THE DETERMINANTS OF WAGE DIFFERENTIALS AND WAGE INEQUALITY IN LATIN AMERICA: OPENNESS, TECHNOLOGY AND LABOR SUPPLY

By

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Submitted to the Faculty of the
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Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
August, 2003

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ACKNOWLEDGMENTS

My most sincere thanks to my advisor, Dr. Andreas Savvides, for his thorough dedication, constructive guidance and time spent on the realization of this research. His genuine friendship was also a key ingredient in my success completing my degree. My special thanks extend to my other committee members, Dr. Lee C. Adkins, Dr. James R. Fain and Dr. Michael M. Smith, for their assistance and suggestions.

I also wish to give my very special appreciation to my wife, Carmen, for her unconditional love, complete understanding and strong encouragement. Thank you Carmen. The inspiration and motivation provided by our yet to be born baby girl has been priceless. I love you Samantha.

I thank my parents, brother and sister for their guidance, support and love. True distance among family members is measured by the quality of the relationship. I always feel you right next to me.

Finally, I would like to thank the financial support and contributions made by fellow researchers from the Corporación Andina de Fomento and the Department of Economics.

TABLE OF CONTENTS

Chapter Page

Chapter Page

LIST OF TABLES

Table Page

Table Page

LIST OF FIGURES

I. INTRODUCTION

Motivation

How do technology transfers and trade affect the distribution of wages in Latin America? To what extent are technological progress, trade or financial openness responsible for the changes in the wage structure observed in many developing economies in the last two decades? How do changes in the demographic and educational characteristics of labor supply interact with technological change and trade liberalization? What are the implications of such interaction for wage distribution?

While there exists some agreement explaining wage differentials and inequality in developed countries -commonly attributed to a combination of skill-biased technological change and the effects of trading with low-wage developing countries- there is much less agreement about the behavior of the wage structure and distribution in developing countries. The recent experience of many developing nations, especially in Latin America, appears to challenge the Hecksher-Ohlin-Samuelson (HOS) trade theory. The theory predicts that greater trade openness should reduce wage differentials by boosting the demand of unskilled workers (relatively abundant in developing nations) in expanding exports sectors, and reducing the demand for skilled workers (relatively scarce) in import-competing sectors. However, contrary to this optimistic prediction, greater openness in Latin America during the last two decades has been accompanied by rising rather than decreasing wage differentials.

During the last two decades, most Latin American countries have shifted their development strategy toward market-based policies, international competition, and a limited role for the state in economic affairs. Nearly all countries in the region opened their economies to international markets, implemented major stabilization and deregulation programs, and privatized a large number of state-owned enterprises. However, as the economic reforms were launched and started to produce positive outcomes, policy makers and economists soon realized that the liberalization process was far from over as new challenges arise. Among them is a growing concern for the sectors that lagged behind and which, in spite of social programs designed to reduce income and wage disparities and eradicate poverty, still constitute sources of social friction that can undermine the development strategy (see Székely, 1997). The increasing wage differentials and wage inequality in the region observed in the last two decades are indeed an unexpected outcome. Achieving the goal of sustainable development remains elusive.

The widening gap between the wages of skilled and unskilled workers has been central to the economic development policy debate and also the source of intense academic investigation. Before the economic reforms undertaken by most Latin American countries during the last two decades, a common explanation for income and wage inequality was found on the supply side of the labor market. The scarcity of skilled labor, which was the result of a combination of demographics, limited public spending on education and restrained access to universities, was among the leading explanations for the wide skill premium. The reforms (financial and trade openness, stabilization, deregulation and privatization), it was hoped, would generate jobs for the less skilled thus reducing wage differentials. However, that did not happen; on the contrary, analysts and policymakers in developing economies, puzzled by the persistent and widening wage gap, have looked for alternative explanations focusing on the work of their counterparts in developed countries. The discussion then shifted to the demand side of the labor market, as the answer seemed to be a combination of skill-biased technological change and the effects of trade. While some studies have been conducted, conclusive evidence has been absent. Lack of data constrained previous studies on wage differentials to focus on specific industries or countries.

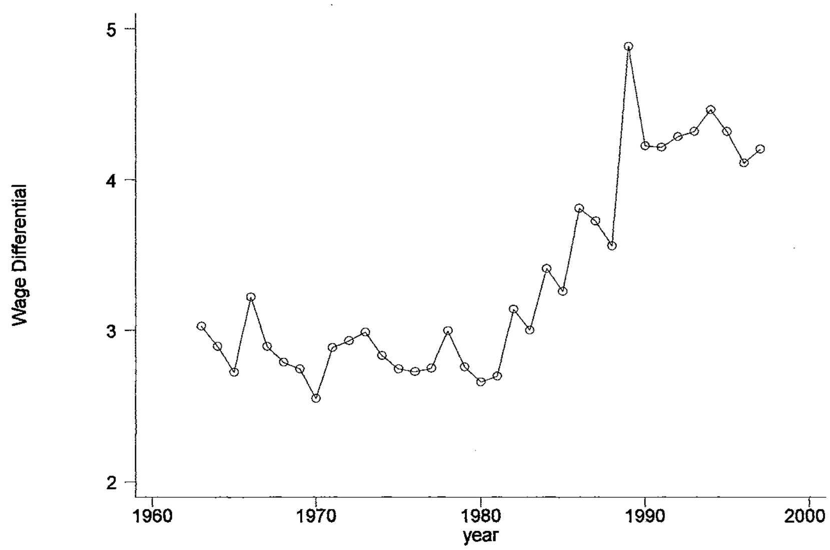
Empirical Trends

In this section we illustrate some major trends and highlight a number of salient facts about the Latin American economies during the past two decades. It is a review of the facts that will motivate the theoretical and empirical discussion.

Figure 1 shows the ratio of the average wage for the top 10 percent of workers relative to the bottom 10 percent of workers across 28 manufacturing industries in 18 Latin American economies. The wage differential shows a general upward trend, especially after 1980. The mean differential is 2.82 during 1963-1980 and increases to 3.40 during 1981-1998. It is worth noticing that the wage differential increased during the 1980s -prior to the trade reform in most Latin American economies- and that this ratio levels off by the early 1990s, when reforms were already in place. Regarding wage income inequality, the same pattern is shown. The Gini coefficient that measures wage inequality in the manufacturing sector is shown in Figure 2: it begins to increase steadily from 1980 and starts decreasing in the early 1990s.

Figure 1

Wage Differential in Latin American Manufacturing Industries (top 10 % / bottom 10 %)



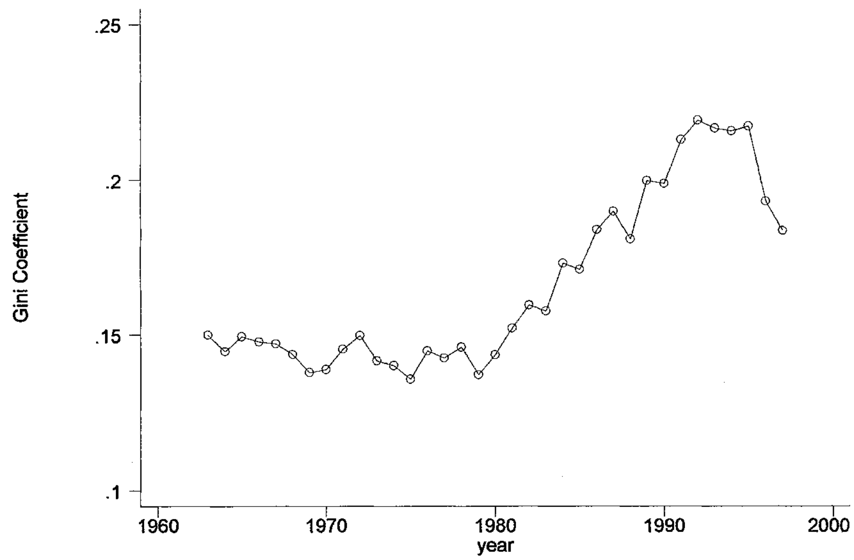
Source: Author's calculations based on data from UNIDO (2001)

It is worth noting that the wage differential and wage inequality increased at the same time that the number of skilled workers relative to unskilled workers increased (shown in Figure 3). That is, until the early 1990s there had not been a tendency for the wage differentials to decline in spite of the relative increase in the number of skilled workers.

Parallel to this behavior in relative wages and employment in Latin America, the world has experienced at least two main forces of international economic integration which have also had an impact on the region: rapid increase in flows of foreign direct investment (FDI) and increased global trade openness. Virtually no country has escaped the influence of these forces, however, major differences across regions persist. The developed world continues to dominate inward and outwards FDI flows.

Figure 2

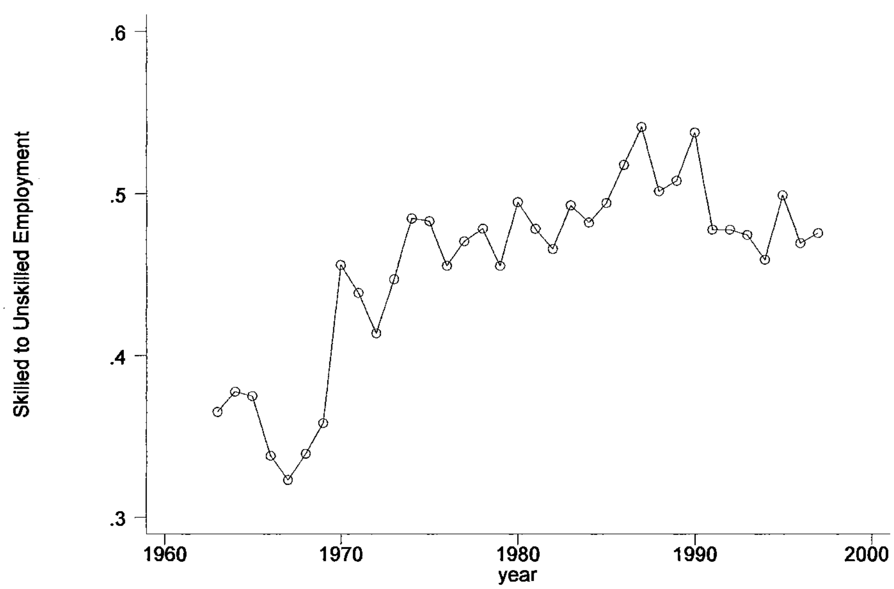
Wage Inequality in Latin American Manufacturing Industries



Source: Author's calculations based on data from UNIDO (2001)

Figure 3

Employment in Latin American Manufacturing Industries (Skilled to Unskilled Employment Ratio)



Source: Author's calculations based on data from UNIDO (2001)

As shown in Table I below, Latin American and Caribbean economies have received less than 15 percent of total global FDI flows in the last three decades, in contrast to an average of more than 75 percent received by developed economies. Also, more importantly, FDI flows received by Latin American economies as a percent of the total received by developing economies has declined in the last two decades. At the same time, although it is true that most economies have become more open to international trade, the Latin American and the Caribbean region is among the most open in the world, at least with respect to the G-7. Looking at total trade as a percentage of GDP, for Latin American economies trade has played a more important role than for developed economies.

Table I

FDI Inflows (Million US$) and Total Trade Indicators

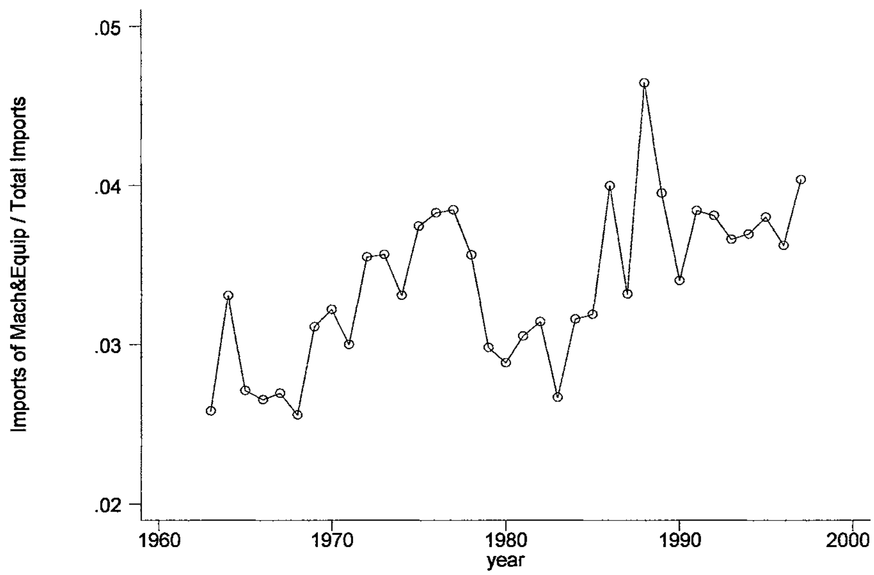
	1970	1980	1985	1990	1995	2000
Developed Countries	9,799	46,451	41,679	164,480	203,462	1,005,178
Percent of World Total	78.13%	84.80%	73.66%	81.31%	61.46%	79.10%
Developing Countries	2,743	8,263	14,889	37,249	113,338	240,167
Percent of World Total	21.87%	15.09%	26.31%	18.41%	34.23%	18.90%
Latin America and Caribbean	1,395	7,299	6,692	10,150	32,311	86,172
Percent of World Total	11.12%	13.33%	11.83%	5.02%	9.76%	6.78%
Percent of Developing Countries	50.86%	88.33%	44.95%	27.25%	28.51%	35.88%
World Total	12,542	54,775	56,583	202,297	331,068	1,270,764
(Exports + Imports) / GDP						
Latin America and Caribbean	38.7%	48.4%	42.6%	51.4%	60.0%	59.3%
G7	30.6%	41.2%	41.3%	38.4%	45.1%	48.5%

Source: UNCTAD, WIR (2001) and Global Development Finance Indicators (2001)

Total trade as a percentage of GDP indicates the degree of overall trade openness; however, looking at indicators of openness in specific sectors of the economy can also be revealing. For example, imports of machinery and transportation equipment from the five major (G5) industrialized countries (United States, Germany, United Kingdom, France and Japan) as a percentage of total imports can be one channel for technology transmission from developed to developing countries. Figure 4 shows an upward trend, as this indicator grew from around 2.5 percent in the early 1960s to close to 4 percent during the 1990s.

Figure 4

Imports of Machinery & Equipment in Latin America (% of Total Imports)

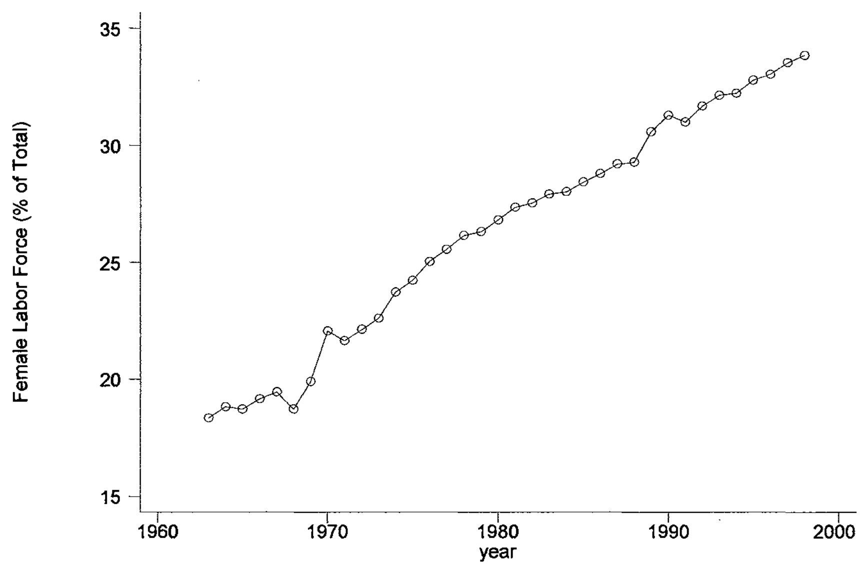


Source: Author's calculations based on World Bank, WDI (2001)

Now we turn briefly to two of the main forces driving the quantity and the quality labor supply in the region: demographics and education. Since the mid 1960s Latin America has experienced a significant reduction in its population growth. The fertility rate (defined as the number of births per woman) declined from around 6 in the mid 1960's to around 3 in the late 1990's. This demographic transition has had substantial effects in the age and gender composition of the labor force. For example the average age dependency ratio, defined the ratio of dependents (people younger than 15 and older than 65) to the working-age population (those age 15–64), for 18 Latin American economies has experienced a sharp decline from close to 1 in the early 1960s to around 0.7 in the late 1990s. That is, the relative size of the working-age population has remarkably increased since the 1960's. Another noteworthy fact is the growing feminization of the Latin American labor force.

Figure 5

Female Labor Force in Latin America (% of Total)

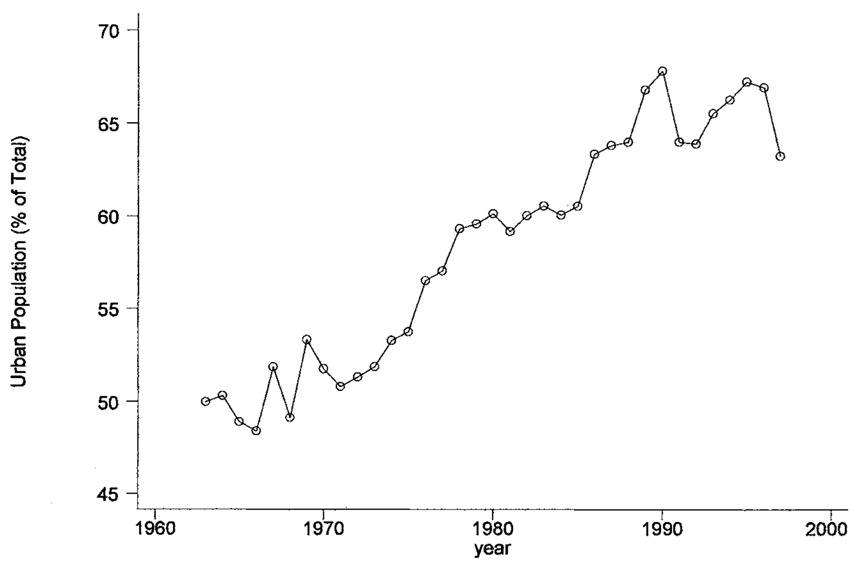


Source: Author's calculations based on World Bank, WDI (2001)

As fertility rates have declined, more women are able to enter the labor force since they have fewer children making them more available for work. Also, with technological innovation and the movement of the region's economic activities to industry and services, the importance of physical strength diminishes relative to other workplace skills and attributes. As more women can perform the same working activities as men, the equality of the sexes in the region's labor force has been enhanced. Figure 5 illustrates this trend. The female labor force as a percentage of total labor force in the region, increased from approximately 18 percent in the early 1960s to close to 35 percent in the late 1990s. All individual countries included in the sample follow the same trend. Also, along with declines in population growth rates and increases in the female labor force as a percentage of the total labor force, Latin American countries have also experienced increases in the percentage of people living in the cities. While in the 1960s urban population as a percentage of total population fluctuated around 50% by the late 1990s this ratio had reached 65% (Figure 6).

Figure 6

Urban Population in Latin America (% of Total Population)

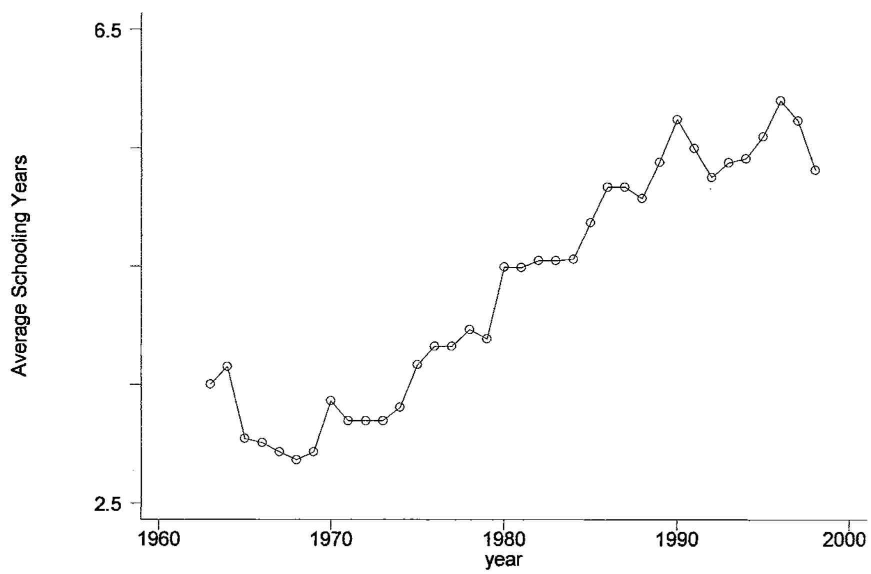


Source: Author's calculations based on World Bank, WDI (2001)

Finally, with regard to the educational attainment of Latin America's population, younger generations are increasingly more educated than older ones, but progress has been slow. Although the number of years of schooling varies significantly across countries, growth in the average level of education for the Latin American region as a whole has been extremely slow. As Figure 7 shows, it takes approximately ten years to raise the average level of education by one year in the region.

Figure 7

Average Educational Attainment in the Total Population



Source: Author's calculations based on Barro and Lee (2000)

Major trends and salient facts are summarized as follows:

1. The wage differential rose sharply from 1980 to 1990, but the trend leveled off by the early 1990s. The differential, though, is still higher than 20 or 30 years ago.

2. Wage inequality rose from 1980 to 1990. Its increase was less dramatic than the increase in the wage differential.
3. Employment of skilled relative to unskilled labor increased significantly since the early 1970's. This trend seems to have reversed in the early 1990's.
4. Overall trade openness has steadily increased since the 1980s. Latin America is becoming more integrated to world markets.
5. The relative size of the working-age population has increased since the 1960s. Latin American population is growing slower and it is ageing.
6. Participation of females in the labor force has increased sharply since the early 1960s. Latin America's labor force is experiencing a growing feminization.
7. The number of people living in the cities as a percentage of total population has steadily increased since the 1960s. Urban population growth in Latin American countries is one of the most significant demographic phenomena of the postwar era.
8. Educational attainment has steadily improved since the early 1970's. This progress however, has been slow.

Hypotheses

The aim of this study is to explore the nexus between openness, technological change and labor supply factors, and the increasing wage differential and wage inequality in Latin America. The investigation focuses mainly on the following hypotheses:

a) Increased trade openness and increased exposure to foreign direct investment facilitates the transmission of new technologies from the more to the less advanced countries. We test that access to foreign technology is achieved mainly through increases in the amount of capital goods imported and increases in foreign direct investment.

b) Recent consensus establishes that technical change tends to favor more skilled workers, that is, technological advances are skilled biased. This bias is reinforced because effective adoption and utilization of newly available foreign technology depend significantly on the supply of skilled labor. That is, new technologies tend to be strong skill complements not only because intrinsic characteristics, but also because their absorption and application implies the use of skilled workers. Therefore, skill-biased technological change implies an increase in the relative labor demand for skilled workers. We test that for a given relative labor supply, skill-biased technology change implies a simultaneous increase in both, the wage differential and the relative level of employment.

c) On the other hand, skill upgrading of the labor force through academic education and technical formation implies an increase in the relative labor supply. That is, we test that for a given relative demand, this implies a simultaneous reduction of the wage differential and an increase in relative employment. Therefore, relative employment increases but the wage differential depends on the relative increases of both, relative demand and relative supply.

