate inputs that are associated with freer trade, are insufficient to compensate for the competitive disadvantages arising from the lack of a local critical mass of knowledge. As stressed by Grossman and Helpman (1991: chapters 8 and 9) and Feenstra (1996), this situation may arise when countries differ in size and/or prior research experience, and there are lags in the international diffusion of technology so that, even under free trade, countries do not have access to the same stock of knowledge. In these circumstances, local firms in high-technology sectors might be driven out of the market by their foreign competitors, and the net contribution of these industries to aggregate productivity growth might suffer a reduction after the opening of the economy to international trade.

In addition, even if one assumes that technological spillovers are instantaneous and global in reach, trade is expected to cause an increase in the share of the sectors in which the country has a (static) comparative advantage, and these sectors might well have, for technological reasons, an intrinsically lower rate of productivity growth. This is

[4] See Grossman and Helpman (1991) and the review in the first chapter of this dissertation.

likely to occur when the countries in question are unskilled-labor abundant, as is generally the case in Latin America. Summing-up, even if one assumes that international trade eases the international diffusion of knowledge and thus favors faster productivity growth in all sectors of the economy, it can also be expected to cause changes in the composition of the economy's output that do not necessarily favor an acceleration of aggregate productivity growth[5].

The objective of this chapter is to contribute to the research on the impact of the "opening" of Latin America on its productivity performance, by focusing on the developments observed at the industry level. This type of analysis has two different motivations. The first one is of a theoretical nature and is given by the fact that the new models of trade and endogenous growth fail to predict an unequivocal effect of increased openness on productivity growth at the aggregate level but do, under certain assumptions, make testable predictions at the sectoral level. These predictions can be summarized by saying that, in the context of global technology spillovers and relative abundance of unskilled labor – as in Latin America – trade will lead to faster growth in productivity in all sectors, even if it may cause the shrinking of the high-technology sectors and the expansion of the traditional (labor-intensive) ones[6].

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[5] Quoting Grossman and Helpman (1991): "the rate of innovation cannot fall in the country that is relatively poorly endowed with human capital (...) Still, the labor-rich country can experience a decline in its growth rate of real output, since its resources shift, in accordance with comparative advantage from the production of high-technology goods to the production of traditional goods. That is, the country specializes in the stagnant manufacturing activity, even as it enjoys faster technological progress in its dynamic manufacturing sector" (p. 255).

[6] As stressed above, when research spillovers are geographically concentrated and the home country is smaller in size or has an initial disadvantage in research, productivity growth in the high-technology sectors may be subject, in addition to the general positive

Our second, more practical, motivation is based on the recognition that all measures of openness are partial and arbitrary, but the aggregate ones are even more so. In Latin America, in particular, it is a reality that the increased openness to international trade that has been observed in the last few years has not always been uniform, and has affected some sectors more than others. Thus, even if one believes that at the sectoral level trade has positive effects on productivity growth, "faster productivity will be observed in those sectors where protectionism has been reduced and will not be observed in those still subject to trade barriers or other forms of regulation" (Edwards, 1995: 131).

More precisely, we seek, in this paper, to perform an econometric estimation of the effect of several indicators of openness to international trade on the rates of labor productivity and total factor productivity (TFP) growth of Latin American manufacturing industries. To this end, we regress the rate of growth of labor productivity on indicators of trade intensity, intra-industry trade, export growth, growth in import-output ratios, and tariff and non-tariff barriers to trade. By controlling for the accumulation of factors of production, we also test for the effect of these openness variables on the rate of growth of TFP.

The regressions are run separately for each one of the countries considered. This is justified by the fact that the relationship between openness and productivity growth is expected to depend on the countries' industrial structures and their historical patterns of development, as affected by government policies. We concentrate on the manufacturing industries both for data availability and for theoretical reasons: most research and

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effects that trade exerts on the traditional sectors, to the specific negative effects of the increased competition faced by the local firms in the innovation races in which they get development and international trade takes place in manufacturing, so that it appears to be the part of the economy to which the new models of endogenous growth are best suited. The choice of the countries on which we focus, as well as the periods and industries covered, are dictated exclusively by data quality and availability. In the case of tariffs and non-tariff barriers, data are available for 17 industries in three countries (Argentina, Brazil and Mexico) during the period 1986/1993, which covers most of the recent episodes of trade liberalization. For the rest of the openness indicators data are available at a level of disaggregation of 28 industries, in five countries – the three already mentioned plus Chile and Colombia – during the period 1970/1994. In order to purge from the data the effects of the short-run fluctuations in output, we construct panels in which the data are averaged over, respectively, 3- and 5-year subperiods. The econometric estimation is performed using the Generalized Method of Moments. This technique allows us to control for the likely endogeneity of the indicators of openness when analyzed as determinants of growth performance. In particular, it allows us to provide a possible solution to the problem of determining the direction of causation when a relationship is found to exist between the trade and growth variables.

The paper is organized as follows. The next section provides some historical background on the evolution of the main economic policies implemented in Latin America from the period of import substitution to the recent trade liberalization. Section 3 summarizes the economic performance of the manufacturing industries in the countries considered in our empirical exercise, the specification of which is described in section 4.

involved. Grossman and Helpman (1991: 257).

Section 5 introduces the econometric procedure that we adopt. Section 6 describes the estimation results, and section 7 offers concluding remarks.

2 - From Import Substitution to Trade Liberalization: Historical Background

During the past decade most Latin American countries have undergone a series of market-oriented reforms, including not only the liberalization of the region's trade regimes, but also a heightened fiscal and monetary discipline, the privatization of state-owned enterprises, and the deregulation of financial markets. The changes in the field of trade policy have included a sharp reduction in the average rates of import tariffs, as well as in their level of dispersion. In addition, the coverage of the non-tariff barriers to trade has fallen abruptly, in many cases to the point of their complete elimination. These policy changes have been reflected in significant increases in the openness to trade of most Latin American countries, as measured by the ratio of total trade to GDP[7]. In addition to these unilateral measures, several regional integration arrangements – MERCOSUR and NAFTA among others – have been launched or revived, further promoting outward orientation in the region. Finally, since 1986 fourteen Latin American countries have acceded to the GATT/ WTO multilateral trade system, a movement that reflects an attempt by these countries to link the unilateral liberalization of their trade regimes to the negotiation of reciprocal offers on the part of industrial countries[8].

[7] Indicators of trade regimes before and after the reforms can be found in the first chapter of this dissertation – Table 1.1 – and Burki and Perry (1997) – chapter II.
[8] It is worth noting that only eight countries from the region had participated in the previous seven negotiation rounds since 1947 – Primo Braga et al. (1997: 100).

The extent of these changes is even more surprising when one considers the historical background against which they have occurred. Indeed, only a decade ago Latin America's external sector was considered to be "the most distorted in the world"[9]. Furthermore, Latin American governments had been, for several decades, among the strongest defenders of inward-oriented strategies of development. Since the 1930s and especially after World War II, most countries in the region had relied substantially on a policy of import substitution as a route to industrialization. This approach, which implied high levels of protectionism, was initially implemented as a short and medium-term response to external shocks, but was progressively transformed into a long-term economic philosophy based mostly on infant industry arguments. These suggested that the sheltering of the domestic market from foreign competition would lead to the creation of a local industrial base and spur productivity growth through the mastering of state-of-the-art technologies and the development of indigenous technological capabilities.

The dominance of this approach lasted, in most countries, at least until the mid 1980s. However, as noted by Fishlow (1991), the exclusive reliance on the import substitution strategy "reached its peak in the 1950s when import ratios were sharply lowered and trade policies were consciously biased against exports" (p. 157). Starting in the late 1960s, in the midst of recurring internal and external disequilibrium, an increasing number of countries – notably Brazil, Chile, Colombia and Mexico – adopted

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9 Edwards (1995: 115). As this author has noted, however, the very high levels of protection found during the mid-1980s are in part the result of measures taken as a response to the interruption of capital inflows to the region that followed the 1982 "debt crisis".

policy measures aimed at reducing the anti-export bias and promoting non-traditional exports, while maintaining the domestic market protection – Jaspersen (1997: 62).

The new, "mixed", policy approach led to a considerable growth and diversification of the region's industrial output and foreign sales during the 1970s. It was not enough, however, to deal with the effects of the adverse external shocks of the period without resorting heavily to external borrowing. Moreover, the reluctance of most governments to adopt adjustment and stabilization policies after the first oil shock reinforced the dependence of the region's economies on the availability of funds in the international financial markets and contributed considerably to their external vulnerability, especially after the new terms of trade and interest rate shocks of 1979/80. When the Mexican government announced, in August 1982, that it could no longer meet its international financial obligations, the flow of commercial bank loans to the region was drastically reduced, leading most governments in the region to implement severe contractionary policies.

Between 1981 and 1984, the Latin American Countries went from a deficit of $2 billion in their trade balance to a surplus of $39 billion[10]. This turnaround in the transfer of resources to the rest of the world was achieved through sharp reductions in imports and even greater increases in exports (minus 24.7 percent and 33.5 percent, respectively, between 1981 and 1987 for the region as a whole)[11]. To produce these changes, most countries heightened their trade restrictions and promoted considerable devaluations of their real exchange rates. At the same time, most governments implemented drastic

[10] Edwards (1995: 23).
[11] Idem, p. 25.

reductions in public expenditures – especially public investments and wages – and sharp increases in interest rates, with the natural effects on the contraction of private investments. Mostly as a consequence of these policies, the majority of the countries in the region experienced negative rates of growth in per capita gross domestic product during the 1980s, which explains the usual reference to this period as the "lost decade" for growth in Latin America[12].

In the midst of the crisis, inflation rates soared reaching three and four digit figures in a few cases. In some of these countries – Argentina, Brazil and Peru – non-orthodox stabilization programs were implemented starting in 1985/86, using price and exchange rates freezes, at the expense of the emphasis on fiscal discipline, to combat the inertial component of inflation. Despite short-lived periods of success, these programs ended up causing an acceleration of the previous rates of inflation. Their failure, however, exerted an important influence on the thinking of policy-makers in the region. Indeed, it reinforced the generalized sense of frustration with "the once-dominant view based on heavy state interventionism, inward orientation, and disregard for macroeconomic balance", thus contributing to the acceptance of "a new paradigm based on competition, market orientation, and openness" – Edwards (1995: 41). The emergence of this new policy consensus was also associated with the growing influence of the multilateral financial institutions – mainly the IMF and the World Bank – whose share in the flow of foreign funds to the region increased substantially during the 1980s, and who routinely

[12] The only countries that experienced positives rates of real per capita GDP growth in the period 1981-1990 are the Dominican Republic, Chile, Colombia, and Jamaica (ECLAC, 1996: 17). The annual GDP growth rate for the region as a whole was 1.2 percent in the period 1980-90 – it had been 5.6 percent in the previous decade and was 3.4 percent in

included the implementation of market-oriented "structural reforms" as an integral part of the conditionality of their lending programs.

3 - Growth and Structural Change in Industry: 1970-94

During the past two decades Latin America's manufacturing sector has grown, on average, at lower rates than total output. In the countries on which this chapter focuses, this type of performance was most clearly seen in Argentina and Brazil, where the share of manufacturing in GDP fell from around 35 percent in the early 1970s to levels close to 30 percent in the early 1990s (Figure 2.1).

The relatively slow pace of output growth of the Latin American manufacturing industries in the past two and a half decades does not reflect, however, their overall economic performance. Indeed, the region did experience significant changes in the pattern of international specialization of its economy and in the structure of its manufacturing sector. In terms of exports, in particular, the countries here considered underwent, with the only exception of Chile, a considerable reduction in the share of primary products in their foreign sales, with corresponding increases in the shares of industrial exports (Table 2.1)[13]. In Brazil, for example, the share of primary products in total exports fell from 67 percent in 1970 to 20 percent in 1994.

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the period 1990-94 (ECLAC, 1995: 65).

[13] The definition adopted for "primary products" and "industrial products" is the same adopted by ECLAC (1992), which in turn is based upon the classification proposed by the United Nations Industrial Development Organization in UNIDO (1983). This concept of industrial products is a broad one, and includes all primary products that undergo some type of transformation process. Thus, industrial products can be divided in two groups: semi-manufactures, or industrial products based upon natural resources (included in sections 0 to 4 of the SITC), and manufactures in a strict sense, or industrial products not

Within manufacturing, important changes also took place, both in terms of the structure of output and especially in terms of the structure of foreign trade. To appraise these changes, we classify manufactures into five groups, using factor intensity as the defining criteria (Table 2.A.1). We thus distinguish, first, between the goods that are intensive in natural resources, called "semi-manufactures", and those that are not. Among the latter group, we separate those that have a high input of skilled labor, which we call "new industries", from those that have not, and then make a further distinction within each group based on whether the industries are labor or capital intensive[14].

One of the main developments, since the 1970s, has been the relative expansion of the so-called "semi-manufactures" and of the "basic input industries" (Table 2.3) – corresponding, respectively, to industries intensive in natural ressources, and capital-intensive industries with a low input of skilled labor. This can be associated with an increase, mainly since the late 1970s, in the relative importance in the region's economy of the sectors that produce industrial commodities – such as, for example, aluminium, iron and steel, petrochemical products, pulp and paper, vegetable oils, etc. As shown by Benavente et al. (1996: 60), the expansion of these sectors has been promoted, since the late 1970s, through the use of fiscal incentives for the establishment of new plants and the modernization of the existing ones. Thus, during the past two decades these industries

(directly) based on natural resources (included in sections 5 to 8 of the SITC)

[14] This classification was proposed by ECLAC (1992, 1996) and is mostly based on the criteria suggested by UNIDO (1983). The industries are classified as intensive in skilled labor on the basis of the fraction of scientists, engineers, and highly specialized workers, in the total workforce of the corresponding industries in the United States. A listing of the industries included in each of the five groups, by their ISIC codes, is provided in the notes to Table 2.A.1.

received "a new infusion of capital and were equipped with a new generation of highly modern production plants and up-to-date technology" (ECLAC, 1996: 78).

During the 1980s, a decline in the share in total value added of the labor intensive industries with a low input of skilled labor ("other traditional industries"), particularly of the textile industries, was also observed. This trend has persisted in the first half of the 1990s, which has also witnessed an increase in the share of capital intensive "new industries" (industries with a high input of skilled labor), associated mainly with the recent revitalization of the automotive industry in four of the five countries considered – the exception being Chile, where this industry is very small.

Considerable changes have also taken place in the structure of foreign trade, although it is difficult to establish general trends at the industry level (Table 2.2). Most of the changes, however, can be better understood by analyzing the industries' export and import shares in output (Table 2.3). Increases in export shares have been observed in almost all sectors and countries. In the case of exports, they have been particularly large in the "other traditional industries". As previously mentioned, growth in value added was generally slower in these sectors than in the manufacturing industry as a whole. However, there was a very strong reorientation of output towards export demand, which led to an increase in the sectors' share in total exports. Also worthy of comment are: the fall in the share of "semi-manufactures" in total exports, which occurred in the context of higher than average rates of output growth but relatively stable export-output ratios; and the increasing share of the "basic inputs industries" in total exports, which was usually associated to the conjunction of above-average output growth and increases in export-output ratios.

With respect to the aggregate export performance of the manufacturing industry, Mexico appears as the most successful case, with an average export-output share that went from 3.9 percent in the 1970s to 21.3 percent in the 1990s. Brazil and Colombia also showed a very good performance in terms of total industrial exports, basically doubling their export-output ratios to levels close to 14 percent during the 1990s. Argentina, on the other hand, experienced only small increases in its manufacturing export-output ratio, reaching 8.6 percent, on average, during the 1980s, and falling back to 7.9 percent in the early years of the present decade. Finally, Chile showed a downward trend in its manufacturing export-output ratio, but the country still maintains the highest levels for this index (35.6 percent during the 1990s), which is explained by the very strong export orientation of its non-ferrous metals industry – mainly cooper.

With regard to the evolution of manufacturing imports, a comparison of the import-output ratios of the 1970s with their average levels during the 1990s shows an upward trend in all five countries – even in Argentina and Brazil, which had reduced their import shares during the previous decade (Table 2.3). Increases in imports were particularly large – both relative to output and to other sectors' imports – in the "other traditional industries" and, with the exception of Brazil, in the "new industries" (Tables 2.2 and 2.3). Overall, Argentina and Brazil remain the most closed of our sample with import-output ratios close to 10 percent in the 1990s – the corresponding indexes for Chile, Colombia and Mexico being, respectively, 44.1 percent, 30.8 percent and 34.1 percent. In terms of trade balances in manufacturing, Brazil is the only country to have shown a surplus since the 1980s.

With regard to the relative levels of labor productivity, Argentina has maintained, at least since the early 1970s, a considerable advantage over the other four countries (Figure 2.2). Although during the 1970s all five countries experienced relatively similar average rates of growth in value added per worker (Table 2.4), their reactions to the external shocks of the late 1970s, and especially the "debt crisis" of the 1980s, were very different. Indeed, Colombia and Mexico managed to maintain a steady trend of growth in labor productivity – with annual rates of growth above 3 percent – while the other three countries showed almost no growth in value added per worker in the first half of the 1980s. After 1985, however, Brazil and especially Argentina began showing signs of recovery and, in the early 1990s, they attained annual rates of labor productivity growth of almost 10 percent. Chile only recovered after 1990, growing at a rate of 2.8 percent during 1990/94.

With regard to the productivity performance of particular industries, it is clear that Argentina's lead in labor productivity is greatest in "semi-manufactures" and in the labor-intensive "new" industries (Figures 2.3 to 2.7). Chile, on the other hand, has the lowest levels of labor productivity in all manufacturing sectors except for the basic inputs industries. The other three countries share similar levels of productivity in most industries, except for the "other traditional industries" (labor intensive industries with low input of skilled labor), in which Mexico has performed particularly well.

The evidence presented above suggests that both the composition of industrial value added and the rates of growth of labor productivity at the industry level have changed considerably during the past decades. To obtain insight into the relative importance of these two phenomena in the evolution of the rates of productivity growth in manufacturing, we have performed a decomposition of these growth rates using a methodology originally proposed by Nordhaus (1972).

This author emphasized the fact that "the aggregate growth of productivity is not merely an average with constant weights of the sectoral productivity growth rates"[15]. Indeed, aggregate productivity growth can also be affected by shifts in the composition of output that benefit sectors with relatively high (or low) productivity *growth rates*, as well as by shifts that benefit sectors with relatively high (or low) productivity *levels*. More formally, a (discrete time) version of the decomposition proposed by Nordhaus (1972) can be described in the following terms. Let Ait denote the level of productivity (value added per worker) of sector i at time t, Xit denote value added of sector i at time t, Eit denote employment in sector i at time t, and let the subscript i = o refer to the aggregate manufacturing sector. Then, aggregate productivity can be written:

$$A_{ot} = X_{ot} / E_{ot} = \Sigma (X_{it} / E_{it}) (E_{it} / E_{ot}) = \Sigma A_{it} S_{it}$$

where $S_{it}=(E_{it} / E_{ot})$ is the share of sector i in aggregate employment, and the summations are over i. The rate of change (denoted by a lower case letter) of aggregate productivity can then be written:

$$a_{ot} = (A_{ot} - A_{ot}\text{-}1) / A_{ot}\text{-}1 = (\Sigma A_{it} S_{it} - \Sigma A_{it}\text{-}1 S_{it}\text{-}1) / A_{ot}\text{-}1.$$

After some simple algebra, and denoting the initial period by a subscript t=0, the above expression can be rewritten:

[15] Nordhaus (1972: 519).

$$a_{ot} = \Sigma\, a_{it}\, (X_{i0} / X_{o0}) \;+\; \Sigma\, a_{it}\, [(Xit\text{-}1 / X_{ot}\text{-}1) - (X_{i0} / X_{o0})]$$

(I) (II)

$$+\, \Sigma\, (S_{it} - S_{it}\text{-}1)\, [(A_{i0} / A_{o0}) - 1] \;+\; \Sigma\, (S_{it} - S_{it}\text{-}1)\, [(A_{it}\text{-}1 / A_{ot}\text{-}1) - (A_{i0} / A_{o0})]$$

(III) (IV)

$$+\, \Sigma\, a_{it}\, (A_{it}\text{-}1 / A_{ot}\text{-}1)\, (S_{it} - S_{it}\text{-}1)$$

(V)

Folowing Nordhaus'(1972) terminology, we denote the first two terms as rate terms, and the third and fourth terms as level terms. The rate terms represent the rate of aggregate productivity growth that would be observed if the levels of productivity were identical in all industries. This rate effect is in turn decomposed in two parts. The first term, denoted the fixed-weight rate term, represents the rate of productivity growth that would have prevailed if the relative output shares had stayed constant. The second term, denoted the change in fixed weight term, represents the effect of relaxing the previous assumption, thus incorporating the effect of changes in output shares (still assuming identical productivity levels). A positive value for (II) indicates that output shares have shifted toward industries with relatively high rates of productivity growth.

The level effect is also broken into two parts. The third term, denoted the fixed weight level term, measures the extent to which employment has tended to shift toward or away from industries with initial above-average productivity levels. The fourth term, denoted actual weight level term, measures the extent to which the shifts in employment occurred toward or away from sectors which increased their productivity levels relative to the average. Finally, (V) captures the interaction of the rate and level terms, and represents the extent to which employment has shifted toward or away from sectors with relatively high productivity levels *and* growth rates[16].

Table 2.5 reports the results of the above-described decomposition of the rates of labor productivity growth for the period 1970/94, using data from the 28 sectors included in the International Standard Industrial Classification (ISIC) at the 3-digit level. The first finding suggested by these results is that the fixed-weight rate term explains most of the growth in labor productivity. In other words, the changes in the composition of output and employment seem to have had, on average, a relatively small importance in the explanation of productivity growth.

There are, nonetheless, two important exceptions, namely Argentina during the early 1990s, and Chile during the 1970s. During these periods, the countries involved experienced drastic changes in their degrees of openness to international trade, and their aggregate rates of productivity growth in manufacturing were particularly high. In both cases, however, productivity growth would have been considerably faster – respectively 55 percent and 83 percent faster – if the changes in the composition of output and employment had not benefited sectors with relatively slow productivity growth (both countries) and / or relatively low productivity levels (particularly Argentina). These compositional effects were much less visible in Brazil, Colombia, and Mexico, where output shares also shifted toward sectors with relatively lower rates of productivity growth, but at a much smaller rate.

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[16] In the exercise performed by Nordhaus (1972) for the US economy during the period 1948/71, this second-order term is not reported due to its negligible value. As in the countries and periods here analyzed, the changes in the variables involved are not always very small, we have decided to report this fifth term, whose value is sometimes quite

Summing-up, it can be said that although the region has witnessed a decay in the share of manufacturing in GDP, this sector's performance in terms of exports has been outstanding compared with that of the rest of these economies. Increases in export coefficients have been observed in almost all countries and manufacturing industries. Manufacturing imports have also expanded considerably in recent years, after having recovered from the effects of the contractionary policies implemented in the region during the 1980s, and with the stimulus of trade liberalization policies. In terms of labor productivity growth, Argentina and Brazil have experienced dramatic increases in their rates of productivity growth in manufacturing, after the opening of their trade regimes, during the early 1990s. Both countries remain, however, the most "closed" of our sample with regard to international trade, with manufacturing imports still close to 10 percent of output in the early 1990s. Mexico and Colombia, on the other hand, have shown steady rates of productivity growth since the 1970s, while Chile has only recently recovered from a decade of stagnation in its manufacturing productivity. Although considerable changes have taken place in terms of the composition of manufacturing value added, a decomposition of the rates of labor productivity for the period 1970/94 shows that, with some exceptions (Chile during the 1970s and Argentina during the early 1990s), these changes have not played an important role in the explanation of overall productivity growth.

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large.

4 - Empirical Specification

As mentioned in the introduction, the chief objective of this paper is to study the influence of the exposure of Latin American industries to international trade on their productivity performance. Thus, based on the new endogenous growth literature, we assume that the rates of growth of both labor productivity and total factor productivity are potentially affected by variables representative of the openness of the corresponding industries to international trade, and test empirically for the direction and significance of these relationships.

Our empirical specification is based on the assumption of a neoclassical production function with two factors of production at the industry level. More formally, for a given country in year t, we assume that in industry i value added y_{it} is a function of the level of employment l_{it} and the real capital stock k_{it}:

$$y_{it} = f_{it} (l_{it}, k_{it}) \quad (1)$$

We also assume that there are Hicks-neutral technical differences over time and across industries so that this function can be written as the product of an index of total factor productivity a_{it} and a function g:

$$f_{it} (l_{it}, k_{it}) = a_{it} \cdot g (l_{it}, k_{it}) \quad (2)$$

Totally differentiating and dividing by y_{it} yields:

$$d \ln (y_{it}) = d \ln (a_{it}) + (\delta_1) d \ln (l_{it}) + \delta_2 d \ln (k_{it}) \quad (3)$$

where the parameters δ_1 and δ_2 are the elasticities of output with respect to labor and capital respectively. This equation can in turn be rearranged into:

$$d \ln (y_{it}/ l_{it}) = d \ln (a_{it}) + (\delta_1 + \delta_2 -1) \cdot d \ln (l_{it}) + \delta_2 d \ln (k_{it}/ l_{it}) \quad (4)$$

This expression is nothing more than the conventional growth accounting framework introduced by Solow. It indicates that the growth in labor productivity – defined as value added per worker – can be explained by three different factors: technological change, growth in employment, and growth in the capital-labor ratio.

This framework provides the basis for our empirical specification. Initially, however, we do not distinguish whether the influence of openness on labor productivity occurs through its effect on the growth of TFP or by an alteration of the rate of growth of the factors of production. Thus, our first estimating equation is:

$$\ln (y_{it}/ l_{it}) - \ln (y_{i(t-1)}/ l_{i(t-1)}) = \alpha + \beta_0 \ln (y_{i(t-1)}/ l_{i(t-1)}) + \Sigma^j \beta_j \, OPEN^j_{it} + \eta_i + \varepsilon_{it} \qquad (5)$$

where α is a constant, $OPEN^j_{it}$ are variables representative of the industry's exposure to international trade, η_i is an industry-specific effect that may reflect factors such as the industry's specific rate of exogenous technological change, and ε_{it} is a disturbance term, which is assumed to be serially uncorrelated.

The motivation for including the initial productivity term is twofold. First, as argued by Jong-Wha Lee (1996: 397), initial levels of state variables may affect the rate of growth of industry labor productivity in the same way as they affect aggregate growth in the simple Solow-type neoclassical growth model. Thus, the initial labor productivity term can be interpreted as a measure of how far the industries are from their steady-state levels of productivity: the farther they are, the faster they grow in their transition to steady-state. A second motivation for the inclusion of the level variable is that it can affect the rate of growth of TFP through the existence of technological externalities.

Indeed, it can be argued that individual firms can benefit from the knowledge capital accumulated elsewhere in the economy. In one scenario, firms located in industries with low levels of productivity would grow faster as they absorb at a low cost the results of technology or human capital investments undertaken in high-tech sectors. It can be argued, however, that technology spillovers are stronger within industries than across industries: if these within-industries spillovers prevail, lower initial productivity would lead to slower growth, thus generating divergence instead of convergence in productivity[17]. Which effect dominates is an empirical question that we attempt to answer.

