NBER WORKING PAPER SERIES

SKILLS, EXPORTS, AND THE WAGES OF SEVEN MILLION LATIN AMERICAN WORKERS

Irene Brambilla
Rafael Dix Carneiro
Daniel Lederman
Guido Porto

Working Paper 15996
http://www.nber.org/papers/w15996

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2010

The authors gratefully acknowledge the financial support from the World Bank's Latin American and Caribbean Studies Program and a grant funded by the World Bank executed Multi-Donor Trust Fund on Trade. Invaluable insights and comments on previous versions of this paper were received from William F. Maloney, J. Humberto López, Augusto de la Torre, Pravin Krishna, Betty Sadoulet, and three anonymous referees. The opinions expressed herein do not represent the views of theWorld Bank, its Executive Directors, the governments they represent, or the National Bureau of Economic Research. All remaining errors are the authors' responsibility.

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2010 by Irene Brambilla, Rafael Dix Carneiro, Daniel Lederman, and Guido Porto. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Skills, Exports, and the Wages of Seven Million Latin American Workers
Irene Brambilla, Rafael Dix Carneiro, Daniel Lederman, and Guido Porto
NBER Working Paper No. 15996
May 2010, Revised December 2011
JEL No. F13,F14

ABSTRACT

The returns to schooling and the skill premium are key parameters in various fields and policy debates, including the literatures on globalization and inequality, international migration, and technological change. This paper explores the skill premium and its correlation with exports in Latin America, thus linking the skill premium to the emerging literature on the structure of trade and development. Using data on employment and wages for over seven million workers from sixteen Latin American economies, the authors estimate national and industry-specific returns to schooling and skill premiums and study some of their determinants. The evidence suggests that both country and industry characteristics are important in explaining returns to schooling and skill premiums. The analyses also suggest that the incidence of exports within industries, the average income per capita within countries, and the relative abundance of skilled workers are related to the underlying industry and country characteristics that explain these parameters. In particular, sectoral exports are positively correlated with the skill premium at the industry level, a result that supports recent trade models linking exports with wages and the demand for skills.

Irene Brambilla
Calle 6 entre 47 y 48
Departamento de Economía
Universidad Nacional de La Plata
Argentina
and Universidad de San Andrés (UdeSA)
irene.brambilla@econo.unlp.edu.ar

Rafael Dix Carneiro
Fisher Hall - Dept of Economics
Princeton University
Princeton, NJ 08540
rdc@princeton.edu

Daniel Lederman
The World Bank
1818 H Street NW
MSN I-8-801
Washington, DC 20433
DLederman@worldbank.org

Guido Porto
Calle 6 entre 47 y 48
Departamento de Economía
Universidad Nacional de La Plata
Argentina
guido.porto@depeco.econo.unlp.edu.ar

An online appendix is available at:
http://www.nber.org/data-appendix/w15996

1 Introduction

In the field of international trade, the skilled-wage premium is a key parameter linking globalization with income distribution. Goldberg and Pavcnik (2007), for instance, highlight that increases in the returns to schooling might reflect trade-induced skill-biased technical change, a channel through which globalization has benefited skilled workers relative to unskilled workers. Also, Galiani and Porto (2010) explore how tariff reforms have affected the skill premium across time and sectors in Argentina. The skill premium also plays an important role in the literature on international migration and the brain drain (Beine, Docquier and Rapoport, 2001). A central concern is that the education of workers in developing countries might lead to emigration of skilled workers who seek higher wages in developed economies. Thus the issue of the so-called "brain drain" has permeated policy discussions about the developmental consequences of public education policies in poor countries.

In spite of the central role played by the returns to schooling parameter or skill premiums in various literatures of importance for developing countries, there has been surprisingly little research about the relative roles played by industrial structure versus national characteristics in developing countries. If skill premiums vary systematically across industries, then industrial policies that favor one sector over another could have important consequences for closing the gap between the private and social returns to education, for reducing the scope of the brain drain due to emigration of highly educated workers, and for affecting the relationship between globalization and income inequality. Hence this paper can also be seen as a contribution to the literature on whether the industrial composition of exports matter for development as in Hausmann, Hwang, and Rodrik (2005).