Literature Overview

This section is not intended to be an exhaustive review of the already extensive literature on wage differentials and wage inequality, but rather an overview of the studies related to this paper. Cline (1997) offers an excellent literature review for the U.S; for a recent review of the trade and technology literature for Latin America see Morone (2001). The view that both technological change and increased international trade have important implications on labor markets has received support for a long time. Jerome (1934) for example states: "…in the future…there is considerable reason to believe that the effect of further [mechanization] will be to raise the average skill required". The work of Hecksher and Ohlin (1933) also laid out the fundamental tools to examine the effects of international trade and factor endowments. Nevertheless, it was not until several years later that researchers amplified the analysis to take into account the simultaneous determination of relative wages and relative levels of employment. Pioneers in this field include Becker (1964), Welch (1970) and Tinbergen (1974), who talks about a "race" between technological progress and expansion of the number of skilled workers. If the demand for skilled workers runs ahead of the supply then, under competitive labor markets, the results will be an increase in the wage differential. In fact, most researchers agree that changes in wage differentials can be explained by a supply and demand structure and the debate now centers on the nature and relative magnitude of the shifts of both curves. While some economists hold that technological change is the main factor responsible for the demand shifts (for example Romer, 1990; Acemoglu, 2000 and Galor and Maov, 2000) other economists have pointed to increased exposure to global trade as the source (for example Leamer, 1996 and Wood, 1994). Interpretation of these shifts remains open due to the difficulty of offering direct evidence about the effects of technological progress and increased international trade. Separating the effects of both factors has been the source of intense investigation (see Leamer, 1994). In fact, as Kiley (1999) has proposed, regardless of the sources of the demand shifts, it is not possible to make inferences about their effects on wage differentials without controlling for changes in the relative supplies of labor.

The literature explaining wage differentials and inequality in developed countries is abundant. Although evidence differs across regions most analyses emphasize the simultaneous determination approach. In the U.S. for example, Katz and Murphy (1992) find that a simple supply-demand model fits the pattern of variation in the wage premium over time. Also, most researchers agree that the increasing wage differential is due to a combination of technological change, trade with low-wage developing countries, educational failures and immigration of unskilled workers. Sachs and Schatz (1994) for example, discuss how trade with low-income countries has shifted labor market demand away form low-educated workers having an increasing impact on U.S. wage inequality. In Western Europe, where increases in wage differentials have been practically absent, researchers instead have called attention to the role of wage-setting institutions to explain the increase in relative employment among skilled workers (see Manacorda and Manning, 2001 for example). Blau and Kahn (1996) have pointed out that the considerably higher level of wage inequality that has been observed in the U.S. compared to that of OECD countries can be explained by differences in labor market institutions in the two regions. They found that more centralized systems of collective bargaining and wage-setting mechanisms in OECD countries than in the U.S. produce wage distributions with lower variance.

Research in developing countries has been less extensive but is growing. The current research agenda has been greatly motivated by what Wood (1997) calls "conventional wisdom". According to this view, greater openness to trade in developing countries should not only increase efficiency but also reduce wage inequality. These stylized facts found empirical support in East Asian countries but were challenged by the recent experience of Latin American economies, which experienced increasing rather than declining wage differentials after they increased their exposure to international trade and foreign direct investment (FDI). Several hypotheses have been offered. Early explanations for the increasing wage differentials focused on supply factors such as the scarcity of skilled labor (Birdsall, Ross and Sabot, 1995). However, as Robbins (1999) has argued, the majority of these studies –mainly conducted by labor economists- have not explicitly considered human capital or formal education as determined endogenously within the trade process. Instead, these studies usually incorporate supply shifts only to help the identification of shifts in relative demand. Recent studies have focused on demand factors, particularly the role of increased international trade and rapid technological progress. O'Connor and Lunati (1999) for example have argued that a policy reform like trade liberalization can accelerate structural change which for some developing countries is translated in an increase in skills demand associated with the adoption of newly available foreign technology and lower cost of imported capital goods. In fact, although economists have looked at the role of trade, labor supply shifts, educational quality changes, weakening unions and de-industrialization, their inability to explain fully the increase in wage dispersion has led many researchers to argue that skill-biased technological change is perhaps the main factor responsible. The skill-enhancing trade hypothesis proposed by Robbins (1996, 1999) has found strong support. According to this approach, when a developing country opens its economy to trade it experiences technical spillovers that change the available technology favoring skilled workers and therefore widening of the wage differential. That is, the hypothesis suggests that imported goods –machinery and equipment mainly- are the conduits for the international diffusion of technology favoring skilled workers. This approach is applicable to developing countries where domestic investment and R&D are too small to justify skill biased technological change (SBTC) as an explanation (see Berman, Bound and Machin, 1997 and Card and DiNardo, 2002). Hanson and Harrison (1995), for example, examine plant-level data for 1984-1990 in Mexico and conclude that the most likely cause of the rise in the wage inequality was the importation of skill-biased technology from abroad. Mazumdar and Quispe-Agnoli (2002) have found supporting evidence that skilled-biased technology is embodied in imported machinery for the Peruvian case. Also recently, Feenstra and Hanson (2001) have argued that both trade in intermediate inputs and skill-biased technological change increase the relative labor demand and therefore, distinguishing whether the change in wages is due to international trade or technological change is fundamentally an empirical rather than an theoretical question. Other researchers have claimed that while the trade argument can explain increasing wage differentials across industries it is not a comprehensive explanation because of its inability to explain the widening in wage differentials within industries. That is, trade theory can for example predict that greater trade openness should reduce wage differentials by boosting the demand of unskilled workers (relatively abundant in developing nations) in expanding exports industries, and reducing the demand for skilled workers (not so abundant) in import-competing industries, but cannot predict what would happen to wage differentials within given industries, either expanding or import-competing. Hanson and Harrison (1995) argue that others elements must be considered in other to get a more comprehensive explanation. For example, they argue that foreign direct investment (FDI) by bringing technology that is skill-biased contributes substantially to the increasing gap between skilled and unskilled wages. In a study by Aitken, Harrison and Lipsey (1995), it is held that this argument is consistent with several characteristics of the manufacturing sector where foreign-owned firms pay higher wages than domestic firms and also exhibit higher labor productivity. Furthermore, there is no wage spillover from foreign investment to local firms. A good survey on trade, FDI and technology transfer can be found in Saggi (2000).

The impact of policy on wage differentials has also been investigated. Berhman, Birdsall and Székely (2000) for example find that liberalizing policy has a short-run widening effect on wage differentials due to the strong impact of domestic market reform, capital account liberalization and tax reform. Also, Harrison and Hanson (1999) found that the removal of tariff restrictions from the sectors which were relatively intensive in the use of unskilled labor is a prime factor responsible for the increase in wage inequality in Latin American economies. These findings are corroborated in Feliciano (2001) for the Mexican case. Wood (2000) has developed a theoretical framework that synthesizes three of the most influential theories to explain the varied effects of globalization on wage distribution on both, developed and developing countries. The first is the standard Hecksher-Ohlin (HO) trade theory. The second is the Feenstra and Hanson (1996) theory, which focus on a production shift from the North to the South that could increase the relative demand for skilled labor in both regions. And the third is the Tang and Wood (2000) theory, which focuses on the falling cost of moving the 'know-how' around the world. The authors argue that cheaper travel and communication, and improved institutions and policies have enabled high-skilled workers who live in developed countries to cooperate more extensively in production with workers in developing countries. Wood argues that these three theories in combination can explain why inequality has fallen in some developing countries but risen in others. Wood's synthesized theoretical framework has not been empirically tested.

Finally, other researchers have focused on the effects of institutional factors as determinants of wage distribution. Fortin and Lemieux (1997) report in their analysis of the U.S. labor market that declines in the real value of the minimum wage, the decline in unionization rate and economic deregulation explain about a third of the increase in wage inequality during the 1980's measured as wage differentials between less and more educated workers. Also, in an attempt to disentangle between institutional and market forces explaining increases in wage inequality measured as the 90-10 percentile wage differential, Blau and Kahn (1996) report that market forces do not appear to be a viable explanation for international differences in wage inequality increases between the U.S. and OECD countries. They argue that rates of unionization and centralized wage-setting processes (which are more important in OECD countries other than in the U.S.) explain better the increases in wage inequality observed across countries.

Outline of Work

The aim of this study is to explore the nexus between openness, technological change, labor supply, and the wage differential and wage inequality in Latin America using a new and comprehensive data set on industrial wages. In what follows a simple supply and demand framework that looks at the determinants of the wage differential is presented and subsequently we apply this framework to a panel of Latin American economies. In the final section of the study, the performance of Latin American economies is compared to that of East Asia. We find that along with most studies in the literature the estimated value for the elasticity of substitution is greater than one, that is, skilled and unskilled workers are imperfect substitutes. The degree of substitutability between more and less skilled workers is higher in Latin American than in East Asian economies. Also, we find that greater overall trade openness contributes to reducing wage differentials and wage inequality and that increased exposure to foreign direct investment is associated with greater wage differentials and greater wage inequality in Latin American economies. Furthermore, technological change implies an increase in the demand for skilled workers in Latin America when it comes in the form of foreign machinery and equipment and foreign direct investment. Both, wage differentials and wage inequality raise as imports of capital goods and increased exposure to FDI increase. We do not find evidence that imports of capital goods have an impact on wage differentials or wage inequality in East Asia.

II. THEORETICAL FRAMEWORK

Basic Model

Consider an open economy with three factors of production: capital *K*(t), skilled labor *S*(t) and unskilled labor *U*(t). Assume initially that total labor force $L(t) = S(t) + U(t)$ is fully employed and that the ratio of skilled to unskilled labor (S/U) is price unresponsive (i.e. perfectly inelastic). The aggregate production $Y(t)$ takes the following constant returns to scale form:

$$Y(t) = F(K(t), S(t), U(t)) \qquad (1).$$

In order to simplify the analysis, we assume a nested Cobb-Douglas (CB) aggregate production function that depends on capital and a labor aggregate defined as a constant elasticity of substitution (CES) function between skilled and unskilled labor. This type of single-sector aggregate production functions have been extensively used in the literature with alternative expressions. Card and DiNardo (2002) for example, use a similar production function but, for simplicity, omit capital as a factor of production. Their expression is similar in nature to that of Acemoglu (2002). Following Murphy, Riddell and Romer (1998), the expression used in this study takes the form:

$$Y(t) = F(K(t), S(t), U(t)) = K(t)^{\alpha}\left(\lambda[A(t)S(t)]^{\rho} + (1-\lambda)[B(t)U(t)]^{\rho}\right)^{(1-\alpha)/\rho} \qquad (2),$$

where α is the elasticity of production with respect to capital and $(1-\alpha)$ is the elasticity of production with respect to the aggregate CES labor expression, λ is the distribution parameter $(0 < \lambda < 1)$ that defines factor intensity and $\rho \leq 1$ is the substitution parameter between skilled and unskilled workers. Since the elasticity of substitution between skilled and unskilled workers is $\sigma \equiv 1/(1-\rho)$, skilled and unskilled workers are gross substitutes when the elasticity of substitution $\sigma > 1$ or $\rho > 0$ and gross complements when $0 < \sigma < 1$ or $\rho < 0$. The arguments A(t) and B(t) represent technological change determining the productivity of skilled and unskilled workers respectively. Notice that technological change involves either a change in A(t) and B(t) or a change in λ. A rise in λ, for example, increases the marginal productivity of skilled labor and at the same time reduces the marginal productivity of unskilled workers. This type of technological change, that affects the relative productivity of both types of workers while leaving productivity of capital unchanged, has been referred in the literature as *extensive* skilled biased technological change (SBTC). Since λ is constant, technological change does not change factor intensity. Thus, in this framework there are no explicit skilled-labor or unskilled-labor replacing technologies, and the only effect of technology change is either to increase the productivity of skilled or unskilled labor, that is, a change in either A(t) or B(t) or both. That is, technological change can alter the demand for the two kinds of labor by changing their relative productivities. This type of technological change, which affects the productivity of one type of worker, without affecting the productivity of the other, has been referred in the literature as *intensive* SBTC (Card, 2002).

Assuming that labor markets are competitive, the skilled $W_S(t)$ and unskilled $W_U(t)$ wages are equal to their respective marginal products. The wage differential $\omega(t)$ or the relative wage of skilled to unskilled labor is:

$$\omega_t(t) = \frac{W_S(t)}{W_U(t)} = \frac{\lambda}{1-\lambda}\left(\frac{A(t)}{B(t)}\right)^{\rho}\left(\frac{S(t)}{U(t)}\right)^{-(1-\rho)} = \frac{\lambda}{1-\lambda}\left(\frac{A(t)}{B(t)}\right)^{(\sigma-1)/\sigma}\left(\frac{S(t)}{U(t)}\right)^{-1/\sigma} \qquad (3),$$

where the wage differential (and the marginal product ratio) depends on the relative technology level and the relative labor supplies. Therefore, for a given relative technology level $\left(\frac{A(t)}{B(t)}\right)$ the relative wage of skilled workers varies inversely with their relative supply. Also, if the relative number of skilled workers is held constant, the only way to explain a rise in the wage differential is through changes in the technology parameters, that is, skilled biased technological changes. Equation (3) can be expressed in a more convenient form by taking logarithms:

$$\ln\omega(t) = C + \frac{\sigma-1}{\sigma}\ln\left(\frac{A(t)}{B(t)}\right) - \frac{1}{\sigma}\ln\left(\frac{S(t)}{U(t)}\right) \qquad (4),$$

where $C = \ln\frac{\lambda}{1-\lambda}$ is a constant. The elasticity of substitution, σ, is an important parameter that determines the response of the wage differential to both changes in the relative labor supply and changes in relative technology. The wage differential increases (decreases) when skilled workers become more scarce (abundant) relative to unskilled workers for any positive value of σ (when skilled and unskilled workers are substitutes) or:

$$\frac{\partial \ln \omega(t)}{\partial \ln\left(\dfrac{S(t)}{U(t)}\right)} = -\frac{1}{\sigma} < 0 \qquad (5).$$

When the elasticity of substitution is high, increases in the relative labor supply have a small effect on the wage differential; conversely, when the elasticity of substitution is low, increases in the relative labor supply have a large effect on the wage differential.

Equation (5) implies that the relative demand curve for skilled workers $\left(\dfrac{S(t)}{U(t)}\right)^{D}$ is downward sloping as shown in Figure 8 below. More formally, an expression for relative demand is derived from the profit-maximizing behavior:

$$\text{Max } \Pi = PY(t) - W_S(t)S(t) - W_u(t)U(t) - R(t)K(t)$$

where Π represents profit, P is the price of the good and R is the return to capital. Computing the derivates with respect to S, U and K gives the first order conditions (FOC) from which the relative demand curve for skilled workers can be derived:

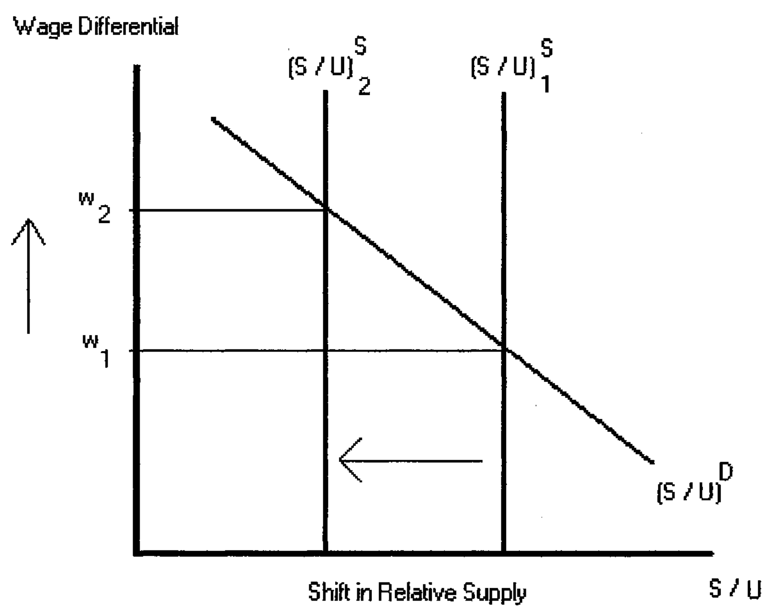
$$\left(\frac{S(t)}{U(t)}\right)^{D} = \left(\frac{1}{\rho-1}\right)\left(\frac{1-\lambda}{\lambda}\right)^{1/(\rho-1)}\left(\frac{B(t)}{A(t)}\right)^{\rho/(\rho-1)}\left(\frac{W_S(t)}{W_U(t)}\right)^{-\rho/(\rho-1)} \qquad (6).$$

From (6) it can be verified that the relative demand is downward sloping for an elasticity of substitution $\sigma > 1$ or $\rho > 0$, that is, when skilled and unskilled workers are substitutes:

$$\frac{\partial\left(\frac{S(t)}{U(t)}\right)^{D}}{\partial\left(\frac{W_S(t)}{W_U(t)}\right)} = \left(\frac{1-\lambda}{\lambda}\right)^{1/\rho-1}\left(\frac{B(t)}{A(t)}\right)^{\rho/\rho-1}\left(\frac{1}{\rho-1}\right)\left(\frac{W_S(t)}{W_U(t)}\right)^{-\rho/\rho-1} < 0 \qquad (7).$$

Figure 8

An Increase in the Relative Supply of Unskilled Workers
(Wage unresponsive relative supply)



Therefore, a decrease in the relative labor supply increases the wage differential as can be seen in Figure 8. It is also clear from Figure 8 that given a constant relative labor supply, an increase in the relative demand for skilled workers raises the wage differential.

Differentiation of equation (4) shows how the wage differential responds to relative technology change:

$$\frac{\partial \ln \omega(t)}{\partial \ln\left(\frac{A(t)}{B(t)}\right)} = \frac{\sigma - 1}{\sigma} \qquad (8),$$

which clearly depends on the elasticity of substitution. If $\sigma > 1$, that is when skilled and unskilled workers are substitutes, improvements in the skill-complementary technology $A(t)$ relative to unskilled-complementary technology $B(t)$, shifts outward relative demand and increase the wage differential. If $0 < \sigma < 1$, that is when skilled and unskilled workers are complements, improvements in the skill-complementary technology relative to unskilled-complementary technology, shifts inward the relative demand and reduces the wage differential. This last result can be interpreted as follows: when $A(t)$ increases relative to $B(t)$, skilled workers become more productive, therefore, the demand for unskilled workers -who complement the more productive skilled workers- increases by more than the demand for skilled workers. In other words, as Acemoglu (2000) pointed out, interpreting relative increases in $A(t)$ as skill-biased is not appropriate when skilled and unskilled workers are complements. Notice that in this model the forces that drive changes in relative wages are of two types: 1) changes in relative supply of different types of labor or changes in factor proportions and 2) changes in relative demand for labor that are driven by technical change. Changes in relative demand for labor driven by changes in the composition of product demands are ignored.

Finally, it is worth mentioning that some researchers have analyzed the effects of technological progress on labor supply rather than labor demand. Leith and Li (2001) for example, examine the job reallocation effect of technological change as new technologies not only destroy old jobs but also create new ones. They argue that this process affects the effort incentives of workers and hence the effective labor supply. In this study, this job reallocation mechanism is ignored.

Endogenous Relative Labor Supply

Section 2.1 treated the relative supply $\left(\frac{S}{U}\right)$ as exogenous. It is clear, however, that human capital investment decisions respond to returns and other factors. The purpose of this section is to build an endogenous relative supply with two main arguments: relative wages (ω) and a set of demographic factors. Following Acemoglu (1998), assume that each potential entrant to the labor force must decide at time t whether to acquire education and become a skilled worker or remain unskilled and jump into the labor force pool immediately. Also assume that it takes J periods to become skilled and that during this time no labor income is earned. If a worker with education cost J decides to invest in education, another worker with $J' < J$ must also acquire skills. Therefore, a cutoff level $\hat{J}$ exists such that all workers with cost $J > \hat{J}$ do not acquire skills. Then, the ratio of skilled to unskilled workers can be represented by:

$$\left(\frac{S}{U}\right) = \Omega(\hat{J}, D) \qquad (9),$$

where $\hat{J}$ is the cutoff level and D is a set of demographic factors that determine the decision whether to acquire skills or not. The derivative $\Omega_{\hat{J}}$ is positive, meaning that the greater the cutoff level, the larger the ratio of skilled to unskilled workers. In other words, the greater $\hat{J}$, the more people become skilled. Notice that a worker with cost $\hat{J}$ is indifferent between investing in education or not. Assuming that workers expect skilled wages to grow at a constant rate g_S and unskilled wages to grow at a constant rate g_U, when the worker takes the no-schooling option her return is given by the present value of her labor income stream:

$$R_U = \int_t^{\infty} e^{-rt} W_U(t)\partial t = W_U \int_t^{\infty} e^{-(r-g_S)} \partial t = \frac{W_U e^{-(r-g_S)t}}{r-g_S} \tag{10}$$

and when she takes the schooling option her return is given by:

$$R_S = \int_{t+\hat{J}}^{\infty} e^{-rt} W_S(t)\partial t = W_S \int_{t+\hat{J}}^{\infty} e^{-(r-g_U)} \partial t = \frac{W_s e^{-(r-g_U)(t+\hat{J})}}{r-g_U} \tag{11}$$

where r is the discount rate. Therefore, for this worker to be indifferent at all times, the returns of both options must be equal (i.e. $R_U = R_S$). Equating (10) and (11) and solving for the wage differential ω we obtain the following equation:

$$\omega(t) = \frac{W_S(t)}{W_U(t)} = \left(\frac{r-g_S}{r-g_U}\right) e^{(r-g_S)(t+\hat{J})-(r-g_U)t} \tag{12}$$

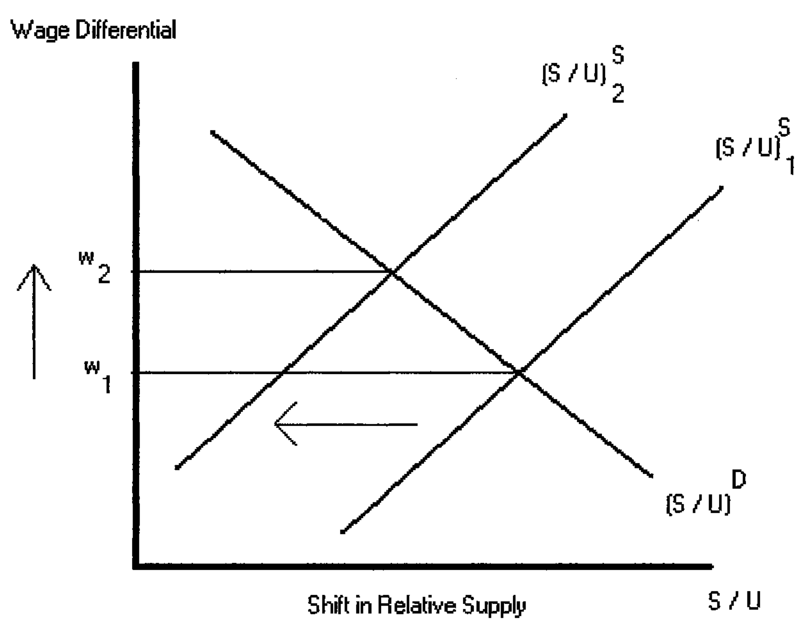
Finally, substituting (12) into (9), we obtain a relative supply as a function of the wage differential, the discount rate, the growth rates of skilled and unskilled wages, and the set of policy variables and demographic factors:

$$\left(\frac{S(t)}{U(t)}\right)^{S} = \Omega(\omega, g_S, g_U, r, D) \tag{13}$$

which defines an upward sloping relative supply (since $\Omega_\omega > 0$).