Our second estimating equation is intended to measure the effect of the openness and the initial state variables on technological change alone. A simple procedure to do so – suggested by equation (4) – would be to include in equation (5) the rates of change of employment and the capital-labor ratio. The problem is that data for the latter is not available at the industry level for the countries on which we focus. However, it is possible to circumvent this practical difficulty by slightly modifying the growth accounting framework presented above and making use of data on labor shares to which we do have access.

The additional and relatively general assumptions that are needed are: that the function g is translog, that producers are cost-minimizers, that they are price takers in

[17] The mechanism by which technology spillovers across industries could be expected to generate convergence or divergence in productivity would be the same that operates in the models of trade and endogenous growth described by Grossman and Helpman (1991: chapters 8 and 9) and Feenstra (1996), where the firms' productivity in research and development is positively related to the stock of knowledge capital developed in the environment in which they are located – their country or, as in the present case, their

input markets, and that the production function is homogeneous (not necessarily of degree one). Under the first assumption, the log of value added can be written as:

$$\ln y_{it} = \ln a_{it} + \alpha_0 + \alpha_1 \ln k_{it} + \alpha_2 \ln l_{it} + \alpha_3 (\ln k_{it})^2 + \alpha_4 (\ln l_{it})^2 + \alpha_5 \ln k_{it} \cdot \ln l_{it} \qquad (6)$$

Under the second and third assumptions, the elasticities of output with respect to labor and capital can be shown to be equal to the shares of the corresponding factors of production in total value added (s^l_{it} and s^k_{it}, respectively):

$$s^l_{it} = (d\, y_{it}/ d\, l_{it}) \cdot (l_{it}/ y_{it}) = \alpha_2 + 2\, \alpha_4 \ln l_{it} + \alpha_5 \ln k_{it} \qquad (7)$$

$$s^k_{it} = (d\, y_{it}/ d\, k_{it}) \cdot (k_{it}/ y_{it}) = \alpha_1 + 2\, \alpha_3 \ln k_{it} + \alpha_5 \ln l_{it} \qquad (8)$$

Substituting these expressions into equation (6) and taking the first difference of this equation yields:

$$\ln (y_{it}/ y_{i(t-1)}) = \ln (a_{it}/ a_{i(t-1)}) + ½ (s^l_{it} + s^l_{i(t-1)}) \cdot \ln (l_{it}/ l_{i(t-1)}) + ½ (s^k_{it} + s^k_{i(t-1)}) \cdot \ln (k_{it}/ k_{i(t-1)})$$

(equation 9)[18].

Imposing homogeneity on the production function (6) implies the following restrictions:

$$2\alpha_3 + \alpha_5 = 0 \qquad (10)$$

$$2\alpha_4 + \alpha_5 = 0 \qquad (11)$$

Substituting these expressions into the factor shares – equations (7) and (8) – yields:

$$s^l_{it} = \alpha_2 - 2\, \alpha_3 \ln (k_{it} / l_{it}) \qquad (12)$$

$$s^k_{it} = \alpha_1 + 2\, \alpha_3 \ln (k_{it} / l_{it}) \qquad (13)$$

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industry.

[18] It is worth noting that equation (9) can also be obtained as a discrete-time approximation to equation (3) under the assumptions of perfect competition. Obtained in this fashion, equation (9) is the basis of the Divisia-Tornquist index of TFP growth used by Solow (1957). However, under the assumption of a translog production function, equation (9) is obtained directly and is not an approximation. Since the translog specification is considered to be fairly general – it can interpreted as a second-order approximation to any production function (Greene, 1997, p. 229) – it is usually thought to

Substituting these equations into equation (9) yields:

$$\ln (y_{it}/ y_{i(t-1)}) = \ln (a_{it}/ a_{i(t-1)}) + (\alpha_1 + \alpha_2) \cdot \ln (l_{it}/ l_{i(t-1)}) + [(\alpha_1 + \alpha_2 - 1)/ \alpha_5] \cdot (s^l_{it} - s^l_{i(t-1)})$$

$$+ (1/ \alpha_5) [1- ½ (s^l_{it} + s^l_{i(t-1)})] \cdot (s^l_{it} - s^l_{i(t-1)}) \quad (14)$$

Similarly, an expression for the rate of growth of labor productivity can be derived by re-arranging this equation:

$$\ln (y_{it}/ l_{it}) - \ln (y_{i(t-1)}/ l_{i(t-1)}) = \ln (a_{it}/ a_{i(t-1)}) + \gamma \ln (l_{it}/ l_{i(t-1)}) + \phi_1 (s^l_{it} - s^l_{i(t-1)})$$

$$+ \phi_2 (1 - \bar{s}_{it}) \cdot (s^l_{it} - s^l_{i(t-1)}) \quad (15)$$

where $\gamma = (\alpha_1 + \alpha_2 - 1)$, $\phi_1 = \gamma / \alpha_5$, $\phi_2 = 1 / \alpha_5$, and $\bar{s}_{it} = (1/2) (s^l_{it} + s^l_{i(t-1)})$. It is worth noting that since $(1 + \gamma)$ is the elasticity of scale, γ can be interpreted as a measure of the degree to which the production function differs from constant returns to scale. This provides the basis for our second estimating equation:

$$\ln (y_{it}/ l_{it}) - \ln (y_{i(t-1)}/ l_{i(t-1)}) = \alpha + \beta_0 \ln (y_{it0}/ l_{it0}) + \Sigma^j \beta_j \, OPEN^j_{it} + \gamma \, d \ln l_i + \phi_1 (s^l_{it} - s^l_{i(t-1)})$$

$$+ \phi_2 (1 - \bar{s}_{it}) \cdot (s^l_{it} - s^l_{i(t-1)}) + \eta_i + \varepsilon_{it} \quad (16)$$

All the data on output, value added, employment, wages, and trade flows, comes from the data base *PADI* (version 2.0), developed by the United Nations' joint ECLAC/UNIDO Industrial and Technological Development Unit, to whom we are most grateful[19]. The data is available, for most countries, for the period 1970-1994, and covers

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provide a justification for the use of the Divisia-Tornquist index of TFP growth.
[19] PADI stands for "Program for the Analysis of Industrial Dynamics". It was developed at ECLAC, in Santiago, Chile, on the basis of information from the database on industrial statistics of the United Nations Industrial Development Organization (UNIDO). These statistics were checked at ECLAC for consistency with those provided directly to this

the 28 industries included in the International Standard Industrial Classification (ISIC) at the 3-digit level (see Table 2.A.2).

As for $OPEN^{j}_{it}$, we use two different types of variables representing the degree of openness to international trade of the industries considered, namely variables based on actual trade flows, and direct measures of trade barriers based on trade policy data[20]. Because the industries and periods for which data is available on the two types of openness variables are different, we estimate two different versions of our regression equations: in the first, we use the set of "outcome-based" openness variables and in the second the policy-based variables.

Within the group of openness variables based on trade flows, we consider four variables: the share of imports plus exports in the total output of the corresponding industry (*TI*), the Grubbel-Lloyd index of intra-industry trade (*IIT*), the rate of growth of exports (*GX*), and the rate of growth of the import-output ratio (*GMC*). Each variable measures a different dimension of the degree of openness of a given industry, so that we use them simultaneously in our regression equations.

The first variable that we use (*TI*) is usually thought to be the simplest measure of "trade intensity" and is generally found to be positively related to output growth in aggregate studies (Harrison, 1996: 421). When used in cross-country comparisons, this variable has the disadvantage of being affected not only by trade policy but also by non-policy characteristics of the countries involved, such as their size, distance to markets and

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organization by the governments of the countries involved.

[20] The two groups of variables can be classified, respectively, in what Baldwin (1989) – quoted in Pritchett (1996: 308) – calls outcome-based and incidence-based measures of trade barriers.

resource endowments[21]. In the present context, however, since we compare the performance of industries within a given country, it can be argued that this criticism is of lesser importance.

The second variable that we consider (*IIT*) is defined as one minus the share of the absolute value of the trade deficit (or surplus) in total trade: it varies from zero to one, taking the value zero when for a given industry trade flows are observed in a unique direction (either imports or exports), and the value one when the industry's imports are exactly equal to its exports. This measure of intra-industry trade is expected to capture the extent to which trade in a given industry is constituted by trade in differentiated products –Dixit and Norman (1980), Krugman (1981), and Grossman and Helpman (1991, chapter 7). Thus, it can be argued that innovation-based growth should be more prevalent in industries with high *IIT*, so that these industries should be expected to grow at faster rates for given rates of labor growth and capital accumulation. In fact, Backus, Kehoe and Kehoe (1992) have found that, in a cross-section of countries, growth in manufacturing labor productivity is positively correlated with the extent of intra-industry trade, a result that they interpret as evidence in favor of the theories of endogenous growth – at least in the manufacturing sector. It is possible, however, that in some of the countries considered, protectionist policies have led to the insulation of the industries with a bigger potential for technology development, so that trade occurs, at best, in a unique direction

[21] This problem has led several authors to adjust trade shares for the effect of non-policy variables. Examples are given by the "structure adjusted trade intensity" measures used, for example, by Pritchett (1996: 312): the author uses the residuals from a regression of trade shares on the countries population, area, transports costs, and GDP per capita. Leamer (1988), on the other hand, constructs measures of openness based on the residuals from the estimation of a Heckscher-Ohlin-Vanek model of trade, using resources supplies

and *IIT* appears to be relatively low in those industries. In any case, caution should be used in the interpretation of this variable since, as suggested by Leamer (1988: 163), high levels of *IIT* could also reflect higher levels of aggregation in the corresponding industries and not necessarily a higher degree of intra-industry trade.

The third and fourth openness variables that we use (*GX* and *GMC*) are constructed as the first-differences of the log of, respectively, total exports and the share of imports in total output. They are measures of the rate of change of the degree of exposure of local industries to foreign competition, either in international markets, or on the domestic market. Using these same variables, past studies of the trade-productivity link at the industry level have encountered a positive relationship between productivity growth and export growth, but have also often found – with some exceptions – that productivity growth is negatively related to the growth of the import-output ratio[22]. Some authors have interpreted these relationships in the context of the so-called "Verdoon's Law", that postulates a positive association between output and productivity growth, which is "taken to reflect scale economies or the embodiment of new technologies during periods of rapid investment" (Tybout, 1992: 193). As stated by Nishimizu and Page (1991: 253), "this argument is usually cast in terms of the benefits of increased demand

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and distance to markets data to predict trade flows.

[22] Nishimizu and Robinson (1984), Nishimizu and Page (1991), Tybout (1992), and Bonelli (1992), all find that the growth of exports is positively correlated with TFP growth. However, only the first paper – which focuses on Japan, Korea, Turkey and Yugoslavia – finds a negative relationship between import substitution (defined as one minus import penetration) and TFP growth. Import substitution is found to be positively related to TFP growth by Tybout (1991, 1992) – who describes evidence from a study of pooled data from 3-digit industries in Chile, Colombia, Turkey and Morocco – while Nishimizu and Page (1991), in a study of 17 countries, find that import penetration has a negative effect on TFP growth in the period 1973/85, and is not significant when only the

through export expansion, but it applies equally to rapid import substitution in large domestic markets". A different explanation is proposed by Harrison (1996: 424), which attributes the asymmetry between the effects of exports and imports on productivity growth, to "estimation problems arising from simultaneity bias". Indeed, exports tend to grow faster in sectors in which countries are experiencing higher rates of productivity growth, while imports are likely to increase in sectors with a poor productivity performance. Thus, a proper empirical treatment of the trade and growth link should deal explicitly with the fact that causality between the two probably runs in both directions[23].

In the group of the policy-based measures of openness, we consider two variables: the average tariff rates for each industry (*TARIFF*) and the corresponding coverage of non-tariff barriers to trade (*NTB*). The data comes from UNCTAD's (1994) *Directory of Import Regimes*, which provides information for the product lines included in the Standard International Trade Classification (SITC) at the 3-digit level. In order to make *TARIFF* and *NTB* consistent with the variables used to measure productivity, we considered only 17 of the industries defined by the SITC. These industries, as well as their correspondence with those defined by ISIC, are described in Table 2.A.3. The countries for which we have enough data to estimate our model are Argentina, Brazil and Mexico, over the period 1986-1993.

The reason to include *TARIFF* as well as *NTB* is that, although both variables usually have a high correlation, their effect on productivity may be quite different. As

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period prior to 1973 is analyzed.

[23] As stated by Harrison (1996: 441): "Does openness cause growth? Or is it the other way around?". In practice, the author deals with this issue *ex post* (after performing her regression analysis), using vector autoregressions, and finds that "causality between

stressed by Nishimizu and Page (1991: 253), "the *instruments* by which protection is afforded to domestic industries can affect productivity performance quite appart from the *levels* of protection granted." Indeed, non-tariff barriers to trade (NTBs) insulate domestic producers from the effect of changes in international prices – and thus from the effects of international productivity trends – in a way that is not possible under tariff protection. Still, it is important to keep in mind that *NTB* is only an approximate measure of the importance of non-tariff restrictions to trade, since it only indicates the fraction of the total number of products that are subject to NTBs, without measuring how intense the barriers in question are. As stressed by Leamer (1988: 147), "not all non-tariff barriers can be measured, and not all barriers are equally restrictive". On the other hand, neither *TARIFF* nor *NTB* are free from the endogeneity problems mentioned above for the outcome-based openness variables. As shown by Harrison (1996: 424), "trade policy itself may be a function of other variables, including growth". One could think, for example, that the sectors with slower productivity growth are exactly those that spend more efforts in lobbying for increased levels of protection, or for a slower pace of trade liberalization. Thus, the econometric procedure adopted must deal with the potential endogeneity of all openness variables.

5 - Econometric Methodology

The estimation procedure that we adopt takes explicitly into consideration the possibility of simultaneity and reverse causality between the rate of productivity growth of a given industry and the degree of openness of this industry. Furthermore, we allow for

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openness and growth runs in both directions" (p. 442).

the existence of an industry-specific effect contained in the error term, and potentially correlated with our explanatory variables. Thus, we deal explicitly with the fact that the openness variables are likely to be endogenous in our estimating equations. To do so, we make use of a Generalized Method of Moments (GMM) estimator of the type proposed by Blundell and Bond (1997).

To simplify the exposition, consider the following regression equation, which encompasses our two estimating equations,

$$Y_{it} - Y_{i(t-1)} = \alpha + \beta_0 Y_{i(t-1)} + \beta_1 X_{it} + \eta_i + \varepsilon_{it} \quad (17)$$

where Y_{it} is labor productivity in industry i at time t, X_{it} represents the set of explanatory variables included in equations (5) and (16), η_i is an industry-specific effect potentially correlated with the explanatory variables, and ε_i is a serially uncorrelated error[24]. As is well known, due to the dynamic nature of this model the conventional fixed-effects transformation does not lead to a consistent estimator. Similarly, taking the first difference of equation (17) eliminates the individual effect but also creates an endogeneity problem, as the first-differenced lagged dependent variable is correlated with the first-differenced error. A solution proposed, among others, by Anderson and Hsiao (1981) and Arellano and Bond (1991), is to estimate the first-differenced equation by GMM, assuming that the error terms are not serially correlated and that the explanatory variables are at least weakly exogenous. In these circumstances, it is possible to make use of moment conditions of the following type:

$$E\left[Y_{i(t-s)} \bullet (\varepsilon_{it} - \varepsilon_{i(t-1)})\right] = 0 \qquad \text{for } s \geq 2 \text{ and } t \geq 3 \quad (18)$$

[24] Note that this model can be rewritten with Y_{it} (the level of labor productivity) as the dependent variable, which is the standard specification in the literature on dynamic panel-

$$E [X_{i(t-s)} \bullet (\varepsilon_{it} - \varepsilon_{i(t-1)})] = 0 \qquad \text{for } s \geq 2 \text{ and } t \geq 3 \qquad (19)$$

These conditions are implied by the assumptions about the lack of serial correlation in the error term and the weak exogeneity of the explanatory variables X_{it}. The meaning of the latter assumption is that X_{it} is potentially correlated with both contemporaneous and past values of the error term, but not with future values of this variable:

$$E [X_{it} \bullet \varepsilon_{is}] = 0 \qquad \text{for } t < s \qquad (20)$$

Thus, for example, rapid productivity growth – or one of its time-varying determinants – may be the cause of greater openness in the present and future, but not in the past.

A property of the GMM estimators that are based on first-differences is that they only make use of the time-series variation in the data – the cross-sectional variation being lost in the first-differencing. In the context of the present paper, this constitutes a problem since we attempt to estimate not only the effect of greater openness on growth that arises from the comparison of given industries during different periods of time, but also the evidence that can be obtained from the comparison of different industries during the same period – the cross-sectional variation.

There are also statistical problems related with the use of the first-differences GMM estimator. As shown by Ahn and Schmidt (1995), this estimator does not make use of all the moment conditions that are available under fairly general assumptions, and is not efficient under these assumptions. Furthermore, Blundell and Bond (1997) show that, in many practical cases, lagged levels provide weak instruments for first differences. To deal with these problems, Blundell and Bond (1997) suggest the use of additional linear moment conditions. Specifically, they suggest to follow Arellano and Bover (1995) in the

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data models.

use of "an extended linear GMM estimator that uses lagged *differences* of Y_{it} as instruments for equations in levels, in addition to lagged *levels* of Y_{it} as instruments for equations in first-differences" (Blundell and Bond, 1997:1). The linear moment conditions proposed by Blundell and Bond (1997: 11) encompass non-linear moment conditions suggested by Ahn and Schmidt (1995), and the authors show that both methods improve upon the simple first-difference specification with lagged levels as instruments.

In this paper, we utilize the system GMM estimator proposed by Blundell and Bond (1997: 14), making use of the moment conditions implied by equations (18) and (19) for the equations in differences[25], and of the following moment conditions for the equations in levels:

$$E\,[\eta_i \bullet (X_{i(t-1)} - X_{i(t-2)})] = 0 \qquad \text{for } t \geq 3 \qquad (21)$$

$$E\,[\varepsilon_{it} \bullet (X_{i(t-1)} - X_{i(t-2)})] = 0 \qquad \text{for } t \geq 3 \qquad (22)$$

$$E\,[\eta_i \bullet (Y_{i(t-1)} - Y_{i(t-2)})] = 0 \qquad \text{for } t \geq 3 \qquad (23)$$

$$E\,[\varepsilon_{it} \bullet (Y_{i(t-1)} - Y_{i(t-2)})] = 0 \qquad \text{for } t \geq 3 \qquad (24)$$

Equation (21) amounts to assuming that changes in X_{it} are uncorrelated with the industry-specific effect. Thus, for example, even though the level of trade-intensity or the average tariff of a given industry may be correlated with the industry-specific rate of exogenous technological change, we assume that the rates of change of the openness variables are not correlated with the industry-specific effect[26]. Equation (22) is implied by the

[25] In practice, because of the limited size of our sample, we limit ourselves to the use of the second lag of the variables X_{it} and Y_{it} as instruments in the equations in differences: we actually use only the moment conditions implied by (18) and (19) in the case s=2.
[26] Consistently, we assume that the variables *GX* and *GMC*, which measure changes in

assumption of weak exogeneity of the explanatory variables X_{it} (equation 20). The validity of equation (23) is shown by Blundell and Bond (1997: 12) to depend "on a restriction on the initial conditions process generating Y_{i1}", namely that the deviations of the initial level of Y_{it} from the convergent level of this variable, which depends on the industry-specific effect, is uncorrelated with the industry-specific effect itself. Since we picked the first year of our series (1970) only because it was the first year for which ECLAC reported industrial productivity, and since there is nothing special about the level of productivity in the industries of our sample during this year, we might expect the moment conditions (23) to be valid in the present case. Finally, equation (24) is implied by the assumption of lack of serial correlation in the error term.

Based on this set of moment conditions, we construct a system GMM estimator by stacking the equations in first differences and the equations in levels for which instruments are available[27]. As explained above, lagged levels are used as instruments in the equations in differences – conditions (18) and (19) – and lagged differences (of the explanatory and the dependent variable) are used as instruments in the equations in levels – conditions (21) to (24)[28].

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and not levels of trade openness, are not correlated with the industry-specific effect. For these variables, the following moment conditions are substituted for those derived from (21) and (22):

$E[\eta_i \bullet X_{i(t-1)}] = 0 \qquad \text{for } t \geq 2$

$E[\varepsilon_{it} \bullet X_{i(t-1)}] = 0 \qquad \text{for } t \geq 2$

[27] In practice, all the estimation based on GMM is performed using the Gauss-based DPD 96 program, whose original version is described in Arellano and Bond (1988).

[28] The only exceptions are the variables *GX* and *GMC*, for which the instrument is the first lag (and not the lagged first-difference) in the equations in levels of the levels plus differences specification (see note 27).

Since in order to control for industry-specific effects we are forced to drop the observations of at least the first period of our panels – which are already quite short – we also estimate a model in which there are no industry-specific effects. In this case, the estimation is performed in levels, and the moment conditions are given by the assumptions of weak exogeneity of the explanatory variables X_{it}, as reflected in equation (20), and no serial correlation in the error term, as expressed in the following moment condition:

$$E\left[Y_{i(t-1)} \bullet \varepsilon_{it}\right] = 0 \qquad (25)$$

In both types of estimation procedures – levels and levels plus differences – we report a Sargan test for overidentifying restrictions proposed by Arellano and Bond (1991), which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. We also report tests of serial autocorrelation of the error term ε_{it}. Specifically, we test whether the error term is first- or second-order serially correlated in the level regression and, when sufficient observations are available, we also test whether the differenced error is second-order serially correlated in the specification with both levels and differences (by construction, first-order serial correlation is likely to appear in this case). It is worth noting that both under the Sargan and the serial correlation tests, failure to reject the null hypothesis gives support to the model. Moreover, in the levels specification, rejection of the hypothesis of no serial correlation of the residuals constitutes evidence in favor of a model that allows for an industry-specific effect.

6 - Estimation Results

As previously mentioned, we run two sets of regressions using, respectively, trade flows-based and trade policy-based measures of openness. In the first case, we have data for the period 1970-92 for Argentina, and 1970-94 for Brazil, Chile, Colombia and Mexico. For each country, we use a panel of 28 industries (27 in the cases of Chile and Mexico) described in Table 2.A.2, which correspond to the industries defined at the 3-digit level in the International Standard Industrial Classification (ISIC)[29].

In order to separate the long-run relationship between openness and growth – in which we are interested – from spurious links arising from short-run fluctuations, we construct a panel where the observations are averaged over five-year periods[30]. The type of short-run relationship that we attempt to purge from the data is the one that arises, for example, in the cases where countries faced with large external shocks react with policies that reduce the degree of openness of the economy, while the latter experiences low or negative growth (Harrison, 1996: 434)[31].

Our dependent variable is calculated as the average rate of growth of value added per worker in each 5-year period, while initial productivity is measured as value added per worker during the first year of each of these periods. Similarly, the trade flows-based openness variables are calculated as 5-year-averages of the corresponding annual variables.

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[29] In the cases of Chile and Mexico, the sector ISIC 314 (Tobacco) was excluded because of the lack of consistent data.

[30] The only exception is Argentina, for which the fifth period observations correspond to 1990-1992 averages.

[31] The author quotes Quah and Rauch (1990), "who use trade shares as a proxy for openness, (and) find that most of the observed positive relationship between openness

In the case of the trade policy-based openness variables, we have data for 17 industries in Argentina, Brazil and Mexico, during the years 1987 (1986 for Brazil), 1990, and 1993 (1992 for Mexico). We implement our model by constructing panels that cover three 3-year periods (1986/88, 1989/91, and 1992/94), and treat the available annual observations for tariffs and NTBs as representative of the trade policies applied during the corresponding periods[32].

Tables 2.6 to 2.10 present the results of the regressions estimated using the GMM technique, and making use of trade flows-based openness variables. Tables 2.12 to 2.14 cover the regressions that use trade policy-based measures of openness. In each Table, regressions (1) and (2) correspond to our first estimating equation (equation 5), implemented successively in a levels specification, and a differences plus levels specification – the second one allowing, as explained in the previous section, for the existence of an industry-specific effect. Similarly, regressions (3) and (4) correspond to our second estimating equation (equation 16), implemented in the two above-mentioned specifications. As shown in section 4, regressions (3) and (4) control for the accumulation of labor and capital so that the coefficients on the openness variables should be interpreted as representing the partial effects of changes in these variables on the rate of TFP growth. The corresponding coefficients in regressions (1) and (2), on the other hand, measure the impact of changes in the degree of openness on labor productivity growth,

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and growth is due to short-run cyclical fluctuations" (Harrison, 1996: 434).

[32] We also have data on weighted averages of tariffs and NTBs, using the imports of a group of 120 developing countries as weights. We only report regression results using the non-weighted *TARIFF* and *NTB*. However, similar results were obtained in (non-reported) regressions using the weighted measures of tariffs and NTBs. Averages of weighted and non-weighted tariffs and NTBs are presented in Table 2.A.4. Correlations

including both the effects that operate through changes in the rates of TFP growth, and those that act through changes in the rates of capital accumulation and employment growth.

6.1 - Regressions with Trade Flows-Based Openness Variables

The first finding suggested by the regression results in Tables 2.6 to 2.10 is the great heterogeneity existing in the relationship between trade openness and productivity growth. Indeed, the hypothesis of a positive effect of openness – as measured by our trade flows-based variables – on the rates of growth of both labor and total factor productivity is supported in only some of the countries considered, while a negative relationship is found in others. Table 2.11 summarizes this finding, by listing the countries for which statistically significant relationships – either positive or negative – were found between each openness variable and each measure of productivity growth[33].

Overall, the result for which most supportive evidence was found is that of a positive relationship between trade intensity and TFP growth, which appears to be present in four of the five countries. In Colombia, however, higher trade-shares in output have caused a decline in TFP growth. Furthermore, in the case of labor productivity growth, it appears that only in two countries (Argentina and Brazil) does trade intensity have a positive and significant effect. Thus, our results show that dynamic gains from trade have

between the two types of measures are very high, as can be seen in Tables 2.A.5 to 2.A.7.
[33] We have not included in this Table the countries for which the corresponding regressions were not supported by the specification tests at the 5 percent level of significance). When both the levels and the differences-and-levels regressions were valid, we have reported the results of the latter, which controls for the presence of industry-specific effects.

been prevalent in most countries but they have been usually limited to TFP growth – and do not necessarily apply to capital accumulation (the other component of labor productivity growth).

We measure the static effects of trade openness through the coefficients of the rates of change of exports and import-output ratios. The results indicate that these effects have been positive in some countries and negative in others. Thus, in the case of export growth, it appears that it has caused both faster TFP and labor productivity growth in two countries (Argentina and Brazil), but has had contrary effects in two others (Colombia and Mexico)[34]. The evidence for the effects of greater import penetration is even less clear: in Brazil they are positive both for TFP and for labor productivity growth, in Colombia they are both negative, in Argentina the effect on labor productivity is positive but that on TFP is negative, and in Mexico only the effect on labor productivity growth is statistically significant (and positive).

Similarly, the productivity performance of Latin American industries does not show an unequivocal relationship with the extent of their intra-industry trade. As with the other openness variables, the results are mixed. It appears, however, that in most of the cases the effects of changes in the Grubbel Lloyd index of intra-industry trade and those of changes in the growth of import-output ratios have acted in the same direction.

Finally, evidence of convergence in productivity growth is present only in Argentina and Brazil, and in both cases it only appears to operate through the faster TFP growth of industries with initially lower levels of labor productivity. Returns to scale, on

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[34]A positive effect of both *GX* and *GMC* on TFP growth was also found in Chile. Nothing can be said for labor productivity, however, since the corresponding regressions are not

the other hand, appear to be increasing in Argentina but decreasing in all the other countries considered.