This article examines the returns to schooling and skill premiums in Latin America with two objectives. First, we document the patterns of returns to schooling and skill premiums in the region by estimating these parameters with data from eighty-eight household surveys for sixteen countries: Argentina, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Guatemala, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay. The data cover over seven million workers. Our second objective is to explore *industry-specific* returns to schooling and skill premiums in Latin America. Following the

literature on industry wage differentials (Dickens and Katz, 1986; Dickens and Lang, 1988; Gibbons and Katz, 1992), we allow the skill premiums to vary across industries, as in Galiani and Porto (2010).[1] Using the eighty eight household surveys, we estimate and document industry-specific skill premiums for sixty industries in each country.

We then work with those estimates to study the empirical relationship between industry-specific returns to schooling and skill premiums and the level of sectoral exports. Our motivation lies in the work of Bernard and Jensen (1995, 1999), which documents the better performance of exporting firms vis-à-vis firms that sell in domestic markets: exporters are larger, more productive, and pay higher wages.[2] In this paper, we extend this literature by investigating the correlation between exports and the returns to schooling and skill premiums at the industry level.

Brambilla, Lederman, and Porto (2010) review theories linking exports and the skill premium based on skill-intensive activities associated with exports. These include marketing activities as well as quality upgrades (labeling, warranties, certification) needed to export. Using firm-level data from Argentina, the authors find support for such a link. Previous related research by Pavcnik et al. (2004) found a positive partial correlation between export exposure and skill premiums for university graduates in Brazil. In this paper, we generate additional supportive evidence for models of exports and skills. In cross-country, cross-industry regressions we find a positive and statistically significant partial correlation between industry-specific returns to schooling and skill premiums, on the one hand, and sectoral exports on the other hand. This correlation, however, is not large in magnitude: doubling sectoral exports (a reasonable shock in our data) is associated with a 0.26 percentage point increase in the manufacturing-industry returns to education. With an average return of 7.9 percent in the region, this is equivalent to an increase of slightly over 3 percent. The skill premium would increase by 1.8 percentage points. With an average skill premium of around

[1]The existence of skill premiums at the industry level requires either some sort of labor immobility or compensating differentials due to working conditions or efficiency wages. In Galiani and Porto (2010), imperfect labor mobility is generated by union membership. On efficiency wages, see Krueger and Summers (1988).

[2]For details, see Bernard and Wagner (1997), Isgut (2001), Bernard and Jensen (2004), Alvarez and Lopez (2005), De Loecker (2007), Schank, Schnabel, and Wagner (2007), Verhoogen (2008), Clerides, Lach, and Tybout (1998), Pavcnik (2002), and Park, Yang, Shi, and Jiang (2010).

62 percent, this is also equivalent to an increase in the average premium of around 3 percent.

The related analytical issues might have important policy implications. Most countries in Latin America and the Caribbean currently pursue various export-promotion policies, including trade liberalization, export-processing zones, and export promotion agencies. One justification for such policies might be the apparent existence of wage premiums for workers employed by firms that sell a large share of their production abroad. If sectoral wage premiums are in fact related to foreign markets, then export-promotion policies could be welfare enhancing if the private returns to schooling are lower than the social returns to schooling. In other words, such policies could help narrow the gap between the private and social returns to schooling. More generally, industry-specific policies, including other forms of industrial policies, could help reduce the gap between the private and social returns to schooling. However, the existence of export driven industry-specific skill premiums or returns to schooling do not by themselves imply welfare gains from exporting, because they could simply reflect wage inequality.

The rest of this paper is organized as follows. Section 2 reports several estimates of average skill premiums for the countries under investigation. To test their robustness, we discuss results from various model specifications that differ in terms of definitions of skilled workers, sub-samples of the data, and econometric estimators. In addition, Section 2 assesses whether international differences in skill premiums are associated with relative endowments of skilled workers, heterogeneity in the composition of skilled workers, or heterogeneity in gender-specific skill premiums. Section 3 presents estimates of industry-specific skill premiums for 60 tradable and non-tradable sectors covered by the employment survey data, including 23 manufacturing sectors. After a brief analytical discussion of inter-industry wage differentials and the role of exports, we discuss the empirical analysis of exports as determinants of the skilled premium in manufacturing sectors. Section 4 concludes by summarizing the main findings.