Figure 9

An Increase in the Relative Supply of Unskilled Workers (Wage responsive relative supply)



Finally, if the number of unskilled workers increases more rapidly than the numbers of skilled workers, the relative supply $\left(\frac{S}{U}\right)^{S}$ shifts to the left increasing the wage differential (see Figure 9). The set of demographic factors D includes the composition of the labor force, schooling level, the percentage of female in the labor force, fertility and death rates, and age dependency rates.

Endogenous Technology Level Ratio

Section 2.1 treated the relative technology level $\left(\frac{A(t)}{B(t)}\right)$ as exogenous. For empirical purposes, the technology level –embedded in the production function- is not directly observable or quantifiable. So, a measurable expression for the technology level is needed. This section presents the relative technology level as a function of domestic and foreign factors, which in turn have important effects on the wage differential. The basic argument is that fundamental changes in an economy can cause shifts in relative factor demands that are not necessarily equivalent among factors and therefore can change factor returns. The effects of events like trade and foreign direct investment on wage differentials are of special interest.

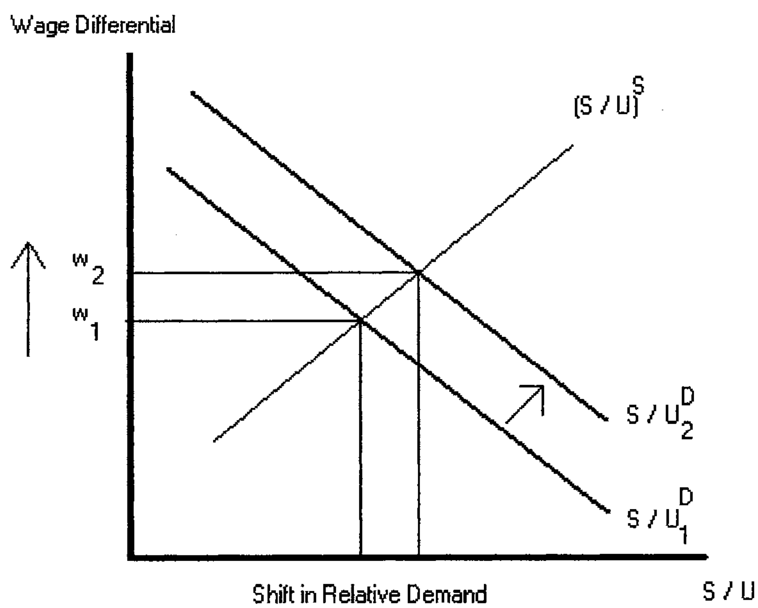
Following an approach similar to Pissarides (1997), assume that the relative technology level $\left(\frac{A(t)}{B(t)}\right)$ changes as economic agents in the South engage in activities to discover ways to "emulate" the technology of the mode developed countries (North) or to "learn" how to use imported machinery. This occurs because it is cheaper for the less developed economies (South) to imitate and to learn from the technology that already exists than to incur costs of original research to develop their own technology. Therefore, increased exposure to Northern technology, which can be achieved through trade and foreign direct investment, has a direct effect on the relative technology level of the South. Assume that the productivity ratio $\left(\frac{A(t)}{B(t)}\right)$ in the South is given by:

$$\left(\frac{A(t)}{B(t)}\right) = f(OPEN(t), FDI(t), RD(t)) \tag{14}$$

where $OPEN$ is a measure of trade openness, FDI is a measure of exposure to foreign direct investment (FDI) and RD is a measure of research and development (R&D) transfer. Lets explore the intuition behind equation (14). First, increased trade openness facilitates a more rapid transfer of technologies from North to South. Nevertheless, it is not clear in which direction the technology ratio will move. Therefore, we must distinguish between overall openness, which includes all sorts of goods and services, and the type of openness that implies technology transfer, that is, imports of capital goods. However, although most economists accept the importance of imports of capital goods in transmitting foreign technology to domestic industries, the relative effect among skilled-labor and unskilled-labor intensive industries depends on the composition of imports and on the degree to which new technologies are complementary to skilled or unskilled labor. Therefore assuming that new technologies (obtained either through increased imports of capital goods or by 'emulating' or 'learning' from the technology of the North) are strong skill complements, the productivity of skilled-labor is enhanced with increased trade in capital goods. Second, following an analogous reasoning to the openness argument, increased exposure to foreign direct investment complementary to skilled-labor, can also increase the productivity of skilled workers relative to unskilled-workers. Therefore, the derivative $f_I > 0$ is also positive.

Figure 10

An Increase in the Relative Demand of Skilled Workers



Finally, as Coe, Helpman and Hoffmaister (1997) have suggested, a developing country trading with an industrial country that has a large "stock of knowledge" from its cumulative R&D activities, can boost its productivity by importing a larger variety of intermediate products and capital equipment embodying foreign knowledge.

However, since we don't know if R&D complement skilled or unskilled labor, the sign of this derivative becomes an empirical question. Moreover, because Latin

American economies carry out very little own R&D and data for this are unavailable, we study only the effects of R&D transfers from developed economies.

Based on the previous discussion and assuming that skilled and unskilled workers are substitutes ($0 > \sigma > 1$), a relative increase in labor demand triggered by an increase in any factor in (14) can be viewed as a rightward shift (see Figure 10 above) and therefore as an increase in the wage differential.

III. DATA

Wage Data and Measures of the Wage Differential and Wage Inequality

Wage data on manufacturing industries are taken from the Industrial Statistics Database of the United Nations Industrial Development Organization (UNIDO), which contains annual data by manufacturing industry for the period 1963-1998. The UNIDO Industrial Statistics Database contains manufacturing employment and wage data at the 3-digit level of International Standard Industrial Classification (ISIC Rev.2) code for 28 industries shown in Table II.

Table II

International Standard Industrial Classification 3-digit level (Rev.2)

CODE		*CODE*	
311	Food products	354	Miscellaneous oil and coal products
313	Beverages	355	Rubber products
314	Tobacco	356	Plastic products
321	Textiles	361	Pottery, china, earthenware
322	Wearing apparel, except footwear	362	Glass and products
323	Leather products	369	Other non-metallic mineral products
324	Footwear, except rubber or plastic	371	Iron and steel
331	Wood products, except furniture	372	Non-ferrous metals
332	Furniture, except metal	381	Fabricated metal products
341	Paper and products	382	Machinery, except electrical
342	Printing and publishing	383	Machinery, electric
351	Industrial chemicals	384	Transport equipment
352	Other chemicals	385	Prof. and scientific equipment
353	Petroleum refineries	390	Other manufactured products

The sample employed in this study contains 18 Latin American countries and 8 East Asian countries for a total of 662 observations as can be seen in Table III.

Table III

Country Sample by Region

Latin America	Code	Period	Obs.	East Asia	Code	Period	Obs.
Argentina	ARG	1978-1996	17	Hong Kong	HKG	1973-1998	26
Bolivia	BOL	1970-1998	29	Indonesia	IDN	1970-1996	27
Brazil	BRA	1990-1995	5	Korea, Republic of	KOR	1963-1997	35
Chile	CHL	1963-1998	36	Malaysia	MYS	1968-1998	31
Colombia	COL	1963-1998	36	Philippines	PHL	1963-1997	35
Costa Rica	CRI	1963-1997	17	Singapore	SGP	1963-1997	35
Dominican Republic	DOM	1963-1985	23	Thailand	THA	1967-1994	19
Ecuador	ECU	1970-1997	28	Taiwan	TWN	1973-1997	25
Guatemala	GTM	1968-1998	27	**Total Countries**	**8**		
Honduras	HND	1981-1995	15	**Total Obs.**			**233**
Mexico	MEX	1970-1998	29				
Nicaragua	NIC	1965-1985	21				
Panama	PAN	1963-1997	34	**Tot. Number of Countries = 26**			
Peru	PER	1982-1994	12	**Tot. Numbers of Obs. = 662**			
El Salvador	SLV	1965-1997	27				
Trinidad y Tobago	TTO	1974-1995	19				
Uruguay	URY	1976-1997	22				
Venezuela	VEN	1963-1996	32				
Total Countries	**18**						
Total Obs.			**429**				

Based on this data two measures of the wage differential are computed for each country: the ratio of the average manufacturing industry wage received by the top 50% relative to the bottom 50% and the ratio of the average manufacturing industry wage received by the top 10% relative to the bottom 10%. Computing these ratios follows two steps. First, for any given year, the average wage per worker is calculated by dividing total wage disbursements by total employment in each industry and sorted in ascending order (see Table IV). Second, the 28 industries are divided in two sets of 14 industries each. The 14 industries in the top 50% are those for which the average wage per worker for all years is higher than the overall average wage rate and vice versa for the bottom

50%. The wage differential for each year is the average wage per worker of the first set of 14 industries divided by the average wage per worker of the second set of 14 industries. Similarly, for the top 10% to the bottom 10% ratio, for any given year, the average wage per worker of the first 3 industries in the list is calculated and divided by the average wage per worker of the last 3 industries. The coefficient of correlation between these measures is 0.774.

Table IV

Classification of Skilled and Unskilled Workers

		1963	1964	...	...	...	1997	1998		Avg. Wage per Worker All Years
INDUSTRY	311	...	...	...	...	...	...	...	→	...
	312	...	...	...	...	...	...	...		...
	...	...	...	...	...	...	...	...	→	...
	...	...	...	...	...	...	...	...		...
	...	...	...	...	...	...	...	...	→	... ↓
	390	...	...	...	...	...	...	...		...
										Avg. Overall Wage per Worker

In addition to the wage differential and in order to take full advantage of the information contained in the database, four measures of wage inequality are computed: the Gini Coefficient, Theil's Mean Logarithmic Deviation Index, Theil's Entropy Index and the Coefficient of Variation. Calculation of these measures follows conventional formulas taken from Cowell (1995):

1) GINI Coefficient $$G = \frac{1}{2n^2 \bar{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|$$

2) Theil's Mean Logarithmic Deviation Index $THEIL1 = \frac{1}{n}\sum_{i=1}^{n}\log\frac{\bar{y}}{y_i}$

3) Theil's Entropy Index $THEIL2 = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\bar{y}}\log\frac{y_i}{\bar{y}}$

4) Coefficient of Variation $CV = \frac{\sum_{i=1}^{n}(y_i - \bar{y})^2}{\sum_{i-1}^{n}\frac{y_i}{n}}$

where n and $\bar{y}$ are the sample size and mean respectively, and y_i is the average wage per worker for industry *i*. Inequality indices should display four desirable properties:

- *Transfer Principle*: requires that an income transfer from a poorer person to a richer person should be registered as an increase in inequality (or at least not as a decrease). Also, that an income transfer from a richer person to a poorer person should be registered as a decrease in inequality (or at least not as an increase).
- *Income Scale Independence*: requires the inequality measure to be invariant to uniform proportional changes in income. In other words, if income of each individual changes by the same proportion, inequality should not change.
- *Principle of Population*: requires that when merging two or more identical populations, the inequality should not change.
- *Decomposability*: requires overall inequality to be related consistently to consistent parts of the distribution such as population sub-groups. That is, if inequality were to increase among each sub-group of the population then we would expect overall inequality also to increase.

Table V shows the properties of each of the inequality measures considered in this study as well as their range. Except for the Gini coefficient's failure to exhibit decomposability, the inequality indicators selected satisfy all desirable principles.

Table V

Which Measures Does What?

	GINI	THEIL 1	THEIL 2	CV
The Transfer Principle	Yes	Yes	Yes	Yes
Income Scale Independence	Yes	Yes	Yes	Yes
Principle of Population	Yes	Yes	Yes	Yes
Decomposability	No	Yes	Yes	Yes
Range	[0,1]	[0,infinite)	[0,infinite)	[0,infinite)

Employment Data and Classification of Skilled and Unskilled Workers

Total employment data by industry is also available in the UNIDO data set. The classification between skilled and unskilled workers for each country corresponds to the measures of the wage differential. That is, we have two classifications, one between the more skilled and less skilled workers –which corresponds to the wage differential for the top 50% to bottom 50% - and another between the highest and lowest skilled workers - which corresponds to the wage differential for the top 10% to bottom 10%. Classifying workers follows four steps. First, for any given year, the average wage per worker for each industry is calculated by dividing total wage disbursements by total employment (see Table IV). Second, the average wage per worker by industry is calculated for all years for which data exist (right column). Third, the overall average wage per worker for all industries and all years is calculated. Finally, for the classification between the more skilled and less skilled workers, if the average wage per worker for all years for a given industry is larger than the average overall wage, workers employed in this industry are classified as more skilled. If the average wage per worker for all years for a given industry is lower than the average overall wage, workers employed in this industry are classified as less unskilled. The classification between the highest and lowest skilled is slightly different. After computing the overall average wage per worker by industry for all years, industries for all years are ranked from the highest to lowest overall average wage per worker. Then, workers employed in the first 3 industries in the ranked list are classified as the highest skilled workers, while workers employed in the last 3 industries in the ranked list are classified as the lowest skilled workers. The implicit assumption of both classifications is that more skilled workers receive higher wages than less skilled workers. Since the average wage per worker by industry in each country is calculated considering all years available, this method separates between 'skilled' industries and 'unskilled' industries for the whole period of data availability.

Finally, a note of caution regarding the measurement of skills. As Forbes (2000) has shown, attention should be paid to the definition of skills when measuring the effect of trade on wage distribution since estimates of this relationship are highly dependant on the skill classification utilized. Although researchers realize the importance of this finding, most studies use different definitions for at least two reasons. First, there is little consensus on how to accurately measure skills, which should capture education and training, as well as on the job training. These elements are difficult to capture in any one measurement. Second, statistics on skills and education are not consistently measured across countries and across time. The UNIDO Industrial Statistics Database used in this study is comparable and consistent, both between countries and over time.

Other Data and Measurements

The other variables used in this study and their sources are as follows:

- *(GDP per capita)*: Current GDP in US$, as reported in the World Development Indicators (2002) database of the World Bank divided by total population. Real GDP per capita is in constant dollars as reported in Penn World Table 5.6. Missing data calculated from 1985 GDP per capita and GDP per capita growth rates as reported in Global Development Finance (2002) and World Development Indicators (2002)
- (*FDI/GDP*): Net Foreign Direct Investment in current US$ as a percentage of GDP. World Development Indicators (2002)
- ((*X+M)/GDP*): Exports (X) and Imports (M) of Goods and Services in current US$ as a percentage of GDP. This is our measure of overall openness. World Development Indicators (2002).
- (*Imp. mach&equip/GDP*): Data for imports are taken from exports of machinery and transport equipment of the five major (G5) industrialized countries (United States, Germany, United Kingdom, France and Japan) to each country from the International Trade by Commodity Statistics (ITCS) database. This database is maintained by the Organization for Economic Co-operation and Development (2001) and follows the Standard International Trade Classification (SITC) Rev.2. These countries are the leading nations in technological development and also major suppliers of machinery and equipment of developing countries. For each developing country we measure imports of technological equipment as the ratio of imports of machinery and transportation equipment (SITC Code 7) to GDP.

- (*R&D Int./man*) and (*R&D Int./GDP*): Research and development (R&D) expenditure in manufacturing for the five major (G5) industrialized countries (United States, Germany, United Kingdom, France and Japan) were taken from the OECD's Research and Development Expenditure in Industry (ANBERD) database. Based on these data two indicators of foreign R&D (R&D intensity) were computed: the weighted average research and development expenditures intensity with respect to total manufacturing output and with respect to total GDP according to the following formula: $\sum_{j=1}^{5} \frac{M_{ijt}}{M_{it}} RDINT_{jt}$ where $M_{it} = \sum_{j=1}^{5} M_{ijt}$, M_{ijt} = imports of technology of country *i* from country *j* at time *t* (*j* = 1,...5 represents the G5) and $RDINT_{jt}$ = R&D intensity of each G5 (*j* = 1,...5) at time *t*. We restrict our study to the G5 countries because they represent the bulk of global R&D activity and are also the major sources of capital equipment for developing economies. R&D intensity along with the data for foreign direct investment (FDI) and the data for imports of machinery and transport equipment are used as proxies to capture transfer technology from industrialized countries.
- (*Terms of Trade*): Terms of trade of goods and services in constant local currency (1995=100) as reported in the World Development Indicators (2002) and Global Development Finance (2002) databases.
- *(POP), (Total LF), (Female LF), (Urban Pop)* and *(Age Dependency Ratio):* Demographic variables were taken from World Development Indicators (2001) and Social Indicators of Development (1996). These include total population, total labor force, female labor force, urban population and age dependency ratio.

- (*Avg. School Yrs. In Tot. Pop.*) and (*GINIEDUC*): Data on educational attainment were taken from the educational database developed by Barro and Lee (2000). The educational variable employed in this study is the average number of total years of schooling in the total population. In order to test not only for educational attainment but also for educational distribution inequality, we use the education inequality measure calculated by Thomas, Wang and Fan (2000). Their educational dataset contains Gini coefficient for education for the population age over 15 from 1960 to 1990.
- (*Private Credit / GDP*) and (*Liquid Liabilities/GDP*): To analyze the effects of access to the financial market we use two measures of financial development proposed by Levine, Loayza and Beck (2000). The first is liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP. The second is the value of credits by financial intermediaries to the private sector divided by GDP. It is expected that a more developed financial sector will facilitate access to credit and presumably reduce inequality.
- (GINILAND): The Gini coefficient for land distribution is from Deininger and Squire (1996).

Table VI reports descriptive statistics of the variables used in the empirical section.

Table VI

Descriptive Statistics by Region

	Latin America				
	Mean	Std. Dev.	Min. Value	Max. Value	Obs.
Wages (T50%/B50%)	170.57%	1.200	103.67%	291.25%	429
Wages (T10%/B10%)	316.45%	1.422	106.08%	2002.54%	429
S / U (T50%/B50%)	37.46%	1.908	6.90%	227.96%	429
S / U (T10%/B10%)	42.23%	2.942	1.54%	354.66%	429
FDI / GDP	10.13%	0.103	9.26%	22.44%	411
R&D Int. / GDP	0.10%	0.001	0.00%	2.07%	419
(X + M) / GDP	36.35%	1.570	9.04%	190.03%	429
Terms of Trade	105.425	1.252	67.830	217.457	393
Real GDP per Capita	3649.48	2013.01	1271	11738	429
Avg School Tot Pop.	4.463	1.567	1.426	8.119	429
GINILAND	0.802	0.072	0.621	0.924	393
Liquid Liabilities / GDP	27.70%	0.118	4.50%	68.70%	409
Urban Pop / Tot Pop	59.50%	0.164	33.10%	90.50%	429
Female LF / Tot LF	27.10%	0.058	10.20%	41.00%	429
Age Dependency Ratio	0.801	0.142	0.550	1.048	419
GINI	0.169	0.052	0.078	0.395	429
CV	0.361	0.124	0.161	1.027	429
Theil 1	0.061	0.042	0.012	0.336	429
Theil 2	0.058	0.045	0.011	0.324	429
	East Asia				
	Mean	Std. Dev.	Min. Value	Max. Value	Obs.
Wages (T50%/B50%)	174.19%	1.181	106.61%	265.65%	233
Wages (T10%/B10%)	304.04%	1.461	190.03%	634.71%	233
S / U (T50%/B50%)	21.06%	1.536	7.27%	54.23%	233
S / U (T10%/B10%)	33.52%	2.512	2.61%	246.70%	233
FDI / GDP	10.24%	0.103	9.96%	11.48%	175
R&D Int. / GDP	0.00%	0.001	0.00%	0.00%	227
(X + M) / GDP	79.20%	2.136	21.03%	370.53%	233
Terms of Trade	98.396	1.196	32.105	170.375	216
Real GDP per Capita	4944.53	4293.41	715	18811	233
Avg School Tot Pop.	5.324	1.884	2.285	10.088	233
GINILAND	0.482	0.087	0.310	0.582	172
Liquid Liabilities / GDP	59.10%	0.384	8.30%	187.10%	197
Urban Pop / Tot Pop	56.30%	0.302	13.10%	99.90%	208
Female LF / Tot LF	35.90%	0.051	20.70%	48.10%	208
Age Dependency Ratio	0.683	0.167	0.400	0.969	188
GINI	0.149	0.054	0.044	0.305	233
CV	0.319	0.118	0.092	0.651	233
Theil 1	0.047	0.031	0.004	0.162	233
Theil 2	0.043	0.029	0.003	0.151	233

Table VII shows the correlation coefficients among these variables for both regions.