6.2 - Regressions with Trade Policy-Based Openness Variables

Before presenting the results of the regressions performed using trade policy-based openness variables, it is important to note that, at least during 1986/1993, trade liberalization policies have been implemented in very different ways in Argentina, Brazil and Mexico. Indeed, during this period, the first two countries made considerable cuts in both tariffs and NTBs. Mexico, on the other hand, had already initiated its trade liberalization process – in 1985/1986 – so that both types of trade barriers had already undergone significant changes.

Tables 2.A.5 to 2.A.7 report bivariate correlations among policy-based measures of trade openness, and between these variables and the growth rates of exports and imports. These Tables reveal at least two important differences between the trade policy reforms of Argentina and Brazil, on one hand, and Mexico on the other. The first is related to the correlation between tariffs and NTBs. Indeed, in the former two countries this correlation is positive (0.65 for Argentina and 0.34 for Brazil), while in the latter country it is negative (-0.27). This reflects the fact that during the period here considered Argentina and Brazil abruptly reduced the degree of protection of their local industries, using cuts in both tariffs and NTBs in a complementary fashion. Mexico, which had already made the biggest changes in its trade policies prior to 1987, made use of tariffs and NTBs as alternative or substitute means of adjusting levels of protection from import

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supported by specification tests.

competition – e.g. making the biggest cuts of NTBs in sectors where tariffs were experiencing the smallest reductions or were even being increased[35].

A second distinguishing characteristic of the trade liberalization policies implemented in the three countries considered is encountered in the different impacts of these policies on the growth of foreign trade. In the case of imports, their growth appears to be negatively correlated with both tariffs and NTBs only in Argentina (Table 2.A.5). In Brazil, these correlations are negligible indicating that in this country low protection – either through low tariffs or through low NTBs – is not necessarily associated with high import growth, at least in the short run (Table 2.A.6). In the case of Mexico, the evidence is even more puzzling, as NTBs show a small but negative correlation with import growth, but this variable appears to have a considerable positive correlation with average tariffs (Table 2.A.7). A possible explanation for this result is that in Mexico, at least during the period on which we have data, tariffs were kept high or even increased in the sectors that were most vulnerable to import penetration[36].

With regard to exports, in Argentina their growth was negatively correlated with the growth of imports and positively correlated with the levels of tariffs and NTBs. In Brazil, low tariffs and NTBs were also associated with low export growth but the

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[35] Ros (1994: 192) describes the trade reforms undertaken by the Mexican government in 1985 and 1986, which included the replacement of "direct controls" (NTBs) by tariffs. This replacement was initiated before the July 1986 GATT membership agreement, but in this agreement Mexico pledged to continue this type of policy, while also making a commitment to future tariff reductions. Liberalization measures, however, were waived in some manufacturing industries – automobiles, pharmaceuticals and electronics – where the government had been implementing special promotion programs.

[36] In fact, in January and March 1989, the Salinas Administration made an upward adjustment in tariff rates which was motivated by "concerns about making effective protection more uniform and, probably even more, about the surge of consumer goods

correlation was smaller, and there was no apparent relationship between import and export growth. Mexico is the only country where increases in imports were associated with increases in exports, and where at least one of the forms of protection (NTBs) was negatively associated with exports. Low tariffs, however, were, as in the other two countries, positively correlated with low export growth.

All in all, the above bivariate correlations indicate, first, that trade liberalization policies were implemented in very different ways in each country here studied and, second, that their effects on the growth of foreign trade were also completely different. It is therefore no surprise that the econometric estimation of the influence of trade policy on productivity growth yields quite different results in the various countries considered.

Regression results are presented in Tables 2.12 to 2.14, and summarized in Table 2.15. The first important finding is that in Argentina trade policies at the industry level have had no significant effect on either labor or total factor productivity. This is quite surprising since, as shown in section 3 of this chapter, this country has the highest levels of labor productivity of our sample – which should reduce its vulnerability to foreign competition and favor the occurrence of beneficial effects from trade liberalization – and has in fact performed remarkably well, in the aggregate, after the opening of its economy in 1990. One possible explanation is that, as shown above, the more liberal trade policies of this country have been correlated with both higher imports and lower exports, thus having conflicting consequences on productivity growth. We also know, from our decomposition of labor productivity growth – "à la Nordhaus (1972)" –, that during the early 1990s Argentina has witnessed considerable changes in the composition of output

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imports during 1988" (Ros, 1994: 193).

and employment, which have favored industries with relatively low levels and rates of growth of labor productivity. Since the "room" for these compositional effects is probably different within each of the 3-digit industries considered, different responses of these (3-digit) aggregates to the same policy changes could arise.

With regard to Brazil's and Mexico's results, we found that in both countries tariff reductions have had beneficial effects on both labor and total factor productivity growth. The magnitude of these effects, however, has been much larger in Mexico, where they appear to have occurred mainly through changes in the rates of capital accumulation – rather than through increases in the rates of TFP growth. Reductions in NTBs, on the other hand, have been beneficial to productivity growth in Mexico, but they have had the opposite effect in Brazil.

In the case of Brazil, it is important to keep in mind that its trade policies have had a negligible correlation with import growth at the industry level and low (negative) correlation with export growth. Thus, Brazil's industries have not necessarily experienced a larger exposure to foreign competition after the implementation of more liberal trade policies, a fact that could reflect the existence of other government policies that favor local production to the detriment of imports. In this context, the beneficial effect of tariff reductions could be interpreted as reflecting the fact that low tariffs, even when accompanied by other barriers to trade, allow local firms to better monitor the changes in international prices, and thus to have a better appraisal of trends in international productivity. With regard to the positive association between high NTBs and faster productivity growth, it is worth noting that although the average coverage of NTBs has been drastically reduced, their relative dispersion has been raised considerably (Table

2.A.4). The result that the sectors whose NTBs were left at higher levels have performed relatively better can be interpreted as evidence that, in this country, the incentives arising from government policies still prevail over market-incentives in the determination of the industries' decisions to make efficiency enhancing investments.

Finally, it is worth noting that, in the three countries considered, regression results indicate that in recent years there was increasing divergence in either labor (Argentina) or total factor productivity (Brazil and Mexico). Thus, the sectors with higher initial levels of labor productivity have performed relatively better in the context of trade liberalization, which, as previously mentioned, is consistent with the predictions of the new theories of trade and growth.

7 - Summary and Conclusions

During the past twenty five years, manufacturing exports in several of the biggest Latin American countries experienced unprecedented rates of growth. This can be attributed, in part, to the effort, by some of the governments in the region, to correct the anti-export bias of their highly "closed" trade regimes. But exports were also stimulated by the macroeconomic policies implemented during the 1980s, as a response to the "debt crisis". Indeed, these policies caused sharp contractions in domestic demand as well as considerable devaluations of the local currencies, which had the effect of reorienting an important share of industrial output towards export demand. This, together with a sharp contraction of imports, allowed the region's economy to accomplish an enormous reversal of the flow of resources towards the rest of the world. The cost of these policies was not low, and a growing sense of frustration with the development strategies that had been applied before the crisis began to take shape. By the end of the decade a new policy consensus was becoming dominant among policy-makers, involving a shift towards more market-oriented economic policies, with trade liberalization featuring prominently in the reforms agenda. By the early 1990s, most countries in the region had taken important steps in this direction, slashing tariffs and other import barriers, while also deregulating financial markets, privatizing public enterprises and adopting macroeconomic policies involving a stricter fiscal and monetary discipline.

Implicit in the new development strategy is the idea that there are important static and dynamic gains to be obtained by increasing the openness to international trade of the region's economy. The main channel through which these gains will come, it is generally believed, is the increase in productive efficiency associated with greater exposure to foreign competition – either through increased imports or through a larger presence of local firms in international markets – and with greater local access to foreign inputs and technologies. These trade-growth links, which had long been ignored by economic theorists, have recently been the subject of new research, mostly associated with the new models of endogenous growth. This new literature has formalized the idea behind the higher-efficiency-through-trade "story", but it also has highlighted potential negative effects of trade on growth. Indeed, it has been shown that, in some circumstances, labor-rich countries may be led, under free trade, to specialize in slow growing industries. Thus, in the aggregate, these countries may eventually experience slower growth under free trade, even if their sectoral growth rates are now higher[37]. Particularly in the context of

[37] It is important to note, however, that slower growth is not necessarily associated with lower welfare. An evaluation of the effects of trade on the latter must take into

localized research spillovers, the aggregate effect of openness on growth is theoretically ambiguous, and depends on the resource endowments of each country – including knowledge and technology stocks – which in turn determine the performance of individual industries.

The present chapter has attempted to assess, empirically, the relationship between trade openness and productivity growth, focusing on the manufacturing industries of five Latin American countries in the period 1970-1994. To this end, we have estimated an empirical model in which the industries' rates of growth of labor productivity is explained by the growth of exports, the growth of the import-output ratio, the ratio of imports plus exports to output, and the Grubbel-Lloyd index of intra-industry trade. For three of the five countries and during the period after 1985, we have also estimated a model in which productivity growth is explained by trade policy-based measures of openness, namely tariffs and non-tariff barriers to trade. In all cases, we have included in the regressions the level of initial productivity as an explanatory variable, in order to control for the component of productivity growth that is potentially explained by the existence of convergence in productivity. We have also run the regressions with the inclusion of variables that are shown to control, under fairly general assumptions, for the accumulation of factors of production, so that the coefficients on the other explanatory variables can be interpreted as reflecting their effect on total factor productivity growth. All models have been estimated using an econometric procedure, based on the Generalized Method of Moments, that allows for the possible endogeneity of the

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consideration the fact that under free trade consumers may have increased access to cheaper and more varied goods.

explanatory variables, as well as for the existence of industry-specific effects. This procedure allows us to interpret the results as reflecting causality from the explanatory to the dependent variable, and not the other way around, which distinguishes this study from previous attempts at uncovering the trade and growth relationship.

We have found that productivity growth at the industry level has been related to international trade flows and policies in different ways depending on the country considered. Thus, for none of the trade flows-based openness variables did we find a general positive relationship with productivity growth that applies to all countries. The result that applies to most countries (four out of five) is that the level of trade openness is, as expected, positively and significantly associated with faster TFP growth, suggesting the existence of dynamic gains from trade – the only exception is Colombia, where this effect is negative. This result, however, does not extend to labor productivity, which is positively affected by trade intensity in only two countries (Argentina and Brazil).

With respect to export growth, we find that it has a positive effect on both TFP and labor productivity growth in Argentina and Brazil, but a negative effect on these variables in Colombia and Mexico. Similarly, growth in import-output ratios has a positive impact on labor productivity in Argentina, Brazil, and Mexico, but a negative one in Colombia. Moreover, only in Brazil and Chile does TFP growth significantly benefit from larger degrees of import penetration, while there is evidence that the latter leads to a decline in the rates of TFP growth of Argentina and Colombia. Finally, larger intra-industry trade is positively associated with labor productivity growth in Argentina, Brazil and Mexico, but only in Chile does it favor TFP growth. Furthermore, a negative relationship between intra-industry trade and TFP growth is found in Argentina and Colombia.

When trade policy-based openness variables were used to explain industrial productivity growth during the recent wave of trade liberalization reforms, our findings were even less encouraging. Indeed, regression results suggest that, contrary to expectations, Mexico is the only country where productivity growth appears to be negatively related to both tariffs and NTBs. In Argentina, on the contrary, the effects of trade policies are found to be statistically non-significant, while Brazil appears to be in an intermediate situation, with productivity growth being affected positively by tariff cuts but negatively by reductions in NTBs.

Overall, the empirical results obtained in this chapter indicate that the hypothesis of a general positive relationship between openness and productivity growth at the industry level does not encounter support in the recent experience of the largest Latin American countries. When formulated in the context of the "new" theories of trade and growth – as synthesized, for example, by Grossman and Helpman (1991) – this hypothesis is based on the assumption of global and instantaneous technology spillovers. Thus, its empirical rejection could be interpreted as suggesting that research spillovers are in fact geographically concentrated, so that there is a role, in the determination of relative comparative advantage, for the size and previous research experience of each country.

From a policy perspective, this implies that the dynamic gains from trade liberalization are, to a great extent, country specific. Thus, although welfare effects do not necessarily correlate with growth effects, it appears that the mere opening of an economy to free international trade is not, at least in the short and medium term, a guaranteed road to prosperity.

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APPENDIX A

TABLES AND FIGURES

Table 2.1: Composition of Merchandise Exports, 1970/1994 (percent)

Country/ Sector	1970	1980	1994(**)
Argentina			
1. Primary Products	61.3	48.9	36.3
2. Semi-Manufactures(*)	25.6	30.6	33.4
3. Manufactures	13.1	20.5	30.3
4. Other	0.1	0.0	0.0
Total	100.0	100.0	100.0
Brazil			
1. Primary Products	67.0	30.2	19.9
2. Semi-Manufactures(*)	21.2	36.0	30.3
3. Manufactures	11.5	33.6	48.0
4. Other	0.3	0.2	1.8
Total	100.0	100.0	100.0
Chile			
1. Primary Products	12.9	20.2	30.4
2. Semi-Manufactures(*)	84.9	74.4	56.3
3. Manufactures	2.2	5.3	8.9
4. Other	0.0	0.1	4.4
Total	100.0	100.0	100.0
Colombia			
1. Primary Products	85.1	70.3	51.5
2. Semi-Manufactures(*)	7.7	11.3	10.6
3. Manufactures	6.6	16.1	31.6
4. Other	0.6	2.3	6.3
Total	100.0	100.0	100.0
Mexico			
1. Primary Products	45.3	80.7	38.2
2. Semi-Manufactures(*)	26.7	9.7	13.5
3. Manufactures	27.7	9.5	47.6
4. Other	0.3	0.1	0.6
Total	100.0	100.0	100.0

Source: ECLAC (1996), p. 113.

(*) Food products, beverages, tobacco, wood products, pulp and paper products, industrial chemicals, petroleum refineries, and petroleum and coal products (ISIC groups 311, 313, 314, 331, 341, 351, 353, 354). (**) Data available for 1993 in the case of Colombia, and 1992 for Mexico.

Table 2.2: Composition of Industrial Value Added, Exports and Imports, 1970/1994 (percent)

Country/Sector	Value Added			Exports			Imports		
	1970/80	1981/90	1991/94	1970/80	1981/90	1991/94	1970/80	1981/90	1991/94
Argentina[*]									
1. Traditional Industries	59.3	61.1	57.1	77.7	76.2	73.1	34.4	37.1	32.9
1.1. Semi-Manufactures [a]	40.2	47.1	45.4	64.8	63.6	59.9	30.4	33.0	23.0
1.2. Other [b]	19.1	13.9	11.6	12.8	12.6	13.2	4.0	4.1	9.9
2. Basic Inputs [c]	8.7	9.6	10.3	4.4	10.7	8.3	19.4	10.7	6.7
3. New Industries	32.0	29.3	32.6	18.0	13.1	18.6	46.1	52.2	60.4
3.1. Labor-Intensive [d]	13.3	10.3	11.1	9.3	6.4	7.4	28.2	32.5	34.9
3.2. Capital-Intensive [e]	18.8	19.0	21.5	8.7	6.7	11.3	17.9	19.7	25.5
Brazil									
1. Traditional Industries	46.6	48.0	47.9	79.6	58.6	49.3	32.0	38.9	42.1
1.1. Semi-Manufactures [a]	29.9	32.2	33.6	69.0	46.1	35.7	29.3	34.6	36.3
1.2. Other [b]	16.7	15.8	14.4	10.6	12.5	13.6	2.7	4.3	5.8
2. Basic Inputs [c]	14.3	13.6	14.6	4.4	15.4	20.7	14.7	7.7	5.0
3. New Industries	39.1	38.4	37.5	16.0	25.9	30.0	53.2	53.4	52.9
3.1. Labor-Intensive [d]	20.2	20.1	18.4	7.3	11.2	14.3	34.6	33.5	32.4
3.2. Capital-Intensive [e]	18.9	18.2	19.1	8.6	14.7	15.7	18.6	19.9	20.6
Chile									
1. Traditional Industries	49.4	53.1	56.5	19.6	33.5	41.3	36.8	39.1	33.8
1.1. Semi-Manufactures [a]	35.3	43.9	47.7	19.0	32.2	37.1	29.3	27.8	21.5
1.2. Other [b]	14.1	9.1	8.8	0.5	1.2	4.2	7.4	11.3	12.3
2. Basic Inputs [c]	26.6	29.3	22.6	78.3	63.6	52.5	6.2	6.1	7.0
3. New Industries	24.0	17.7	21.0	2.2	2.9	6.2	57.0	54.8	59.2
3.1. Labor-Intensive [d]	9.5	6.3	7.2	0.8	1.0	2.7	32.3	31.2	33.6
3.2. Capital-Intensive [e]	14.5	11.4	13.8	1.3	1.9	3.5	24.7	23.6	25.6

Table 2.2 (cont'd)

Country/Sector	Value Added			Exports			Imports		
	1970/80	1981/90	1991/94	1970/80	1981/90	1991/94	1970/80	1981/90	1991/94
Colombia									
1. Traditional Industries	67.6	65.5	61.3	77.0	76.7	72.5	34.1	38.3	37.6
1.1. Semi-Manufactures [a]	43.6	46.4	42.3	44.6	48.4	32.2	30.6	35.0	31.3
1.2. Other [b]	24.1	19.1	18.9	32.4	28.3	40.3	3.5	3.3	6.3
2. Basic Inputs [c]	8.7	10.9	12.3	5.5	9.1	8.5	11.2	11.0	9.5
3. New Industries	23.7	23.6	26.4	17.5	14.2	19.1	54.7	50.7	52.9
3.1. Labor-Intensive [d]	8.4	8.6	8.5	7.7	7.4	9.6	29.2	29.8	28.4
3.2. Capital-Intensive [e]	15.3	15.0	17.9	9.8	6.7	9.5	25.5	21.0	24.6
Mexico									
1. Traditional Industries	61.5	59.3	55.9	57.3	41.7	23.8	29.5	32.8	29.3
1.1. Semi-Manufactures [a]	41.9	39.9	39.4	44.7	33.7	13.7	25.6	28.0	20.0
1.2. Other [b]	19.6	19.4	16.6	12.6	8.0	10.2	3.8	4.8	9.2
2. Basic Inputs [c]	10.4	11.5	11.1	13.7	16.0	8.1	9.2	9.1	8.8
3. New Industries	28.2	29.2	33.0	29.0	42.3	68.1	61.4	58.1	61.9
3.1. Labor-Intensive [d]	12.1	11.6	12.1	10.6	13.3	36.2	33.6	34.8	35.7
3.2. Capital-Intensive [e]	16.1	17.6	20.9	18.4	29.0	31.9	27.7	23.3	26.2

Source: see text.
(*) Data available for 1970-93. [a] Food products, beverages, tobacco, wood products, pulp and paper products, industrial chemicals, petroleum refineries, and petroleum and coal products (ISIC groups 311, 313, 314, 331, 341, 351, 353, 354). [b] Textiles, wearing apparel, leather products, footwear, rubber products, pottery, china and earthenware, glass and glass products, and other miscellaneous manufactures (ISIC groups 321, 322, 323, 324, 355, 361, 362, 390). [c] Plastic products, other non-metallic mineral products, iron and steel, and non-ferrous metals (ISIC groups 356, 369, 371, 372). [d] Furniture, printing and publishing, non-electrical and electrical machinery (ISIC groups 332, 342, 382, 383). [e] Pharmaceutical and other chemical products, fabricated metal products, transport equipment, and professional and scientific equipment (ISIC groups 352, 381, 384, 385).

Table 2.3: Export and Import Coefficients in Manufacturing Output, 1970/1994 (percent)

Country/Sector	Export Shares			Import Shares		
	1970/80	1981/90	1991/94	1970/80	1981/90	1991/94
Argentina (*)						
1. Traditional Industries	9.0	10.2	9.7	4.8	4.1	6.1
1.1. Semi-Manufactures [a]	10.9	11.0	10.3	6.1	4.7	5.2
1.2. Other [b]	4.7	7.5	7.4	1.9	2.0	9.7
2. Basic Inputs Industries [c]	3.5	11.0	8.1	21.8	8.3	8.7
3. New Industries	3.7	4.1	4.2	12.6	12.8	20.3
3.1. Labor-Intensive [d]	4.9	5.9	5.5	20.2	23.5	35.5
3.2. Capital-Intensive [e]	2.9	3.1	3.5	7.8	7.4	12.6
Total Manufactures	6.8	8.6	7.9	8.5	6.9	10.6
Brazil						
1. Traditional Industries	11.4	12.6	13.8	5.5	3.8	7.9
1.1. Semi-Manufactures [a]	14.2	13.4	14.0	7.2	4.7	9.5
1.2. Other [b]	5.1	10.4	13.5	1.6	1.6	3.9
2. Basic Inputs Industries [c]	2.3	11.9	19.3	9.5	2.7	3.1
3. New Industries	3.6	9.3	12.3	14.2	8.9	14.5
3.1. Labor-Intensive [d]	3.4	8.6	12.5	19.9	11.8	18.9
3.2. Capital-Intensive [e]	3.7	10.0	12.1	9.2	6.3	10.7
Total Manufactures	7.5	11.4	14.1	9.0	5.3	9.4
Chile						
1. Traditional Industries	16.9	24.4	26.4	24.8	26.1	26.7
1.1. Semi-Manufactures [a]	21.2	27.5	27.8	27.0	21.6	19.8
1.2. Other [b]	2.7	6.2	18.5	22.6	53.0	67.7
2. Basic Inputs Industries [c]	150.7	89.8	73.8	9.5	8.0	12.3
3. New Industries	5.1	7.3	11.5	103.7	133.0	136.9
3.1. Labor-Intensive [d]	4.9	7.8	14.8	149.8	223.9	232.9
3.2. Capital-Intensive [e]	5.2	7.2	9.8	74.2	87.4	88.9
Total Manufactures	46.6	40.6	35.6	36.8	37.7	44.1

Table 2.3 (cont'd)

Country/Sector	Export Shares			Import Shares		
	1970/80	1981/90	1991/94	1970/80	1981/90	1991/94
Colombia						
1. Traditional Industries	7.1	8.4	15.8	9.5	12.3	18.0
1.1. Semi-Manufactures [a]	6.0	6.8	9.6	12.5	14.9	20.2
1.2. Other [b]	9.7	13.1	32.9	3.1	4.3	12.0
2. Basic Inputs Industries [c]	4.3	6.8	10.4	27.7	23.9	25.5
3. New Industries	4.8	4.3	10.1	46.8	47.3	63.5
3.1. Labor-Intensive [d]	6.8	7.1	16.6	76.1	83.9	108.6
3.2. Capital-Intensive [e]	4.0	3.0	7.2	32.4	29.3	43.3
Total Manufactures	6.4	7.3	13.7	19.4	21.5	30.8
Mexico						
1. Traditional Industries	3.6	5.4	8.2	5.3	7.6	16.7
1.1. Semi-Manufactures [a]	3.8	5.8	5.8	6.3	8.7	14.7
1.2. Other [b]	3.0	4.6	16.4	2.5	4.6	23.4
2. Basic Inputs Industries [c]	5.0	11.3	14.2	10.0	11.1	27.0
3. New Industries	4.5	15.0	47.5	26.8	30.3	67.5
3.1. Labor-Intensive [d]	4.2	13.9	83.9	37.9	52.1	122.4
3.2. Capital-Intensive [e]	4.6	15.5	30.0	19.8	18.6	41.5
Total Manufactures	3.9	8.9	21.3	11.3	14.6	34.1

Source: see text.

(*) Data available for 1970-93. [a] Food products, beverages, tobacco, wood products, pulp and paper products, industrial chemicals, petroleum refineries, and petroleum and coal products (ISIC groups 311, 313, 314, 331, 341, 351, 353, 354). [b] Textiles, wearing apparel, leather products, footwear, rubber products, pottery, china and earthenware, glass and glass products, and other miscellaneous manufactures (ISIC groups 321, 322, 323, 324, 355, 361, 362, 390). [c] Plastic products, other non-metallic mineral products, iron and steel, and non-ferrous metals (ISIC groups 356, 369, 371, 372). [d] Furniture, printing and publishing, non-electrical and electrical machinery (ISIC groups 332, 342, 382, 383). [e] Pharmaceutical and other chemical products, fabricated metal products, transport equipment, and professional and scientific equipment (ISIC groups 352, 381, 384, 385).

Table 2.4: Rates of Growth of Industrial Labor Productivity(*), 1970/1994 (percent)

Country/Sector	1970/1980	1980/1990	1990/1994	1970/1994
Argentina(**)				
1. Traditional Industries	2.6	2.1	3.8	2.6
1.1. Semi-Manufactures [a]	1.9	2.5	2.3	2.2
1.2. Other [b]	2.9	0.2	6.3	2.1
2. Basic Inputs Industries [c]	2.0	1.3	14.7	3.3
3. New Industries	4.2	2.1	21.4	5.8
3.1. Labor-Intensive [d]	5.3	1.0	25.5	5.8
3.2. Capital-Intensive [e]	3.4	2.7	19.3	5.0
Total Manufactures	3.1	2.2	10.3	3.6
Coefficient of Variation [f]	1.4	1.1	9.4	1.7
Brazil				
1. Traditional Industries	3.2	0.4	8.7	2.9
1.1. Semi-Manufactures [a]	3.3	0.7	8.7	3.1
1.2. Other [b]	2.7	-0.1	7.5	2.3
2. Basic Inputs Industries [c]	1.1	1.1	12.3	2.9
3. New Industries	1.7	0.3	10.3	2.5
3.1. Labor-Intensive [d]	2.4	-0.1	9.7	2.5
3.2. Capital-Intensive [e]	1.3	0.8	10.0	2.5
Total Manufactures	2.4	0.4	9.7	2.7
Coefficient of Variation [f]	0.9	0.5	1.8	0.3
Chile				
1. Traditional Industries	5.0	-1.4	4.4	2.2
1.1. Semi-Manufactures [a]	5.2	-1.6	3.0	1.9
1.2. Other [b]	1.8	-2.4	4.1	0.4
2. Basic Inputs Industries [c]	-2.2	0.2	-1.4	-1.1
3. New Industries	4.6	-1.1	5.5	2.3
3.1. Labor-Intensive [d]	3.6	-1.8	6.8	1.8
3.2. Capital-Intensive [e]	5.3	-0.9	4.9	2.6
Total Manufactures	2.8	-1.1	2.8	1.2
Coefficient of Variation [f]	3.1	1.0	3.1	1.5

Table 2.4 (cont'd)

Country/Sector	1970/1980	1980/1990	1990/1994	1970/1994
Colombia				
1. Traditional Industries	2.5	2.5	2.1	2.4
1.1. Semi-Manufactures [a]	3.5	1.5	1.4	2.3
1.2. Other [b]	0.3	3.8	1.6	2
2. Basic Inputs Industries [c]	1.5	6.3	2.0	3.6
3. New Industries	-0.2	4.5	7.4	3.0
3.1. Labor-Intensive [d]	0.3	2.4	5.1	1.9
3.2. Capital-Intensive [e]	-0.5	6.0	8.5	3.6
Total Manufactures	1.8	3.3	3.5	2.7
Coefficient of Variation [f]	1.6	2.1	3.1	0.9
Mexico				
1. Traditional Industries	2.6	3.5	1.9	2.8
1.1. Semi-Manufactures [a]	1.8	3.9	2.4	2.8
1.2. Other [b]	3.9	2.3	0.6	2.7
2. Basic Inputs Industries [c]	2.7	4.6	1.6	3.3
3. New Industries	3.2	2.4	3.3	2.9
3.1. Labor-Intensive [d]	3.5	1.1	3.4	2.5
3.2. Capital-Intensive [e]	3.0	3.1	3.3	3.1
Total Manufactures	2.7	3.2	2.3	2.9
Coefficient of Variation [f]	0.8	1.4	1.2	0.3

Source: see text.