2 Estimation of National Skill Premiums

We start by estimating national wage premiums paid to skilled workers using household-level data from sixteen economies: Argentina, Brazil, Bolivia, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Uruguay. In our analysis, we include information on wages, skills, industry affiliation and characteristics of workers from 88 household surveys. Details of the household surveys, years of data and number of observations are found in Table 1. For each country we have between two (Nicaragua) and eight (Dominican Republic, El Salvador, Peru, Uruguay) years of data. We use surveys from 2000 to 2007, and the number of observations by country range from 60,000 in Nicaragua to 1,742,000 in Brazil, covering more than seven million workers.[3]

Table 2 displays descriptive statistics on education and skill levels of the workers. The first two columns show sharp differences in the average number of years of education and in the share of skilled workers (defined as individuals who hold a high school diploma) across countries. Average years of education are comparatively high in Argentina (10.73), Uruguay (9.68), Chile (9.10), Panama (8.97), Colombia (8.55), and Ecuador and the Dominican Republic (around 8). These countries also have the highest shares of skilled workers, ranging from 30 percent in the Dominican Republic to 52 percent in Argentina, although in Colombia the share is relatively lower at 20 percent. The lowest years of education are observed in Nicaragua, Guatemala and Honduras (5.31, 5.70, and 5.92) but the lowest share of skilled workers are observed in Nicaragua and Brazil (9 and 15 percent). In the cases of Argentina and Uruguay, the relatively high averages are partly explained by survey design because the surveys cover only urban households. In the other fourteen countries the surveys are representative of rural and urban populations.

[3]The survey data come from the Socioeconomic Database for Latin America and the Caribbean (SEDLAC), a joint-project of CEDLAS at the Universidad Nacional de La Plata (Argentina) and the World Bank's LAC poverty group (LCSPP). All variables in SEDLAC are constructed using consistent criteria across countries and years and identical programming routines. Note that our sample starts in 2000, because the information on workers' industry affiliation (see Section 3) became comprehensive and consistent only in recent years. Also, the surveys have become more homogeneous in coverage (for most countries we have yearly data) and this makes cross-country analysis more convincing.

Columns 3 and 4 compare male and female workers. For some countries the share of skilled workers is higher among females than among males, most noticeably in Argentina, Brazil, Chile, the Dominican Republic, Honduras, Panama, Paraguay, and Uruguay. This difference ranges from 1 to over 6 percentage points. In contrast, in Colombia, El Salvador, Mexico, Peru and Guatemala the share of skilled workers is between 2 and 4 percentage points higher among males than females.

It is also informative to look at skilled workers at a finer level of disaggregation, as workers of different educational levels are grouped together in the skilled category. Column 5 presents the share of highly-skilled workers conditional on being skilled, that is, the share of workers with more than a high school diploma (individuals with tertiary education, some college experience, college degree, and graduate degrees) in the total number of workers with at least a high school diploma. This statistic indicates the composition of skilled labor in each country. The differences across countries are again sharp, thus implying that the composition of the skilled labor force varies across countries. Countries with high shares of highly-skilled workers in the skilled group (41 to 55 percent) are Colombia, Peru, Mexico and Nicaragua. Notice, for instance, that because Nicaragua has the lowest skill share, the relatively few workers with degrees tend to reach a high educational attainment. Countries with low shares of highly-skilled workers are Argentina, Brazil, El Salvador, Paraguay, Argentina and Chile (22 to 25 percent). The participation of highly-skilled workers in the total labor force can be obtained by multiplying column 5 by column 2.