Table VII

Correlation Coefficients by Region

Latin America	Wages (T50%/B50%)	Wages (T10%/B10%)	S / U (T50%/B50%)	S / U (T10%/B10%)	FDI / GDP	R&D Int. / GDP	(X + M) / GDP	Terms of Trade	Real GDP per Capita	Avg School Tot Pop.	GINILAND	Liquid Liabilities / GDP	Urban Pop / Tot Pop	Female LF / Tot LF	Age Dependency Ratio	GINI	CV	Theil 1	Theil 2
Wages (T50%/B50%)	1.00																		
Wages (T10%/B10%)	0.65	1.00																	
S / U (T50%/B50%)	0.03	0.07	1.00																
S / U (T10%/B10%)	0.09	0.05	0.72	1.00															
FDI / GDP	0.23	0.17	-0.03	0.04	1.00														
R&D Int. / GDP	0.49	0.33	0.06	0.02	0.08	1.00													
(X + M) / GDP	-0.06	-0.01	-0.02	0.23	0.29	-0.14	1.00												
Terms of Trade	-0.43	-0.33	-0.04	-0.10	-0.11	-0.74	0.01	1.00											
Real GDP per Capita	-0.01	0.09	-0.03	0.29	0.08	0.10	0.19	-0.09	1.00										
Avg School Tot Pop.	0.28	0.25	0.01	0.02	0.15	0.71	0.03	-0.48	0.47	1.00									
GINILAND	0.20	0.09	-0.24	-0.20	-0.18	0.11	-0.18	0.00	-0.18	-0.08	1.00								
Liquid Liabilities / GDP	0.07	0.21	-0.20	0.08	0.12	0.23	0.23	-0.22	0.42	0.33	-0.04	1.00							
Urban Pop / Tot Pop	0.06	0.04	0.07	0.13	-0.04	0.38	-0.24	-0.27	0.69	0.62	0.04	0.24	1.00						
Female LF / Tot LF	0.14	0.17	0.41	0.35	0.03	0.62	0.11	-0.52	0.28	0.60	-0.19	0.38	0.50	1.00					
Age Dependency Ratio	-0.24	-0.23	-0.03	-0.03	-0.15	-0.67	-0.01	0.53	-0.51	-0.84	-0.01	-0.33	-0.71	-0.67	1.00				
GINI	0.63	0.63	0.09	0.23	0.22	0.38	-0.14	-0.42	-0.10	-0.16	0.01	-0.09	0.02	0.29	-0.24	1.00			
CV	0.58	0.66	-0.09	0.03	0.26	0.27	-0.14	-0.31	-0.02	-0.10	0.08	-0.12	0.11	0.15	-0.12	0.88	1.00		
Theil 1	0.59	0.68	-0.02	0.13	0.24	0.26	-0.15	-0.33	0.02	0.09	0.00	0.12	-0.09	0.18	-0.11	0.94	0.95	1.00	
Theil 2	0.54	0.57	0.02	0.19	0.17	0.24	-0.15	-0.32	0.00	0.04	0.03	0.08	-0.04	0.17	-0.06	0.90	0.81	0.92	1.00
East Asia																			
Wages (T50%/B50%)	1.00																		
Wages (T10%/B10%)	0.87	1.00																	
S / U (T50%/B50%)	0.13	0.23	1.00																
S / U (T10%/B10%)	0.30	0.25	0.01	1.00															
FDI / GDP	0.03	0.05	-0.34	-0.21	1.00														
R&D Int. / GDP	0.11	0.00	-0.20	-0.41	0.24	1.00													
(X + M) / GDP	0.04	-0.02	-0.24	-0.26	0.83	0.33	1.00												
Terms of Trade	0.04	0.08	0.13	0.10	-0.01	0.01	0.00	1.00											
Real GDP per Capita	-0.35	-0.41	0.23	-0.33	0.36	0.46	0.60	0.00	1.00										
Avg School Tot Pop.	-0.03	-0.13	0.13	0.00	-0.01	0.44	0.25	-0.01	0.70	1.00									
GINILAND	0.48	0.59	-0.65	0.06	0.47	0.06	0.24	0.04	-0.29	-0.52	1.00								
Liquid Liabilities / GDP	-0.02	-0.16	-0.07	-0.18	0.63	0.44	0.81	0.02	0.71	0.36	0.15	1.00							
Urban Pop / Tot Pop	-0.05	-0.11	0.07	-0.21	0.13	0.42	0.41	-0.04	0.77	0.89	-0.44	0.46	1.00						
Female LF / Tot LF	-0.33	-0.59	0.55	-0.01	-0.16	0.28	-0.14	0.20	0.15	0.13	0.38	0.06	-0.11	1.00					
Age Dependency Ratio	0.31	0.40	-0.14	0.54	-0.06	-0.18	-0.29	0.09	-0.76	-0.69	0.47	-0.40	-0.76	-0.22	1.00				
GINI	0.19	0.21	-0.04	0.03	-0.34	-0.12	-0.54	0.03	-0.66	-0.54	0.22	-0.53	-0.73	0.26	0.45	1.00			
CV	0.39	0.39	-0.14	0.18	-0.24	-0.09	-0.46	0.02	-0.69	-0.51	0.32	-0.45	-0.71	0.22	0.53	0.92	1.00		
Theil 1	0.25	0.26	-0.04	0.07	-0.27	-0.10	-0.49	0.01	-0.63	-0.52	0.26	-0.47	-0.72	0.28	0.47	0.97	0.97	1.00	
Theil 2	0.18	0.21	-0.02	0.02	-0.29	-0.14	-0.50	0.02	-0.63	-0.55	0.25	-0.50	-0.74	0.26	0.46	0.98	0.93	0.98	1.00

Table VIII reports descriptive statistics by country of relative wages and relative labor supply.

Table VIII

Descriptive Statistics by Country: Selected Variables

		Latin America				
	Top 10% / Bot 10%	Mean	Std. Dev.	Min. Value	Max. Value	Obs.
ARG	Relative Wages	3.623	1.110	2.365	7.200	17
	S / U	0.252	0.035	0.203	0.319	17
BOL	Relative Wages	3.172	1.229	1.632	5.713	29
	S / U	2.002	0.588	1.312	3.547	29
BRA	Relative Wages	3.271	0.338	2.689	3.535	5
	S / U	1.295	0.114	1.169	1.447	5
CHL	Relative Wages	3.436	0.697	2.342	4.962	36
	S / U	0.353	0.118	0.200	0.577	36
COL	Relative Wages	2.933	0.192	2.524	3.442	36
	S / U	0.431	0.055	0.305	0.524	36
CRI	Relative Wages	2.747	0.485	1.785	3.983	17
	S / U	0.455	0.150	0.082	0.647	17
DOM	Relative Wages	2.468	0.308	1.846	3.360	23
	S / U	0.047	0.118	0.015	0.586	23
ECU	Relative Wages	3.870	1.038	2.344	6.124	28
	S / U	0.480	0.109	0.271	0.778	28
GTM	Relative Wages	5.119	2.457	2.925	11.215	27
	S / U	0.515	0.129	0.302	0.710	27
HND	Relative Wages	2.407	1.153	1.061	4.131	15
	S / U	0.770	0.341	0.365	1.245	15
MEX	Relative Wages	2.130	0.235	1.883	2.916	29
	S / U	0.998	0.480	0.333	2.102	29
NIC	Relative Wages	2.900	0.360	2.321	3.810	21
	S / U	0.740	0.100	0.658	1.079	21
PAN	Relative Wages	3.562	1.365	2.365	6.946	34
	S / U	0.230	0.047	0.153	0.352	34
PER	Relative Wages	4.978	1.525	2.539	7.464	12
	S / U	0.351	0.049	0.292	0.442	12
SLV	Relative Wages	3.244	0.688	2.208	5.035	27
	S / U	0.208	0.122	0.028	0.628	27
TTO	Relative Wages	5.954	4.320	2.241	20.034	19
	S / U	1.463	0.343	0.717	2.145	19
URY	Relative Wages	3.660	1.118	2.478	6.320	22
	S / U	0.121	0.048	0.049	0.211	22
VEN	Relative Wages	2.776	0.546	2.155	4.405	32
	S / U	1.445	0.257	0.979	1.818	32

		East Asia				
	Top 10% / Bot 10%	Mean	Std. Dev.	Min. Value	Max. Value	Obs.
HKG	Relative Wages	2.097	1.024	1.153	4.364	26
	S / U	0.103	0.048	0.058	0.199	26
IND	Relative Wages	4.383	0.438	3.532	5.280	36
	S / U	0.232	0.077	0.173	0.382	36
KOR	Relative Wages	2.473	0.320	1.671	3.372	35
	S / U	0.352	0.173	0.177	0.779	35
MYS	Relative Wages	3.964	0.674	2.100	4.917	31
	S / U	0.476	0.239	0.229	1.139	31
PHL	Relative Wages	4.833	0.847	3.327	6.353	35
	S / U	1.221	0.410	0.651	2.467	35
SGP	Relative Wages	3.505	0.501	2.546	4.791	35
	S / U	0.357	0.210	0.189	0.189	35
THA	Relative Wages	2.351	0.509	1.254	3.146	19
	S / U	0.915	0.230	0.559	1.273	19
TWN	Relative Wages	2.146	0.336	1.679	2.790	25
	S / U	0.381	0.133	0.264	0.693	25

IV. WAGE DIFFERENTIALS IN LATIN AMERICA

Exogenous Relative Labor Supply

Equation (4) defines the wage differential assuming that relative labor supply is exogenous. This is the basic equation that is tested empirically. As far as the relative technology ratio $\left(\frac{A(t)}{B(t)}\right)$ is concerned, substituting equation (14) into equation (4) a reduced form expression for the wage differential can be found:

$$\omega_t = \Psi\left(O_t, I_t, RD_t, S/U\right) \tag{15}$$

Some authors have suggested and estimated simpler versions of this framework. For example, Psacharopoulos and Hinchliffe (1972) estimate a version of (4) for a panel of developing and developed countries distinguishing among three types of educated labor and including a measure of the capital-labor ratio. More recently, Katz and Murphy (1992) estimate a version of (4) for the U.S. assuming that the relative technology ratio depends on a linear time trend and thus grows at a constant rate. In our approach, the wage differential is examined by modeling the relative technology ratio explicitly.

Empirical Results

The least squares dummy variable (LSDV) estimates are in Table IX. The software used in all estimations is STATA 7.0. Columns 1 through 6 show results when the dependent variable is measured by the ratio of average wage of top 50 percent to bottom 50 percent and columns 7 through 10 show results for the ratio of average wage of top 10 percent to bottom 10 percent. The Hausman specification test is significant for all models suggesting that individual effects are correlated with the regressors, and hence the appropriateness of a fixed-effects estimator. Following Green (2000), a modified Wald test for groupwise heteroskedasticity in a fixed effects model indicated the presence of heteroskedasticity[1]. Therefore, White robust standard errors are computed. Time effects are also significant in all models showing an increasing magnitude over time. This is an indication that global shocks have tended to increase the skill differential over time.

The results indicate that an increase in the supply of skilled workers relative to unskilled workers reduces the wage differential as suggested by equation (4). The elasticity of substitution (σ) between skilled and unskilled workers is calculated by taking the negative of the reciprocal of the estimated coefficients for the S/U ratio. This elasticity of substitution however, has a slightly different interpretation for the two dependent variables. The elasticity of substitution for the top 50 percent to bottom 50 percent (columns 1-6) is between more skilled and less skilled workers while the elasticity of substitution for the top 10 percent to bottom 10 percent (columns 7-12) is between the highest and lowest skilled workers.

The value of the estimated coefficients implies an elasticity of substitution (σ) in the range 9-12 for the top 50 percent to bottom 50 percent variable and in the range 5-7 for the top 10 percent to bottom 10 percent variable. This result confirms the intuitive expectation that the degree of substitutability should be larger between more and less skilled workers than between the highest and lowest skilled workers.

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[1] The modified Wald statistic tests the hypothesis that $\sigma^2(i) = \sigma^2$ for i=1, N where N is the number of cross-sectional units. The resulting test statistic is distributed as a $\chi^2(N)$ under the null hypothesis of homoskedasticity. Table 5 reports values for this test statistic in the 'Modified Wald Test' row.

Table IX

Determinants of Wage Differentials: Exogenous Relative Labor Supply

	Dependent Variable: Ratio avg. wage top 50% to bottom 50%							Dependent Variable: Ratio avg. wage top 10% to bottom 10%						
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	BETA*	(7)	(8)	(9)	(10)	(11)	(12)	BETA*
Intercept	0.455	0.759	0.556	0.534	0.088	0.045		1.185	0.911	1.104	0.745	0.461	0.543	
	(8.24)	(7.90)	(7.62)	(7.29)	(0.08)	(0.11)		(7.12)	(5.50)	(6.43)	(3.96)	(1.11)	(1.03)	
S/U Workers	-0.015	-0.094	-0.106	-0.105	-0.081	-0.107	-0.395	-0.094	-0.129	-0.142	-0.167	-0.153	-0.177	-0.271
	(-0.53)	(-2.11)	(-2.37)	(-2.37)	(-2.35)	(-4.71)		(-0.41)	(-1.81)	(-1.79)	(-2.01)	(-1.85)	(-2.71)	
FDI / GDP			0.956	0.725	0.821	0.388	0.075			0.625	0.573	0.591	0.439	0.016
			(2.97)	(2.87)	(2.34)	(1.87)				(2.54)	(2.58)	(1.89)	(1.80)	
R&D Int. / GDP					0.582	0.402	0.331					0.109	0.104	0.371
					(9.53)	(6.37)						(7.34)	(6.26)	
Imp. mach&equip / GDP					0.201	0.061	1.197					0.118	0.122	1.821
					(1.45)	(2.56)						(2.01)	(1.98)	
(X+M) / GDP		-0.002		-0.011	-0.035	-0.019	-0.363		-0.116		-0.134	-0.217	-0.186	-1.371
		(-1.09)		(-0.42)	(-1.64)	(-0.95)			(-1.92)		(-2.17)	(-2.92)	(-3.11)	
Terms of Trade						-0.188	-0.246						-0.192	-0.126
						(-6.36)							(-3.22)	
Country Effects	YES	YES	YES	YES	YES	YES		YES	YES	YES	YES	YES	YES	
Time Effects	YES	YES	YES	YES	YES	YES		YES	YES	YES	YES	YES	YES	
F tests														
Country Effects	22.78	27.83	27.03	25.31	31.06	28.47		15.41	21.85	28.67	19.53	20.73	19.52	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Time Effects	5.59	5.21	5.71	4.33	3.16	1.65		4.01	3.93	3.87	3.65	3.90	2.81	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.011]	[0.016]		[0.000]	[0.000]	[0.000]	[0.017]	[0.017]	[0.032]	
Hausman Test	11.21	10.23	12.75	13.03	18.16	17.21		9.77	9.95	10.52	10.72	14.21	21.62	
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Modified Wald Test	443.87	401.61	366.32	351.19	277.87	245.87		581.21	455.3	398.12	371.04	366.9	384.08	
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Adjusted R Squared	0.43	0.46	0.45	0.48	0.59	0.66		0.37	0.38	0.38	0.42	0.46	0.50	
No. Obs	381	381	381	381	381	381		381	381	381	381	381	381	

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

The numbers in brackets are probability levels

** Standardized coefficient estimates (Beta coefficients)*

These findings however, must be taken with caution. According to Freeman (1986), evidence from most studies suggests a lower value of the elasticity of substitution between highly educated workers and less educated workers (in the range 1-2). In their analysis of the U.S. wage structure, for example, Katz and Murphy (1992) suggest a value for the elasticity of substitution in the range 0.5-4.0 distinguishing between college (skilled) workers and high school (unskilled) workers. In a more recent study, Robbins (1996) finds values for the elasticity of substitution in the 1-1.5 range. His measurement is between university educated workers and workers who have completed primary education for 9 developing countries, including 6 Latin American economies. Our definition of skilled and unskilled workers however, differs from such studies for at least three reasons: first, we do not classify labor by education level; second, most studies refer to educated labor for the whole economy rather than focusing on manufacturing industries; third, we focus on Latin American economies rather than developing economies in general. Therefore, the findings of this study are not directly comparable with others. Furthermore, as Acemoglu (2000) suggests, this parameter is difficult to estimate since it refers to an (overall) elasticity of substitution that combines substitution both within and across industries. This study is only concerned with elasticity within industries.

The negative coefficient for our measure of overall trade openness (measured by the total trade to GDP ratio) in columns (2) and (8) is evidence in favor of the standard Hecksher-Ohlin-Samuelson (HOS) trade theory for countries abundant in unskilled labor. The coefficients however, are only significant for the top10% to bottom10% wage ratio. This finding suggests that greater overall trade openness contributes to reducing wage differentials in Latin American economies. Other researchers have found different results. Beyer, Rojas and Vergara (1999) for example, report that for the case of Chile, openness (measured as the volume of trade over GDP), widens the wage gap between skilled and unskilled labor. They realize this finding should be taken with caution and suggest that biased technological change against unskilled labor could explain this result; they do not provide evidence to substantiate this claim. Also, Feliciano (2001) reports that for Mexico wage dispersion increased as a result of reduced tariffs and import license coverage between 1960 and 1990. In the analysis of the wage effects of trade openness, these studies are not based on a model for the determination of the skill premium and do not account for structural characteristics.

Increased exposure to foreign direct investment is associated with greater wage differentials as indicated in columns (3) and (9). Hausmann and Fernandez-Arias (2000) have argued that capital flows in the form of FDI are the kind of "good cholesterol" since they bring new technology, managerial skills and market access that accelerate growth and development. Nevertheless, the distributive effect of FDI through the technology it embodies has not been explored. The result that increased exposure to FDI, or the technology it embodies, favors skilled workers provides evidence on this issue and corroborates the findings of Berhman, Birdsall and Székely (2001). Indeed, as Feenstra and Hanson (1996) report for Mexico, even when developed countries transfer their least-skill-intensive part of the production process through FDI, these processes are skill intensive "by local standards" and may contribute to widening the wage differential. Columns (4) and (10) show the effect of both increased overall openness and increased exposure to FDI combined. Again, there is evidence that trade openness reduces wage differentials while FDI increases it.

When it comes to the openness of specific sectors of the economy (controlling for the characteristics of the goods imported), the results are more revealing. As shown in columns (5) and (11) increased imports of machinery and transportation equipment (as a percentage of total imports) increases industrial wage differentials. This result echoes

Robbins (1996) who finds that trade liberalization is associated with large increases in machinery imports, and that the stock of imported machinery is closely related with relative demand shifts in favor of skilled labor. Also, Mazumdar and Quispe-Agnoli (2002) find that for Peru, "most of the decrease in the blue-collar wage share in manufacturing industries can be explained by the increase in machinery imports that followed liberalization, suggesting that skill-biased technology is embodied in imported technology".

We also find evidence that foreign R&D spillovers tend to widen the wage differential in Latin America. Coe, Helpman and Hoffmaister (1997) have reported in their study for 77 developing economies that R&D spillovers from (a weighted average of 22) industrial countries can produce substantial benefits for developing countries by boosting total factor productivity and output. However, their study does not address the domestic distributive effects of foreign R&D activities. The findings in this study suggest that foreign R&D transfer increases wage differentials through increases in relative labor demand. The estimated coefficients imply that a 10 percent increase in foreign R&D intensity leads to an increase of between 1 and 5 percent in the wage differential. Other authors have reported similar results. Butler and Dueker (1999), for example, report a 3 percent increase in the wage differential in response to a 10 percent increase in foreign innovation.

In columns (6) and (12) we test for improvements in the terms of trade, defined as the ratio of the export price index to the import price index. Improvements in the terms of trade are associated with reductions in wage differentials. That is, when export prices increase relative to import prices wage differentials diminish and when the terms of trade deteriorate, wage differentials increase.

Finally, in order to provide a quantitative appreciation of these results, we also show in Table IX the standardized coefficients estimates (based on models 6 and 12) for each of the independent variables[2]. Three key results emerge from comparing these coefficients. First, increases in the relative labor supply have substantial influence in reducing wage differentials. A one standard deviation increase in the skilled-unskilled supply of workers results in a reduction of 0.395 standard deviations in the top 50% to bottom 50% wage differential and of 0.271 in the 10% to bottom 10% wage differential. Second, the variable associated with overall openness has a smaller influence on wage differentials than the variable measuring imports of machinery and equipment. Thus, the joint effect of a one standard deviation increase in overall openness and a one standard deviation increase in imports of machinery and equipment, results in an increase of 0.834 standard deviations in the 50% to bottom 50% wage differential and of 0.450 in the 10% to bottom 10% wage differential. That is, although increased overall openness tends to reduce wage differentials, this effect is offset by the increasing effect over wage differentials of increased imports of machinery and equipment. Finally, the influence of increased exposure to FDI flows is small relatively to that of all other variables. A one standard deviation increase in FDI flows results in an increase of 0.075 standard

[2] Standardized coefficient estimates –also known as *beta coefficients*- measure the change in the explained variable (in standard deviation units) for a unit change in each explanatory variable (in standard deviation units) holding other variables constant. To calculate the standardized coefficient estimates we multiply the regression coefficient of each explanatory variable by the ratio of the standard deviation of the explanatory variable to the standard deviation of the explained variable. The transformation makes the coefficients comparable as they become independent of the units of measurement of the variables. For a discussion of *beta coefficients* see Ezekiel (1941).

deviations the 50% to bottom 50% wage differential and of 0.016 in the 10% to bottom 10% wage differential.

Endogenous Relative Labor Supply

Equation (4) together with equation (13) (and the expression for $\left(\frac{A(t)}{B(t)}\right)$ in equation (14)), form a system of structural equations. Estimating equations (4) and (13) through least squares dummy variable (LSDV) generates biased and inconsistent estimators because the dependent variables ω and S/U are determined simultaneously. Also, it is clear that both equations in the system are *over-identified*, thus indirect least squares (ILS) does not produce a unique estimate of the structural parameters. Therefore, in order to obtain a unique estimate for each structural parameter, two stage least squares (2SLS) is employed to estimate equations (4) and (13). In order to use possible cross equation correlation, three stage least squares (3SLS) is employed to estimate equations (4) and (13) simultaneously. The 3SLS estimator is asymptotically more efficient and it is shown for comparison purposes. The instruments for the estimation of equation (4) are the set of all exogenous variables. These include the set of demographic variables, age dependency ratio, female labor as a percentage of total labor force, urban population as a percentage of total population and the average schooling years in the total population, foreign direct investment as a percentage of GDP, R&D expenditures intensity with respect to total with respect to total GDP, imports of machinery and equipment as a percentage of GDP, total trade as a percentage of GDP and the terms of trade.

Empirical Results

The two stage least squares (2SLS) estimates are in Table X. It reproduces the models of Table IX with one main difference: the relative labor supply is now endogenous. The Pagan-Hall (1983) test of heteroskedasticity for instrumental variables indicated the presence of heteroskedasticity.[3] Therefore, White robust standard errors are computed. Davidson-MacKinnon (1993) developed a test of exogeneity for a fixed-effects regression estimated via instrumental variables.[4] The Davidson-MacKinnon test is significant for all models confirming the appropriateness of the instruments. As with OLS, in 2SLS models time effects are significant in all models showing an increasing magnitude over time, indicative that global shocks have tended to increase the skill differential over time. The results show that increases in the supply of skilled workers relative to unskilled workers have a negative effect on the wage differential as suggested by equation (4). The value of the estimated coefficients implies a lower elasticity of substitution (σ) -when compared to the OLS estimates- but it is still higher than the suggested by Freeman (1986). It is now in the range 3.6-8.6 for the top 50 percent to bottom 50 percent variable and in the range 3.2-5.4 for the top 10 percent to bottom 10 percent variable. So, results show again that there is a higher degree of substitutability between more and less skilled workers than between the highest and lowest skilled workers. The size of the elasticity of substitution is important when examining the impact

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[3] Under the null hypotheis of no heteroskedasticity the Pagan-Hall test statistic is distributed as $\chi^2(N)$ where N is the number of exogenous variables.

[4] The null hypothesis in the Davidson-MacKinnon tests is that the OLS estimator of the same equation would yield consistent estimates, that is, any endogeneity among the regressors would not have deleterious effects on OLS estimates. Therefore, a rejection of the null hypothesis indicates that the endogenous regressors' effects on the estimates are meaningful and therefore instrumental variables techniques are required. The test is distributed F(m,N-k) where m is the number of regressors specified as endogenous in the original instrumental variables regression and N-k are the degrees of freedom.

of changes in the relative labor supply. When the elasticity is high, increases in the relative labor supply will have a small effect on the wage differential. When the elasticity is low, increases in the relative labor supply will have a large effect on the wage differential. In other words, the higher the elasticity of substitution, the higher the possibilities of substitution between skilled and unskilled workers. It is important to emphasize that even when the estimated elasticity of substitution is relatively high, skilled and unskilled workers are substitutes, but far from perfect substitutes. Or as Murphy, Riddell and Romer (1998) point out, "...four workers with six years of education cannot do the job that one worker with 24 years of education can do". So, there is always some degree of substitutability between skilled and unskilled workers.