(*) Geometric means of annual rates. (**) Data available for 1970-93. [a] Food products, beverages, tobacco, wood products, pulp and paper products, industrial chemicals, petroleum refineries, and petroleum and coal products (ISIC groups 311, 313, 314, 331, 341, 351, 353, 354). [b] Textiles, wearing apparel, leather products, footwear, rubber products, pottery, china and earthenware, glass and glass products, and other miscellaneous manufactures (ISIC groups 321, 322, 323, 324, 355, 361, 362, 390). [c] Plastic products, other non-metallic mineral products, iron and steel, and non-ferrous metals (ISIC groups 356, 369, 371, 372). [d] Furniture, printing and publishing, non-electrical and electrical machinery (ISIC groups 332, 342, 382, 383). [e] Pharmaceutical and other chemical products, fabricated metal products, transport equipment, and professional and scientific equipment (ISIC groups 352, 381, 384, 385). [f] Calculated on the basis of the sectors 1.1, 1.2, 2, 3.1, and 3.2.

Table 2.5: Decomposition of the Rates of Labor Productivity Growth in 28 Industrial Sectors(*), 1970/1994

Country / Period	1970/1980	1980/1990	1990/1994	1970/1994
Argentina				
Rate Terms				
1. Fixed Weight	3.13	1.90	16.13	4.19
2. Change in Fixed Weight	-0.19	-0.26	-0.62	-0.18
Level Terms				
3. Fixed Weight	0.59	0.92	-3.50	0.16
4. Change in Fixed Weight	-0.08	0.05	-0.24	0.00
Interaction of Rate and Level Terms	-0.21	-0.14	-1.35	-0.33
Aggregate Productivity Growth	3.23	2.47	10.42	3.84
Brasil				
Rate Terms				
1. Fixed Weight	3.43	0.69	10.03	3.45
2. Change in Fixed Weight	-0.39	-0.16	-0.08	-0.30
Level Terms				
3. Fixed Weight	-0.06	0.22	0.08	0.09
4. Change in Fixed Weight	0.10	0.13	0.03	0.09
Interaction of Rate and Level Terms	-0.18	-0.31	-0.23	-0.24
Aggregate Productivity Growth	2.89	0.56	9.83	3.08
Chile				
Rate Terms				
1. Fixed Weight	6.23	1.26	3.39	3.67
2. Change in Fixed Weight	-3.46	-0.41	-0.07	-1.61
Level Terms				
3. Fixed Weight	1.66	-0.90	-0.49	-0.26
4. Change in Fixed Weight	-0.88	-0.66	0.12	-0.13
Interaction of Rate and Level Terms	-0.13	-0.29	-0.09	-0.19
Aggregate Productivity Growth	3.41	-1.00	2.85	1.48

Table 2.5 (cont'd)

Country / Period	1970/1980	1980/1990	1990/1994	1970/1994
Colombia				
Rate Terms				
1. Fixed Weight	1.98	4.54	3.37	3.45
2. Change in Fixed Weight	-0.40	-0.93	-0.08	-0.74
Level Terms				
3. Fixed Weight	0.29	-0.17	0.19	0.03
4. Change in Fixed Weight	0.03	0.00	0.04	0.08
Interaction of Rate and Level Terms	-0.10	-0.07	-0.03	-0.08
Aggregate Productivity Growth	1.81	3.37	3.49	2.74
Mexico				
Rate Terms				
1. Fixed Weight	2.85	3.31	2.32	2.92
2. Change in Fixed Weight	-0.28	-0.12	0.04	-0.13
Level Terms				
3. Fixed Weight	0.42	0.16	0.00	0.27
4. Change in Fixed Weight	-0.11	0.00	0.02	-0.08
Interaction of Rate and Level Terms	-0.09	-0.10	-0.06	-0.09
Aggregate Productivity Growth	2.78	3.25	2.33	2.90

Source: see text.

Note: (*) Sectors as defined in Table 2.A.1.

Table 2.6: GMM Estimates of Industry Labor Productivity Growth on Trade Flows-based Openness Variables: Argentina, 1970/1992 (p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	0.03	-0.0002	0.004	-0.002
	(0.34)	(0.77)	(0.02)	(0.05)
Trade Intensity[a]	0.004	0.012	-0.010	0.009
	(0.37)	(0.00)	(0.00)	(0.02)
Index of Intra-Industry Trade[b]	0.032	0.010	0.006	-0.005
	(0.00)	(0.00)	(0.00)	(0.07)
Growth of Exports	0.131	0.136	0.067	0.101
	(0.00)	(0.00)	(0.00)	(0.00)
Growth in Import -Output Ratio Coefficient[c]	0.090	0.084	-0.029	-0.028
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.011		-0.002	
	(0.81)		(0.92)	
Growth in Employment			0.292	0.365
			(0.00)	(0.00)
Change in the Labor Share in Value Added			4.143	4.690
			(0.00)	(0.00)
Change in the Labor Share in Value Added times one minus the Labor Share[d]			-9.970	-10.561
			(0.00)	(0.00)
Wald Test of Joint Significance: p-value	0.00	0.00	0.00	0.00
Sargan Test of Overidentifying Restrictions: p-value	0.211	0.832	0.245	0.998
Test for First-Order Serial Correlation: p-value	0.264	0.006	0.035	0.001
Test for Second-Order Serial Correlation: p-value	0.376	0.886	0.762	0.539
Number of Observations	140	112	140	112

Notes: (*) See text. (a) Log of the ratio of total trade to total output. (b) Log of one minus the ratio of the absolute value of the trade deficit to total trade. (c) Growth of imports minus growth of total output. (d) The average of the current and the lagged labor share is used.

Table 2.7: GMM Estimates of Industry Labor Productivity Growth on Trade Flows-based Openness Variables: Brazil, 1970/1994 (p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	0.015	-0.002	0.010	-0.002
	(0.00)	(0.22)	(0.00)	(0.02)
Trade Intensity[a]	0.010	0.018	0.008	0.012
	(0.00)	(0.00)	(0.00)	(0.00)
Index of Intra-Industry Trade[b]	0.007	0.010	0.001	-0.002
	(0.03)	(0.00)	(0.65)	(0.44)
Growth of Exports	0.066	0.067	0.122	0.051
	(0.00)	(0.00)	(0.00)	(0.00)
Growth in Import-Output Ratio Coefficient[c]	0.129	0.089	-0.002	0.032
	(0.00)	(0.00)	(0.85)	(0.11)
Constant	-0.148		-0.113	
	(0.00)		(0.00)	
Growth in Employment			-0.550	-0.463
			(0.00)	(0.00)
Change in the Labor Share in Value Added			-15.411	-18.907
			(0.00)	(0.00)
Change in the Labor Share in Value Added times one minus the Labor Share[d]			20.392	25.313
			(0.00)	(0.00)
Wald Test of Joint Significance: p-value	0.00	0.00	0.00	0.00
Sargan Test of Overidentifying Restrictions: p-value	0.068	0.655	0.346	0.993
Test for First-Order Serial Correlation: p-value	0.012	0.000	0.228	0.001
Test for Second-Order Serial Correlation: p-value	0.499	0.972	0.057	0.709
Number of Observations	140	112	140	112

Notes: (*) See text. (a) Log of the ratio of total trade to total output. (b) Log of one minus the ratio of the absolute value of the trade deficit to total trade. (c) Growth of imports minus growth of total output. (d) The average of the current and the lagged labor share is used.

Table 2.8: GMM Estimates of Industry Labor Productivity Growth on Trade Flows-based Openness Variables: Chile, 1970/1994 (p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	-0.006	-0.005	0.006	-0.002
	(0.14)	(0.08)	(0.25)	(0.33)
Trade Intensity[a]	0.022	0.043	0.010	0.026
	(0.00)	(0.00)	(0.00)	(0.00)
Index of Intra-Industry Trade[b]	0.006	0.064	0.015	0.039
	(0.29)	(0.00)	(0.01)	(0.00)
Growth of Exports	0.054	0.031	0.098	0.081
	(0.00)	(0.01)	(0.00)	(0.00)
Growth in Import-Output Ratio Coefficient[c]	0.016	-0.014	0.030	0.056
	(0.78)	(0.25)	(0.55)	(0.05)
Constant	-0.013		-0.060	
	(0.77)		(0.21)	
Growth in Employment			-0.596	-0.579
			(0.00)	(0.00)
Change in the Labor Share in Value Added			-8.197	-4.127
			(0.01)	(0.10)
Change in the Labor Share in Value Added times one minus the Labor Share[d]			12.234	6.616
			(0.00)	(0.06)
Wald Test of Joint Significance: p-value	0.00	0.00	0.00	0.00
Sargan Test of Overidentifying Restrictions: p-value	0.061	0.850	0.628	0.997
Test for First-Order Serial Correlation: p-value	0.004	0.007	0.012	0.007
Test for Second-Order Serial Correlation: p-value	0.739	0.020	0.968	0.460
Number of Observations	135	108	135	108

Notes: (*) See text. (a) Log of the ratio of total trade to total output. (b) Log of one minus the ratio of the absolute value of the trade deficit to total trade. (c) Growth of imports minus growth of total output. (d) The average of the current and the lagged labor share is used.

Table 2.9: GMM Estimates of Industry Labor Productivity Growth on Trade Flows-based Openness Variables: Colombia, 1970/1994 (p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	-0.004	0.004	-0.023	0.0001
	(0.27)	(0.00)	(0.00)	(0.88)
Trade Intensity[a]	0.012	-0.001	-0.002	-0.0005
	(0.00)	(0.67)	(0.00)	(0.80)
Index of Intra-Industry Trade[b]	-0.012	-0.004	-0.002	-0.014
	(0.00)	(0.01)	(0.00)	(0.00)
Growth of Exports	-0.041	-0.064	-0.003	-0.014
	(0.01)	(0.00)	(0.72)	(0.10)
Growth in Import-Output Ratio Coefficient[c]	-0.052	-0.029	-0.054	-0.025
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.021		0.233	
	(0.58)		(0.00)	
Growth in Employment			-0.296	-0.403
			(0.00)	(0.00)
Change in the Labor Share in Value Added			32.717	20.142
			(0.00)	(0.04)
Change in the Labor Share in Value Added times one minus the Labor Share[d]			-46.186	-30.501
			(0.00)	(0.00)
Wald Test of Joint Significance: p-value	0.00	0.00	0.00	0.00
Sargan Test of Overidentifying Restrictions: p-value	0.287	0.659	0.285	0.997
Test for First-Order Serial Correlation: p-value	0.567	0.266	0.443	0.144
Test for Second-Order Serial Correlation: p-value	0.996	0.572	0.543	0.590
Number of Observations	140	112	140	112

Notes: (*) See text. (a) Log of the ratio of total trade to total output. (b) Log of one minus the ratio of the absolute value of the trade deficit to total trade. (c) Growth of imports minus growth of total output. (d) The average of the current and the lagged labor share is used.

Table 2.10: GMM Estimates of Industry Labor Productivity Growth on Trade Flows-based Openness Variables: Mexico, 1970/1994 (p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	-0.028	0.005	-0.026	0.002
	(0.00)	(0.00)	(0.00)	(0.00)
Trade Intensity[a]	0.013	0.0004	0.009	0.008
	(0.00)	(0.78)	(0.00)	(0.00)
Index of Intra-Industry Trade[b]	0.004	0.018	-0.0002	-0.001
	(0.56)	(0.00)	(0.97)	(0.82)
Growth of Exports	-0.132	-0.091	-0.108	-0.059
	(0.00)	(0.00)	(0.00)	(0.00)
Growth in Import-Output Ratio Coefficient[c]	0.048	0.021	0.008	0.001
	(0.01)	(0.00)	(0.49)	(0.92)
Constant	0.290		0.277	
	(0.00)		(0.00)	
Growth in Employment			-0.256	-0.191
			(0.02)	(0.00)
Change in the Labor Share in Value Added			0.561	-2.857
			(0.31)	(0.00)
Change in the Labor Share in Value Added times one minus the Labor Share[d]			-0.246	4.819
			(0.76)	(0.00)
Wald Test of Joint Significance: p-value	0.00	0.00	0.00	0.00
Sargan Test of Overidentifying Restrictions: p-value	0.319	0.909	0.433	1.000
Test for First-Order Serial Correlation: p-value	0.071	0.010	0.260	0.013
Test for Second-Order Serial Correlation: p-value	0.639	0.079	0.905	0.068
Number of Observations	135	108	135	108

Notes: (*) See text. (a) Log of the ratio of total trade to total output. (b) Log of one minus the ratio of the absolute value of the trade deficit to total trade. (c) Growth of imports minus growth of total output. (d) The average of the current and the lagged labor share is used.

Table 2.11: Summary of Regression Results from Tables 2.6 to 2.10

Variables/ Countries	Countries where a significant effect on labor productivity growth was found		Countries where a significant effect on total factor productivity growth was found	
	Increases	Reductions	Increases	Reductions
Trade Intensity	Argentina Brazil	--	Argentina Brazil Chile Mexico	Colombia
Export Growth	Argentina Brazil	Colombia Mexico	Argentina Brazil Chile	Colombia Mexico
Growth in Import-Output Ratios	Argentina Brazil Mexico	Colombia	Brazil Chile	Argentina Colombia
Index of Intra-Industry Trade	Argentina Brazil Mexico	Colombia	Chile	Argentina Colombia

Source: see text.

Table 2.12: GMM Estimates of Industry Labor Productivity Growth on Trade Policy-based Openness Variables: Argentina, 1986/1993 (p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	0.025	0.008	0.008	-0.003
	(0.05)	(0.10)	(0.72)	(0.50)
Average Tariffs	0.002	-0.0002	-0.0004	0.003
	(0.45)	(0.95)	(0.86)	(0.15)
Coverage of Non-Tariff Barriers	-0.001	-0.0002	-0.00002	0.0004
	(0.08)	(0.83)	(0.99)	(0.53)
Constant	-0.213		-0.028	
	(0.22)		(0.88)	
Growth in Employment			-0.659	-0.101
			(0.50)	(0.68)
Change in the Labor Share in Value Added			0.200	11.009
			(0.99)	(0.00)
Change in the Labor Share in Value Added times one minus the Labor Share[d]			0.090	-16.036
			(0.96)	(0.62)
Wald Test of Joint Significance: p-value	0.074	0.000	0.001	0.000
Sargan Test of Overidentifying Restrictions: p-value	0.866	0.452	0.914	0.643
Test for First-Order Serial Correlation: p-value	0.258	0.574	0.495	0.854
Test for Second-Order Serial Correlation: p-value	0.848	--	0.062	--
Number of Observations	51	34	51	34

Notes: (*) See text. (a) The average of the current and the lagged labor share is used.

Table 2.13: GMM Estimates of Industry Labor Productivity Growth on Trade Policy-based Openness Variables: Brazil, 1986/1994 (p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	-0.050	0.013	0.030	0.008
	(0.09)	(0.00)	(0.05)	(0.00)
Average Tariffs	-0.004	-0.004	0.0002	-0.003
	(0.00)	(0.00)	(0.71)	(0.00)
Coverage of Non-Tariff Barriers	0.002 (0.01)	0.005 (0.00)	-0.002 (0.10)	0.005 (0.00)
Constant	0.626		-0.184	
	(0.04)		(0.19)	
Growth in Employment			0.861	-0.780
			(0.01)	(0.00)
Change in the Labor Share in Value Added			-3.128 (0.90)	-13.379 (0.44)
Change in the Labor Share in Value Added times one minus the Labor Share[a]			7.308 (0.81)	16.524 (0.43)
Wald Test of Joint Significance: p-value	0.00	0.00	0.00	0.00
Sargan Test of Overidentifying Restrictions: p-value	0.212	0.187	0.355	0.585
Test for First-Order Serial Correlation: p-value	0.303	0.670	0.111	0.961
Test for Second-Order Serial Correlation: p-value	0.998	--	0.685	--
Number of Observations	51	34	51	34

Notes: (*) See text. (a) The average of the current and the lagged labor share is used.

Table 2.14: GMM Estimates of Industry Labor Productivity Growth on Trade Policy-based Openness Variables: Mexico, 1986/1994 (p-values in parenthesis)

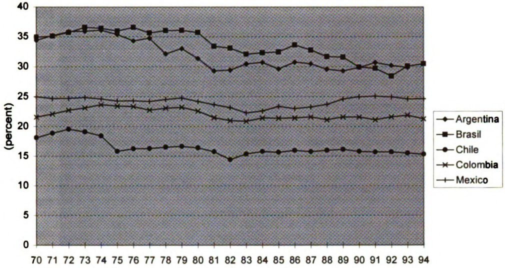
	(1)	(2)	(3)	(4)
Regression Specification	Levels	Dif.-Lev.	Levels	Dif.-Lev.
Instruments (*)	Levels	Lev.-Dif.	Levels	Lev.-Dif.
Initial Labor Productivity	-0.061	0.022	-0.014	0.020
	(0.08)	(0.00)	(0.45)	(0.00)
Average Tariffs	-0.022	-0.016	-0.005	-0.014
	(0.01)	(0.00)	(0.02)	(0.00)
Coverage of Non-Tariff Barriers	-0.007	-0.003	-0.001	-0.001
	(0.02)	(0.08)	(0.26)	(0.06)
Constant	0.949		0.226	
	(0.02)		(0.28)	
Growth in Employment			-0.619	-0.615
			(0.01)	(0.00)
Change in the Labor Share in Value Added			7.807	2.154
			(0.00)	(0.10)
Change in the Labor Share in Value Added times one minus the Labor Share[a]			-10.012	-2.521
			(0.00)	(0.16)
Wald Test of Joint Significance: p-value	0.046	0.001	0.000	0.000
Sargan Test of Overidentifying Restrictions: p-value	0.210	0.235	0.067	0.163
Test for First-Order Serial Correlation: p-value	0.094	0.054	0.182	0.022
Test for Second-Order Serial Correlation: p-value	0.145	--	0.479	--
Number of Observations	51	34	51	34

Notes: (*) See text. (a) The average of the current and the lagged labor share is used.

Table 2.15: Summary of Regression Results from Tables 2.12 to 2.14

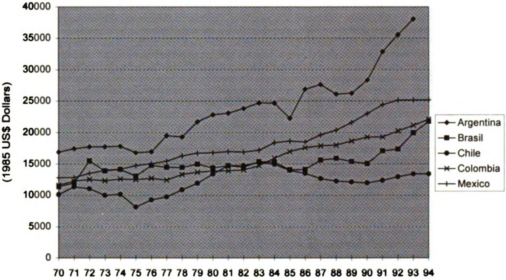
Variables/ Countries	Countries where a significant effect on labor productivity growth was found		Countries where a significant effect on total factor productivity growth was found	
	Increases	Reductions	Increases	Reductions
Tariffs (reductions in)	Brazil Mexico	--	Brazil Mexico	--
Non-Tariffs Barriers (reductions in)	Mexico	Brazil	Mexico	Brazil

Source: see text.



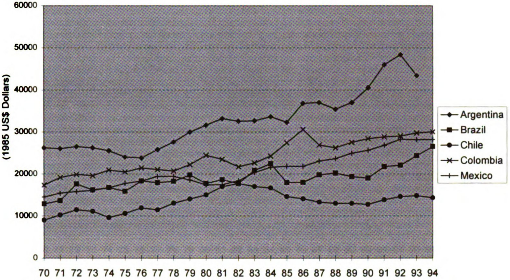
Source: see text.

Figure 2.1: Manufacturing Share in GDP, 1970/1994



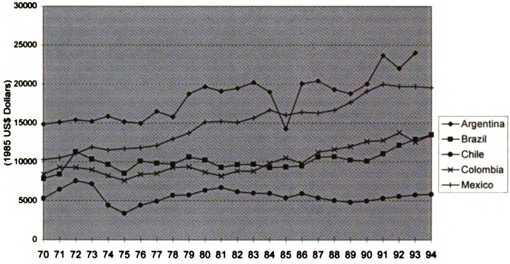
Source: see text.

Figure 2.2: Labor Productivity in Manufacturing, 1970/1994



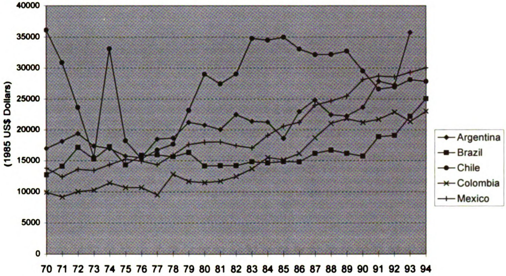
Source: see text.

Figure 2.3: Labor Productivity in Semi-Manufactures, 1970/1994



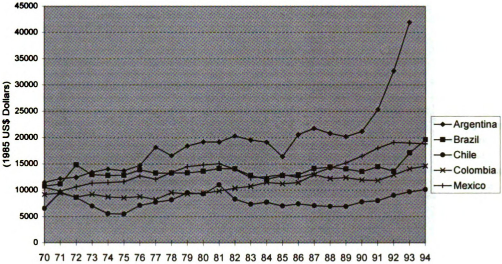
Source: see text.

Figure 2.4: Labor Productivity in Other Traditional Industries (excluding Semi-Manufactures), 1970/1994



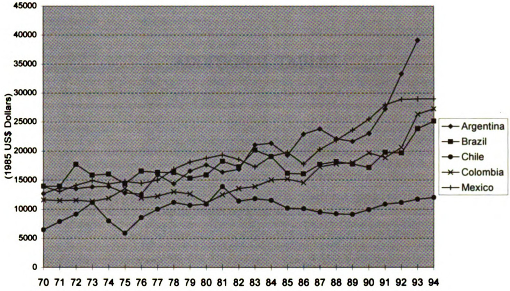
Source: see text.

Figure 2.5: Labor Productivity in Basic-Inputs Industries, 1970/1994



Source: see text.

Figure 2.6: Labor Productivity in New Labor-Intensive Industries, 1970/1994



Source: see text.

Figure 2.7: Labor Productivity in New Capital-Intensive Industries, 1970/1994

APPENDIX B

ADDITIONAL TABLES

Table 2.A.1: Classification of Manufacturing Industries According to Factor Intensity

Industry Denomination	Description
1. Traditional Industries	
1.1. Semi-Manufactures [a]	Industrial products based upon natural resources
1.2. Other [b]	Labor-intensive industrial products, not based upon natural resources and with a low input of skilled labor
2. Basic Inputs Industries [c]	Capital-intensive industrial products, not based upon natural resources and with a low input of skilled labor
3. New Industries	
3.1. Labor-Intensive [d]	Labor-intensive industrial products not based upon natural resources and with a high input of skilled labor
3.2. Capital-Intensive [e]	Capital-intensive industrial products not based upon natural resources and with a high input of skilled labor

Source: see text.

[a] Food products, beverages, tobacco, wood products, pulp and paper products, industrial chemicals, petroleum refineries, and petroleum and coal products (ISIC groups 311, 313, 314, 331, 341, 351, 353, 354). [b] Textiles, wearing apparel, leather products, footwear, rubber products, pottery, china and earthenware, glass and glass products, and other miscellaneous manufactures (ISIC groups 321, 322, 323, 324, 355, 361, 362, 390). [c] Plastic products, other non-metallic mineral products, iron and steel, and non-ferrous metals (ISIC groups 356, 369, 371, 372). [d] Furniture, printing and publishing, non-electrical and electrical machinery (ISIC groups 332, 342, 382, 383). [e] Pharmaceutical and other chemical products, fabricated metal products, transport equipment, and professional and scientific equipment (ISIC groups 352, 381, 384, 385).

Table 2.A.2: Codes and Descriptions of Sectors at the 3-digit Level of the International Standard Industrial Classification

Code ISIC	Description
311	Food products
313	Beverages
314	Tobacco
321	Textiles
322	Wearing Apparel
323	Leather Products (Except Footwear)
324	Footwear
331	Wood Products
332	Furniture
341	Pulp and Paper Products
342	Printing and Publishing
351	Industrial Chemicals
352	Pharmaceutical and other Chemicals
353	Petroleum Refineries
354	Miscellaneous Petroleum and Coal Products
355	Rubber Products
356	Plastic Products
361	Pottery, China, Earthenware
362	Glass Products
369	Other Non-Metallic Mineral Products
371	Iron and Steel
372	Non-Ferrous Metals
381	Fabricated Metal Products, Except Machinery and Equipment
382	Machinery, Except Electrical
383	Electrical Machinery
384	Transport Equipment
385	Professional and Scientific Equipment
390	Other Manufacturing Industries

Source: see text.

Table 2.A.3: Codes and Descriptions of Sectors used in the Regressions of Industry Labor Productivity Growth on Trade Policy-based Openness Variables (Tables 11, 12 and 13)

Sector Number	Code SITC	Code ISIC	Description
1	110	311 + 313 + 314	Food products, Beverages and Tobacco
2	140	353 + 354	Mineral Fuels
3	150	372	Non Ferrous Metal Industries
4	210	351 + 352	Chemical Products
5	220	371	Iron and Steel
6	231	382	Non-Electrical Machinery
7	232	383	Electrical Machinery
8	233	384	Transport Equipment
9	241	323	Leather Products (except Footwear)
10	242	355	Rubber Manufactures
11	243	331	Wood Products
12	244	341	Pulp and Paper Products
13	245	321 + 322	Textiles and Clothing
14	246	361 + 362 + 369	Non-Metallic Mineral Products
15	247	332	Furniture
16	248	324	Leather Footwear
17	249	385	Professional, Scientific and Controlling Equipment

Source: see text.

Table 2.A.4: Tariff and Non Tariff Barriers to Trade: Averages and Coefficients of Variation across 17 Sectors(*) in Argentina, Brasil and Mexico, 1986/1993

Country, Period	Tariffs		Non Tariff Barriers		Weighted Tariffs(**)		Weighted Non Tariffs Barriers(**)	
	Average	Coef. of Varia-tion	Average	Coef. of Varia-tion	Average	Coef. of Varia-tion	Average	Coef. of Varia-tion
Argentina								
1987	29.5	18.3	38.6	76.2	27.7	21.0	36.4	84.0
1990	21.2	8.8	12.5	228.1	21.0	9.2	13.9	208.4
1993	11.7	39.4	0.4	406.3	11.7	41.2	2.1	318.6
Brazil								
1986	59.4	37.2	37.8	79.4	56.6	38.5	40.2	76.6
1990	31.6	40.0	4.7	233.6	31.1	47.1	10.3	222.4
1993	13.7	40.9	3.0	374.9	14.2	36.1	5.6	402.7
Mexico								
1987	12.3	34.6	9.0	133.0	11.6	40.7	16.4	137.2
1990	11.6	36.5	6.2	224.5	11.4	41.9	12.5	182.2
1992	13.8	20.8	3.7	155.4	13.6	22.9	10.1	184.3

Source: see text.