The treatment of relative labor supply as endogenous does not change substantially the effects of other determinants of the wage differential. An increase in the overall trade openness is again (weakly) associated with reductions in wage differentials.

With respect to the composition of imports there is evidence again that imports of technology goods increase the wage differential. Indeed, as O'Connor and Lunati (1999) have suggested, reduced trade barriers that lower the cost of imported machinery and equipment, bring about capital deepening that raises the demand for skilled labor and thus increases the wage differential. The results also show that the transfer of foreign R&D tends to widen wage differentials.

Table X
2SLS: Determinants of Wage Differentials
Endogenous Relative Labor Supply
(Skilled Workers / Unskilled Workers was Instrumented)

	Dependent Variable: Ratio avg. wage top 50% to bottom 50%							Dependent Variable: Ratio avg. wage top 10% to bottom 10%						
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	BETA*	(7)	(8)	(9)	(10)	(11)	(12)	BETA*
Intercept	0.464	0.406	0.463	0.374	-0.879	-1.115		0.921	0.492	0.711	0.703	-0.455	-1.423	
	(5.33)	(4.33)	(5.23)	(3.84)	(-0.77)	(-0.78)		(7.26)	(1.99)	(3.19)	(1.87)	(-0.49)	(-0.92)	
S/U Workers	-0.028	-0.126	-0.116	-0.137	-0.149	-0.274	-1.001	-0.108	-0.185	-0.201	-0.279	-0.291	-0.304	-0.383
	(-1.16)	(-1.76)	(-1.97)	(-2.20)	(-1.97)	(-2.65)		(-0.42)	(-2.13)	(-1.97)	(-1.82)	(-2.04)	(-1.97)	
FDI / GDP			0.993	0.915	0.836	0.722	0.109			0.504	0.515	0.444	0.319	0.031
			(2.72)	(2.88)	(2.04)	(2.76)				(1.54)	(1.62)	(0.91)	(1.22)	
R&D Int. / GDP					0.235	0.611	0.531					0.438	0.538	0.215
					(1.64)	(1.93)						(1.83)	(1.87)	
Imp. mach&equip / GDP					0.031	0.036	0.706					0.138	0.161	1.410
					(1.18)	(1.88)						(2.21)	(1.99)	
(X+M) / GDP		-0.033		-0.044	-0.004	-0.008	-0.153		-0.222		-0.194	-0.231	-0.193	-1.292
		(-1.34)		(-1.08)	(-1.70)	(-0.34)			(-4.03)		(-2.98)	(-1.85)	(-1.89)	
Terms of Trade						-0.179	-0.234						-0.184	-0.117
						(-6.04)							(-2.41)	
Country Effects	YES	YES	YES	YES	YES	YES		YES	YES	YES	YES	YES	YES	
Time Effects	YES	YES	YES	YES	YES	YES		YES	YES	YES	YES	YES	YES	
F tests														
Country Effects	29.6	28.88	29.77	29.08	31.06	28.47		24.03	27.41	22.54	25.66	22.52	20.62	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Time Effects	4.87	4.99	5.01	5.14	3.16	1.65		5.16	4.95	5.92	6.01	5.53	3.02	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.011]	[0.016]		[0.000]	[0.000]	[0.000]	[0.018]	[0.019]	[0.037]	
Pagan-Hall Test	82.403	82.39	84.469	83.28	79.43	80.32		130.78	124.21	119.47	111.94	120.43	117.49	
Prob>chi2	[0.007]	[0.001]	[0.001]	[0.001]	[0.003]	[0.001]		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Davidson-MacKinnon	3.641	2.97	3.44	3.98	8.554	2.123		5.321	5.239	4.034	3.82	4.11	2.045	
Prob>F	[0.027]	[0.033]	[0.0033]	[0.001]	[0.0370]	[0.0355]		[0.028]	[0.021]	[0.021]	[0.001]	[0.02]	[0.031]	
Adjusted R Squared	0.42	0.43	0.45	0.48	0.58	0.64		0.29	0.37	0.38	0.41	0.47	0.49	
No. Obs	381	381	381	381	381	381		381	381	381	381	381	381	

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

The numbers in brackets are probability levels

** Standardized coefficient estimates (Beta coefficients)*

Evidence that increased exposure to foreign direct investment is related to greater wage differentials holds more firmly for the ratio of average wage of the top 50% to bottom 50%. As explained in the theoretical section, FDI involves more than a simply transfer of capital for the establishment of a local factory. FDI brings among other, technologies of production that are complementary to skilled workers. Our results are evidence of such complementarities. Again, there is strong evidence that improvements in the terms of trade are associated with reductions in wage differentials.

Table X also shows the standardized coefficients estimates (based on models 6 and 12) for each of the independent variables. They are similar to the OLS estimates from Table IX. A one standard deviation increase in the number of more skill workers relative to less skill workers results in a reduction of 1.001 standard deviations in the top 50% to bottom 50% wage differential and of 0.383 in the 10% to bottom 10% wage differential. The joint effect of a one standard deviation increase in overall openness and a one standard deviation increase in imports of machinery and equipment, results in an increase of 0.553 standard deviations in the 50% to bottom 50% wage differential and of 0.118 in the 10% to bottom 10% wage differential. Finally, the influence of increases exposure to FDI flows is relatively smaller than all other variables. A one standard deviation increase in FDI flows results in an increase of 0.109 standard deviations in the 50% to bottom 50% wage differential and of 0.031 in the 10% to bottom 10% wage differential.

Finally, the three stage least squares (3SLS) estimates are presented in Table XI. It reproduces the models of Tables IX and X. The value of the estimated coefficients with 3SLS does not change substantially from the 2SLS estimate. The elasticity of substitution is now in the range 4.7-8.0 for the top 50 percent to bottom 50 percent variable and in the range 3.1-5.6 for the top 10 percent to bottom 10 percent variable. 3SLS estimation does not change substantially the effects of other wage differential determinants. An increase in the overall trade openness is again associated with reductions in wage differentials. Increased exposure to foreign direct investment, greater intensity of imports of machinery and transportation equipment, and increased transfer of foreign R&D are also associated with greater wage differentials. Finally, improvements in the terms of trade are associated with reductions in wage differentials.

Table XI
3SLS: Determinants of Wage Differentials
Endogenous Relative Labor Supply

	Dependent Variable: Ratio avg. wage top 50% to bottom 50%						**Dependent Variable:** Ratio avg. wage top 10% to bottom 10%					
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	0.405	0.406	0.462	0.374	-1.158	-0.247	0.801	0.393	0.532	0.639	-0.499	-1.001
	(6.22)	(4.78)	(6.22)	(4.73)	(-0.15)	(-0.22)	(6.41)	(2.11)	(2.16)	(2.01)	(-0.54)	(-0.64)
S/U Workers	-0.028	-0.125	-0.129	-0.139	-0.138	-0.209	-0.101	-0.178	-0.181	-0.255	-0.297	-0.313
	(-1.23)	(-1.72)	(-1.87)	(-1.97)	(-2.11)	(-3.40)	(-0.49)	(-2.00)	(-1.66)	(-1.89)	(-2.31)	(-1.98)
FDI / GDP			0.997	0.885	0.712	0.518			0.493	0.528	0.331	0.257
			(3.78)	(3.01)	(3.18)	(1.95)			(1.71)	(1.31)	(0.94)	(1.07)
R&D Int. / GDP					0.319	0.423					0.412	0.517
					(1.49)	(1.47)					(1.79)	(1.81)
Imp. mach&equip / GDP					0.029	0.047					0.139	0.155
					(1.89)	(2.00)					(1.96)	(2.21)
(X+M) / GDP		-0.033		-0.011	-0.031	-0.007		-0.217		-0.175	-0.210	-0.173
		(-1.29)		(-0.42)	(-1.76)	(-1.33)		(-4.21)		(-3.25)	(-3.74)	(-2.13)
Terms of Trade						-0.168						-0.188
						(-3.69)						(-2.57)
Country Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
F tests												
Country Effects	41.19	34.07	35.76	40.64	31.06	28.47	51.97	48.03	42.64	35.06	28.45	25.71
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time Effects	9.65	9.76	7.04	5.01	3.16	1.65	6.72	6.41	5.32	3.82	3.22	3.01
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.011]	[0.016]	[0.000]	[0.000]	[0.000]	[0.011]	[0.019]	[0.032]
Adjusted R Squared	0.31	0.31	0.31	0.37	0.40	0.41	0.22	0.27	0.25	0.29	0.32	0.35
No. Obs	381	381	381	381	381	381	381	381	381	381	381	381

Notes: The numbers in parentheses are t-statistics. The numbers in brackets are probability levels

Determinants of the Relative Labor Supply

In order to complete the examination of the simultaneous determination of wage differentials and relative labor supply, the relative labor supply equation (13) is estimated with both methods (2SLS and 3SLS). Estimates are in Table XII. Columns (1) and (3) show results for the ratio of average wage of the top 50% to bottom 50% for both methods and columns (2) and (4) show results for the ratio of average wage of the top 10% to bottom 10% for both methods. Results do not vary substantially between methods employed. The possibility of some independent variables being correlated with the error term could lead to inconsistent parameters estimates. In this study, the urban/total population ratio might be correlated with the error term in either equation (4) or equation (13). In other words, it might be determined endogenously. The reason for this is that the urban/total population ratio is directly related to rural-urban migration decisions, which are essentially based on economic considerations such as wage differentials. Therefore, this variable is instrumented. The average schooling years in the total population variable is lagged three periods to account for lag effects between education and labor supply. The age dependency ratio defined as the ratio of dependents (people younger than 15 and older than 65) to the working-age population (those age 15–64) is also lagged three periods. The Pagan-Hall test of heteroskedasticity for instrumental variables is only applicable to the 2SLS method. It indicated the presence of heteroskedasticity. Therefore, robust standard errors are computed for this method. The Davidson-MacKinnon test is also only applicable to the 2SLS method. It is significant for both models, hence the appropriateness of the instruments. The exogenous variables identifying the labor supply are education and demographic characteristics, that is, average schooling years, the proportion of women in the labor force and the age dependency ratio.

Evidence suggests that relative labor supply responds positively to increases in relative wages, that is, there is evidence of an upward sloping relative labor supply. The responsiveness of relative labor supply is higher for the top50% to bottom 50% ratio than for the top10% to bottom 10% ratio. Results suggest that a 10 percent increase in the top50% to bottom 50% wage differential implies a relative labor supply increase of around 7 percent while a the same percentage increase in the top10% to bottom 10% wage differential implies an increase of around 1 percent.

There is evidence that increases in the average level of education are associated with increases in the relative number of skilled workers. Coefficients are statistically significant for all models and suggest that a 10 percent increase in the average number of years of schooling (around half a year considering that the 1960-1998 average increase for this variable is 4.8 years) increases relative labor supply by between 7 and 10 percent. Although this effect may seem high, it should be noted that overall educational progress has been sluggish for the Latin America compared to other regions. As Duryea and Székely have reported, in 1970 the ratio of persons above 25 years of age with secondary education or higher to those with primary education of less was only 0.5 in industrialized countries, 0.4 in East Asian economies and 0.2 in Latin America. By the 1990s the ratio reversed in industrialized countries to around 1.2, in East Asia reached more than 0.6 and, by contrast, in Latin America this ratio rose to around 2.5 in the early 1990s. In fact, it has taken three decades to the Latin American region to increase the average schooling level by three years, that is, only one year per decade. This data combined with results in this study imply that relative labor supply increases between 14% and 20% every 10 years as a result of educational progress.

Table XII

Determinants of Relative Labor Supply

Dependent Variable:
More Skilled workers / Less Unskilled Workers for (1) and (3)
Highest Skilled workers / Least Unskilled Workers for (2) and (4)

Explanatory	**Two Stages Least Squares**				**Three Stages Least Squares**	
Variables	(1)	BETA*	(2)	BETA*	(3)	(4)
Intercept	0.081		0.348		0.099	0.333
	(0.35)		(1.01)		(0.35)	(1.12)
Ws / Wu (top10% / bottom10%)			0.134	0.119		0.144
			(1.71)			(1.92)
Ws / Wu (top50% / bottom50%)	0.830	0.224			0.735	
	(1.92)				(1.88)	
Avg. schooling years in the Tot. Pop.	1.085	0.746	0.621	0.420	0.924	0.624
	(3.64)		(2.17)		(2.42)	(2.19)
Urban Pop / Tot Pop	-0.871	-0.727	-0.264	-0.238	-0.402	-0.271
	(-1.93)		(-1.82)		(-4.25)	(-2.41)
Female Labor / Tot. Labor Force	1.172	0.539	0.522	0.301	1.205	0.497
	(3.19)		(1.98)		(1.76)	(1.94)
Age Dependency Ratio	-0.351	-0.121	-0.347	-0.113	-0.096	-0.226
	(-2.05)		(-1.69)		(-1.11)	(-1.04)
Country Effects	YES		YES		YES	YES
Time Effects	YES		YES		YES	YES
F tests						
Country Effects	17.56		20.48		16.22	17.36
Prob>F	[0.000]		[0.000]		[0.000]	[0.000]
Time Effects	6.45		8.06		5.33	5.69
Prob>F	[0.000]		[0.000]		[0.000]	[0.000]
Pagan-Hall Test	54.21		49.11			
Prob>chi2	[0.001]		[0.001]			
Davidson-MacKinnon	10.579		4.317			
	[0.001]		[0.007]			
R Squared	0.257		0.342		0.221	0.252
No. Obs	381		381		381	381

Notes: The numbers in parentheses are t-statistics
The numbers in brackets are probability levels
** Standardized coefficient estimates (Beta coefficients)*

Increases in the share of urban population are associated with substantial reductions in the relative number of skilled workers. Although the factors influencing rural-urban migration decisions are varied and complex, it is reasonable to assume that the majority of rural migrants are less skilled and poorer than urban inhabitants for the Latin American region. So, all else equal, an increase in the number of migrants to the cities enlarges the relative number of unskilled workers. It is worth noticing that besides being a partial cause for increased urban unemployment as many studies have shown, migration can also increase wage differentials through augmenting the pool of unskilled workers. This hypothesis is not directly tested but it is implied in the results since a decrease in relative labor supply entails an increase in the wage differential. An increase of 10% in the urban to total population ratio reduced relative labor supply by approximately 5%, which based on the results of Tables X and XI implies an increase of approximately 1% in the wage differential.

Evidence suggests that higher female participation rates in the labor force have an increasing effect in the relative labor supply. As shown in the introduction, female labor force as a percentage of the total labor force for has increased from 18% to near 35% in the last 30 years for the Latin American region and according to some authors (see Duryea and Székely, 1998) this increase is partly due to increasing education for women. They argue that the gender gap in education has changed considerably since 1960 since, in terms of educational attainment, women have made larger gains than men. In fact, as reported by de Ferranti, Perry, Lederman and Maloney (2001) for Latin American countries, female average wages have increased relative to men's average wages in recent years and greater educational levels of the workforce have accompanied the rising rates of female participation. This suggests that increasing rates of female participation could bring reductions not only in overall wage differentials but in gender wage differentials as well. Our data however is limited to test this hypothesis.

Finally, results indicate that a rise in the number of dependents relative to the working-age population reduces the relative number of skilled workers. The intuition behind this finding is simple. Larger numbers of young people increases the number of unskilled workers and more elderly people reduce the number of skilled workers as they exit the labor force.

Table XII also shows the standardized coefficients estimates (based on 2SLS only) for each of the independent variables. The average level of education and female participation in the labor force, have the highest influence in increasing the relative number of skilled workers. The joint effect of a one standard deviation increase in the average level of education and a one standard deviation increase in the female participation in the labor force, results in an increase of between 0.7 and 1.3 standard deviations in the skilled to unskilled workers ratio. Also, urbanization and increases in the age dependency ratio have substantial influence in reducing the relative number of skill workers. The joint effect of a one standard deviation increase in the percentage of the population living in the city and a one standard deviation increase in the age dependency ratio, results in an decrease of between 0.35 and 0.85 standard deviations in the skilled to unskilled workers ratio.

Conclusions

Recent theoretical and empirical studies explaining wage differentials have been based on a simple relative labor supply and demand structure and the debate has centered on the nature and relative magnitude of the shifts of both curves. For the most part, however, these studies focus on the demand-side determinants of wage differentials for developed economies -trying to disentangle effects of technological change and trade with low-wage developing economies- and assign only a minor role to the effects of relative supply by assuming it is perfectly inelastic (i.e. exogenous). This study, by contrast, has presented empirical evidence for Latin American economies analyzing both, demand and supply on equal grounds.

On the demand side, our findings are consistent with the standard Hecksher-Ohlin-Samuelson (HOS) trade theory as overall trade openness is associated with reductions in wage differentials. Nevertheless, results also indicate that increased import of machinery and equipment from developed economies increases wage differentials. This result along with the finding that increased exposure to FDI increases the wage differential shows that, for Latin American economies, the adoption of new technologies, embodied in increased FDI flows and machinery imports, increases relative labor demands thus augmenting wage differentials. Therefore, this study presents evidence in favor of the skill-enhancing trade hypothesis proposed by Robbins (1996) according to which access to skilled-biased foreign technology is achieved mainly through increases in the amount of capital goods imported and increased exposure to FDI flows.

On the supply side, evidence indicates that increases in the average level of education and increases in female participation in the labor force are associated with increases in relative labor supply of roughly the same magnitude. A 10% increase on either the average level of education or female participation in the labor force, brings about an increase in the relative labor supply of between 7% and 12%. The importance of these findings is clear. For a given relative labor demand, an increase in labor supply implies a reduction in the wage differential. Unfortunately for the Latin American region, educational progress has been extremely sluggish as it takes approximately 10 years to raise the average level education by 1 year. As for the role of women in the labor force results indicate that higher rates of participation bring more rapid reductions in the wage differential than educational progress as female participation has doubled in only 30 years. Evidence also shows that higher numbers of people living in Latin American cities are associated with reductions in relative labor supply thus augmenting the wage differential. Urbanization rates in most Latin American countries however, have decelerated in the last 10 years as high urban unemployment rates discourage additional rural-urban migrants. So this effect will become less significant over time. Finally, results reveal that a larger number of dependents relative to the working-age population leads to a decline in the relative labor supply thus augmenting the wage differential. Population growth rate in Latin America has been declining consistently since the mid 1960s when the annual rate was 2.7% and the fertility rate –births per woman- was around 6. Today they are below 1.5% and 3 respectively. Younger generations are getting smaller relative to the working-age population, which implies that all else equal, access to skills is less difficult.

V. *WAGE INEQUALITY IN LATIN AMERICA*

Determinants of Wage Inequality

In this section we investigate the determinants of wage inequality focusing on the effects of trade openness, technological change, demographic and natural resource endowments. Distinguishing wage inequality from wage differential is important since the former is a measure of wage distribution while the later is a measure of relative wages. Some researchers fail to make this distinction. So, special attention will be devoted to the definition of wage inequality used in different studies. The roots of the analysis of the determinants of wage inequality are found in Kuznets (1955). He argued that income inequality rises during the early stages of economic development due to the industrialization process and declines during the latter. The literature on the Kuznets hypothesis is voluminous. While the earlier studies tended to find evidence favorable to the hypothesis, more recent studies using panel data disclaim its existence, some even pointing to the possibility of a 'U' rather than an inverted 'U' pattern describing the inequality-development relationship.[5] Nevertheless, Bourguignon and Morrison (1998) argue that a consensus seems to have been reached and "that there is probably no iron link governing this relationship as once supposed following Kuznets, but that some macroeconomic variables related to development could be significant, along with others, in explaining country differences in income distribution".

Evidence on the effects of trade openness and technology change on wage inequality has been the subject of an intense debate by both academic researchers and

[5] Bruno et al. (1998) provide a recent survey of the literature on this regard.

policy makers, particularly for the developed world. Some economists have argued that the main cause of the increased wage inequality in developed countries has been the expansion of trade with (low skill/wage) developing countries (Wood, 1995; Leamer, 1996). On the other hand, there are other researchers (Lawrence and Slaugther, 1993; Krugman and Lawrence, 1994) who think the effects of trade have been small pointing to technological change as the main culprit for the rising wage inequality. Although separating the effects of both factors has been the source of extensive investigation, the 'trade-versus-technology' debate remains open due to the difficulty of offering direct evidence on the effects of technological evidence and increased exposure to international trade. Evidence on the effects of demographic factors on wage inequality is less abundant. It is worth pointing out that most of these studies, although referring to wage inequality, in fact are dealing with wage differentials. For example, using the 90-10 percentile wage differential as his measure of wage inequality, Topel (1997) reports that low-skilled immigrants and larger female labor force participation rates raise the supply of low skilled workers pushing down their wages in the United States and the OECD. On the other hand, Borjas and Ramey (1994) using cointegration techniques find no evidence relating the number of immigrants or a higher proportion of females in the labor force with wage inequality in the United States. They report the durable-goods trade deficit as a percentage of GDP as the only variable explaining wage inequality. Their measure of wage inequality, however, is average log wage differential between college graduates and high school graduates. Therefore, results from both studies are not truly comparable. Evidence on the effects of trade openness, technology change and demographic and natural resource endowments on wage inequality for developing countries has been less abundant. Cross-country empirical evidence has been particularly scant, due partly to the lack of consistent data. In their theoretical exercise, Chaudhuri and Ghosh (2002) conclude that removal of tariff restrictions from the relatively unskilled labor intensive sectors, growth in foreign direct investment and a decline of trade union are prime factors responsible for the growing incidence of wage inequality (measured by the skilled to unskilled wage ratio) in Latin American economies. Country case studies are more abundant. Beyer et al. (1999) suggest that increased openness in Chile, measured as the volume of trade over GDP, raises wage inequality, measured by the ratio between the labor incomes of the last and first quintile of the wage distribution. In contrast, Hanson and Harrison (1995) report that for Mexico the reduction in tariff protection disproportionately affected low-skilled industries partly explaining the observed increase in wage inequality. Their measure of wage inequality is the ratio of white-collar to blue-collar average annual wage. Mazumdar and Quispe-Agnoli (2002) report for Peru that the increase in machinery imports that followed liberalization is associated with a decrease in the blue-collar wage share in the manufacturing industries. Their findings concur with the cross-country evidence provided by Robbins (1996) for a sample of nine developing economies including six in Latin America. He finds that trade liberalization increases the inflow of machinery partly explaining relative demand increases. Both studies suggest that technology can have an enlarging effect on wage inequality. Only a few researchers have looked at the effects of demographic and institutional factors. Cortez (2001) for example, finds that for Mexico increased wage inequality –measured by the GINI coefficient estimated from the hourly wage rate- is largely explained by increased flexibility in the Mexican labor market that takes the form of declines in unionization rates and a steady increase in the minimum wage as an effective floor. It is worth mentioning that his study is one of the few exceptions among studies treating wage inequality as equal to wage differential.

Most studies have investigated the effects of natural resource endowments on income rather than on wage inequality. Gavin and Hausmann (1998) report that for Latin America natural resource abundance is associated with greater income inequality. They find that land intensity –measured as arable land per capita-, nonfuel primary exports and exports of metals and minerals are positively correlated with income inequality. Their evidence echoes the findings of Leamer et al. (1999) according to whom land and natural resource abundant countries show higher income inequality. In their analysis of the Latin American region, they point out that natural resources absorb capital, delaying the emergence of a manufacturing sector and therefore limiting increases in the demand for unskilled labor. As a result, natural resource rich Latin American economies experience higher levels of income inequality than other developing economies with lower natural resource endowments.

The theoretical model presented previously does not strictly correspond to the determinants of inequality, however, we can think of $\omega(t)$ in equation (4) as a measure of wage inequality (see Acemoglu, 2002). The analysis then is guided by the assumption that inequality is a function of fundamental variables –or their proxies- that capture economic structure.

Empirical Results

As explained in the data section four measures of wage inequality are computed: Gini Coefficient (GINI), Theil's Mean Logarithmic Deviation Index (THEIL 1), Theil's Entropy Index (THEIL 2), and Coefficient of Variation (CV). The results for the determinants of wage inequality for the GINI coefficient applying pooled Ordinary Least Squares (OLS) to the data are in Table XIII. The Hausman specification test is significant for all models suggesting that individual effects are correlated with the regressors, and hence the appropriateness of a fixed-effects estimator. The modified Wald test for groupwise heteroskedasticity in a fixed effects model indicated the presence of heteroskedasticity. Therefore, robust standard errors are computed. Time effects are also significant in all models showing an increasing magnitude over time, an indication that global shocks have tended to increase wage inequality over time.

In order to test for the relationship between wage inequality and development, all models in Table XIII include both real GDP per capita and its square.[6] There is strong evidence that higher levels of GDP per capita reduce wage inequality as all models show a negative and significant coefficient for real GDP per capita. However, when testing for increasing or diminishing returns, although GDP per capita squared shows a consistent positive coefficient suggesting a 'U-shaped' relationship it is not statistically significant. Thus, as Borguignon and Morrison (1998) have pointed out, evidence regarding the relationship between inequality and development is inconclusive.

[6] Nominal GDP and its square were also tested producing very similar results.

Table XIII

Determinants of Wage Inequality (GINI)

Explanatory Variables	Dependent Variable: GINI Coefficient (1)	(2)	(3)	(4)	(5)	BETA*
Intercept	-1.336	-2.58	-3.69	-3.82	-4.17	
	(-6.95)	(-5.91)	(-3.30)	(-3.70)	(-4.01)	
Real GDP per Capita	-0.089	-0.102	-0.156	-0.162	-0.170	**-1.249**
	(-1.97)	(-1.91)	(-2.68)	(-2.96)	(-3.02)	
(Real GDP per Capita)^2	0.00001	0.0001	0.0001	0.0001	0.0001	
	(1.36)	(1.52)	(1.47)	(1.71)	(1.63)	
Avg. School Yrs in Tot. Pop.		-0.127	-0.147	-0.130	-0.127	**-0.578**
		(-3.94)	(-4.43)	(-3.84)	(-3.72)	
GINILAND		2.549	2.911	2.738	2.681	**1.085**
		(6.01)	(5.88)	(5.97)	(5.17)	
Liquid Liabilities / GDP		-0.351	-0.281	-0.474	-0.483	**-0.308**
		(-2.41)	(-1.93)	(-3.33)	(-3.21)	
Urban Pop / Tot Pop			1.453	1.616	1.567	**0.921**
			(2.11)	(2.48)	(2.23)	
Female LF / Total LF			0.496	0.594	0.802	
			(0.51)	(1.13)	(1.12)	
Age Dependency Ratio			-0.324	-0.322	-0.291	
			(-1.05)	(-1.01)	(-0.88)	
FDI / GDP				1.244	1.159	**0.078**
				(2.17)	(2.04)	
(X+M) / GDP				-0.351	-0.365	**-0.215**
				(-3.67)	(-3.80)	
Imp. Mach&Eq / Tot Imports					0.386	
					(0.76)	
R&D Int. in Man. / Man. Output					0.282	
					(1.23)	
Fixed Effects	YES	YES	YES	YES	YES	
Time Effects	YES	YES	YES	YES	YES	
F tests						
Fixed Effects	37.45	33.73	32.21	31.22	28.55	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Time Effects	6.72	5.43	5.11	5.09	4.98	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Hausman Test	8.34	10.88	9.76	9.44	9.58	
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Modified Wald Test	4974.54	3226.09	3236.09	2143.55	2543.23	
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Adjusted R Squared	0.67	0.72	0.74	0.78	0.78	
No. Obs	429	372	372	372	372	

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

** Standardized coefficient estimates (Beta coefficients)*

Model (2) shows our base regression, which draws upon Li, Squire and Zou (1998). Along with their results evidence suggests first, that increases in the Gini coefficient for land distribution – taken as a measure of asset inequality- augment wage inequality, and second, that increases in the average number of years of schooling in the total population and a more developed financial sector reduce wage inequality. Li, Squire and Zou (1998) argue in their paper that a more developed financial sector and a better distribution of assets -which can be used as collateral- can improve income inequality by facilitating access to credit to the poor. That is, ownership of assets to borrow against can provide access to formal credit markets and cheaper credits, thus reducing the cost of investment. We tested for increasing or diminishing returns by including the square of the liquid liabilities to GDP ratio, however the coefficient was not statistically significant. This result concurs with Xu and Zou (2003) who report no evidence of non linear relationship between financial sector development and inequality.

With regard to the educational variable, the result is intuitive as a higher average number of years of schooling in the total population means that more people have access to a higher educational level improving their chances to have better paid jobs. Also, although it is not shown in the table, we test for educational inequality by including the education Gini index, which measures inequality in educational attainment. The intuitive expectation is that higher educational inequality –holding the educational level constant- should reflect in higher wage inequality. However, we find no evidence of such expectation. Furthermore, as Thomas, Wang and Fan (2000) have reported, the education Gini index is negatively correlated with the average years of schooling so, to avoid collinearity the schooling level variable was omitted. Again, there is no evidence that higher educational inequality increases wage inequality. We turn next to analyze the effects of demographic variables.

Model (3) shows that increases in the share of urban population are associated with increases in wage inequality. This result complements our earlier finding that migration to the cities implies substantial reductions in the relative number of skilled workers and thus increasing wage differentials. As presented in the introduction section, female labor force as a percentage of the total labor force has substantially increased in Latin American countries in the last three decades. However, we find no evidence of this trend having an effect on wage inequality. Although coefficients in models (3)-(5) are negative suggesting that higher rates of female participation reduce wage inequality, they are not statistically significant. Finally, the age dependency ratio is not associated with wage inequality. We turn now to examine the impact of openness and technological change factors.

Increased flows of FDI shows a positive sign suggesting that it can be a factor that enhances wage inequality through the complementarities between the technology it embodies and skilled labor. On the other hand, there is strong evidence that increased exposure to international trade is associated with reductions in wage inequality. The coefficients in both models (4) and (5) are statistically significant and are consistent with the standard Hecksher-Ohlin-Samuelson (HOS) trade theory. In contrast, there is no evidence that imports of machinery and equipment increase wage inequality. Thus, although overall openness appears to be related to reductions in inequality, nothing equally conclusive can be said with respect to the impact of imports of machinery and equipment. Finally, Butler and Dueker (1999) report evidence that foreign innovation increased domestic wage inequality. It is worth noticing that their measure of wage inequality is the ratio between the high-tech wage and the low-tech wage. On the other hand, there is only weak evidence that foreign R&D increases wage inequality.

In order to provide with a quantitative appreciation of these results, we also show in Table XIII the standardized coefficients estimates (shown in bold font only for the significant coefficients in model 5) for each of the independent variables. Three key results emerge from comparing these coefficients. First, the percentage of the population living in the city has a much greater influence on wage inequality than the openness and technological change variables. The joint effect of a one standard deviation increase in the percentage of the population living in the city and a one standard deviation increase in the FDI and openness ratios, results in an increase of 0.784 standard deviations in the GINI coefficient. Second, the distribution of assets –measured by the GINI coefficient for the distribution of land- and the level of income per capita have the largest impact on wage inequality. Third, increases in the average number of years of schooling in the total population have a large impact in reducing wage inequality. A one standard deviation increase in the average number of years of schooling in the total population, results in a reduction of 0.578 points in the GINI coefficient. Finally, it is worth highlighting the finding that an increase in the FDI/GDP ratio of 1% increases the GINI coefficient by 1.244 points while an increase in the (X+M)/GDP ratio of 1% reduces the GINI coefficient by 0.351 points.

The results for the determinants of wage inequality for the THEIL 1, THEIL 2 and CV measurements applying pooled Ordinary Least Squares (OLS) to the data are in Tables XIV, XV and XVI respectively. As in the models for the GINI coefficient, the

Hausman specification test is significant for all models in for these inequality indicators suggesting that individual effects are correlated with the regressors, and hence the appropriateness of a fixed-effects estimator. The modified Wald test for groupwise heteroskedasticity in a fixed effects model indicated the presence of heteroskedasticity. Therefore, robust standard errors are computed. Time effects are also significant in all models showing an increasing magnitude over time, an indication that global shocks have tended to increase wage inequality over time. The last column of each table also shows the standardized coefficients estimates (based on model 5) for each of the statistically significant independent variables.

As evidenced in Tables XIV, XV and XVI the main results obtained for the GINI coefficient hold for the other wage inequality measurements considered. Namely, there is evidence that higher levels of GDP per capita reduce wage inequality as all models show a negative and significant coefficient for real GDP per capita. Again, although the coefficient for the square of real GDP per capita in this set of wage inequality indicators suggests increasing returns, it is not statistically significant. Also, there is strong evidence that higher inequality of land distribution (i.e. asset distribution) is positively correlated with wage inequality. Moreover, the standardized coefficient for the GINILAND coefficient indicates that asset distribution has the larger impact on wage inequality when compared to other statistically significant determinants. A one standard deviation increase in GINILAND coefficient, results in an increase of 0.99, 0.95 and 1.10 points in the THEIL 1, THEIL 2 and CV coefficient respectively.

Table XIV

Determinants of Wage Inequality (THEIL 1)

Explanatory Variables	Dependent Variable: THEIL 1 (1)	(2)	(3)	(4)	(5)	BETA*
Intercept	0.111	0.042	0.103	0.078	0.66	
	(4.69)	(0.85)	(0.71)	(0.57)	(0.47)	
Real GDP per Capita	-0.013	-0.014	-0.011	-0.008	-0.007	**-0.562**
	(-1.80)	(-1.76)	(-1.78)	(-1.73)	(-1.69)	
(Real GDP per Capita)^2	0.00001	0.0001	0.0001	0.0001	0.0001	
	(0.21)	(0.34)	(0.05)	(0.04)	(0.06)	
Avg. School Yrs in Tot. Pop.		-0.021	-0.016	-0.015	-0.015	**-0.746**
		(-4.24)	(-3.79)	(-3.26)	(-3.23)	
GINILAND		0.241	0.201	0.186	0.226	**0.997**
		(4.53)	(3.21)	(3.23)	(3.34)	
Liquid Liabilities / GDP		-0.009	-0.008	-0.039	-0.036	**-0.250**
		(-0.42)	(-0.38)	(-1.93)	(-1.81)	
Urban Pop / Tot Pop			0.085	0.061	0.075	
			(0.89)	(0.66)	(0.74)	
Female LF / Total LF			0.103	0.050	0.063	
			(0.78)	(0.40)	(0.48)	
Age Dependency Ratio			-0.049	-0.046	-0.041	
			(-1.08)	(-0.97)	(-0.85)	
FDI / GDP				0.092	0.98	
				(1.00)	(1.07)	
(X+M) / GDP				-0.055	-0.056	**-0.361**
				(-3.41)	(-3.50)	
Imp. Mach&Eq / Tot Imports					0.551	
					(0.80)	
R&D Int. in Man. / Man. Output					0.515	
					(0.14)	
Fixed Effects	YES	YES	YES	YES	YES	
Time Effects	YES	YES	YES	YES	YES	
F tests						
Fixed Effects	22.38	17.31	15.94	15.44	14.42	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Time Effects	4.66	3.64	2.98	2.33	2.26	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Hausman Test	5.76	10.03	11.12	10.56	9.11	
Prob>chi2	[0.05]	[0.001]	[0.001]	[0.001]	[0.001]	
Modified Wald Test	4529.75	4126.76	3909.44	3832.23	3500.98	
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Adjusted R Squared	0.62	0.64	0.65	0.66	0.66	
No. Obs	429	372	372	372	372	

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

** Standardized coefficient estimates (Beta coefficients)*

Table XV

Determinants of Wage Inequality (THEIL 2)

Explanatory Variables	Dependent Variable: THEIL 2 (1)	(2)	(3)	(4)	(5)	BETA*
Intercept	0.104	0.048	0.129	0.112	0.073	
	(4.74)	(1.07)	(0.90)	(0.81)	(0.52)	
Real GDP per Capita	-0.014	-0.015	-0.012	-0.011	-0.008	**-0.613**
	(-2.12)	(-1.88)	(-1.72)	(-1.51)	(-1.59)	
(Real GDP per Capita)^2	0.00001	0.0001	0.0001	0.0001	0.0001	
	(0.81)	(0.90)	(0.62)	(0.63)	(0.09)	
Avg. School Yrs in Tot. Pop.		-0.019	-0.016	-0.014	-0.014	**-0.665**
		(-3.23)	(-2.73)	(-2.38)	(-2.39)	
GINILAND		0.221	0.179	0.162	0.225	**0.950**
		(4.21)	(3.01)	(2.91)	(3.28)	
Liquid Liabilities / GDP		-0.011	-0.009	-0.038	-0.034	**-0.226**
		(-0.49)	(-0.34)	(-1.76)	(-1.50)	
Urban Pop / Tot Pop			0.115	0.097	0.123	
			(1.07)	(0.90)	(0.61)	
Female LF / Total LF			0.047	0.011	0.009	
			(0.39)	(0.90)	(0.28)	
Age Dependency Ratio			-0.042	-0.038	-0.031	
			(-0.95)	(-0.82)	(-0.66)	
FDI / GDP				0.096	0.103	
				(1.02)	(1.07)	
(X+M) / GDP				-0.051	-0.053	**-0.327**
				(-3.33)	(-3.47)	
Imp. Mach&Eq / Tot Imports					0.312	
					(1.26)	
R&D Int. in Man. / Man. Output					0.652	
					(0.20)	
Fixed Effects	YES	YES	YES	YES	YES	
Time Effects	YES	YES	YES	YES	YES	
F tests						
Fixed Effects	20.27	13.16	12.02	11.63	11.72	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Time Effects	3.76	2.92	2.35	1.70	1.57	
Prob>F	[0.000]	[0.000]	[0.000]	[0.01]	[0.02]	
Hausman Test	4.11	8.33	8.44	7.44	8.21	
Prob>chi2	[0.05]	[0.001]	[0.001]	[0.001]	[0.001]	
Modified Wald Test	3359.75	2900.12	2804.98	2600.34	2498.27	
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Adjusted R Squared	0.58	0.60	0.60	0.61	0.61	
No. Obs	429	372	372	372	372	

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

** Standardized coefficient estimates (Beta coefficients)*

Table XVI

Determinants of Wage Inequality (CV)

Explanatory Variables	Dependent Variable: CV (1)	(2)	(3)	(4)	(5)	BETA*
Intercept	0.497	0.286	0.217	0.087	0.161	
	(6.87)	(1.54)	(0.49)	(0.20)	(0.36)	
Real GDP per Capita	-0.041	-0.039	-0.039	-0.034	-0.028	**-0.714**
	(-2.01)	(-1.62)	(-1.51)	(-1.47)	(-1.54)	
(Real GDP per Capita)^2	0.00001	0.0001	0.0001	0.0001	0.0001	
	(0.61)	(0.53)	(0.55)	(0.54)	(0.41)	
Avg. School Yrs in Tot. Pop.		-0.055	-0.053	-0.047	-0.048	**-0.758**
		(-4.43)	(-4.20)	(-3.63)	(-3.60)	
GINILAND		0.676	0.688	0.687	0.787	**1.105**
		(3.68)	(3.28)	(3.51)	(3.61)	
Liquid Liabilities / GDP		-0.038	-0.024	-0.107	-0.098	**-0.216**
		(-0.56)	(-0.34)	(-1.61)	(-1.43)	
Urban Pop / Tot Pop			0.067	0.152	0.137	
			(0.26)	(0.61)	(0.50)	
Female LF / Total LF			0.145	0.006	0.023	
			(0.36)	(0.02)	(0.06)	
Age Dependency Ratio			-0.029	-0.027	-0.007	
			(-0.22)	(-0.59)	(-0.05)	
FDI / GDP				0.377	0.416	
				(1.39)	(1.51)	
(X+M) / GDP				-0.159	-0.156	**-0.320**
				(-3.70)	(-3.69)	
Imp. Mach&Eq / Tot Imports					0.085	
					(0.21)	
R&D Int. in Man. / Man. Output					0.942	
					(0.71)	
Fixed Effects	YES	YES	YES	YES	YES	
Time Effects	YES	YES	YES	YES	YES	
F tests						
Fixed Effects	27.57	20.65	21.72	22.15	19.68	
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
Time Effects	6.40	4.93	4.02	3.31	3.18	
Prob>F	[0.000]	[0.000]	[0.000]	[0.01]	[0.02]	
Hausman Test	5.49	7.01	7.55	6.52	6.44	
Prob>chi2	[0.05]	[0.001]	[0.001]	[0.001]	[0.001]	
Modified Wald Test	7184.29	6534.99	6623.09	6521.11	6300.84	
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	
Adjusted R Squared	0.65	0.67	0.68	0.70	0.70	
No. Obs	429	372	372	372	372	

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

** Standardized coefficient estimates (Beta coefficients)*

Also, there is strong evidence that increases in the average number of years of schooling in the total population reduce wage inequality. Although smaller than the impact of asset distribution, the average number of years of schooling in the total population has also a substantial impact on wage inequality. A one standard deviation increase in the average number of years of schooling in the total population, results in an reduction of 0.74, 0.66 and 0.75 points in the THEIL 1, THEIL 2 and CV coefficient respectively.

Similar to the results found for the GINI coefficient, there is strong evidence that increased exposure to international trade is associated with reductions in wage inequality. The coefficients for (X+M/GDP) are statistically significant for all wage inequality indicators and are consistent with the standard Hecksher-Ohlin-Samuelson (HOS) trade theory. In contrast, there no evidence that either imports of machinery and equipment or foreign R&D can increase wage inequality. Thus, although overall openness appears to be related to reductions in inequality, nothing equally conclusive can be said with respect to the impact of imports of machinery and equipment.

Although most results hold for all wage inequality indicators, there are three determinants of wage inequality that are sensitive to the measurement of wage inequality. First, in Table XIII we reported for the GINI coefficient that a more developed financial sector was correlated with reductions in wage inequality. However, the coefficient for the liquid liabilities to GDP ratio is only marginally significant for the three alternative wage inequality indicators. That is, there is weaker evidence that a more developed financial sector reduce wage inequality. Second, increased exposure to FDI shows no correlation with wage inequality in THEIL 1, THEIL 2 or CV suggesting that complementarities between the technology embodied in the FDI flows and skilled labor have no impact in augmenting wage inequality. Indeed, even for the GINI coefficient, the standardized coefficient indicates that increased exposure to FDI flows has a very small impact on wage inequality when compared to other statistically significant determinants. A one standard deviation increase in the FDI to GDP ratio, results in an increase of 0.07 in the GINI coefficient. Finally, increased numbers of people living in the city show no correlation with wage inequality in THEIL 1, THEIL 2 or CV.

Conclusions

Some researchers fail to make the distinction between wage inequality and wage differential, which is important since the former is a measure of wage distribution while the later is a measure of relative wages. This research goes further than most studies as it takes into account this subtle but significant distinction.

Our findings indicate that although there is evidence that higher levels of GDP per capita reduce wage inequality, the relationship between inequality and development is still inconclusive. Also, findings suggest that higher inequality in asset distribution and increases in the share of urban population augments wage inequality, and that increases in the average number of years of schooling in the total population and a more developed financial sector are related to reductions in wage inequality. Moreover, increased flows of FDI are related to increases in wage inequality through the complementarities between the technology it embodies and skilled labor. On the other hand, there is strong evidence that increased exposure to international trade is associated with reductions in wage inequality.

VI. EMPIRICAL RESULTS: LATIN AMERICA VS. EAST ASIA

Economic Performance Compared

In this section we look into possible differences in responsiveness of wage differentials to trade and financial openness, technological change and labor supply between Latin America and East Asia. The development strategies followed by both regions differed substantially during the 1960s setting these groups of economies on divergent paths. Both regions followed import substitution policies in the 1950s and early 1960s. However, East Asia introduced export-oriented strategies in the mid 1960s while most Latin American nations continued to pursue import substitution until the early 1980s with important implications for economic growth and equity. The data in Table XVII capture the main historical differences in economic performance in these two regions in the 1965-80 and 1981-98 periods.

Table XVII
Economic Performance in Latin America and East Asia (Average Rates)

Indicator	1965-1980 LA	1965-1980 East Asia	1981-1998 LA	1981-1998 East Asia
Annual Rate of Growth of Real GDP	6.0%	7.2%	2.3%	7.5%
Annual Rate of Inflation	31.5%	9.3%	24.3%	11.1%
Annual Rate of Growth of Exports	-1.0%	10.0%	6.8%	10.1%
LATIN AMERICA	**1965**	**1975**	**1985**	**1995**
Wage Differential in Manuf. (Top50% / Bot50%)	1.57	1.53	1.80	1.82
Wage Differential in Manuf. (Top10% / Bot10%)	2.75	2.74	3.25	4.31
Wage Inequality in Manufacturing (GINI)	0.14	0.13	0.17	0.21
EAST ASIA	**1965**	**1975**	**1985**	**1995**
Wage Differential in Manuf. (Top50% / Bot50%)	1.69	1.68	1.74	1.81
Wage Differential in Manuf. (Top10% / Bot10%)	3.44	3.15	3.22	3.41
Wage Inequality in Manufacturing (GINI)	0.16	0.15	0.13	0.13

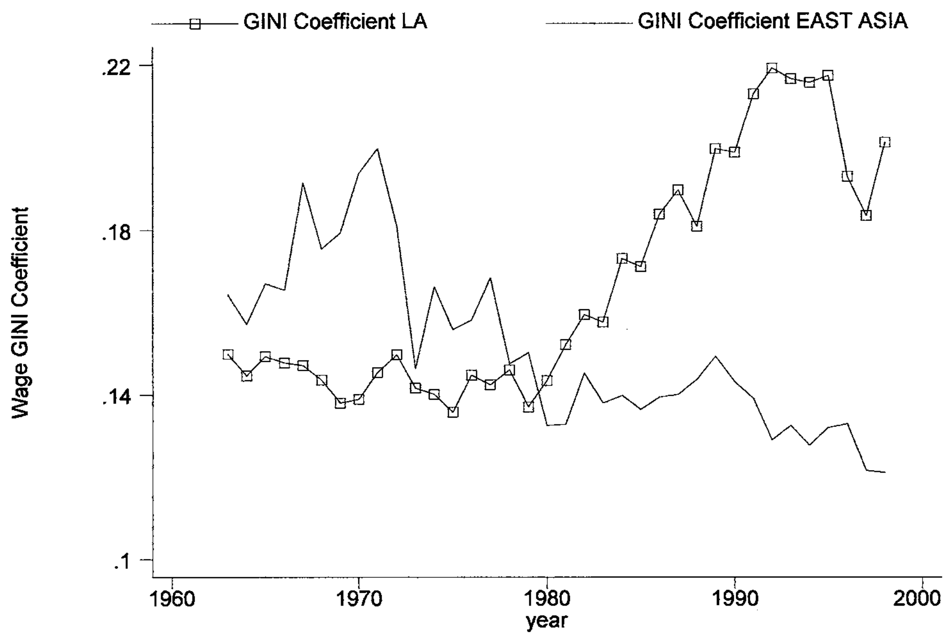
Source: Edwards (1995) and author's calculations based on data from UNIDO (2001) and WDI (2002)

During the 1965-80 period, East Asia's exports grew by10 percent per year, contrasted with a decline of 1 percent per year in Latin America. In addition to export growth differences, the average inflation rate was three times lower in East Asia than in Latin America. Nevertheless, there were no substantial differences between these regions in terms of wage differentials and wage inequality (see Figures 11 and 12). Although Latin American economies showed slightly lower levels, both regions registered fairly small reductions in both wage differentials and wage inequality. During the 1980's, against a background of severe global recession, Latin American economies switched from inward-looking growth policies to more outward-oriented growth policies. East Asia continued its strong growth trend, relatively low inflation rates and strong export growth. Latin America on the other hand, although with lower inflation rates and higher export growth rates, continued to experience lower growth rates than East Asia, about one third that of East Asia. Also, wage inequality and the wage differential in the manufacturing sector increased faster in Latin America from 1965 to 1995. In fact, wage inequality in East Asia even decreased slightly during this period.