Notes: (*) See Table 2.A.2 for a description of the sectors; (**) Weights are based on the 1985 imports of a group of 120 developing countries.

Table 2.A.5: Bivariate Correlations between Tariffs, Non-Tariff Barriers to Trade, and the Growth of Exports and Imports: Argentina, 1986/1993 (*)

	Tariffs	Non-Tariff Barriers (NTBs)	Weighted Tariffs	Weighted NTBs	Growth in Imports
Non Tariff Barriers (NTBs)	0.65				
Weighted Tariffs	0.98	0.63			
Weighted NTBs	0.60	0.97	0.60		
Growth in Imports	-0.23	-0.34	-0.22	-0.33	
Growth in Exports	0.33	0.53	0.36	0.55	-0.20

Source: see text.
(*) 17 sectors, 3-year periods.

Table 2.A.6: Bivariate Correlations between Tariffs, Non-Tariff Barriers to Trade, and the Growth of Exports and Imports: Brazil, 1986/1993 (*)

	Tariffs	Non-Tariff Barriers (NTBs)	Weighted Tariffs	Weighted NTBs	Growth in Imports
Non Tariff Barriers (NTBs)	0.34				
Weighted Tariffs	0.98	0.33			
Weighted NTBs	0.13	0.89	0.14		
Growth in Imports	-0.02	0.02	-0.02	-0.02	
Growth in Exports	0.10	0.14	0.09	0.01	0.06

Source: see text.
(*) 17 sectors, 3-year periods.

Table 2.A.7: Bivariate Correlations between Tariffs, Non-Tariff Barriers to Trade, and the Growth of Exports and Imports: Mexico, 1986/1993 (*)

	Tariffs	Non- Tariff Barriers (NTBs)	Weighted Tariffs	Weighted NTBs	Growth in Imports
Non Tariff Barriers (NTBs)	-0.27				
Weighted Tariffs	0.93	-0.28			
Weighted NTBs	-0.47	0.77	-0.52		
Growth in Imports	0.50	-0.12	0.46	-0.21	
Growth in Exports	0.41	-0.24	0.40	-0.39	0.20

Source: see text.
(*) 17 sectors, 3-year periods.

Chapter 3:

WHAT CAUSES VIOLENT CRIME?

1 - Introduction

A growing concern across the world is the heightened incidence of criminal and violent behavior. Rampant criminal behavior is a major concern in a variety of countries, ranging from the United States to the so-called transition economies of Eastern Europe and the developing countries in Sub-Saharan Africa and Latin America and the Caribbean.[1] A recent paper on the topic states that, "Crime and violence have emerged in recent years as major obstacles to the realization of development objectives in the countries of Latin America and the Caribbean" (World Bank 1997, abstract). In fact, crime rates for the world as whole have been rising since the mid-1970s, as illustrated in Figure 3.2. The growing public awareness is justified because rampant crime and violence may have pernicious effects on economic activity and, more generally, because they directly reduce the quality of life of all citizens who must cope with the reduced sense of personal and proprietary security. Despite the fact that violent crime is emerging as a priority in national policy agendas worldwide, we actually do not know what are the economic, social, institutional, and cultural factors that make some countries have higher crime rates than others over time.

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[1] See, for example, the attention given to the "rising crime wave" in Latin America and the Caribbean in "Law and Order," Latin Trade, June 1997, "Mexico City Crime Alarms Multinationals," The Wall Street Journal, October 29, 1996, p. A18, and "Reform Backlash in Latin America," The Economist, November 30-December 6, 1996.

At least since the publication of Becker (1968), the economics profession has analyzed the determinants of criminal behavior from theoretical and empirical points of view. Most empirical studies have addressed the issues associated with criminal behavior within cities and across regions within countries, especially the United States; yet very few empirical studies have addressed the question of why crime rates vary across countries and over time. This paper is an attempt to fill this vacuum in the economics literature.

We assembled a new data set of crime rates for a large sample of countries for the period 1970-1994, based on information from the United Nations World Crime Surveys. Then, we propose a simple model of the incentives faced by individuals to commit crimes, and explicitly consider possible causes of the persistence of crime over time (criminal inertia). The empirical implementation of the model estimates several econometric models attempting to capture the determinants of crime rates across countries and over time. The empirical models are first run for cross-sections and then applied to panel data. Working with panel data (that is, pooled cross-country and time-series data) allows us to consider both the effect of the business cycle (i.e., GDP growth rate) on the crime rate and the presence of criminal inertia (accounted for by the inclusion of the lagged crime rate as an explanatory variable). Furthermore, the use of panel data techniques will allow us to account for unobserved country-specific effects, for the likely joint endogeneity of some of the explanatory variables, and for the existence of some types of measurement errors afflicting the data of reported crimes.

Some of the interesting results are the following: Greater inequality is associated with higher intentional homicide and robbery rates, but the level of income per capita is not a significant determinant of national crime rates. "Deterrence" effects are also shown to be significant. Contrary to our expectations, national enrollment rates in secondary education and the average number of years of schooling of the population appear to be positively (but weakly) associated with higher homicide rates. We address this puzzle (also found in other empirical studies) when the regression results are presented. Drug production and drug possession are both significantly associated with higher crime rates. Regarding dynamic effects, we find that the homicide rate rises during periods of low economic activity. Also, we find that crime tends to persist over time (criminal inertia), even after controlling for other determinants of criminal behavior. All these results are robust to models that take into account the likely joint endogeneity of the explanatory variables, the presence of country-specific effects, and certain types of measurement errors in reported crime rates.

The rest of the paper is organized as follows: Section II provides a selective review of theoretical and empirical contributions to the economics literature dealing with criminal behavior. Section III presents a simple economic model of criminal behavior that begins with an individual-level analysis of the incentives to commit crimes, and then considers time effects. Under a couple of assumptions, the model provides a framework to analyze the empirical determinants of national crime rates. Section IV presents the data sets used in the econometric estimation, describing the sources of the data as well as its basic statistical characteristics. Section V presents the econometric models used for estimating the impact of selected variables on national crime rates, and interprets the results of each econometric exercise. Section VI presents the conclusions of the paper and suggests future directions for research.

2 - Literature Review

In his Nobel lecture, Becker (1993, 390) emphasized that the economic way of looking at human behavior "implie[s] that some individuals become criminals because of the financial and other rewards from crime compared to legal work, taking account of the likelihood of apprehension and conviction, and the severity of punishment." More recent literature has emphasized the role of time effects and criminal inertia that may result from social interactions, or delayed responses to surges in criminal activity on the part of police and judicial systems.

The theoretical and empirical literature has considered the role of three types of economic conditions in determining the incidence of criminal activity, namely the average income of the communities involved, the pattern of income distribution, and the level of education. Fleisher (1966) was a pioneer in studying the role of income on the decision to commit criminal acts by individuals, and stated that the "principal theoretical reason for believing that low income increases the tendency to commit crime is that ... the probable cost of getting caught is relatively low... because [low-income individuals] view their legitimate lifetime earning prospects dismally they may expect to lose relatively little earning potential by acquiring criminal records; furthermore, if legitimate earnings are low, the opportunity cost of time actually spent in delinquent activity, or in jail, is also low" (Fleisher 1966, 120). However, the level of legal income expected by an individual is not the only relevant "income" factor; the income level of potential victims also matters. The higher the level of income of potential victims, the higher the incentive to commit crimes, especially crimes against property. Thus, according to Fleisher (1966, 121), "[average] income has two conceptual influences on delinquency which operate in opposite directions, although they are not necessarily equal in strength."

Fleisher's (1966, 128-129) econometric results showed that higher average family incomes across 101 U.S. cities in 1960 were actually associated with lower court appearances by young males, and with lower numbers of arrests of young males for the crimes of robbery, burglary, larceny, and auto theft.[2] The author also found that the difference between the average income of the second lowest quartile and the highest quartile of households tended to increase city arrest and court-appearance rates, but the coefficient was often small in magnitude, and became statistically insignificant when the regressions were run for high-income communities alone.

The effects of income levels and distribution on crime were further analyzed by Ehrlich (1973, 538-540). He argued that payoffs to crime, especially property crime, depend primarily on the "opportunities provided by potential victims of crime," as measured by the median income of the families in a given community. The author assumed that, "the mean legitimate opportunities available to potential offenders," may

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[2] The crime-reducing effect of income appeared robust to various regression specifications that controlled for preferences or tastes of different communities. For example, average family incomes tended to reduce crime even when taking into account the shares of the local young populations that were composed of African-Americans, divorced or single mothers, and immigrants.

be approximated by, "the mean income level of those below the state's median [income]" (p. 539). For a given median income, income inequality can be an indication of the differential between the payoffs of legal and illegal activities. In his econometric analysis of the determinants of state crime rates in the U.S. in 1960, Ehrlich (1973, 546-551) found that higher median family incomes were associated with higher rates of murder, rape, and assault, and with higher rates of property crimes, such as burglary. In addition, a measure of income inequality – the percentage of families below one-half of the median income – was also associated with higher crime rates. The former finding contradicts Fleisher (1966), but the latter finding on the role of income inequality supports Fleisher's findings that inequality is associated with higher crime rates. Both Fleisher (1966, 136) and Ehrlich (1973, 555) considered the effect of unemployment on crime rates, viewing the unemployment rate in a community as a complementary indicator of income opportunities available in the legal labor market. [3] In their empirical studies, however, both authors find that unemployment rates were less important determinants of crime rates than income levels and distribution.

Another important factor related to the effect of economic conditions on crime is the level of education of the population, which can determine the expected rewards from both legal and criminal activities. In addition, Usher (1993) has argued that education may also have a "civilization" effect, tending to reduce the incidence of criminal activity. However, after controlling for income inequality and median income, Ehrlich (1975a,

[3] In the words of Fleisher (1966, 121), "in attempting to estimate the effect of income on delinquency, it is important to consider the effects of both normal family incomes and deviations from normal due to unemployment."

333) found a positive and significant relationship between the average number of school years completed by the adult population (over 25 years) and particularly property crimes committed across the U.S. in 1960. Four possible explanations of this puzzling empirical finding were provided by the author. First, it is possible that education may raise the marginal product of labor in the crime industry to a greater extent than for legitimate economic pursuits (Ehrlich 1975a, 319). Second, higher average levels of education may be associated with less under-reporting of crimes (Ehrlich 1975a, 333). Third, it is possible that education indicators act as a "surrogate for the average permanent income in the population, thus reflecting potential gains to be had from crime, especially property crimes" (Ehrlich 1975a, 333). Finally, combined with the observation that income inequality raises crime rates, it is possible to infer that certain crime rates are "directly related to inequalities in schooling and on-the-job training" (Ehrlich 1975a, 335).

Together with the relationship between economic conditions and crime, one of the main issues in the pioneering studies of Becker (1968) and Ehrlich (1973, 1975b, 1981) was the assessment of the effects of police presence, convictions, and the severity of punishments on the level of criminal activity. Individuals who are considering whether to commit crimes are assumed to evaluate both the risk of being caught and the associated punishment. The empirical evidence from the United States confirmed that both factors have a negative effect on crime rates – see Ehrlich (1973, 545, and 1996, 55).

Analysts often make a subtle distinction between the "deterrent" effects of policing and convictions and the "incapacitation" effects of locking-up (or killing, in the case of capital punishment) criminals who may have a tendency to rejoin the crime industry once they are released. As stated by Ehrlich (1981, 311), "deterrence essentially aims at modifying the 'price of crime' for all offenders," while incapacitation – and for that matter, rehabilitation – acts through the removal of, "a subset of convicted offenders from the market for offenses either by relocating them in legitimate labor markets, or by excluding them from the social scene for prescribed periods of time." The author showed that, in theory, the effectiveness of rehabilitation and incapacitation, vis-à-vis the purely deterrent approach to crime control, depends on the rate of recidivism of offenders, and on their responsiveness to economic incentives – i.e., changes in the "price of crime."[4] For example, the relatively higher rates of recidivism observed for property crimes – in comparison to violent crimes (Leung 1995, 66) – may imply that incapacitation and/or rehabilitation are more appropriate means for controlling these types of crime than deterrence policies. However, if property offenders respond readily to economic incentives, the argument would be the opposite.

Since most forms of punishment that incapacitate offenders also involve deterrent effects – e.g. imprisonment – it is often difficult to evaluate empirically the importance of each type of action. Using estimates based on regression results for the U.S. states in 1960, Ehrlich (1981) concluded that, "in practice the overwhelming portion of the total preventive effect of imprisonment is attributable to its pure deterrent effect." Moreover,

[4] Ehrlich (1981, 311-313) showed that the reduction in crime that follows the rehabilitation and/or incapacitation of past offenders is partially compensated by the entry or reentry of new offenders into the market, attracted by the temporary increase in the returns from crime that follows the departure of individual offenders. The author demonstrates that while the aggregate response of the supply of offenses to the removal of past offenders – through incapacitation or rehabilitation – decreases with the elasticity

Ehrlich (1975b) found that capital punishment provisions across the U.S. tended to reduce crime rates primarily through their deterrent effect, rather than through their incapacitation effect. Levitt (1995) addressed these issues jointly with one of the most recurrent problems in the aforementioned literature; namely, the author attempts to assess whether the seemingly negative relationship between crime rates and arrest rates were the product of deterrence effects, incapacitation, or measurement errors associated with the fact that crime tends to go unreported.[5] The author finds that most of this negative relationship in the U.S. is due to deterrence effects, and not measurement error or incapacitation, for most types of crime.

Another important consideration for assessing the effectiveness of deterrence is the individual's attitude towards risk, because an individual's expected utility from illegal income will be affected by his/her tastes for the risk involved. Becker (1968, 178) and Ehrlich (1973, 528), for example, established that a risk-neutral offender will tend to spend more time in criminal activity than a risk-averse individual. Another implication of assuming risk-aversion is that raising the probability of conviction may have a greater deterrent effect than raising the severity of punishment (Becker 1968, 178).

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of this function (with respect to the return from offenses), the efficacy of general deterrence increases with this elasticity.

[5] The crime rate is the number of crimes over population, while the arrest (or conviction) rate is the number of arrests (convictions) over the number of reported crimes. Therefore, it is possible that a negative relationship may exist between these two variables simply because under-reporting would produce a downward bias in the crime rate, while raising the arrest (conviction) rate. However, the relationship between these variables may be more complex, because the number of arrests (convictions) also depends on the number of reported crimes.

Some recent contributions to the theoretical literature consider the possible endogeneity of the perceived probability of punishment of offenders, and emphasize that the timing of the rewards and punishments from crime will affect the incidence of criminal activity over time. Davis (1988), for example, considers a model where the probability of a criminal being caught at any point in time is positively related to both the intensity of the individual's criminal activity, and to the rate of enforcement at that point in time. The author stresses that this probability is a component of the rate used by potential offenders to discount future streams of income from illegal activities, and derives optimal crime rates for given levels of punishment and rates of enforcement. Leung (1995) extends this type of model by considering an infinite time horizon, and by introducing recidivism into the analysis. The author allows the individual's number of previous convictions to affect the probability of a new conviction when a past offender commits new crimes, as well as the severity of the corresponding punishment. In Leung's (1995) model, past criminal records also reduce the returns from engaging in legal activities, both through stigma and human capital effects. The latter are associated with the depreciation of past skills and the foregoing of new investments in education during the period spent on illegal activities or in jail.

Sah (1991) studied a different relationship between the intensity of crime rates over time and the probability of apprehension. The author argued that individuals living in areas with high crime-participation rates can perceive a lower probability of apprehension than those living in areas with low crime-participation rates, because the resources spent in apprehending each criminal tend to be low in high crime areas. An important implication of this analysis is that "past crime breeds future crime" (Sah 1991, 1282). In a similar analysis, Posada (1994) presented a simple model where a random increase in crime rates can result in a permanent increase in the crime rate, when the increase in crime is not compensated by a proportional increase in the resources spent in the detection and punishment of crimes, which results in a lower perceived rate of apprehension.

Glaeser, Sacerdote, and Scheinkman (1996) emphasized the role of local social interactions in determining crime rates in U.S. cities. In contrast to Sah (1991) and Posada (1994), who emphasized the effect of what we call "systemic" interactions (i.e., an individual's perceived probability of apprehension depends on society's crime crate), Glaeser et al. (1996) argued that "local" interactions among individuals act through the transfer of information between agents regarding, "criminal techniques and the returns to crime, or interactions result from the inputs of family members and peers that determine the costs of crime or the taste for crime (i.e., family values), and monitoring by close neighbors" (Glaeser, et al. 1996, 512). A notable implication of the local interactions approach is that crime rates across communities need not converge. For the purposes of this paper, the implication of systemic and local interactions is that countries may experience criminal inertia over time.

In sum, the economics literature on crime has transited from an emphasis on economic conditions (including education) and deterrence effects to more recent considerations of factors that may explain how crime is propagated over time and within communities. In the following section we attempt to organize some of the ideas addressed in the literature in a simple framework.

3- A Simple, Reduced-Form Model of Criminal Behavior

We now present a simple model of criminal behavior that may help us organize ideas and motivate the variables postulated as determinants of crime rates in the empirical section of the paper.[6] We first model criminal behavior from the perspective of the individual and then aggregate to the national level to obtain a reduced-form equation of the causes of national crime rates.

The basic assumptions are that potential criminals act rationally, basing their decision to commit a crime on an analysis of the costs and benefits associated with a particular criminal act. Furthermore, we assume that individuals are risk neutral, and respond to changes in the probability of apprehension and the severity of punishment. Thus, individuals will commit a crime whenever its expected net benefits are large enough. Equation (1) below says that, for a particular individual, the expected net benefit (*nb*) of committing a crime is equal to its expected payoff (that is, the probability of not being apprehended (*1-pr*) times the loot *l*), minus the total costs associated with planning and executing the crime (*c*), minus the foregone wages from legitimate activities (*w*), minus the expected punishment for the committed crime (*pr*pu*):[7]

$$nb = (1-pr)*l - c - w - pr*pu \qquad (1)$$

[6] For a comprehensive survey of models of criminal behavior, see Schmidt and Witte (1984, 165-182).

Assuming that individuals have some "moral values," the expected net benefits of a crime would have to exceed a certain threshold before she/he commits a crime. The individual's threshold would be determined by her/his moral stance (m), to which we can assign a pecuniary value to make it comparable to the other variables in the model. Equation (2) establishes this relationship between the decision to commit a crime and the net benefits of such behavior:

$$d = 1 \text{ when } nb \geq m$$

$$d = 0 \text{ when } nb < m \qquad (2)$$

where d stands for the decision to commit the crime ($d = 1$) or not to commit the crime ($d = 0$).

In the empirical section of the paper, we estimate a model in which the dependent variable is the national crime rate and the explanatory variables are a number of national economic and social characteristics. We first link those characteristics with the elements entering the individual decision to commit a crime. Then, we aggregate over individuals in a nation to obtain a reduced-form expression for the country's crime rate in terms of the underlying socio-economic variables. (Figure 3.1 summarizes the discussion below.)

The first underlying variable is individual education (e), which may impact on the decision to commit a crime through several channels. Higher levels of educational attainment may be associated with higher expected legal earnings, thus raising w. Also, education, through its civic component, may increase the individual's moral stance, m.

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[7] Lower-case letters represent the variables related to a particular individual (not necessarily a representative individual in society). Upper-case letters represent society's averages for the respective variables.

On the other hand, education may reduce the costs of committing crimes (i.e., reducing c) or may raise the crime's loot, l, because education may open opportunities for an individual to enter higher-paying crime industries. Hence the net effect of education on the individual's decision to commit a crime is, a priori, ambiguous. We can conjecture, however, that if legal economic activities are more skill- or education-intensive than illegal activities, then it is more likely that education will induce individuals not to commit crimes. In addition, following Tauchen and Witte (1994), it is possible that school enrollment alone (independently of the level of educational attainment) will reduce the time available for participating in the crime industry. Hence, the empirical section will assess the effect of both secondary enrollment rates and educational attainment on crime rates.

The individual's past experience in criminal activities (d_{t-1}) is another important underlying variable that affects in several ways the decision to commit a crime. First, convicts tend to be stigmatized in the legal labor market, thus having diminished employment opportunities and expected income (lower w). Second, criminals can learn by doing, which means that the costs of carrying out criminal acts, c, may decline over time. Third, people tend to have a reduced moral threshold, m, after having joined the crime industry. The past incidence of crime in society (D_{t-1}), through the local social interactions noted in our literature survey, also affect the individual's decision by both reducing the costs of carrying out criminal activities (lower c) and impairing civic moral values (lower m). These arguments strongly suggest the possibility of criminal inertia, that is, present crime incidence explained to some extent by its past incidence.

The level and growth of economic activity (*EA*) in society create attractive opportunities for employment in the legal sector (higher *w*) but, since they also improve the wealth of other members of society, the size of the potential loot from crime, *l*, also rises. Therefore, the effect of heightened economic activity on the individual's decision to commit a crime is, in principle, ambiguous. The effect of income inequality in society (*INEQ*) will depend on the individual's relative income position. It is likely that in the case of the rich, an increase in inequality will not induce them to commit more crimes. However, in the case of the poor, an increase in inequality may be crime inducing, because such an increase implies a larger gap between the poor's wages and those of the rich, thus reflecting a larger difference between the income from criminal and legal activities (higher *l-w*). A rise in inequality may also have a crime-inducing effect by reducing the individual's moral threshold (lower *m*) through what we could call an "envy effect". Therefore, a rise inequality will have a positive impact on (at least some) individuals' propensity to commit a crime.

The existence of profitable criminal activities (*DRUGS*) in some countries means that the expected loot from crime is larger in those countries than in others. The most important example of profitable criminal activities is the illicit drug trade (other two are gambling and prostitution). Countries where the raw materials for illicit drugs are easily obtained (such as Colombia, Bolivia, and Peru in the case of cocaine) or countries that are located close to high drug consumption centers (such as Mexico in relation to the United States) have frequent and highly profitable opportunities for criminal activities. These activities not only consist of drug production and trade themselves, but also involve the element of violence and official corruption required for them to carry on.

The strength of the police and the judicial system (*JUST*) increases the probability of apprehension (*pr*) and the punishment (*pu*) for criminal actions, thus reducing the incentive for an individual to commit a crime. This is the crime deterrence effect. It should also be noted that the past incidence of crime in society (D_{t-1}) may determine an individual's perceived probability of apprehension (*pr*) via systemic interactions, as discussed above.

Finally, there are other factors that may affect an individual's propensity to commit crimes (*other*) such as cultural characteristics (religion and colonial heritage, for example), age and sex (young males are said to be more violent prone than the rest of the population), the availability of fire arms in the country, and the population density where the individual lives (urban centers would facilitate the social interaction through which crime skills are transmitted). These other factors can affect the individual's decision to commit a crime mainly through the cost of planning and executing the crime (*c*) and through his/her moral threshold (*m*).

Considering the effects summarized in Figure 3.1, and substituting them into equations (1) and (2), we have that a given individual will commit a crime (*d*=1) if the following inequality (3) holds:

$$l(\overset{+}{e}, \overset{+}{EA}, \overset{+}{INEQ}, \overset{+}{DRUGS}, \overset{-}{JUST}) - c(\overset{-}{e}, \overset{-}{d}_{t-1}, \overset{-}{D}_{t-1}, \overset{-}{other})$$
$$- w(\overset{+}{e}, \overset{-}{d}_{t-1}, \overset{+}{EA}) - pr(\overset{+}{JUST}) * pu - m(\overset{+}{e}, \overset{-}{d}_{t-1}, \overset{-}{D}_{t-1}, \overset{-}{INEQ}, \overset{-}{other}) \geq 0$$

Rewriting this condition as a function *f* of the underlying individual and social variables, we obtain the following reduced-form expression:

$$d = 1 \text{ if } f(\overset{?}{e}, \overset{+}{d}_{t-1}, \overset{+}{D}_{t-1}, \overset{?}{EA}, \overset{+}{INEQ}, \overset{+}{DRUGS}, \overset{-}{JUST}, \overset{+}{other}) \geq 0$$

$$\Leftrightarrow d = 1 \ \text{ if } f(\Psi) \geq 0 \qquad (4)$$

where Ψ is a vector of the underlying determinants of crime. Assuming *both* a linear probability model for the decision to commit a crime and a linear functional form for *f*, we obtain the following individual regression equation:

$$d = \beta' \Psi + \mu \qquad (5)$$

The assumption of linearity in both the functional form of *f* and the probability model are, of course, arbitrary. They are chosen because they allow the aggregation of equation (5). Given that our data is not individual but national, our regression equation must be specified in terms of national rates, which is obtained by averaging equation (5) over all individuals in a country and over a given time period,

$$D_t = \beta \Psi_t + v_t \qquad (6)$$

That is,

$$\textit{Crime Rate}_{i,t} = \beta_0 + \beta_1 \textit{EDUC}_{i,t} + \beta_2 \textit{Lagged crime rate}_{i,t} + \beta_3 \textit{EA}_{i,t} +$$

$$\beta_4 \textit{DRUGS}_{i,t} + \beta_5 \textit{JUST}_{i,t} + \beta_6 \textit{OTHER}_{i,t} + \eta_i + \varepsilon_{i,t} \qquad (7)$$

where the subscripts *i* and *t* represent country and time period, respectively; and 0 is an unobserved country-specific effect.

4 - The Data

A full description of the variables (and their sources) used in this paper is presented in the Appendix. Curious readers are urged to examine the descriptions and tables included therein. This section briefly describes the data used to calculate the national crime rates and the set of explanatory variables.

4.1 - National Crime Rates

The empirical implementation of the theoretical model proposed above will rely on crime rates, which were based on the number of crimes reported by national justice ministries to the United Nations World Crime Surveys. The econometric analysis will focus on the determinants of "intentional homicide," and robbery rates between 1970 and 1994.[8] All crime rates are expressed as the number of reported crimes in each category per 100,000 inhabitants. As shown in Table 3.1, there is a considerable variation in the crime-related variables. However, it is worth noting that most countries did not report data for the entire period nor for every type of crime.

Figure 3.2 shows the evolution of the population-weighted average rate of intentional homicides in the group of 34 countries for which there was data available in each 5-year sub-period. As mentioned in the introduction, the world's intentional homicide rate has been increasing steadily, at least since the early 1980s, with a notable acceleration during recent years. Figures 3.3 and 3.4 show the evolution of the median intentional homicide rate in each five-year period for the whole sample of countries, while separating groups of countries by income levels and regions. We use the median rate to describe the evolution of homicide rates because this measure is less sensitive to the influence of outliers than the mean rate. Figure 3.3 shows that much of the increase was due to increases in the median homicide rates of middle-low and low-income

[8] Drug possession crime rates and the lagged values of the intentional homicide and robbery rates were also used as explanatory variables. "Total" homicide statistics were collected for this project, but were not used in the econometric analysis because we feared that this broader definition of "homicide" was subject to more definition differences across countries than "intentional" homicide.

countries (where the former had a GNP per capita ranging from $766 US dollars in 1995 to $3,035, and the latter had an income per capita of $765 or less). Figure 3.5 shows that the highest homicide rates are found in Latin America and the Caribbean, followed by Sub-Saharan Africa. In these regions, and in the developing countries of Europe and Central Asia, considerable increases in intentional homicide rates have been observed in the early nineties. However, it should be noted that the sample of Sub-Saharan African countries is quite small and varies across sub-periods, thus the evolution of the median rate for this group may reflect the inclusion of outliers in the latter two periods (e.g., Swaziland and Sao Tome & Principe have high crime rates, but we only have data for the last two periods).

Figures 3.5 and 3.6 show the evolution of intentional homicide rates in South America and Mexico, and in Central America and the Caribbean, respectively.[9] Regarding Figure 3.5, it is interesting to note that only Argentina and Chile experienced a decline in their homicide rates since the early 1970s, when both countries faced severe economic and political crises. Colombia experienced the most noticeable increase in the homicide rate, jumping from an average of approximately 16 intentional homicides per 100,000 inhabitants during 1970-1974 to over 80 in 1990-1994, possibly reflecting the rise of the drug trafficking industry in that country. Figure 3.6 shows that several small economies, such as Bahamas, Jamaica, Nicaragua, and El Salvador, have had higher intentional

[9] The homicide rates for Argentina, Brazil, Colombia, Mexico, and Venezuela were constructed from data provided by the Health Situation Analysis Program of the Division of Health and Human Development, Pan-American Health Organization, from the PAHO Technical Information System. This source provided us with data on the annual number of deaths attributed to homicides, which come from national vital statistics systems.

homicide rates than most large Latin American countries. All of these countries have experienced rates in excess of 20 intentional homicides per 100,000 population. Furthermore, Bahamas, Barbados, Jamaica, and Trinidad and Tobago have experienced considerable increases in their crime rates since the early 1970s. Of the small countries, only Costa Rica has experienced a steady decline of its intentional homicide rate. Thus, the rise in the overall homicide rate in Latin America and the Caribbean can be attributed to an upward trend in criminal activity in most countries of the region (with a few exceptions such as Argentina, Chile, and Costa Rica), with a few outliers that have experienced dramatic increases in criminal activity (Bahamas, Jamaica, and Colombia).

4.2 - Explanatory Variables

Following the simple model presented in the previous section, we have selected a set of explanatory variables that proxy for the main economic determinants of crime rates, as well as for some of the non-pecuniary factors that may affect the decision to perform illegal activities.

As a proxy of the average income of the countries involved in our econometric study, we use the Gross National Product (GNP) per capita, in prices of 1987. The figures were converted to U.S. dollars on the basis of the methodology proposed by Loayza et al. (1998), which is based on an average of real exchange rates.[10] In the regressions that are

[10] Most of the data was provided by Loayza et al. (1998). For some countries not covered by these authors, however, the conversion factors were constructed on the basis of information from World Bank databases.

based on both cross-sectional and time-series data, we also used the rate of growth of GDP, calculated on the basis of figures expressed in 1987 prices (in local currency).

The degree of income inequality was measured by the Gini index and by the percentage of the national income received by the lowest quintile of a country's income. Both variables were constructed on the basis of the data set provided by Deininger and Squire (1996); we used what these authors have termed "high quality" data for the countries and years for which it was available, and otherwise calculated an average of alternative figures (also provided by Deininger and Squire, 1996). The Gini coefficients which were originally based on expenditure information were adjusted to ensure their comparability with the coefficients based on income data. [11]

Two educational variables were used, as measures of the stock and the flow of investment in human capital in a given country. These are, respectively, the average years of schooling of the population over 15 years of age, as calculated by Barro and Lee (1996), and the secondary enrollment rate, which was taken from World Bank databases, and is defined as the number of people (of all ages) enrolled in secondary schools, expressed as a percentage of the total population of secondary school age.[12]

Another type of economic incentive to commit crime that we considered was the existence of profitable criminal "industries". In particular, we focused on the existence, in a given country, of considerable production and/or distribution of illegal drugs. The

[11] We followed, in this respect, the suggestion of Deininger and Squire (1996, 582) of adding to the indices based on expenditure the average difference of 6.6 between expenditure-based and income-based coefficients.

choice of this particular crime industry was motivated not only by the fact that the drug trade is known to be highly profitable but also because, at least in some countries – e.g. the U.S. – it is also known to use a very "violence-intensive" technology. The latter aspect of this industry, and the intellectual and moral decay associated with the consumption of the substances in question, can be expected to generate externalities for the proliferation of other violent crimes. We used two specific variables as measures of the size of the illegal drug industry. The first was the number of drug possession offenses per 100,000 population, which we calculated on the basis of data from the United Nations' Crime Surveys. It is worth noting that this variable does not measure the extent of actual drug consumption in a given country, but only the fraction of that figure that is considered illegal in the country's legislation, and that has been detected by the law enforcement agencies. Thus, the variable in question reflects not only the size of the drug-consuming population, but also the degree of tolerance for drug consumption in the corresponding society. The second measure that we used is a "dummy" variable that takes the value one when a country is listed as a significant producer of any illegal drug in any of the issues of the U.S. Department of *State's International Narcotics Control Strategy Report* – which has been published on an annual basis since 1986.

Regarding the negative incentives to commit crime, we used several variables to proxy for the probability of being caught and convicted when performing an illegal activity, and for the corresponding severity of the punishments. To capture the first component of the crime deterrence efforts of a given society, we used both the number of

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[12] "Net" enrollment rates (the fraction of people of secondary-school age who are enrolled

police personnel per 100,000 inhabitants, and the conviction rate of the corresponding crime, defined as the ratio of the number of convictions to the number of reported occurrences of each type of crime. Table 3.1 shows summary statistics for both variables, which were constructed on the basis of data provided by the United Nations, in its World Crime Surveys.[13] We also collected information provided by Amnesty International about the existence of the death penalty in countries across the globe, which we use as an indicator of the severity of punishments.

Other determinants of the intensity of criminal activity highlighted by the theoretical model presented above include factors that reduce both the pecuniary and the non-pecuniary cost of engaging in illegal activities. These factors may act by facilitating the development of social interactions between criminals and would-be criminals. Assuming that these interactions are more prevalent in urban agglomerations than in rural areas, we use the rate of urbanization as a possible factor in explaining crime rates across nations. We also include in our empirical exercise the proportion of the total population encompassed by males belonging to the 15-29 age group, which is – at least in the U.S. – the demographic group to which most criminals belong.

The taste or preference for criminal activity may also be influenced by cultural characteristics of the countries involved. As countries with common cultural traits may also share similar economic characteristics, it is important to control for the former in

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in secondary school) are not available for a large number of developing countries.

[13] The conviction rates reported in Table 3.1 are five-year averages, rather than annual observations. The averages provide better descriptions of the convictions rates because reported convictions are often associated with crimes committed in previous years, but

order to obtain an accurate appraisal of the effect of the latter on the determination of national crime rates. With this end in mind, we employed religion and regional "dummies" in our cross-sectional regressions. The first set of variables – related to Buddhist, Christian, Hindu, and Muslim countries – was constructed on the basis of information from the *CIA Factbook*, and each variable takes the value one for the countries in which the corresponding religion is the one with the largest number of followers. Regional dummies were constructed for the developing countries of Sub-Saharan Africa, Asia, Europe and Central Asia, Latin America and the Caribbean, Middle East and Northern Africa, all based on the regional definitions employed by the World Bank and the International Monetary Fund. Finally, we used a variable from Easterly and Levine (1997) that measures the likelihood that two randomly selected people from a given country will not belong to the same ethno-linguistic group. This index is only available for 1960, and hence it should be interpreted with caution. The objective is to capture not only cultural effects on crime that may be derived from a common set of values, but also any potential effects from cultural polarization.

5- Empirical Implementation

A version of the regression equation derived from our model is first run for simple cross-sections and then applied to panel data. On the one hand, cross-sectional regressions are illustrative because they emphasize cross-country variation of the data, allowing us to analyze the effects of variables that do not change much over time. On the

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the annual rates are constructed with contemporary observations of the number of reported crimes.

other hand, working with panel data (that is, pooled cross-country and time-series data) allows us to consider both the effect of the business cycle (i.e., GDP growth rate) on the crime rate and the presence of criminal inertia (accounted for by the inclusion of lagged crime rate as an explanatory variable). Furthermore, the use of panel data will allow us to account for unobserved country-specific effects, for the likely joint endogeneity of some of the explanatory variables, and for some types of measurement errors in the reported crime rates.

As dependent variables, we consider the incidence of two types of crime, namely, intentional homicide and robbery. Under-reporting is a major problem related to the available measures of crime. It is well known that mis-measurement of the dependent variable does not lead to estimation biases when the measurement error is uncorrelated with the regressors. This condition, however, is very likely to be violated in the case of crime under-reporting given that the degree of mis-measurement is surely related, for instance, to the average income of the population, its level of education, and the degree of income inequality, which are considered as explanatory variables in our empirical model of crime. Of all types of crime, intentional homicide is the one that suffers the least from under-reporting because corpses are more difficult to ignore than losses of property or assaults. Therefore, most of the analysis will concentrate on the regressions that have the intentional homicide rate as the dependent variable. To the extent that intentional homicide is a good proxy for overall crime, the conclusions we reach apply also to criminal behavior broadly understood. However, if intentional homicide proxies mostly for violent crime, then our results apply more narrowly. Hence we also focus on the determinants of robbery rates. Robberies are crimes against property that include a violent component; they are defined as the taking away of property from a person, overcoming resistance by force or threat of force. We believe that victims of robberies may have stronger incentives to report them than victims of only theft or assault.

For ease of exposition, we first present the cross-sectional regression results and then the panel regression results.

5.1 - Cross-Sectional Regressions

Tables 2 and 3 report the results from cross-sectional regressions for intentional homicides and robbery rates, respectively. These regressions use country averages of the relevant dependent variables for the period 1970-94, but the averages were calculated using only the annual observations for which the homicide data was available.

Table 3.2 shows that the Gini index of income distribution has a positive coefficient, which is significant in all the regressions, revealing that countries with more unequal distributions of income tend to have higher crime rates than those with more egalitarian patterns of income distribution. In addition, regression (2) includes an alternative measure of the distribution of income; namely, the share of national income received by the poorest 20 percent of the population. The negative and significant coefficient of this variable tells us that crime tends to decline as the poorest quintile receives higher shares of national income. Income (i.e., GNP) per capita seems to be negatively associated with the incidence of intentional homicides, as reflected in its negative coefficient, but this result is significant at conventional levels in only one of the sixteen regressions presented in Table 3.2. The combination of an insignificant effect of

the income per capita with a significant effect of the distribution of income may indicate that changes in income distribution, rather than changes in the absolute levels of poverty, are associated with changes in violent crime rates.

Regarding education, the results in Table 3.2 show that the average years of schooling, or the level of educational attainment of the population, has a negative coefficient in 12 out of the 15 regressions that include this variable, but the coefficient is not significant in any specification. In equation (3) we use the secondary enrollment rate (or the flow of human capital) instead of the attainment variable. Contrary to our expectations, the coefficient of the enrollment rate is positive, but also insignificant. As elaborated in our theoretical model, the relationship between educational variables and crime rates can be ambiguous. However, from an empirical point of view, these results may be explained by an implicit relationship between the extent of crime under-reporting and the level of education of the population; that is, an increase in education may induce people to report more crimes, thus producing a rise in *reported* crime rates. Also, the two education variables are in fact negatively correlated with the homicide rate and at the same time highly correlated with both per capita GNP (correlation about 0.5) and the Gini index (correlation about -0.55). Therefore, it is quite possible that the expected crime-reducing effects of education are captured by the measures of both national income per capita and income distribution, also present in the homicide rate regression equation. We will reconsider the effect of the educational variables when we discuss the panel data results.

Regressions (4) to (6) in Table 3.2 examine the relationship between deterrence and incapacitation effects and intentional homicide rates. The presence of police seems to reduce crime, but the negative coefficient is not significant. The coefficients corresponding to the conviction rate are statistically different from zero, even after including the variable that controls for the existence of the death penalty, which may indicate that high convictions rates tend to deter criminal activity independently of the incapacitation effect of the death penalty. However, as for most results of these OLS cross-sectional regressions, this result must be regarded as preliminary given that the negative relationship between homicide and conviction rates may be due to measurement error in the number of homicides, which is both the numerator of the homicide rate and the denominator of the conviction rate (see Levitt 1995).[14] We reexamine this issue in the context of panel data analysis, in which correction for measurement error is possible to some extent. In regressions not reported in Table 3.2, we included subjective indices of the quality of the state apparatus instead of the police and conviction rates. Neither the index of rule of law nor the index of absence of corruption turned out to be significant. The lack of significance of the estimated coefficients on these subjective indices of the rule of law and absence of corruption in the bureaucracy may be due to the fact that they are highly correlated with other important explanatory variables in the regression, namely, per capita GNP, the Gini index, and the measures of educational stand.

[14] An indication that the negative relationship between homicide and conviction rates may be partially spurious is given by the suspicious jumps in the fit of the regression when the conviction rate is included as an explanatory variable.

Table 3.2 also shows that the incidence of intentional homicides is statistically larger in countries that produce drugs. The drug possession crime rate, which proxies for the effects of both illegal drug consumption and for the violence emanating from the distribution of illegal drugs, is also positively associated with the intentional homicide rate, but it is significant in only two of the 16 specifications. These results give credence to the popular view that violent crimes increase with drug trafficking and consumption. It remains to be studied, however, whether the incidence of homicides in drug producing and/or consuming countries is directly affected by drug-related activities or is also the result of crime externalities of these activities. The latter would be the case if, for example, criminal organizations established to deal with drugs are also used to manage other forms of criminal endeavors.

In the cross-sectional regressions considered in Table 3.2, the urbanization rate appears not to be significantly associated with the homicide rate. This result may be due to the high correlation between the urbanization rate and other economic variables, such as income per capita, the Gini index, and, especially, the education variables. Still, we expected that the urbanization rate could provide information on the strength of social interactions in the formation of criminal behavior; this information would not be necessarily captured by the other indicators of economic development. We will reconsider this issue when discussing the robbery regressions and the panel data regressions for the homicide rate.

We examine the importance of other variables that in principle may be related to the incidence of intentional homicides. We do it by including them one by one in a core regression that considers per capita GNP, the Gini index, the average years of schooling, the urbanization rate, the drug producers dummy, and the drug possession crime rate as explanatory variables.[15] In these additional regressions (also presented in Table 3.2), we find the rather surprising result that the index of ethno-linguistic fractionalization, which has been used as a proxy for social polarization and conflict (see Easterly and Levine 1997), is negatively associated with the rate of intentional homicides, though this association is only marginally significant. Regarding the religion dummies, Christian countries seem to have significantly higher homicide rates, while Hindu and Muslim countries seem to have lower homicide rates than the average, even after controlling for other possible determinants of crime rates. Of the regional dummies, South and East Asian countries seem to have significantly lower homicide rates than the average, while Latin America seems to have higher rates than the average.[16]

Table 3.3 reports the cross-sectional regression results for the incidence of robberies. As mentioned, these results should be interpreted with caution given that the robbery rates may suffer from under-reporting more severely than the intentional homicide rates.

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[15] We do not include the homicide conviction rate in the core regression for two reasons; first, the variables to be examined are likely to also proxy for the strength of the police and judicial system; and second, the inclusion of the conviction rate reduces the sample size of the estimated regression by about 25%.

[16] We also ran regressions that included an index of the coverage of firearm regulations and the share of national population encompassed by males of 15-29 years of age as explanatory variables – see Table 3.A1 for a description of these variables. However, the results showed that these variables were not significant determinants of intentional homicide rates. In addition, we collected information regarding the incidence of firearms in a group of countries, but this data was only available for a small group of countries, the

The results of the robbery regressions are in several respects similar to those for the homicide rate. The level of per capita income is not a significant determinant of robbery rates, but a worsening of income inequality is statistically related to higher robbery rates. However, the drug producers dummy appears to be less important in the robbery regressions than in the homicide regressions. The coefficient of the secondary enrollment rate is also positive in regression (3), and is actually more significant than in the corresponding homicide regression. However, the deterrence and incapacitation variables appear with noticeably different coefficients in the robbery regressions. First, the presence of police personnel variable turns out to have a positive and significant coefficient, which may reflect that police presence is endogenous. The conviction and death penalty variables introduced in regression (5) and (6) appear with the expected negative signs, but neither is statistically significant.

An interesting result, that contrasts with those of the homicide regressions, is that the urbanization rate seems to have a positive and significant association with the robbery rate; the coefficient is significant in 14 of the 16 specifications. This result may indicate that this type of crime may be related to population density and the social interactions that arise from it. As in the homicide regression, the index of ethno-linguistic fractionalization is also not a significant determinant of robbery rates. Regarding the religion and regional dummy variables, the results reported in Table 3.3 are consistent with the results in Table 3.2, but with the additional finding that Sub-Saharan African countries also tend to have a significantly higher robbery rate than the average.

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regressions contained only 18 countries, and the coefficient of this variable was also

5.2 - Panel Regressions

The cross-sectional results emphasize the cross-country variation of crime rates and their determinants. However, further analysis is possible given that the available data on crime rates and their determinants allow the use of an unbalanced panel with five-year periods. The time-series dimension of the data can add important information and permit a richer model specification. First, we would like to test whether the crime rate varies along the business cycle by including the five-year average GDP growth rate in the regression model; this test could not be done using cross-sectional data averaged over a long period of time (1970-94). Second, we would like to test whether there is inertia in crime rates, by including the lagged crime rate in the model. Third, we would like to control for the likely joint endogeneity of some of the explanatory variables and the bias due to under-reporting. And, fourth, we would like to control for the presence of unobserved country-specific effects.

Our preferred panel estimation strategy follows the Generalized Method of Moments (GMM) estimator proposed by Chamberlain (1984), Holtz-Eakin, Newey and Rosen (1988), Arellano and Bond (1991), and Arellano and Bover (1995), which has been applied to cross-country studies by Caselli, Esquivel and Lefort (1996) and Easterly, Loayza and Montiel (1997). The following is a brief presentation of the GMM estimator to be used.[17]

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statistically insignificant.

[17] For a concise presentation of the GMM estimator addressed to a general audience, see the appendix of Easterly, Loayza, and Montiel (1997) and chapter 8 of Baltagi (1995).

We will work under two econometric models. In the first one, we assume that there are no unobserved country-specific effects. In the second one, we allow and control for them. Why do we also work with the constrained model of no country-specific effects? The data requirements to handle appropriately the presence of country-specific effects (namely, a minimum of three consecutive observations per country in the sample) produce the loss of a large amount of observations in our panel, which is of rather limited coverage to start with. Considering the model without country-specific effects increases the number of observations at the cost of estimating a more restricted model.

5.2.1 - Assuming no unobserved country-specific effects

Consider the following regression equation,

$$y_{i,t} = \alpha y_{i,t-1} + \beta X_{i,t} + \varepsilon_{i,t} \qquad (8)$$

where y represents a crime rate, X represents the set of explanatory variables other than the lagged crime rate, ε is the error term, and the subscripts i and t represent country and time period, respectively.

We would like to relax the assumption that all the explanatory variables are strictly exogenous (that is, that they are uncorrelated with the error term at all leads and lags). Relaxing this assumption allows for the possibility of simultaneity and reverse causality, which are very likely present in crime regressions. We adopt the assumption of weak exogeneity of at least some of the explanatory variables, in the sense that they are assumed to be uncorrelated with future realizations of the error term. For example, in the case of reverse causality this weaker assumption means that current explanatory variables may be affected by past and current crime rates but not by future crime rates. In practice we assume that all variables are weakly exogenous except for the drug producers dummy and the GDP growth rate.

Furthermore, we would like to allow and control for the possibility that errors in the measurement of the crime rate (which are imbedded in the error term ε) be correlated with some of the explanatory variables. This would be the case if, for instance, the degree of crime under-reporting decreases with the population's level of education. As explained below, our method of estimation corrects this type of mis-measurement bias, as long as the error in measurement is not serially correlated.

Under the assumption that the error term, ε, is not serially correlated, the assumption of weak exogeneity of the explanatory variables implies the following moment conditions,

$$E[X_{i,\ t-s} \cdot \varepsilon_{i,\ t}] = 0 \quad \text{for } s \geq 1 \qquad (9)$$

These moment conditions mean that the observations of X lagged one or more periods are valid instruments for the corresponding contemporaneous observations.

Given that the lagged crime rate is also measured with error, it must also be replaced by an instrument. Again, under the assumption that , is not serially correlated, observations of the crime rate lagged two or more periods are valid instruments for the lagged crime rate, y_{t-1}. That is, the following moment conditions apply,

$$E[y_{i,\ t-s} \cdot \varepsilon_{i,\ t}] = 0 \quad \text{for } s \geq 2 \qquad (10)$$

5.2.2 - Allowing and controlling for unobserved country-specific effects

Consider the following regression equation,

$$y_{i,t} = \alpha y_{i,t-1} + \beta X_{i,t} + \eta_i + \varepsilon_{i,t} \quad (11)$$

Equation (11) differs from (8) in that it includes η_i, an unobserved country-specific effect. The usual method to deal with the specific effect in the context of panel data has been to first-difference the regression equation (Anderson and Hsiao, 1981). In this way the specific-effect is directly eliminated from the estimation process. First-differencing equation (11), we obtain

$$y_{i,t} - y_{i,t-1} = \alpha (y_{i,t-1} - y_{i,t-2}) + \beta (X_{i,t} - X_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \quad (12)$$

The use of instruments is again required to deal with several problems: first, the likely joint endogeneity of the explanatory variables, X; second, the fact that mis-measurement in the contemporaneous crime rate may be correlated with the explanatory variables; third, the fact that the lagged crime rate is likely to be measured with error; and fourth, the fact that by differencing, we introduce by construction a correlation between the new error term, $\varepsilon_{i,t} - \varepsilon_{i,t-1}$, and the differenced lagged dependent variable, $y_{i,t-1} - y_{i,t-2}$. Under the assumption that the error term, ε, is not serially correlated, the following moment conditions apply in relation to, respectively, the lagged dependent variable and the set of explanatory variables,

$$E[y_{i,\,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \quad \text{for } s \geq 3 \quad (13)$$

$$E[X_{i,\,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \quad \text{for } s \geq 2 \quad (14)$$

Arellano and Bond (1991) develop a consistent GMM estimator based on moment conditions similar to those in equations (13) and (14). However, for reasons explained below, we will use an estimator that complements these moment conditions (applied to the regression in differences) with appropriate moment conditions applied to the regression in *levels*. Before explaining the statistical advantages of the estimator that combines differences and levels regressions over the simple difference estimator, a conceptual justification for our approach is the following. This paper studies not only the time-series determinants of crime rates but also their cross-country variation, which is eliminated in the case of the simple difference estimator.

Alonso-Borrego and Arellano (1996) and Blundell and Bond (1997) show that when the lagged dependent and the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation in differences. The instruments' weakness has repercussions on both the asymptotic and small-sample performance of the difference estimator. As the variables' persistence increases, the asymptotic variance of the coefficients obtained with the difference estimator rises (that is, the asymptotic precision of this estimator deteriorates). Furthermore, Monte Carlo experiments show that the weakness of the instruments produces biased coefficients in small samples; this bias is exacerbated with the variables' over time persistence, the importance of the specific-effect, and the smallness of the time-series dimension. An additional problem with the simple difference estimator relates to measurement error: Differencing may exacerbate the bias due to errors in variables by decreasing the signal-to-noise ratio (see Griliches and Hausman, 1986).

On the basis of both asymptotic and small-sample properties, Blundell and Bond (1997) suggest the use of the Arellano and Bover (1995) estimator in place of the usual difference estimator. Arellano and Bover (1995) present an estimator that combines, in a system, the regression in differences with the regression in levels. The instruments for the regression in differences are the lagged *levels* of the corresponding variables; therefore, the moment conditions in equations (13) and (14) apply to this first part of the system. The instruments for the regression in levels are the lagged *differences* of the corresponding variables. These are appropriate instruments under the following two assumptions: First, the error term ε is not serially correlated. And second, although there may be correlation between the levels of the right-hand side variables and the country-specific effect, there is no correlation between the differences of these variables and the specific effect. The second assumption results from the following stationarity property,

$$E[y_{i,\,t+p} \cdot \eta_i] = E[y_{i,\,t+q} \cdot \eta_i]$$

$$\textit{and}\ E[X_{i,\,t+p} \cdot \eta_i] = E[X_{i,\,t+q} \cdot \eta_i]\ \textit{for all p and q} \qquad (15)$$

Therefore, the moment conditions for the second part of the system (the regression in levels) are given by:

$$E[(y_{i,\,t-s} - y_{i,\,t-s-1}) \cdot (\eta_i + \varepsilon_{i,t})] = 0\ \textit{for}\ s=2 \qquad (16)$$

$$E[(X_{i,\,t-s} - X_{i,\,t-s-1}) \cdot (\eta_i + \varepsilon_{i,t})] = 0\ \textit{for}\ s=1 \qquad (17)$$

5.2.3 - Summary of the Methodology.

The estimation strategy proposed in this paper can deal with unobserved fixed effects in a dynamic (lagged-dependent variable) model, joint endogeneity of the explanatory variables, and serially-uncorrelated crime rate mis-measurement. The moment conditions presented above can be used in the context of the Generalized Method of Moments (GMM) to generate consistent and efficient estimates of the parameters of interest

(Arellano and Bond, 1991; and Arellano and Bover, 1995). Specifically, in the model that ignores unobserved country-specific effects, the moment conditions in equations (9) and (10) are used; and in the model that allows and controls for unobserved specific effects, the moment conditions in equations (13), (14), (16) and (17) are used.[18]

The consistency of the GMM estimator depends on whether lagged values of the crime rate and the other explanatory variables are valid instruments in the crime regression. To address this issue we present two specification test, suggested by Arellano and Bond (1991). The first is a Sargan test of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. The second test examines the hypothesis that the error term $\varepsilon_{i,t}$ is not serially correlated. In the levels regression we test whether the error term is first- or second-order serially correlated, and in the system difference-level regression we test whether the differenced error term is second-order serially correlated (by construction, it is likely that this differenced error term be first-order serially correlated even if the original error term is not). Under both tests, failure to reject the null hypothesis gives support to the model.

5.2.4 - Results

Table 3.4 reports the GMM estimates from the panel regressions for the intentional homicide rate, both ignoring and controlling for unobserved country-specific effects. It must be noted that, given that we are controlling for possible problems of simultaneity

[18] We are grateful to Stephen Bond for providing us with a program to apply his and Arellano's estimator to an unbalanced panel data set.

and reverse causality, we can interpret the estimated coefficients not simply as partial associations but as effects of the explanatory variables on homicide rates. As in the cross-sectional regressions, we consider a "core" set of explanatory variables consisting of the GDP growth rate, the (log) of GNP per capita, the Gini index, the average years of schooling of the population older than 15 years of age, the urbanization rate, a dummy for whether the country produces illegal drugs, the drug possession crimes rate, and (except for the first regression) the lagged homicide rate. To this core set, we add in turn the secondary enrollment rate, the ratio of policemen per inhabitant in the country, and the homicide conviction rate.

The first regression in Table 3.4 considers a static specification (that is, one excluding the lagged crime rate as explanatory variable). This specification is rejected by the error serial-correlation tests; therefore, its estimated coefficients cannot offer valid conclusions. The correlation of the error term in this regression signals that relevant variables with high over-time persistence were omitted; these variables can be the lagged homicide rate (which makes the model dynamic) and/or the country-specific effect. When the lagged homicide rate is included in subsequent regressions, both the hypothesis of lack of residual serial correlation and the hypothesis of no correlation between the error term and the instruments (Sargan test) cannot be rejected, and, thus, the dynamic model is supported by the specification tests. The dynamic model with country-specific effects (regressions (7) and (8)) is also supported by the Sargan and second-order serial correlation tests.