Economic reforms implemented in Latin America have not delivered the expected results of higher growth and lower inequality. In fact, some researchers have argued that reform overall has had an unequalizing effect by expanding wage differentials (see Behrman, Székely and Birdsall, 2000). In this section, we compare the wage differential experience of Latin America and East Asia focusing on trade and financial openness, technological change and labor supply. Some lessons from the comparative examination are drawn.

Figure 11

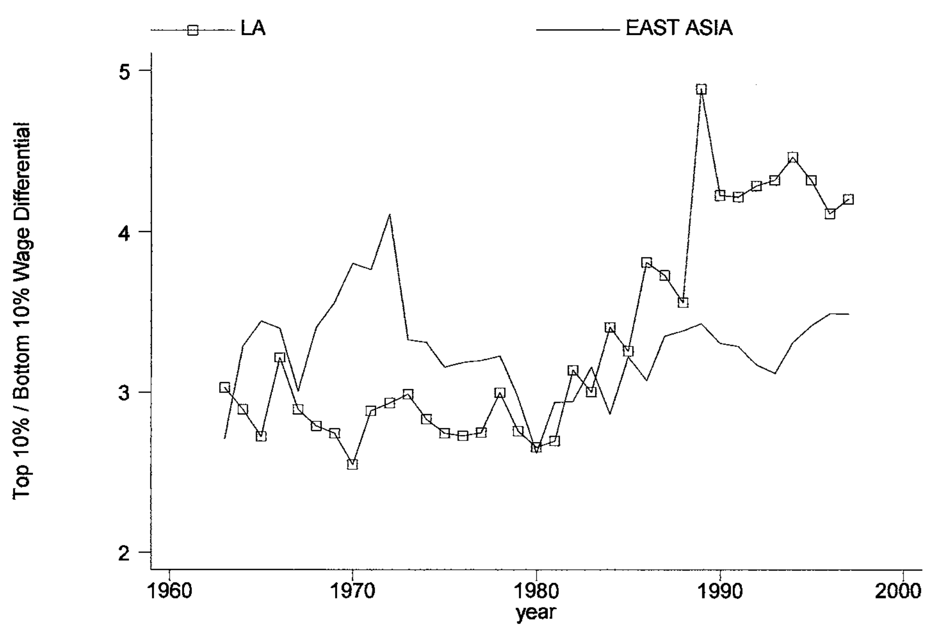
Wage Inequality in LA and East Asia



Source: Author's calculations based on data from UNIDO (2001)

Figure 12

Wage Differential in LA and East Asia



Source: Author's calculations based on data from UNIDO (2001)

The literature comparing the economic performance of Latin America and East Asia is abundant as new challenges arise. Wood (1997) has commented on the conflicting evidence regarding wage differentials in developing countries. He claims that "...the experience of East Asia in the 1960s and 1970s supports the theory that greater openness to trade tends to narrow the wage gap between skilled and unskilled workers in developing countries". On the other hand, the Latin American experience since the early 1980s seems to contradict the theoretical expectation: increased openness has widened wage differentials. Explanations for this apparent contradiction vary. Wood argues that the conflict is due to differences in the timing and deepness of domestic reforms. For example, the entry of the largest low-income countries –Bangladesh, China, India, Indonesia and Pakistan- into world markets during the late 1980's has altered the comparative advantage of Latin American economies whose ratio of skilled to unskilled workers, although above that of other developing nations, is below that of developed nations. East Asian countries during the 1960s and 1970s did not face this sort of competition. Along with this argument, Spilimbergo, Londoño and Székely (1997), hold that each country's factor endowment relative to the average world effective supply of each factor is what really matters to explain these differences. In their study for a panel of developing countries, they find that trade openness is associated with higher income inequality holding endowments constant. They do not offer empirical evidence regarding wage differentials or wage inequality though.

Wood suggests another explanation as to why opening to trade had different effects on wage differentials in East Asia and Latin America. Technological progress over the past few decades has been biased against unskilled workers and thus widened wage differentials in Latin American economies in the 1980s but not in East Asia in the 1960s. That is, world technology has changed in a way that increases the relative demand for skilled labor. Along with this argument and according to the skill-enhancing trade hypothesis proposed by Robbins (1996), increased openness in developing economies in the 1980s affected the skill structure of labor demand –in favor of skilled workers- by changing the production technology acquired through increased imports of capital goods.

Other researchers have focused their attention on supply side explanations. Birdsall, Ross and Sabot (1995) have argued that the combination of a greater supply of education and a greater demand for educated workers, contributed not only to faster growth in East Asia than in other developing regions, but also to reduced wage differentials and wage inequality. They hold that the expansion of education –reflected in both quantity and quality- was mainly the consequence of two factors: faster economic growth and a more rapid decline of fertility rates.

In what follows, we apply the supply and demand framework that looks at the determinants of wage differentials to look into possible differences in responsiveness of wage differentials to trade and financial openness, technological change and labor supply between Latin America and East Asia.

Wage Differential: Exogenous Relative Labor Supply

The least squares dummy variable (LSDV) estimates are in Table XVIII. Columns 1 through 6 show results when the dependent variable is measured by the ratio of average wage of top 50 percent to bottom 50 percent and columns 7 through 10 show results for the ratio of average wage of top 10 percent to bottom 10 percent. The Hausman specification test is significant for all models suggesting that individual effects are correlated with the regressors, and hence the appropriateness of a fixed-effects estimator. The modified Wald test for groupwise heteroskedasticity indicated the presence of heteroskedasticity. Therefore, robust standard errors are computed. Time effects are also significant in all models showing an increasing magnitude over time, an indication that global shocks have tended to increase the skill differential over time. We include a dummy variable for East Asia (EASIA) in order to permit for differences in wage differentials across geographic regions.

The results indicate that an increase in the supply of skilled workers relative to unskilled workers reduces the wage differential for Latin American and East Asian economies when the wage differential is measured by the ratio of average wage of top 50 percent to bottom 50 percent and when it is measured by the ratio of average wage of top 10 percent to bottom 10 percent. The response coefficients for both regions, Latin America and East Asia, are negative and significant in most models but it is higher (in absolute terms) for East Asian economies. Thus the value of the estimated coefficients implies an elasticity of substitution between more and less skilled workers in the range (7.5,11.2) for Latin America and in the range (2.9, 3.3) for East Asia, and an elasticity of substitution between the highest and least skilled workers in the range (5.3, 9.0) for Latin America and in the range (2.4, 2.6) for East Asia. Other authors have reported similar results for East Asia. Te Velde and Morrissey (2002) for example, report an elasticity of substitution between low-skilled labor and skilled labor of 2.8 for five East Asian countries (Hong Kong, Korea, Singapore, Philippines and Thailand). That is, according to them, a one percent increase in the supply of skilled workers relative to unskilled workers reduces the wage differential East Asian economies by 2.8 percent. A slightly larger impact than the one implied by our results, which is between 2.4 and 2.6 percent. The size of the elasticity of substitution is important when examining the impact of changes in the relative labor supply. The higher the elasticity of substitution is, the higher the possibilities of substitution between skilled and unskilled workers. Our results imply that the degree of substitutability between more and less skilled workers is higher than the degree of substitutability between the highest and the least skilled workers in both regions. Also, the degree of substitutability between skilled and unskilled workers is higher in Latin American than in East Asian economies. This last result suggests that some East Asian manufacturing industries require more specialized skilled labor than in Latin America, which makes more difficult to substitute an skilled by an unskilled worker.

The negative coefficient for our measure of overall trade openness (measured by the total trade to GDP ratio) suggests that greater overall trade openness contributes to reducing wage differentials in Latin American economies but has no impact on East Asian economies. The estimated coefficients for East Asia are positive but statistically insignificant.

Increased exposure to foreign direct investment is associated with greater wage differentials in Latin America. As indicated in columns (3) through (6) and in columns (8) through (12) the response coefficient is negative and significant. The result that increased exposure to FDI, or the technology it embodies, favors skilled workers corroborates our earlier findings for the Latin American region. On the other hand, results show that increased exposure to foreign direct investment is associated with reductions in wage differentials in East Asia. The response coefficient for East Asia in column (3) is –0.719 and significant (t-statistic = -1.84) and in column (9) is –1.406 and also significant (t-statistic = -1.97). Results suggest a difference in the responsiveness of wage differentials to FDI in the two regions. According to te Velde and Morrissey (2002), there is no conclusive evidence that FDI reduces wage differentials in East Asia, at least at the macroeconomic level. In their study for five East Asian economies they find that the pooled FDI effect is not significant suggesting that there is no consistent relationship between FDI and wage differentials across countries. They also find mixed evidence at individual country level. FDI appears to have reduced wage differentials in Hong Kong and Philippines but also to have increased it in Thailand. In fact, our results for increased exposure to FDI are not robust to alternative model specifications. Although the response coefficients for East Asia in columns (5), (6), (11) and (12) maintain their positive sign they are not significant. Therefore, we do not find strong evidence that FDI reduces wage differentials in East Asia.

Table XVIII

Determinants of Wage Differentials: LA vs. East Asia

Exogenous Relative Labor Supply

Explanatory Variables	Dependent Variable: Ratio avg. wage top 50% to bottom 50%						Dependent Variable: Ratio avg. wage top 10% to bottom 10%					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	0.518	0.442	0.481	0.400	0.211	0.241	0.712	0.505	0.622	0.562	0.733	0.506
	(10.47)	(4.08)	(9.65)	(5.56)	(2.83)	(2.44)	(5.17)	(4.13)	(4.53)	(2.47)	(2.10)	(1.85)
S/U Workers	-0.053	-0.051	-0.081	-0.089	-0.059	-0.132	-0.095	-0.106	-0.111	-0.143	-0.187	-0.166
	(-1.21)	(-1.74)	(-1.92)	(-1.89)	(-1.83)	(-3.59)	(-0.56)	(-1.59)	(-1.87)	(-1.93)	(-1.90)	(-1.93)
(S/U Workers)*DEASIA	-0.192	-0.183	-0.216	-0.221	-0.153	-0.202	-0.312	-0.353	-0.279	-0.238	-0.222	-0.211
	(-3.35)	(-3.18)	(-3.13)	(-2.86)	(-1.85)	(-2.55)	(-3.53)	(-3.21)	(-2.32)	(-1.99)	(-1.84)	(-2.02)
FDI / GDP			1.117	1.170	0.986	0.578			0.734	0.834	0.643	0.329
			(3.00)	(3.10)	(2.58)	(2.41)			(1.97)	(2.08)	(1.88)	(1.81)
(FDI / GDP)*DEASIA			-1.836	-1.943	-0.813	-0.496			-2.14	-2.54	-0.734	-0.444
			(-3.24)	(-3.44)	(-1.44)	(-1.02)			(-2.43)	(-2.91)	(-1.11)	(-1.52)
R&D Int. / GDP					0.394	0.189					0.739	0.630
					(2.10)	(2.23)					(1.91)	(1.87)
(R&D Int. / GDP)*DEASIA					-0.464	-0.189					-0.206	-0.129
					(-0.69)	(-0.85)					(-0.93)	(-0.11)
Imp. mach&equip / GDP					0.007	0.042					0.101	0.133
					(0.31)	(1.48)					(1.89)	(2.05)
(Imp. mach&equip/GDP)*DEASIA					-0.112	-0.175					-0.285	-0.332
					(-1.15)	(-1.11)					(-1.31)	(-1.66)
(X+M) / GDP		-0.042		-0.043	-0.041	-0.015		-0.196		-0.218	-0.194	-0.177
		(-1.78)		(-1.75)	(-1.82)	(-1.95)		(-4.11)		(-2.94)	(-4.03)	(-3.87)
((X+M) / GDP)*DEASIA		0.023		0.043	0.123	0.123		0.084		0.042	0.099	0.114
		(0.57)		(0.79)	(1.02)	(1.05)		(0.64)		(0.87)	(0.75)	(1.18)
Terms of Trade						-0.186						-0.201
						(-5.94)						(-3.13)
Terms of Trade*DEASIA						0.221						0.229
						(3.03)						(1.91)
Country Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
F tests												
Country Effects	40.51	34.04	35.21	33.31	28.39	27.74	35.82	33.96	32.60	30.65	29.53	28.33
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time Effects	4.88	4.04	4.56	5.01	4.21	4.44	4.45	4.59	3.94	3.65	3.86	3.92
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.011]	[0.016]	[0.000]	[0.000]	[0.000]	[0.017]	[0.017]	[0.031]
Interaction Effects	10.91	5.06	16.51	10.72	12.87	9.20	9.25	7.33	12.54	9.01	10.79	10.76
Prob>F	[0.001]	[0.006]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.006]	[0.000]	[0.001]	[0.001]	[0.001]
Hausman Test	10.17	12.98	11.28	12.54	10.25	11.85	10.04	11.12	9.27	9.35	10.49	9.18
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Modified Wald Test	822.19	893.97	822.07	795.32	687.09	702.01	722.23	699.32	630.45	594.65	580.33	552.65
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Adjusted R Squared	0.60	0.60	0.61	0.61	0.63	0.69	0.63	0.64	0.63	0.64	0.65	0.66
No. Obs	662	662	586	586	586	586	662	662	586	586	586	586

Notes: The numbers in parentheses are t-statistics computed with robust standard errors
The numbers in brackets are probability levels

When it comes to the role of openness in specific sectors of the economy, controlling for the characteristics of the goods imported, the results for Latin America confirm our earlier findings. As shown in columns (11) and (12) increased imports of machinery and transportation equipment (as a percentage of total imports) increases the industrial wage differential when measured by the ratio of average wage of top 10 percent to bottom 10 percent. The response coefficients for East Asia are statistically equal to zero for both measures of the wage differential as seen in columns (5), (6), (11) and (12). Thus, results suggest that overall trade openness as well as increased imports of capital goods have no effect on wage differentials in East Asian economies. Other authors have found that trade liberalization can raise wage differentials in developing economies, including East Asian economies. Robbins (1996) for example, reports that trade liberalization is accompanied by rising relative wages and labor demand. However, his study of a sample of developing countries, which contains Latin American and East Asian countries (nine in total), fails to distinguish between the two regions. Again, we find evidence that the transfer of foreign R&D tends to widen the wage differential through increases in relative labor demand in Latin America. The response coefficients for East Asia are statistically equal to zero for both measures of the wage differential. Thus, we find no evidence that transfer of foreign R&D tends to widen the wage differential in East Asian economies.

Finally, we test for improvements in the terms of trade, defined as the ratio of the export price index to the import price index. As shown in columns (6) and (12) improvements in the terms of trade are associated with reductions in wage differentials in Latin America. Also, there is weak evidence that improvements in the terms of trade are associated with increases in wage differentials in East Asia. The coefficients for the average wage of top 50 percent to bottom 50 percent is 0.035 (t-statistic = 1.82) and for the average wage of top 10 percent to bottom 10 percent is 0.028 (t-statistic = 2.01). The result is intuitive when considering that East Asian countries have tended to concentrate their export activities in skill-intensive manufactures. That is, when export prices increase relative to import prices, wage differentials increases because of increases in relative labor demand.

Wage Differential: Endogenous Relative Labor Supply

As we did before for Latin America, two stage least squares (2SLS) is employed to estimate equations (4) and (13) assuming that relative labor supply is determined endogenously. The instruments for the estimation of equation (4) are the set of all exogenous variables. These include the set of demographic variables, age dependency ratio, female labor as a percentage of total labor force, urban population as a percentage of total population and the average schooling years in the total population, foreign direct investment as a percentage of GDP, R&D expenditures intensity with respect to total with respect to total GDP, imports of machinery and equipment as a percentage of GDP, total trade as a percentage of GDP and the terms of trade.

The two stage least squares (2SLS) estimates are in Table XIX. It reproduces the models of Table X with one main difference: we include a dummy variable for East Asia (EASIA) in order to test for differences in wage differentials across geographic regions. The Pagan-Hall (1983) test of heteroskedasticity for instrumental variables indicated the presence of heteroskedasticity. Therefore, robust standard errors are computed. Davidson-MacKinnon (1993) developed a test of exogeneity for a fixed-effects regression estimated via instrumental variables. The Davidson-MacKinnon test is significant for all models confirming the appropriateness of the instruments. As with OLS, in 2SLS models time effects are significant in all models showing an increasing magnitude over time, indicative that global shocks have tended to increase the skill differential over time. We discuss the results next.

The value of the estimated coefficients for the relative labor supply is larger (in absolute value) with 2SLS than with the LSDV estimate. For Latin America the elasticity of substitution for the top 50 percent to bottom 50 percent variable is now in the range (1.2, 2.4) and in the range (1.4, 2.2) for the top 10 percent to bottom 10 percent variable. For East Asia, the elasticity of substitution for the top 50 percent to bottom 50 percent variable is now in the range (1.07-1.5) and in the range (1.008-1.3) for the top 10 percent to bottom 10 percent variable. As previous results, these indicate that the degree of substitutability between skilled and unskilled workers is higher in Latin American than in East Asian economies.

Table XIX

2SLS, Determinants of Wage Differentials: LA vs. East Asia

Endogenous Relative Labor Supply

	Dependent Variable: Ratio avg. wage top 50% to bottom 50%						Dependent Variable: Ratio avg. wage top 10% to bottom 10%					
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	0.112	0.064	0.236	0.016	-0.761	-0.762	0.319	0.207	0.311	0.553	-0.228	-0.110
	(1.12)	(0.54)	(1.45)	(0.09)	(-1.07)	(-0.51)	(1.11)	(0.96)	(1.42)	(1.62)	(-0.11)	(-0.19)
S/U Workers	-0.579	-0.586	-0.401	-0.620	-0.790	-0.522	-0.622	-0.566	-0.672	-0.606	-0.506	-0.441
	(-4.76)	(-4.05)	(-3.51)	(-2.78)	(-2.40)	(-4.29)	(-2.03)	(-2.21)	(-2.33)	(-1.91)	(-1.83)	(-1.89)
S/U Workers*DEASIA	-0.174	-0.124	-0.242	-0.188	-0.203	-0.289	-0.122	-0.295	-0.234	-0.199	-0.270	-0.551
	(-3.19)	(-2.59)	(-1.98)	(-1.83)	(-1.87)	(-1.88)	(-2.58)	(-2.18)	(-2.21)	(-1.88)	(-1.81)	(-1.91)
FDI / GDP			1.221	1.65	1.05	0.913			1.332	0.711	0.611	0.521
			(3.31)	(2.97)	(2.68)	(2.59)			(2.04)	(1.97)	(2.02)	(1.92)
(FDI / GDP)*DEASIA			-2.229	-2.810	-3.130	-1.411			-1.883	-1.552	-1.222	-0.943
			(-1.22)	(-1.73)	(-1.05)	(-1.22)			(-1.53)	(-1.21)	(-1.21)	(-0.11)
R&D Int. / GDP					0.522	0.439					0.845	0.610
					(0.98)	(1.44)					(1.21)	(1.37)
(R&D Int. / GDP)*DEASIA					-0.164	-0.149					-0.054	-0.022
					(-1.64)	(0.83)					(-1.00)	(-0.56)
Imp. mach&equip / GDP					0.049	0.011					0.101	0.079
					(1.82)	(1.95)					(2.11)	(1.99)
(Imp. mach&equip / GDP)*DEASIA					-0.091	-0.112					-0.094	-0.021
					(-1.11)	(-0.35)					(-0.21)	(-0.89)
(X+M) / GDP		-0.023		-0.035	-0.039	-0.001		-0.167		-0.254	-0.231	-0.93
		(-0.84)		(-1.25)	(-1.12)	(-0.60)		(-2.43)		(-3.66)	(-4.21)	(-3.22)
((X+M) / GDP)*DEASIA		0.990		0.331	0.594	0.162		0.331		0.422	0.395	0.261
		(1.00)		(1.13)	(1.71)	(0.90)		(1.06)		(1.03)	(1.35)	(1.17)
Terms of Trade						-0.180						-0.199
						(-5.35)						(-2.16)
(Terms of Trade)*EASIA						0.188						0.552
						(2.83)						(1.89)
Country Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
F tests												
Country Effects	28.28	25.91	24.29	24.11	22.37	22.14	22.96	19.52	21.65	20.60	19.66	18.17
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time Effects	2.94	3.01	3.84	4.05	3.76	3.29	3.87	3.95	4.55	4.22	4.21	4.10
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.011]	[0.016]	[0.000]	[0.000]	[0.000]	[0.019]	[0.019]	[0.034]
Interaction Effects	7.88	6.39	9.31	10.43	11.54	10.32	6.34	6.98	7.03	12.55	13.43	11.74
Prob>F	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Pagan-Hall Test	75.21	74.11	75.33	76.81	69.22	65.88	94.12	93.31	96.06	95.72	99.12	85.23
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Davidson-MacKinnon	12.00	11.27	12.54	10.23	9.38	8.29	10.53	9.44	8.99	8.31	6.55	5.44
Prob>F	[0.000]	[0.033]	[0.032]	[0.001]	[0.037]	[0.0355]	[0.031]	[0.031]	[0.021]	[0.001]	[0.031]	[0.039]
Adjusted R Squared	0.42	0.42	0.50	0.51	0.52	0.55	0.21	0.21	0.26	0.30	0.31	0.33
No. Obs	607	607	572	572	572	572	607	607	572	572	572	572

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

The numbers in brackets are probability levels

However, the treatment of relative labor supply as endogenous does not change substantially the effects of other wage differential determinants. Results indicate that overall trade openness is (weakly) associated with reductions in wage differentials in Latin American economies but has no impact on East Asian economies. The estimated coefficient for overall openness in Latin America is only significant for top the 10 percent to bottom 10 percent variable and for East Asia it is statistically insignificant for both measures. Also, when controlling for the characteristics of the goods imported, the results for Latin America confirm our earlier findings. As shown in columns (5), (6), (11) and (12) increased imports of machinery and transportation equipment (as a percentage of total imports) increases the industrial wage differential. The response coefficients for East Asia are statistically equal to zero for both measures of the wage differential as seen in columns (5), (6), (11) and (12).