From the regressions ignoring country-specific effects (regressions (2) to (6)) and those accounting for them (regressions (7) and (8)), the most robust and significant results in relation to the core variables are the following: First, the business cycle effect, measured by the coefficient on GDP growth rate holding constant average per capita income, is statistically significant and shows that, as expected, crime is counter-cyclical; stagnant economic activity induces heightened homicide rates. Second, higher income inequality, measured by the Gini index, increases the incidence of homicide rates; this result survives the inclusion of lagged homicide rates and is strengthened when unobserved country-specific effects are taken into account. The only regression where the Gini coefficient loses its statistical significance is the one that allows for time-specific effects. In addition, the combination of significant effects of the business cycle and income distribution tells us that the rate of poverty reduction may be associated with declines in crime rates.[19] Third, higher drug related activity, represented by both drug production and drug possession, induces a higher incidence of intentional homicide. It must be noted that the drug producers dummy loses some of its significance when time effects are allowed, and the drug possession crimes rate is not robustly significant when country-specific effects are accounted for. Fourth, the lagged homicide rate has a positive and significant impact on current rates, which is evidence of criminal inertia, as predicted by recent crime theoretical models. The size of the coefficient on the lagged homicide rate decreases but remains significant when country-specific effects are controlled for, which indicates that country-specific factors explain only a portion of criminal inertia.

[19] The abolute level of poverty (usually measured as the percentage of people below a certain level of income) is determined by the national income and its pattern of distribution. Hence, when GDP grows, while holding the Gini index constant, the abolute level of poverty declines.

As in the cross-sectional regressions, the level of income per capita does not have an independent, significant effect on the homicide rate. The results concerning the urbanization rate are not robust to the issue of country-specific effects. In the model without country-specific effects, the urbanization rate does not affect significantly the homicide rate. However, when country-specific effects are controlled for, the urbanization rate is associated with larger homicide rates.[20]

The puzzle concerning the lack of a significantly negative association between a country's educational stand and its homicide rate is somewhat clarified in the panel regressions that account for country-specific effects. When a country's educational stand is proxied by the secondary enrollment rate, its effect on homicide rates is significantly positive.[21] However, when the average years of schooling in the adult population is used to proxy for the country's educational position, it has a significant crime-reducing impact. The contrast between the results obtained using secondary enrollment rates and average years of schooling may indicate that the efforts to educate the young may not reduce crime immediately but eventually lead to a reduction of crime, especially of the violent sort.

In regressions (4) and (5) we examine the effect of the strength of the police and judicial system in deterring crime. The proxies we use are, in turn, the rate of policemen per inhabitant in the country and the homicide conviction rate. Both variables are subject

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[20] It must be noted that the differences between the results found in the levels and differences specifications are not solely the result of controlling for country-specific effects, for in the latter case the sample size is much smaller than in the former.

[21] The fact that the coefficient on secondary enrollment remains positive even after accounting for criminal inertia and country-specific effects makes it unlikely that this

to joint endogeneity in crime regressions, and the conviction rate may be spuriously negatively correlated with the homicide rate given the mis-measurement in the number of homicides. Because of these reasons, the panel GMM estimator is clearly superior to the cross-sectional results. Since we are instrumenting for both the policemen rate and the conviction rate (and the specification tests support the model), we conclude that the negative and significant coefficient on both proxies means that a stronger police and judicial system does lead to a lower incidence of homicides.

In regression (6) we examine the importance of time-specific effects. We find that in the period 1990-94, the world has experienced a statistically significant increase in homicide rates relative to those in the late 1970s and early 1980s; this rise in homicide rates cannot be fully explained by the evolution of the crime determinants in the core model.

Table 3.5 shows the GMM estimates for the panel regressions for the robbery rate. The model specification without a lagged dependent variable or a country-specific effect is strongly rejected by the residual serial correlation tests. In contrast to the homicide regressions, the dynamic specification of the crime regression that ignores country-specific effects is also rejected by the residual serial correlation test. Therefore, we must base our conclusions on the dynamic specification that accounts for specific effects. This prevents us from analyzing the role of the proxies for the strength of the police and judicial system given that the inclusion of these variables limits dramatically the sample size available for estimation of the specific-effect model.

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controversial coefficient sign is due to the omission of some relevant variable in the homicide rate regression.

The results of the dynamic model that controls for country-specific effects for the robbery rate are virtually the same as the corresponding ones for the homicide rate[22]: Stagnant economic activity (low GDP growth) promotes heightened robbery rates; the counter cyclical behavior of the robbery rate appears to be larger than that in the case of the homicide rate. Larger income inequality (high Gini index) induces an increase in the incidence of robberies, but not to the same extent as in the case of homicide rate. The robbery rate exhibits a significant degree of inertia, which is somewhat larger than that of the homicide rate. The urbanization rate has a significant positive impact on the incidence of robberies; this impact appears to be larger than in the case of homicides. Although the secondary enrollment rate has a puzzling positive effect on robbery rates, the level of educational attainment of the adult population has a robbery-reducing impact. The drug possession crimes rate is positively associated with the robbery rate. Finally, as in the homicide regressions, the level of per capita income does not appear to be robustly correlated with the robbery rate.

6 - Conclusions

The conclusions that can be derived from the theoretical model and the empirical findings regarding potentially fruitful directions for future research and possible policy implications fall under two headings: the good news and the bad news.

[22] The remarkable similarity between the homicide and robbery regression results gives credence to our interpretation of the homicide rate as a relatively broad proxy for criminal behavior.

The bad news first. Some bad news are related to the results of the dynamic panel estimation methods (GMM). The results show that economic downturns and other non-economic shocks, such as a rise in drug trafficking, as in Colombia in the 1970s, can raise the national crime rate. The econometric results also suggest that the rise in the crime rate may be felt long after the initial shock – countries can be engulfed in a crime wave. The policy implication of this finding is that policy-makers should act to counter the crime wave, if not, a country may get stuck at an excessively high crime rate.

Although we do not know the precise channels through which a crime shock tends to be perpetuated over time, the existing literature proposes three possible channels: systemic interactions, local interactions, and recidivism. Future research should attempt to clarify which one of these is at work, but this research would probably need to rely on individual-level analysis, because local interactions and recidivism are forces that are determined by an individual's location with respect to her local community and her past criminal record, respectively.

The good news. Two important determinants of crime rates – inequality and deterrence – are, we believe, "policy-sensitive" variables. Policy-makers facing a crime wave should then consider a combination of counter-cyclical re-distributive policies (e.g., targeted safety nets) and increases in the resources devoted to apprehending and convicting criminals – a "*carrots-and-sticks*" policy response would seem to be appropriate, especially during economic recessions. Regarding the crime-inducing effect of inequality, our empirical findings suggest that there is, "a social incentive for equalizing training and earning opportunities across persons, which is independent of

ethical considerations or any social welfare function" (Ehrlich 1973, 561). In addition, our empirical findings regarding criminal inertia imply that current crime rates respond to current policy variables with a lag. Sah (1991, 1292) observed that, "This apparent lack of response is a source of frustration for politicians as well as for law enforcement officials... Such reactions, though understandable, may be inappropriate if they are caused by an inadequate understanding of the dynamics of crime."

Future research in this area should attempt to solve the crime-education puzzle present in our empirical findings. We have provided a result which may prove to be one of the clues to solve the puzzle: there is a delayed effect of educational effort on crime alleviation, that is, the crime-reducing effect of education does not materialize when the young are being educated but mostly when they become adults. Another clue to the puzzle may be obtained by considering the indirect effects of education on inequality.

This paper was motivated by the impression that crime has pernicious effects on economic activity, and may also reduce welfare by reducing individuals sense of personal and proprietary security. Indeed, a fertile area for future research is to attempt to measure the effects of criminal behavior on economic growth and welfare. We suspect that there are many ways of measuring the economic costs of crime, ranging from the costs of maintaining an effective police and judicial system, to estimates of the forgone output. However, the overall effects on welfare may be more difficult to assess.

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APPENDIX A

DATA DESCRIPTION AND SOURCES

This appendix presents the data used in this paper, with special attention to the variables related with crime rates, conviction rates and police personnel. Table 3.A.1 provides the description and sources of all the variables that were used. References are provided for details on the variables that have been previously used in other academic papers. In the case of the crime-related data, even though the information that was used is publicly available, additional work was required in order to assemble the variables actually used in the econometric estimations.

These variables were constructed with information provided by the United Nations, through its Crime Prevention and Criminal Justice Division. The United Nations has conducted, since 1978, five Surveys of Crime Trends and Operations of Criminal Justice Systems. Each survey has covered periods of 5 to 6 years, requesting crime data from government officials covering the period from 1970 to 1994. The statistics included in these surveys represent the official statistics of member countries of the United Nations. They have been compiled by the United Nations on the basis of questionnaires distributed to member countries, as well as yearbooks, annual reports, and statistical abstracts of these countries. The United Nations Surveys are available on the internet at http://www.ifs.univie.ac.at/~uncjin/wcs.html#wcs123 (March 10, 1998).

In order to construct series covering the period 1970/1994 for the largest number of countries, the five U.N. Surveys were used. When these surveys overlap (in 1975, 1980, 1986 and 1990), the information from the latest survey was used. It is worth noting that most of the countries did not respond to all surveys, so that missing values are a common occurrence in these series. The definitions of the various crimes are stable across the surveys and are detailed in Table 3.A.1. However, as stated by Newman and DiCristina (1992), who constructed a data set with the information of the first and second surveys, the definitions "were applied as far as possible". Moreover, they add, "it will be recognized that, owing to the immense variation in criminal justice systems around the world, these categories are of necessity rough" (Newman and DiCristina 1992, 6).

In addition to assembling the series for the yearly number of crimes and convictions in each country, we conducted a "cleaning" of the data. This process, inherently based on arbitrary judgments, was nonetheless guided by the following criteria. We analyzed the evolution of the variables over time, searching for large and discontinuous changes. More specifically, we looked for situations where a change in the order of magnitude of the variables (e.g., ten-fold or hundred-fold increases) occurred from one survey to the other. In the cases where it was apparent that, in each new survey, the level of a specific variable experienced this type of abrupt and permanent change, all the observations for the corresponding country and variable were dropped for the period in question. This decision was based on the assumption that these changes could only be explained by changes in the definitions or criteria used in the collection of the data by the respondents of the corresponding questionnaires. In addition, when these definition changes were apparent in only one small subperiod (e.g., corresponding to only one survey or subperiod thereof) this subperiod was dropped for the corresponding country and variable.

APPENDIX B

TABLES AND FIGURES

Table 3.1: Summary Statistics for Crime, Convictions and Police Rates

Variables	No. of Obs.	Mean	Standard Deviation	Min.	Max.	No. of Countries
Crime Rates:*						
Intentional Homicides	1579	6.834	11.251	0	142.014	128
Robbery	1251	55.902	95.973	0	676.840	120
Drug Possession	1037	69.990	128.301	0	1358.524	99
Conviction Rates:**						
Intentional Homicides	183	69.730	204.260	0	2694.643	80
Robbery	231	42.266	64.110	0	675.604	72
Police Personnel*	486	329.262	310.264	1.598	2701.31	104

*Per 100,000 inhabitants, annual data.

**Percent of number of crimes, 5-year-averages.

Table 3.2: OLS Cross-Sectional Regressions of Intentional Homicide Rate, 1970/1994 (p-values in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GNP Per Capita	-.004	-.096	-.278	-.090	.014	-.078	-.032
	(.981)	(.577)	(.125)	(.649)	(.935)	(.628)	(.885)
Gini Index	.035		.035	.038	.043	.052	.041
	(.019)		(.034)	(.025)	(.014)	(.002)	(.025)
Average Years of Schooling	-.027	-.017		.011	.013	.079	-.052
	(.744)	(.814)		(.901)	(.885)	(.384)	(.598)
Urbanization Rate	.000	.002	.004	.005	.001	.001	-.001
	(.989)	(.791)	(.625)	(.593)	(.920)	(.919)	(.886)
Drug Producers Dummy	.670	.912	.390	.711	1.305	1.311	.667
	(.074)	(.012)	(.272)	(.069)	(.002)	(.001)	(.093)
Drug Possession Crimes Rate	.002	.001	.003	.002	.001	.001	.004
	(.329)	(.694)	(.090)	(.359)	(.616)	(.758)	(.127)
Income Share of the Poorest Quintile		-20.405					
		(.001)					
Secondary Enrollment Rate			.009				
			(.314)				
Police				-.001			
				(.214)			
Conviction Rate					-.001	-.002	
					(.001)	(.000)	
Death Penalty						-.659	
						(.011)	
Index of Ethno-Linguistic Fractionalization							-.665
							(.200)
Constant	-.066	3.190	1.109	.213	-.755	-.322	.270
	(.963)	(.003)	(.396)	(.885)	(.619)	(.821)	(.887)
R^2	.285	.386	.213	.303	.502	.599	.311
Adjusted R^2	.200	.306	.127	.192	.405	.501	.198
Number of Observations	58	53	62	52	44	42	51

Table 3.2 (cont'd)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
GNP Per Capita	-.006	-.077	-.038	-.069	-.030	-.132	.012	.046	-.024
	(.974)	(.674)	(.831)	(.708)	(.870)	(.489)	(.948)	(.801)	(.898)
Gini Index	.035	.031	.030	.028	.029	.029	.038	.024	.034
	(.021)	(.041)	(.048)	(.073)	(.076)	(.059)	(.015)	(.143)	(.027)
Average Years of Schooling	-.028	-.060	-.049	-.073	-.025	-.009	-.046	-.042	-.038
	(.735)	(.474)	(.559)	(.409)	(.768)	(.911)	(.595)	(.611)	(.660)
Urbanization Rate	.000	.001	-.001	.002	.002	-.004	.001	-.004	.001
	(.977)	(.931)	(.944)	(.813)	(.808)	(.666)	(.915)	(.612)	(.882)
Drug Producers Dummy	.653	.624	.706	.582	.760	.751	.690	.558	.633
	(.087)	(.090)	(.057)	(.121)	(.049)	(.043)	(.067)	(.135)	(.097)
Drug Possession Crimes Rate	.002	.003	.002	.003	.002	.002	.002	.002	.002
	(.328)	(.196)	(.232)	(.214)	(.359)	(.273)	(.247)	(.255)	(.312)
Buddhist Dummy (most common religion)	.140								
	(.737)								
Christian Dummy (most common religion)		.437							
		(.087)							
Hindu Dummy (most common religion)			-.816						
			(.111)						
Muslim Dummy (most common religion)				-.541					
				(.158)					
Sub-Saharan Africa Dummy					.457				
					(.307)				
South and East Asia Dummy						-.663			
						(.073)			
Eastern Europe and Central Asia Dummy							.321		
							(.412)		
Latin America Dummy								.488	
								(.110)	
Middle East Dummy									-.378
									(.530)
Constant	-.052	.545	.605	.967	.232	1.420	-.275	.226	.159
	(.971)	(.702)	(.675)	(.538)	(.872)	(.376)	(.848)	(.871)	(.913)
R^2	.286	.326	.320	.313	.299	.330	.294	.320	.290
Adjusted R^2	.186	.231	.225	.217	.201	.236	.195	.225	.191
Number of Observations	58	58	58	58	58	58	58	58	58

Table 3.3: OLS Cross-Sectional Regressions of Intentional Robbery Rate, 1970/1994 (p-values in parenthesis)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GNP Per Capita	.061	-.169	-.127	-.129	-.101	-.161	.280
	(.821)	(.556)	(.616)	(.653)	(.741)	(.619)	(.430)
Gini Index	.091		.089	.085	.052	.060	.108
	(.000)		(.000)	(.001)	(.098)	(.082)	(.000)
Average Years of Schooling	.113	-.021		.133	-.033	-.028	.061
	(.360)	(.861)		(.290)	(.825)	(.856)	(.673)
Urbanization Rate	.020	.030	.022	.023	.025	.025	.020
	(.108)	(.023)	(.040)	(.070)	(.062)	(.078)	(.121)
Drug Producers Dummy	.139	.378	.206	.154	.699	.673	.276
	(.795)	(.517)	(.682)	(.774)	(.336)	(.370)	(.637)
Drug Possession Crimes Rate	.004	.005	.004	.004	.005	.005	.004
	(.223)	(.155)	(.097)	(.131)	(.111)	(.115)	(.229)
Income Share of the Poorest Quintile		-27.715					
		(.006)					
Secondary Enrollment Rate			.021				
			(.111)				
Police				.002			
				(.132)			
Conviction Rate					-.003	-.001	
					(.697	(.885)	
Death Penalty						-.567	
						(.289)	
Index of Ethno-Linguistic Fractionalization							.349
							(.663)
Constant	-2.851	4.447	-2.055	-2.023	.694	1.146	-5.229
	(.179)	(.012)	(.246)	(.346)	(.807)	(.699)	(.100)
R^2	.452	.374	.469	.495	.404	.410	.460
Adjusted R^2	.375	.283	.402	.406	.264	.235	.355
Number of Observations	50	48	54	48	38	36	44

Table 3.3 (cont'd)

	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
GNP Per Capita	.065	-.061	.073	-.075	.007	-.213	.026	.135	.061
	(.809)	(.812)	(.790)	(.774)	(.979)	(.465)	(.922)	(.596)	(.821)
Gini Index	.092	.088	.093	.076	.072	.077	.088	.067	.091
	(.000)	(.000)	(.000)	(.001)	(.006)	(.001)	(.000)	(.005)	(.000)
Average Years of Schooling	.114	.018	.121	.009	.125	.130	.142	.082	.113
	(.354)	(.881)	(.340)	(.942)	(.302)	(.274)	(.259)	(.480)	(.360)
Urbanization Rate	.019	.021	.020	.023	.023	.016	.019	.012	.020
	(.111)	(.063)	(.110)	(.050)	(.057)	(.181)	(.115)	(.322)	(.108)
Drug Producers Dummy	.201	-.020	.135	-.044	.429	.177	.087	-.295	.139
	(.708)	(.968)	(.803)	(.932)	(.439)	(.731)	(.870)	(.575)	(.795)
Drug Possession Crimes Rate	.003	.005	.003	.005	.003	.004	.003	.004	.004
	(.231)	(.089)	(.251)	(.090)	(.232)	(.147)	(.395)	(.153)	(.223)
Buddhist Dummy (most common religion)	-.639								
	(.271)								
Christian Dummy (most common religion)		1.054							
		(.007)							
Hindu Dummy (most common religion)			.249						
			(.735)						
Muslim Dummy (most common religion)				-1.420					
				(.019)					
Sub-Saharan Africa Dummy					1.083				
					(.105)				
South and East Asia Dummy						-1.127			
						(.042)			
Eastern Europe and Central Asia Dummy							-.648		
							(.268)		
Latin America Dummy								1.292	
								(.010)	
Middle East Dummy									dropped
Constant	-2.852	-1.993	-3.083	-.569	-2.069	.222	-2.467	-2.007	-2.851
	(.178)	(.315)	(.172)	(.796)	(.330)	(.929)	(.249)	(.315)	(.179)
R^2	.468	.540	.453	.520	.485	.504	.468	.533	.452
Adjusted R^2	.379	.463	.362	.440	.400	.421	.379	.455	.375
Number of Observations	50	50	50	50	50	50	50	50	50

Table 3.4: GMM Estimates: Panel Regressions of Intentional Homicide Rate (p-values in parenthesis)

	(1)	(2)	(3)	(4)	(5)
Regression Specification			Levels		
Instruments (*)			Levels		
GDP Growth Rate	-0.101 (0.000)	-0.064 (0.000)	-0.056 (0.000)	-0.047 (0.000)	-0.034 (0.011)
GNP per Capita	-0.305 (0.161)	0.026 (0.588)	0.017 (0.740)	-0.049 (0.039)	-0.021 (0.748)
Gini Index	0.034 (0.060)	0.021 (0.000)	0.016 (0.000)	0.016 (0.001)	0.012 (0.117)
Average Years of Schooling	0.007 (0.923)	0.015 (0.591)		-0.073 (0.000)	0.011 (0.848)
Urbanization Rate	-0.000 (0.971)	-0.002 (0.216)	-0.002 (0.143)	0.003 (0.095)	-0.003 (0.378)
Drug Producers Dummy	0.196 (0.564)	0.338 (0.006)	0.238 (0.000)	0.311 (0.000)	0.648 (0.000)
Drug Possession Crimes Rate	0.004 (0.000)	0.001 (0.058)	0.001 (0.074)	0.002 (0.000)	0.001 (0.259)
Lagged Homicide Rate		0.737 (0.000)	0.761 (0.000)	0.723 (0.000)	0.570 (0.000)
Secondary Enrollment Rate			0.000 (0.912)		
Police				-0.000 (0.019)	
Conviction Rate					-0.006 (0.009)
Constant	2.354 (0.175)	-0.478 (0.154)	-0.117 (0.668)	0.581 (0.042)	0.631 (0.349)
Sargan Test of Overidentifying Restrictions: p-value	0.545	0.397	0.511	0.365	0.369
Test for First-Order Serial Correlation: p - value	0.000	0.530	0.879	0.647	0.888
Test for Second-Order Serial Correlation: p - value	0.006	0.911	0.202	0.284	0.550
Number of Observations (Countries)	153 (68)	85 (45)	76 (42)	49 (27)	31 (21)

Table 3.4 (cont'd)

	(6)	(7)	(8)
Regression Specification	Levels	Dif.-Lev.	
Instruments (*)	Levels	Lev. Dif.	
GDP Growth Rate	-0.052 (0.000)	-0.051 (0.000)	-0.036 (0.001)
GNP Per Capita	-0.046 (.343)	-0.014 (0.289)	-0.207 (0.000)
Gini Index	0.008 (0.335)	0.021 (0.000)	0.036 (0.000)
Average Years of Schooling	0.023 (0.257)	-0.040 (0.001)	
Urbanization Rate	-0.002 (0.340)	0.004 (0.130)	0.004 (0.063)
Drug Producers Dummy	0.246 (0.135)		
Drug Possession Crimes Rate	0.001 (0.083)	0.000 (0.299)	0.001 (0.047)
Lagged Homicide Rate	0.893 (0.000)	0.664 (0.000)	0.640 (0.000)
Secondary Enrollment Rate			0.009 (0.000)
1980-84 Period Dummy	-0.036 (0.530)		
1985-89 Period Dummy	0.071 (0.299)		
1990-94 Period Dummy	0.141 (0.051)		
Constant	0.322 (.468)		
Sargan Test of Overidentifying Restrictions: p-value	0.397	0.589	0.839
Test for First-Order Serial Correlation: p-value	0.357	0.278	0.278
Test for Second-Order Serial Correlation: p-value	0.767	0.280	0.319
Number of Observations (Countries)	86 (46)	60 (22)	54 (20)

(*) In the levels specification, all variables are assumed to be only weakly exogenous, except for the GDP growth rate and the Drug Producers Dummy which are assumed to be strictly exogenous. The second lag is used as an instrument for the lagged crime rate. As for the other variables, the instrument used is the first lag. The only exception to the previous rule is regression (4), where the Gini index and the urbanization rate are assumed to be strictly exogenous due to limitations in the sample size. In the specification that includes both differences and levels, the lagged first differences are used as instruments in the equations in levels, with the exception of the lagged crime rate for which we use the second lag of the first difference, and the GDP growth rate which is assumed to be strictly exogenous. In the equations in differences, all first differences are assumed to be strictly exogenous, except for the lagged first difference of the crime rate, which is instrumented with the third lag of the crime rate (in level).

Table 3.5: GMM Estimates: Panel Regressions of Robbery Rates
(p-values in parenthesis)

	(1)	(2)	(3)	(4)
Regression Specification	Levels		Dif.-Lev.	
Instruments (*)	Levels		Lev.-Dif.	
GDP Growth Rate	-0.069	-0.096	-0.091	-0.072
	(0.009)	(0.000)	(0.000)	(0.000)
GNP per Capita	0.533	0.162	0.038	-0.045
	(0.076)	(0.017)	(0.219)	(0.035)
Gini Index	0.137	0.038	0.006	0.011
	(0.000)	(0.000)	(0.003)	(0.009)
Average Years of Schooling	-0.010	0.031	-0.025	
	(0.866)	(0.045)	(0.093)	
Urbanization Rate	-0.000	-0.005	0.008	0.011
	(0.980)	(0.038)	(0.000)	(0.000)
Drug Producers Dummy	0.625	-0.478		
	(0.053)	(0.000)		
Drug Possession Crimes Rate	0.007	0.000	0.001	0.001
	(0.000)	(0.879)	(0.012)	(0.019)
Lagged Robbery Rate		0.891	0.833	0.839
		(0.000)	(0.000)	(0.000)
Secondary Enrollment Rate				0.002
				(0.191)
Constant	-6.683	-1.791		
	(0.013)	(0.008)		
Sargan Test of Overidentifying Restrictions: p-value	0.156	0.339	0.611	0.628
Test for First-Order Serial Correlations: p-value	0.004	0.091	0.057	0.053
Test for Second-Order Serial Correlation: p -value	0.045	0.313	0.760	0.539
Number of Observations (Countries)	133 (56)	77 (39)	58 (20)	50 (17)

(*) In the levels specification, all variables are assumed to be only weakly exogenous, except for the GDP growth rate and the Drug Producers Dummy which are assumed to be strictly exogenous. The second lag is used as an instrument for the lagged crime rate. As for the other variables, the instrument used is the first lag. The only exception to the previous rule are regressions (4) and (5), where the GNP per capita, the Gini index, the average years of schooling and the urbanization rate are assumed to be strictly exogenous due to limitations in the sample size. In the specification that includes both differences and levels, the lagged first differences are used as instruments in the equations in levels, with the exception of the lagged crime rate for which we use the second lag of the first difference, and the GDP growth rate which is assumed to be stricly exogenous. In the equations in differences, all first differences are assumed to be strictly exogenous, except for the lagged first difference of the crime rate, which is instrumented with the third lag of the crime rate (in level). In regression (8), the Gini index is also assumed to be strictly exogenous due to limitations in the sample size.

Individual education (e): $\uparrow e \Rightarrow \uparrow l, \downarrow c, \uparrow w, \uparrow m$

Individual criminal experience (d_{t-1}): $\uparrow d_{t-1} \Rightarrow \downarrow c, \downarrow w, \downarrow m$

Past incidence of crime in society (D_{t-1}): $\uparrow D_{t-1} \Rightarrow \downarrow c, \downarrow m$

Level and growth of economic activity (EA): $\uparrow EA \Rightarrow \uparrow l, \uparrow w$

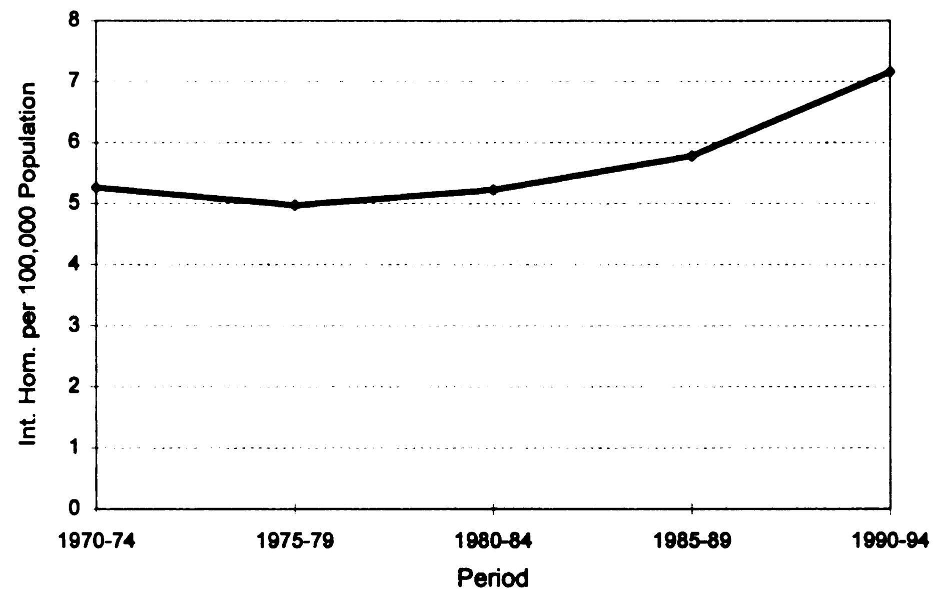
Income inequality ($INEQ$): $\uparrow INEQ \Rightarrow \uparrow (l-w), \downarrow m$

Existence of profitable criminal activities ($DRUGS$): $\uparrow DRUGS \Rightarrow \uparrow l$

Strength of police and justice system ($JUST$): $\uparrow JUST \Rightarrow \uparrow pr, \uparrow pu$

Other factors that affect the propensity to commit a crime ($other$):
$\uparrow other \Rightarrow \downarrow c, \downarrow m$

Figure 3.1: Underlying Determinants of Criminal Activities



NOTE: Weighted average calculated using the following sample of 34 countries: Argentina, Australia, Austria, The Bahamas, Bahrain, Barbados, Bulgaria, Canada, Colombia, Costa Rica, Cyprus, Denmark, Egypt, Germany, Greece, India, Indonesia, Italy, Japan, South Korea, Kuwait, Malaysia, Mexico, Norway, Poland, Qatar, Singapore, Spain, Sweden, Syria, Thailand, Trinidad and Tobago, United States, and Venezuela.

Figure 3.2: The World: Intentional Homicide Rate (population-weighted average)*

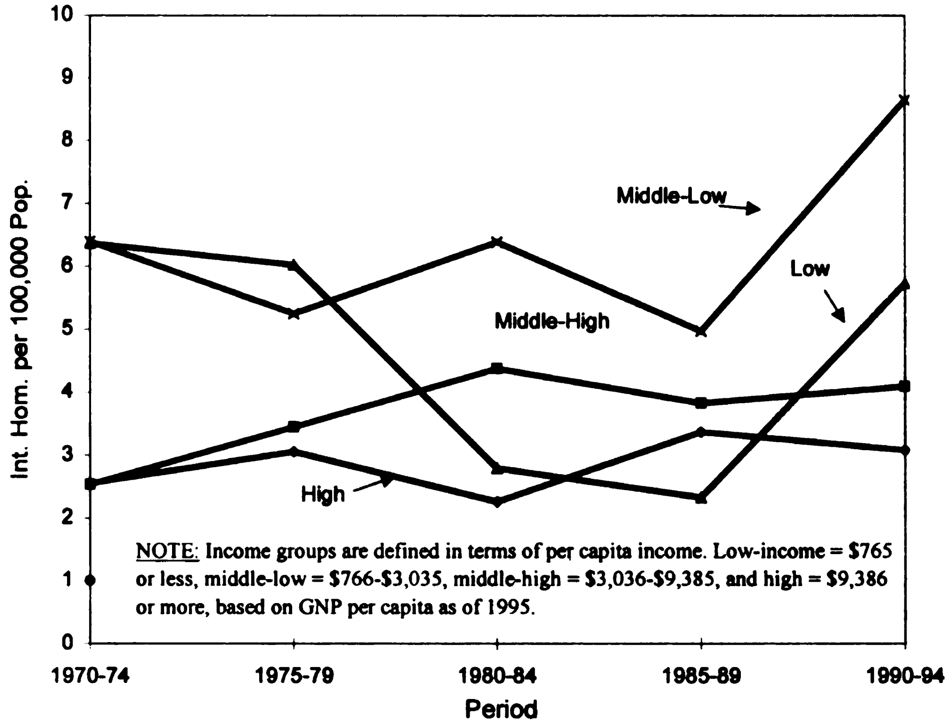


Figure 3.3: Median Intentional Homicide Rates by Income Groups, 1970/1994

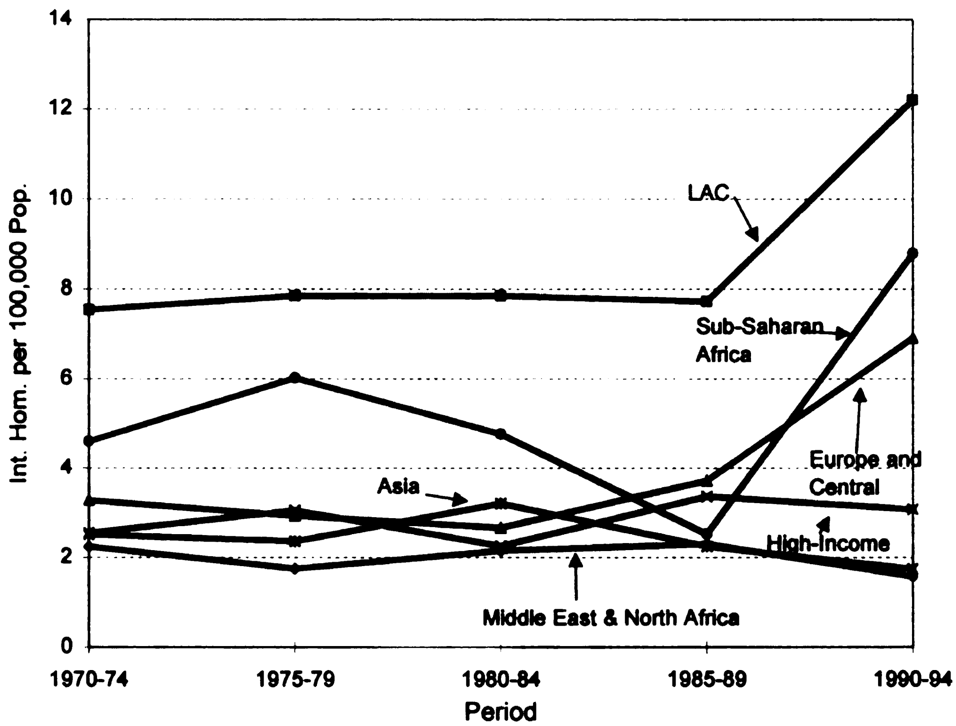


Figure 3.4: Median Intentional Homicide Rates by Regions, 1970-1994

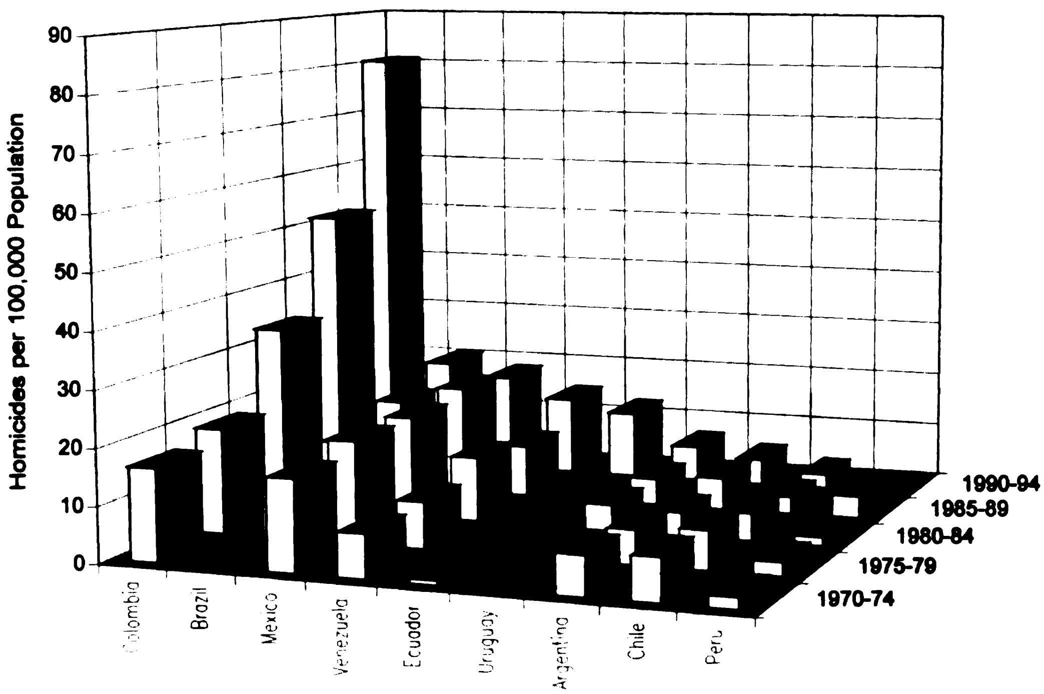


Figure 3.5: Intentional Homicide Rates in South America and Mexico, 1970/1994

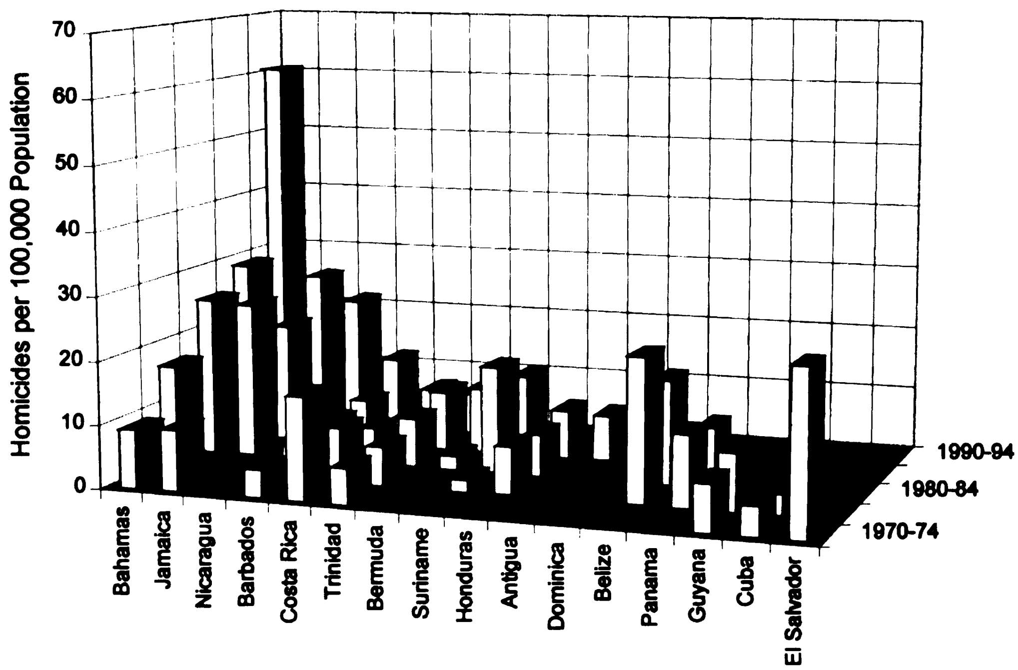


Figure 3.6: Intentional Homicide Rates in Central America and the Caribbean, 1970/1994

APPENDIX C

ADDITIONAL TABLES

Table 3.A.1: Description and Source of the Variables

Variable	Description	Source
Intentional Homicide Rate	Death purposely inflicted by another person, per 100,000 population.	Constructed from the United Nations World Crime Surveys of Crime Trends and Operations of Criminal Justice Systems, various issues, except for Argentina, Brazil, Colombia, Mexico, and Venezuela. The data is available on the internet at http://www.ifs.univie.ac.at/~uncjin/wcs.html#wcs123. The data on population was taken from the World Bank's International Economic Department database. For the five Latin American countries listed above, the source for the number of homicides was the Health Situation Analysis Program of the Division of Health and Human Development, Pan-American Health Organization, from the PAHO Technical Information System. This source provided us with data on the annual number of deaths attributed to homicides, which come from national vital statistics systems.
Robbery Rate	Total number of Robberies recorded by the police, per 100,000 population. Robbery refers to the taking away of property from a person, overcoming resistance by force or threat of force.	Same as above.
Conviction Rates (of Intentional Homicides, Theft, Robbery, and Assault)	The number of persons found guilty of a specific crime (Intentional Homicides, Theft, Robbery, or Assault) by any legal body duly authorized to do so under national law, divided by the total number of the corresponding crime (in percentage).	Same as above.
Police	Number of police personnel per 100,000 population.	Same as above.
Drug Possession Crime rate	Number of drug possession offenses per 100,000 population.	Same as above.

Table 3.A.1 (cont'd)

Variable	Description	Source
Drug Producers Dummy	Dummy that takes the value one for the countries which are considered significant producers of illicit drugs.	International Narcotics Control Strategy Report, U.S. Department of State, Bureau for International Narcotics and Law Enforcement Affairs, various issues.
Gini Index	Gini Coefficient, after adding 6.6 to the expenditure-based data to make it comparable to the income-based data.	Constructed from Deininger and Squire (1996). The dataset is available on the internet from the World Bank's Server, at http://www.worldbank.org/html/prdmg/grthweb/datasets.htm.
Average years of Schooling	Average years of Schooling of the Population over 15.	Barro and Lee (1996). The dataset is available on the internet from the World Bank's Server, at http://www.worldbank.org/html/prdmg/grthweb/datasets.htm.
Secondary Enrollment	Ratio of Total Enrollment, regardless of age, to the population of the age group that officially corresponds to the secondary level of education.	World Bank, International Economic Department data base.
GNP per capita	Gross National Product expressed in constant 1987 U.S. dollars prices.	Same as above.
Growth of GDP	Growth in the Gross Domestic Product expressed in constant 1987 local currency prices.	Same as above.
Urbanization Rate	Percentage of the total population living in urban agglomerations.	Same as above.
Political Assassinations Rate	Number of political assassinations per 100,000 population.	Easterly and Levine (1997). The dataset is available on the internet from the World Bank's Server, at http://www.worldbank.org/html/prdmg/grthweb/datasets.htm.

Table 3.A.1 (cont'd)

Variable	Description	Source
Dummy for War on National Territory	Dummy for war on national territory during the decade of 1970 or 1980.	Same as above.
Absence of Corruption Index	ICRG index of corruption in government, ranging from 1 to 6, with higher ratings indicating few ethical problems in conducting business.	International Country Risk Guide.
Rule of Law Index	ICRG measure of Law and Order Tradition, ranging from 1 to 6, with lower ratings indicating a tradition of depending on physical force or illegal means to settle claims, as opposed to a reliance on established institutions and laws.	Same as above.
Index of ethnolinguistic fractionalization	Measure that two randomly selected people from a given country will not belong to the same ethnolinguistic group (1960).	Easterly and Levine (1997). The data-set is available on the internet from the World Bank's Server, at http://www.worldbank.org/html/prdmg/grthweb/datasets.htm.
Buddhism Dummy	Dummy for countries where Buddhism is the religion with the largest number of followers.	CIA Factbook. The data is available on the internet at http://www.odci.gov/cia/publications/pubs.html.
Christian Dummy	Dummy for countries where Christian religions are the ones with the largest number of followers.	Same as above.
Hindu Dummy	Dummy for countries where Hinduism is the religion with the largest number of followers.	Same as above.
Muslim Dummy	Dummy for countries where Islam is the religion with the largest number of followers.	Same as above.
Africa Dummy	Dummy for Developing Countries of Sub-Saharan Africa.	Classification used in the Data Bases of the World Bank International Economic Department.

Table 3.A.1 (cont'd)

Variable	Description	Source
Asia Dummy	Dummy for Developing Countries of Asia.	Same as above.
Europe and Central Asia Dummy	Dummy for Developing Countries of Europe and Central Asia.	Same as above.
Latin America Dummy	Dummy for Developing Countries of Latin America.	Same as above.
Middle East Dummy	Dummy for Developing Countries of the Middle East and Northern Africa.	Same as above.
Africa and Latin America Dummy	Dummy for Developing Countries of Africa and Latin America.	Same as above.
Index of Firearm Regulations	Measure of restrictions affecting ownership, importing and mobility of hand guns and long guns in the early 1990s. Weights of .5, .25 and .25 were given to the resulting measures (2 given to country if it prohibits or restricts *all* firearms; 1 given to country if it prohibits or restricts *some* firearms; 0 given to country if it does not have either prohibitions or restrictions on firearms) regarding ownership, imports and movement, respectively.	United Nations International Study on Firearm Regulation at http://www.ifs.univie.ac.at/~uncjin/firearms/
Alcohol Consumption	Annual alcohol consumption per capita in litres, covering the period 1982-1991.	Alcoholism and Drug Addiction Research Foundation (Toronto, Ontario, Canada) in collaboration with the Programme on Substance Abuse of the World Health Organization. International Profile: Alcohol & Other Drugs, 1994.
Death Penalty	Dummy for countries whose laws do (1) or do not (0) provide for the death penalty. Some countries experienced changes, either abolishing or imposing the death penalty during 1970-94. Hence period averages range between 0 and 1.	Amnesty International. List of Abolitionist and Retentionist Countries at http://www.amnesty.org/ailib/intcam/dp/abrelist.htm#7

Table 3.A.1 (cont'd)

Variable	Description	Source
Ratio of Males Aged 15 to 29 (34) to Total Population	Ratio of number of males aged 15 to 29 (34) to total population.	Pre-formatted projection tables in the World Development Indicators database of the World Bank.

Table 3.A.2: Summary Statistics of Intentional Homicide Rates by Country (Annual Data)

Country	No. of Obs.	Mean	Standard Deviation	Min.	Max.	First Year	Last Year
Industralized and High-Income Developing Countries							
Australia	22	2.432	0.728	1.586	3.789	1970	1994
Austria	25	2.332	0.339	1.804	3.191	1970	1994
The Bahamas	22	27.950	20.587	6.322	83.088	1970	1994
Belgium	3	3.010	0.323	2.648	3.268	1983	1994
Bermuda	15	4.403	5.182	0.000	17.036	1980	1994
Canada	22	2.355	0.247	0.633	2.732	1970	1994
Cyprus	25	3.551	4.407	0.633	15.902	1970	1994
Denmark	25	3.706	1.939	0.507	6.013	1970	1994
Finland	20	5.445	2.568	2.192	10.061	1975	1994
France	17	3.348	1.963	0.400	4.937	1970	1994
Germany	21	3.432	0.231	3.045	3.886	1970	1990
Hong Kong	12	1.794	0.339	1.285	2.454	1980	1994
Israel	15	4.841	1.089	2.210	6.286	1975	1994
Italy	25	4.151	1.353	2.293	7.284	1970	1994
Japan	25	1.489	0.361	0.980	2.106	1970	1994
Kuwait	23	5.447	3.163	0.879	11.814	1970	1994
Luxembourg	2	7.586	0.011	7.578	7.594	1986	1990
Netherlands	16	11.115	2.476	7.303	15.994	1975	1990
New Zealand	17	1.201	0.502	0.586	2.411	1970	1986
Norway	21	0.959	0.618	0.205	2.546	1970	1990
Portugal	14	4.165	0.628	2.559	4.873	1977	1990
Qatar	25	2.100	0.767	1.103	3.674	1970	1994
Singapore	25	2.400	0.596	1.526	3.828	1970	1994
Spain	23	1.956	1.463	0.083	5.010	1970	1994
Sweden	25	4.06	2.885	1.243	9.532	1970	1994
Switzerland	18	1.883	0.899	0.395	3.188	1970	1994
United Arab Emirates	6	3.589	1.013	2.325	5.149	1975	1980
United Kingdom	15	1.920	0.394	1.481	2.566	1970	1986
United States	22	8.386	1.096	6.436	10.105	1970	1994
Latin America and the Caribbean							
Antigua & Barbuda	2	7.238	1.168	6.412	8.065	1985	1986
Argentina	18	5.159	1.347	3.489	9.079	1970	1993
Barbados	16	5.909	2.317	2.893	11.664	1970	1990
Belize	6	21.506	5.567	12.623	25.647	1975	1980
Brazil	16	14.497	4.270	7.699	21.614	1977	1992
Chile	16	5.662	3.049	2.206	14.127	1970	1994
Colombia	19	44.962	26.634	13.895	86.044	1970	1994
Costa Rica	18	9.218	5.120	3.779	19.122	1970	1994

Table 3.A.2 (cont'd)

Country	No. of Obs.	Mean	Standard Deviation	Min.	Max.	First Year	Last Year
Cuba	7	4.248	1.585	3.176	7.718	1970	1977
Dominica	7	0.080	0.0132	0.032	0.120	1980	1986
Ecuador	9	7.156	6.559	0.325	17.930	1970	1994
El Salvador	4	25.304	7.083	15.024	30.213	1970	1973
Guyana	7	7.873	1.257	6.939	10.426	1970	1976
Honduras	12	7.110	3.087	3.327	13.326	1975	1986
Jamaica	20	19.536	7.949	7.596	41.678	1970	1994
Mexico	25	18.037	2.019	12.723	22.419	1970	1994
Nicaragua	5	21.297	3.853	15.520	25.376	1990	1994
Panama	6	10.932	2.899	7.590	14.692	1975	1980
Peru	13	2.172	1.212	.035	4.777	1970	1986
St. Kitts & Nevis	9	6.592	3.468	2.347	11.450	1980	1990
St. Lucia	1	3.232	n.a.	3.232	3.232	1980	1980
St. Vincent & the Gre.	9	14.441	4.505	9.116	20.896	1980	1991
Suriname	9	7.605	9.908	1.089	30.757	1975	1986
Trinidad & Tobago	18	6.786	1.493	4.991	10.357	1970	1990
Uruguay	12	5.376	1.160	3.680	7.367	1980	1994
Venezuela	23	10.017	2.643	7.280	15.833	1970	1994
Eastern Europe & Central Asia							
Armenia	5	3.002	1.641	1.718	5.726	1986	1990
Azerbaijan	5	7.877	1.194	6.733	9.602	1990	1994
Belarus	5	7.142	1.666	5.316	9.193	1990	1994
Bulgaria	21	5.161	2.413	3.255	10.800	1970	1994
Croatia	5	10.584	3.635	7.283	14.925	1990	1994
Czech Republic	16	1.190	0.306	0.716	2.046	1975	1990
Estonia	5	15.774	7.211	8.685	24.350	1990	1994
Georgia	3	2.610	2.601	0.959	7.216	1990	1994
Gibraltar	8	2.389	3.524	0	2.532	1975	1986
Greece	25	1.466	0.670	0.301	8	1970	1994
Hungary	15	3.853	0.470	2.981	4.517	1980	1994
Kazakstan	9	10.478	3.160	7.020	15.244	1986	1994
Kyrgyz Republic	5	10.912	2.547	8.191	13.720	1990	1994
Latvia	9	8.377	4.738	3.945	16.589	1986	1994
Lithuania	9	7.052	3.966	3.457	14.055	1986	1994
Macedonia	5	0.825	0.293	0.592	1.324	1990	1994
Malta	15	2.047	1.350	0.288	4.428	1980	1994
Moldovia	9	7.035	2.242	4.564	11.465	1986	1994
Poland	21	1.660	0.316	1.001	2.327	1970	1990
Romania	9	4.500	1.866	2.194	6.516	1986	1994
Russian Federation	9	11.928	5.738	6.301	21.815	1986	1994
San Marino	6	2.729	4.615	0	11.111	1970	1975
Slovak Republic	5	2.271	0.315	1.760	2.554	1990	1994

Table 3.A.2 (cont'd)

Country	No. of Obs.	Mean	Standard Deviation	Min.	Max.	First Year	Last Year
Slovenia	9	4.117	0.609	3.181	5.209	1986	1994
Tajikistan	4	2.541	0.462	2.055	3.168	1987	1990
Turkey	6	16.556	1.960	14.090	19.931	1970	1975
Ukraine	15	5.196	1.538	3.439	8.804	1980	1994
Yugoslavia,FR(Serbia)	7	13.007	3.237	10.939	19.934	1975	1990
Middle East & North Africa							
Algeria	6	0.924	0.336	0.524	1.468	1970	1975
Bahrain	15	1.388	1.172	0.382	5.042	1970	1990
Egypt,Arab Rep.	23	2.337	1.023	1.392	4.172	1970	1994
Iraq	9	10.517	2.212	8.076	13.482	1970	1978
Jordan	20	3.352	1.756	1.822	7.038	1975	1994
Lebanon	9	15.495	12.478	4.479	42.898	1970	1988
Morocco	14	1.071	0.386	0.689	2.157	1970	1994
Oman	6	0.824	0.893	0	2.461	1970	1975
Saudi Arabia	10	0.767	0.168	0.519	1.062	1970	1979
Syrian Arab Republic	22	4.083	1.431	1.964	6.263	1970	1994
Sub-Saharan Africa							
Botswana	10	10.179	1.742	6.652	13.031	1980	1990
Burundi	7	1.088	0.164	0.758	1.284	1980	1986
Cape Verde	1	5.242		5.242	5.242	1979	1979
Ethiopia	5	10.185	2.678	5.682	12.298	1986	1990
Liberia	5	2.615	1.635	0.530	5.028	1982	1986
Madagascar	15	6.597	13.327	0.468	53.432	1975	1994
Malawi	7	2.762	0.483	2.059	3.399	1980	1986
Mauritius	15	2.652	0.399	2.081	3.448	1970	1994
SaoTomeandPrincipe	5	118.429	21.184	90.749	142.014	1990	1994
Senegal	6	2.186	0.277	1.914	2.598	1975	1980
Seychelles	6	4.467	2.234	1.642	8.335	1975	1980
South Africa	6	22.874	4.358	18.249	29.853	1975	1980
Sudan	15	5.406	1.301	3.262	7.045	1970	1994
Swaziland	5	68.048	8.495	58.813	81.738	1986	1990
Zambia	6	8.605	1.293	6.973	10.160	1975	1980
Zimbabwe	10	9.544	4.909	4.336	18.344	1975	1994
South and East Asia							
Bangladesh	12	2.541	0.392	1.984	3.340	1975	1986
China	5	0.965	0.078	0.867	1.076	1981	1986
Fiji	15	2.635	1.117	0.329	4.670	1970	1986
India	17	4.814	2.200	2.655	8.085	1970	1994
Indonesia	19	0.895	0.212	0.108	1.127	1970	1994
Korea,Rep.	19	1.444	0.168	1.235	1.834	1970	1994
Malaysia	20	1.883	0.367	1.050	2.397	1970	1994
Maldives	5	1.900	0.983	0.463	3.060	1986	1990
Myanmar	5	0.703	0.091	0.563	0.818	1986	1990

Table 3.A.2 (cont'd)

Country	No. of Obs.	Mean	Standard Deviation	Min.	Max.	First Year	Last Year
Nepal	13	1.584	0.571	0.387	1.994	1970	1986
Pakistan	11	6.069	0.728	4.661	7.034	1970	1980
Papua New Guinea	2	2.080	0.143	1.979	2.181	1975	1976
Philippines	8	9.509	8.378	2.598	29.355	1970	1980
Sri Lanka	17	12.174	10.007	6.295	48.358	1971	1989
Thailand	12	21.506	11.354	7.556	41.776	1970	1990
Tonga	11	7.519	5.163	1.074	14.286	1975	1990
Vanuatu	4	0.881	0.343	0.678	1.395	1987	1994
Western Samoa	5	1.976	1.266	0.613	3.125	1990	1994