Again, results indicate that increased exposure to foreign direct investment is associated with greater wage differentials in Latin America. As shown in columns (3) through (6) and in columns (8) through (12) the response coefficient is negative and significant. On the other hand, results show that increased exposure to foreign direct investment has no impact on wage differentials in East Asia. The response coefficients for East Asia are not significant. Therefore, we do not find evidence that FDI reduce wage differentials in East Asia.

With 2SLS we find no evidence that the transfer of foreign R&D widens the wage differential neither in Latin America nor in East Asia. The response coefficients are statistically equal to zero for both measures of the wage differential. Thus, we find no evidence that transfer of foreign R&D tends to widen the wage differential in Latin American or East Asian economies.

Finally, results of testing for improvements in the terms of trade are similar to those obtained with the LSIV estimate. As shown in columns (6) and (12) improvements in the terms of trade are associated with reductions in wage differentials in Latin America. Also, there is weak evidence that improvements in the terms of trade are associated with increases in wage differentials in East Asia.

Determinants of the Relative Labor Supply

In order to complete the examination of the simultaneous determination of wage differentials and relative labor supply, the relative labor supply equation (13) is estimated with 2SLS. Estimates are in Table XX. Column (1) shows results for the ratio of average wage of the top 50% to bottom 50% for both methods and column (2) shows results for the ratio of average wage of the top 10% to bottom 10%. Again, the urban/total population ratio is instrumented to eliminate the possibility of this variable being correlated with the error term. The average schooling years in the total population variable is lagged three periods to account for lag effects between education and labor supply. The age dependency ratio defined the ratio of dependents (people younger than 15 and older than 65) to the working-age population (those age 15–64) is also lagged three periods.

Table XX

Determinants of Relative Labor Supply: LA vs. East Asia

	Dependent Variable: More Skilled workers / Less Unskilled Workers for (1) Highest Skilled workers / Least Unskilled Workers for (2)	
Explanatory	**Two Stage Least Squares**	
Variables	(1)	(2)
Intercept	0.678	0.331
	(2.82)	(1.91)
Ws / Wu (top10% / bottom10%)		0.144
		(2.01)
Ws / Wu (top10% / bottom10%)*DEASIA		0.095
		(0.56)
Ws / Wu (top50% / bottom50%)	0.565	
	(1.98)	
Ws / Wu (top50% / bottom50%)*DEASIA	0.227	
	(1.10)	
Avg. schooling years in the Tot. Pop.	0.105	0.196
	(2.34)	(2.59)
(Avg. schooling years in the Tot. Pop.)*DEASIA	0.741	0.514
	(1.95)	(2.32)
Urban Pop / Tot Pop	-1.382	-0.954
	(-3.48)	(-2.96)
(Urban Pop / Tot Pop)*DEASIA	-0.234	-0.301
	(-1.34)	(-0.11)
Female Labor / Tot. Labor Force	0.853	0.395
	(2.09)	(1.88)
(Female Labor / Tot. Labor Force)*DEASIA	0.752	0.195
	(1.08)	(1.52)
Age Dependency Ratio	-0.681	-0.453
	(-3.89)	(-2.37)
Age Dependency Ratio*DEASIA	0.574	0.105
	(0.98)	(0.99)
F tests		
Country Effects	12.55	13.02
Prob>F	[0.000]	[0.000]
Time Effects	5.01	4.86
Prob>F	[0.000]	[0.000]
Interaction Effects	10.69	9.34
Prob>F	[0.000]	[0.000]
Pagan-Hall Test	27.18	35.21
Prob>chi2	[0.001]	[0.001]
Davidson-MacKinnon	8.023	8.491
	[0.001]	[0.002]
R Squared	0.301	0.256
No. Obs	572	572

Notes: The numbers in parentheses are t-statistics
The numbers in brackets are probability levels

The Pagan-Hall test of heteroskedasticity for instrumental variables indicated the presence of heteroskedasticity. Therefore, robust standard errors are computed for this method. The Davidson-MacKinnon test is significant, hence the appropriateness of the instruments. The exogenous variables identifying the labor supply are education and demographic characteristics, that is, average schooling years, the proportion of women in the labor force and the age dependency ratio.

Results suggest that relative labor supply responds positive to increases in relative wages for Latin America, that is, there is evidence of an upward sloping relative labor supply. The responsiveness of relative labor supply is higher for the top50% to bottom 50% ratio (0.565) than for the top10% to bottom 10% ratio (0.144). On the other hand, the response coefficients for East Asia, although positive, are not significant. The coefficients are 0.239 (t-statistic = 1.49) for the top50% to bottom 50% ratio and 0.702 for the top10% to bottom 10% ratio (t-statistic = 1.61). Therefore, we are unable to identify a positive sloping relative labor supply for East Asian countries.

There is strong evidence that increases in the average level of education are associated with increases in the relative number of skilled workers for both, Latin American and East Asian countries. Coefficients are statistically significant for both regions being relatively higher for East Asia. They suggest that a 10% increase in the average number of years of schooling increases relative labor supply by around 1% in Latin America and by around 7% in East Asia. As some studies have demonstrated (see OECD, 1994 for example), although public expenditure as a share of GNP is not above the average for all developing countries, most East Asian governments have strongly promoted the upgrading and spread of education.

Increases in the share of urban population are associated with substantial reductions in the relative number of skilled workers in Latin America but the effect is not significant for East Asia. Also, evidence suggests that higher female participation rates in the labor force have an increasing effect in the relative labor supply in Latin American economies but have no effect on East Asian economies. Finally, results indicate that a rise in the number of dependents relative to the working-age population reduces the relative number of skilled workers in Latin America but this effect is not significant in East Asia.

Determinants of Wage Inequality

In this section we look into possible differences in responsiveness of wage inequality to trade and financial openness, technological change and labor supply between Latin America and East Asia.

The results for the determinants of wage inequality for the GINI coefficient applying pooled Ordinary Least Squares (OLS) to the data are in Table XXI. It reproduces the models of Table XIII with one main difference: we include a dummy variable for East Asia (EASIA) in order to test for differences in wage inequality across geographic regions. The Hausman specification test is significant for all models suggesting that individual effects are correlated with the regressors, and hence the appropriateness of a fixed-effects estimator. The modified Wald test for groupwise heteroskedasticity in a fixed effects model indicated the presence of heteroskedasticity. Therefore, robust standard errors are computed. Time effects are also significant in all models showing an increasing magnitude over time, an indication that global shocks have tended to increase wage inequality over time.

Results indicate that higher levels of GDP per capita are associated with reductions in wage inequality in both regions. The coefficients response for real GDP per capita for Latin America and East Asia are negative and significant in all models. However, when testing for increasing or diminishing returns, although GDP per capita squared shows a consistent positive coefficient in both regions suggesting a 'U-shaped' relationship it is not statistically significant.

Table XXI

Determinants of Wage Inequality (GINI): LA vs. East Asia

Explanatory Variables	Dependent Variable: GINI Coefficient (1)	(2)	(3)	(4)	(5)
Intercept	0.227	0.60	0.177	0.38	0.178
	(9.28)	(1.07)	(0.98)	(0.28)	(1.25)
Real GDP per Capita	-0.014	-0.017	-0.029	-0.027	-0.028
	(-2.10)	(-2.05)	(-3.15)	(-3.10)	(-3.06)
Real GDP per Capita*DEASIA	-0.094	-0.019	-0.015	-0.014	-0.037
	(-1.84)	(-1.82)	(-2.29)	(-2.41)	(-2.29)
(Real GDP per Capita)^2	0.00001	0.00001	0.00001	0.00001	0.00001
	(0.92)	(1.15)	(1.11)	(1.31)	(1.25)
(Real GDP per Capita)^2*DEASIA	0.00001	0.00001	0.00001	0.00001	0.00001
	(0.52)	(1.16)	(0.96)	(0.41)	(0.95)
Avg. School Yrs in Tot. Pop.		-0.009	-0.019	-0.018	-0.017
		(-2.00)	(-4.06)	(-3.77)	(-3.64)
Avg. School Yrs in Tot. Pop.*DEASIA		-0.001	-0.024	-0.020	-0.015
		(-1.84)	(-3.10)	(-2.57)	(-2.01)
GINILAND		0.281	0.369	0.344	0.357
		(5.04)	(5.67)	(5.72)	(5.17)
GINILAND*DEASIA		-0.048	-0.040	-0.125	-0.003
		(-0.27)	(-0.14)	(-0.47)	(-0.01)
Liquid Liabilities / GDP		-0.041	-0.042	-0.077	-0.076
		(-1.90)	(-1.87)	(-3.64)	(-3.39)
(Liquid Liabilities / GDP)*DEASIA		0.028	0.025	0.062	0.068
		(1.73)	(1.91)	(2.85)	(2.65)
Urban Pop / Tot Pop			0.137	0.159	0.143
			(1.85)	(1.98)	(2.13)
(Urban Pop / Tot Pop)*DEASIA			-0.259	-0.137	-0.134
			(-1.38)	(-0.75)	(-0.62)
Female LF / Total LF			0.032	0.102	0.133
			(0.26)	(0.91)	(1.12)
(Female LF / Total LF)*DEASIA			-0.787	-0.912	-0.918
			(-3.46)	(-3.86)	(-3.36)
Age Dependency Ratio			-0.007	-0.012	-0.007
			(-0.14)	(-0.24)	(-0.15)
Age Dependency Ratio*DEASIA			0.286	0.303	0.317
			(2.13)	(2.40)	(2.21)
FDI / GDP				0.191	0.179
				(2.25)	(2.12)
(FDI / GDP)*DEASIA				-0.879	-0.789
				(-4.06)	(-3.81)
(X+M) / GDP				-0.064	-0.069
				(-4.30)	(-4.53)
((X+M) / GDP)*DEASIA				-0.294	-0.282
				(-1.61)	(-1.23)
Imp. Mach&Eq / Tot Imports					0.145
					(1.66)
(Imp. Mach&Eq / Tot Imports)*DEASIA					0.672
					(0.89)
R&D Int. in Man. / Man. Output					0.840
					(1.55)
(R&D Int. in Man. / Man. Output)*DEASIA					0.822
					(0.27)
F tests					
Fixed Effects	25.38	21.06	22.89	22.65	28.55
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time Effects	5.31	5.22	4.09	4.88	4.98
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Interaction Effects	7.34	10.78	11.23	10.64	9.49
Prob>F	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Hausman Test	11.94	10.56	10.11	9.23	9.58
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Modified Wald Test	2788.41	2700.45	2645.72	1983.03	2543.23
Prob>chi2	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Adjusted R Squared	0.74	0.75	0.77	0.78	0.78
No. Obs	662	537	497	497	497

Notes: The numbers in parentheses are t-statistics computed with robust standard errors

Although not directly comparable with these findings, other researchers have found similar results in terms of growth for East Asian economies. Birdsall, Ross and Sabot (1995) and Watkins (1998) for example, report a clear positive association between growth and equality. However, as discussed early in the study, evidence regarding the relationship between inequality and development is inconclusive.

Model (2) shows our base regression which tests for land distribution – taken as a measure of asset inequality-, the average number of years of schooling in the total population and the degree of development of the financial sector. Results indicate that increases in the average number of years of schooling in the total population reduce wage inequality in both regions. In fact, the responsiveness is higher for East Asia –the coefficient is –0.01 with t-statistic = -.192. This confirms our previous findings according to which increases in the average number of years of schooling in the total population means that more people have access to a higher educational level improving their chances to have better paid jobs, thus reducing wage inequality. Several authors have pointed out that the accumulation of human capital –measured by the educational attainment of the population- has been a key ingredient for economic growth and development observed in East Asian countries. Birdsall, Ross and Sabot (1995, 1997) for example, have argued that a combination of a greater supply of educated workers and a greater demand for them contributed not only to faster economic growth in East Asia than in other developing regions, but also to reduce inequality.

The response coefficient for the Gini coefficient for land distribution is positive for both regions (the response coefficient for East Asia is 0.233 with t-statistic = 2.83), which suggests that a better distribution of assets -which can be used as collateral- is an important factor in explaining wage inequality. Also, results indicate that a more developed financial sector reduces wage inequality in both regions. This effect however, seems to have a greater impact on Latin American economies as the coefficient for this region is larger (in absolute value) than the coefficient for East Asia (-0.13, t-statistic = 1.86). This suggests that more developed formal credit markets and cheaper credits, which reduce the cost of investment, have a larger influence in reducing wage inequality in Latin America when compared to East Asia.

Model (3) shows that increases in the share of urban population are associated with increases in wage inequality in Latin America but not in East Asia. There are virtually no studies relating wage inequality to rural-urban migration in East Asian economies. International labor migration within Asian countries seems to be better covered in the literature. Manning (2002) for example, argues that while unskilled labor has tended to move from the less developed to more developed countries within the Asia-Pacific region (mainly East Asian countries), skilled labor movements have tended to be in the opposite direction. However, he offers no discussion about the effects of workers flows on wage inequality.

Findings indicate that higher rates of female participation reduce wage inequality in East Asia but not in Latin America. The general expectation is that the increased labor force participation of women, by increasing the supply of relatively low skilled labor, should drive down the wages of low skilled workers thus increasing wage inequality. This last result challenges such expectation. There are at least two explanations for this seemingly contradiction. First, the expectation that increased labor force participation of women increases wage inequality rest on the assumption that women entering the labor force are low skilled. However, this assumption does not always hold, at least for the Latin American case. As it was shown in the previous section, increased female labor participation increases the relative number of skilled workers. Second, the sign and size of the impact on wage inequality of women entering the labor force depends on substitution possibilities. That is, they depend on whether women are good or poor substitutes for low-skilled men (see Topel, 1997). If they are good substitutes, women entering the labor force and competing with male workers can in fact increase wage inequality as male wages fall the most. In contrast, our result suggests that women and low-skilled men are poor substitutes.

Increases (reductions) in the age dependency ratio are associated with increases (reductions) in wage inequality in East Asia but not in Latin America. In fact, results suggest that East Asia's demographic transition during the period 1965-1990, which resulted in its working-age population growing at a much faster pace than its dependent population (see Bloom and Williamson, 1997), has contributed to lower wage inequality in East Asian countries. We turn now to examine the impact of openness and technological change factors in models (4) and (5).

Coefficients response for flows of FDI show opposite results for both regions. Increased exposure to foreign direct investment is associated with greater wage inequality in Latin America. As indicated in columns (4) and (5) the response coefficient is negative and significant. The result that increased exposure to FDI, or the technology it embodies, favors skilled workers corroborates our earlier findings for the Latin American region. On the other hand, results show that increased exposure to foreign direct investment is associated with reductions in wage inequality in East Asia. The response coefficient for

East Asia in column (4) is –0.688 and significant (t-statistic = -3.24) and in column (5) is –0.61 and also significant (t-statistic = -2.67). Thus, findings suggest a difference in the responsiveness of wage inequality to FDI in the two regions. Also, there is stronger evidence that increased exposure to foreign direct investment is associated with reductions in wage inequality than evidence that FDI reduces wage differentials in East Asia. In contrast, te Velde and Morrissey (2002) report lack of evidence that FDI reduce wage inequality in five East Asian economies. Their study however, fails to distinguish between wage inequality and wage differential treating them as synonyms.

Finally, as previously shown, there is evidence that increased exposure to international trade is associated with reductions in wage inequality in Latin America and East Asia. The response coefficients for East Asia are -0.358 in model (4) and -0.351 in model (5) with t-statistics = -2.44 and t-statistics = -2.31 respectively. In his analysis of the impact of globalization on workers of 70 developing countries, Rama (2003) finds that wage inequality (measured as the standard deviation of the log of wages) does not increase with openness. In fact, he suggests that "…if anything, it [wage inequality] could decline." Finally, there is no evidence that increased imports of machinery and equipment or increased foreign R&D can increase wage inequality in either region.

Conclusions

Overall trade openness is associated with reductions in wage differentials and wage inequality in Latin America, which is consistent with the standard Hecksher-Ohlin-Samuelson (HOS) trade theory. However, we find no evidence of this relationship in East Asian economies. There is weak evidence that increased exposure to foreign direct investment is associated with reductions in wage differentials and wage inequality in East Asia, which is exactly the opposite to our result for Latin America. However, as te Velde and Morrissey (2002) have argued, the lumping of several economies as 'East Asia' hinders a full understanding of the effects of increased FDI flows on the distribution of wages. They argue that FDI has different effects in different countries and hence we need to allow for country-specific FDI effects. Our models include country specific intercepts but not country-specific FDI effects, so such exercise falls beyond the scope of this study. Also, as other researchers have pointed out, the type and composition of foreign capital can be an explanation as to why increased exposure to FDI has different impacts in the two regions. Stallings (1990) for example, argues that averages for the postwar period show that private capital was dominant in Latin America (mostly through multinational corporations which may imply profit outflows, elimination of jobs through use of capital-intensive technology, marginalization of poorer regions, etc.), while public capital had a greater role in East Asia (mainly used to service international debt). This suggests that FDI in Latin America could in fact have a more disruptive effect on wage distribution than in East Asia.

We find no evidence that increased imports of machinery and transportation equipment increases the industrial wage differential or wage inequality in East Asia as it does in Latin America. So, the hypothesis that the adoption of new technologies, embodied in increased FDI flows and machinery imports, increases relative labor demands thus augmenting wage differentials, is only confirmed for Latin America.

On the supply side, evidence indicates that increases in the average level of education are associated with increases in relative labor supply in both regions. Increases in the share of urban population are associated with substantial reductions in the relative number of skilled workers in Latin America but the effect is not significant for East Asia. Similarly, higher female participation rates in the labor force have an increasing effect in the relative labor supply in Latin American economies but have no effect on East Asian economies. Finally, although there is evidence that higher levels of GDP per capita reduce wage inequality in both regions, the relationship between inequality and development is still inconclusive.

VII. FINAL REMARKS

Conclusions

This dissertation looks at the nexus between trade openness, technological change and labor supply factors, and the increasing wage differential and wage inequality in Latin America. Also, it compares the performance of Latin American economies with those of East Asia. Using a new data set on industrial wages and a supply and demand framework, the analysis yields several conclusions. First, along with the findings of most studies in the literature the estimated value for the elasticity of substitution is greater than one in both regions. That is, skilled and unskilled workers are found to be imperfect substitutes, which implies that increases in the relative supply of skilled workers can have a sizeable effect on reducing wage differentials. Also we find that the degree of substitutability between more and less skilled workers is higher in Latin American than in East Asian economies. By modeling relative labor supply as wage responsive instead of perfectly inelastic, this research goes further than most studies as it takes into account the simultaneous determination of the wage differential and the relative labor supply.

Second, results show that greater overall trade openness contributes to reducing wage differentials and wage inequality and that increased exposure to foreign direct investment is associated with greater wage differentials and greater wage inequality in Latin America. We do not find evidence that overall openness has an impact on wage differentials or wage inequality in East Asia. However, increased exposure to foreign direct investment is associated with reductions in wage inequality in East Asia.

Third, technological change implies an increase in the demand for skilled workers in Latin America when it comes in the form of foreign machinery and equipment and foreign direct investment. That is, imports of capital goods and increased exposure to foreign direct investment facilitates the transmission of new technologies from the more developed economies to the Latin American region. Both, wage differentials and wage inequality increase as imports of capital goods and exposure to FDI increase. We do not find evidence that imports of capital goods have an impact on wage differentials or wage inequality in East Asia

Fourth, increases in the GDP per capita, increases in the average schooling years in the total population and a more developed financial sector reduce wage inequality in Latin America and East Asia. Also, a worse distribution of assets and increases in the share of urban population are related to increases in wage inequality in Latin America. These factors however, are found to have no impact on wage inequality in East Asian economies. On the other hand, increased female labor participation in the labor force and reductions in the age dependency ratio are associated with reductions in wage inequality in East Asia. These factors are found to have no impact on wage inequality in Latin American economies.

Finally, with regard to the determinants of the relative labor supply, increases in average schooling years in the total population are related to increases in the relative labor supply in both regions. Increases in the share of urban population are related to reductions in the relative labor supply. However, this effect only holds for Latin America. Furthermore, increased female labor participation in the labor force is related to increases in the relative labor supply in both regions, while increases in the age dependency ratio are associated with reductions in the relative labor supply only for the Latin American region.

Policy Considerations

Uneven wage distribution can constitute a source of social friction with the potential to undermine the development strategy, hence the importance of studying the distributive impact of economic policy. The increased international trade flows and capital movements observed in Latin America in the last two decades can be largely explained by policy changes. This investigation reveals that increased overall trade openness tends to improve wage distribution but increased exposure to FDI tends to worsen it. Nevertheless, these findings do not necessarily mean that trade openness is 'good' policy that should be pursued or that increased exposure to FDI is 'bad' policy that should be avoided. Rather, they should serve to highlight the need to reevaluate the timing and implementation of economic policy with special attention to the distributional consequences. The true task of governance is to reconcile conflicting interests in society, that is, economic growth should be seen as a means to maintain a harmonious society rather than as an end itself.

As an example, we focus on one aspect: financial openness. Table I in the introduction section showed that FDI flows to Latin American and Caribbean region have declined in the last decade. How should one interpret the fact that capital does not flow from developed to developing countries where investment opportunities are presumably abundant, particularly in Latin America? Lucas (1990) argues that differences in skills across countries and their impact on overall productivity can explain this apparent paradox. That is, when investors estimate returns they correct for human capital differentials. Evidence found here suggests that FDI flows and skills are indeed complements. Then, the smaller FDI flows arriving to Latin American economies in recent years do so pursuing skills and thus increasing the wage differential. Therefore, increasing the share of skilled workers could well work not only as a FDI flows magnet but also as a wage differentials diminishing tool as a greater proportion of the labor force receives higher labor incomes.

Furthermore, when it comes to the role of openness in specific sectors of the economy, openness can have a negative distributive impact. However, as it has been shown, increased imports of capital goods, together with increased exposure to foreign direct investment, are the transmission mechanism of new technologies, which are essential ingredients for other desirable goals of economic policy: competitiveness and economic growth (see Mody and Yilmaz, 2001). The implications of these relationships however, are not limited to the positive effects of technology transfer on productivity. They gain additional relevance when considering human capital upgrading and the policies available to promote it. When imports of capital goods or FDI flows introduce new technologies, new managerial practices and increased access to markets create the incentive to upgrade skills through the increase in the wage differential. Also, as some authors have argued (Watkins, 1998 for example), trade liberalization cannot be pursued successfully without being accompanied by adequate social policies. He cites the example of Thailand, Indonesia and China, which began the liberalization process after they have invested in attempting to raise the skill levels of their work forces. In contrast, liberalization in Latin America has been pursued without putting sufficient attention to promote productivity through education and skills training.

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