To estimate the returns to skills by country, we pool data from all years and estimate Mincer-type regressions with the log (hourly) wage of each worker explained by individual worker characteristics. The main variable of interest is a binary variable that indicates whether the worker is skilled or unskilled. The equation to be estimated for each country takes the following standard form:

$$(1) \quad \ln w_{ijt} = \gamma Sk_{ijt} + \mathbf{x}'_{ijt}\beta + \delta_j + \delta_t + \varepsilon_{ijt},$$

Subscript i denotes individuals, j the industry of employment, and t denotes years. The hourly wage is given by w. It is computed as the reported weekly wage divided by the

number of hours worked per week. For robustness, we also estimate the model using the log of total wage income as the dependent variable. In our first specification, we measure skills Sk with years of education and γ is thus interpreted as the returns to schooling. In a second specification, we define skilled workers as those with a high school diploma or more. Thus, the binary variable Sk is equal to one if the individual has at least a high school diploma. In this case, γ measures the skill premium, that is, the percentage difference in wages of skilled workers relative to unskilled workers. In both cases, we control for individual characteristics in the vector $\mathbf{x}$ and for industry and year effects in the indicator variables δ_t and δ_j. The controls included in $\mathbf{x}$ are gender, age and age squared, marital status, whether the individual works full-time or part-time, a dummy for individuals in rural areas, and regional (within countries) dummies. The estimates from these equations are correlations from cross-sections of workers, which raises econometric issues that have been discussed at length in the labor literature (see, for example, Griliches 1977, Card 1999, and Krueger and Lindahl 2001). A key concern in this literature is that the estimated correlations capture the ability or talent of workers, which is correlated with both educational attainment and wages, which would yield upwardly biased estimates of the returns to schooling. On the other hand, because wages and educational attainment are reported by the surveyed workers, the estimates might suffer from attenuation bias due to random reporting errors.[4] Therefore, the econometric results should be interpreted as reduced-form coefficients measuring the average difference in wages between skilled and unskilled workers, not as predictions of the wages that would be received by individual workers who enter the skilled-workers category.

In a second specification, we define two groups of skilled workers: semi-skilled workers (those with a high school diploma) and highly-skilled workers (those with tertiary education, some college, a college degree, or a graduate education). In this case we include two binary variables, Sk^1 for the semi-skilled and Sk^2 for the highly-skilled, as shown in the following

[4]Krueger and Lindahl (2001, p. 1101) conclude in their literature review that there is surprisingly little evidence of ability bias in estimates of the returns to schooling. For our purposes, ability bias is not a serious concern because there is no reason to believe that the magnitude of the ability bias varies across countries. It may vary systematically across industries, which is the focus of sections 3 and 4 below. However, we do want to capture complementarities between unobserved worker ability and skills allocated across sectors.

equation:

$$(2) \quad \ln w_{ijt} = \gamma^1 Sk^1_{ijt} + \gamma^2 Sk^2_{ijt} + \mathbf{x}'_{ijt}\beta + \delta_j + \delta_t + \varepsilon_{ijt},$$

The coefficients γ^1 and γ^2 measure the wage premium for semi-skilled and highly-skilled workers. Both coefficients are defined relative to unskilled workers.

To estimate the returns to skills in equations (1) and (2), we restrict the sample to employed workers between 22 and 65 years of age. We drop employed workers who report a wage of zero. Results are in Table 3.

In column 1, we report the estimates of the returns to schooling. This parameter ranges from a minimum of 5.8 percent in Peru to a maximum of 11.1 percent in Chile. The average return to schooling (unweighted) is 7.9 percent. In all cases, the returns to schooling are, as expected, highly statistically significant. It is worth noting that these estimates tend to be on average lower than existing estimates that are commonly used for international comparisons. For example, for our sample of countries, Psacharopoulus et al. (1996), Psacharopoulus and Patrinos (2004), Giovagnoli et al. (2005) and Sanroman (2006) present estimates that are on average 4.5 percentage points higher than our estimates. These differences are most likely due to the differences in the specification of the wage equation, as this existing literature utilizes the basic Mincerian specification with years of education, age and age-squared as the only regressors.[5]

Estimates of skill premiums based on equation (1) are presented in column 2 of Table 3. The coefficients are interpreted as the percentage difference in wages between skilled (high school diploma) and unskilled workers. For example, in Ecuador the wage of an employed individual with a high school diploma is, on average and after controlling for observable worker characteristics and industry affiliation, 50.8 percent higher than the wage of an employed

[5]The existing estimates cover mostly years from the late 1980s to the early 1990s, but Sanroman (2006) utilizes Uruguayan data from 2001-2005, and Giovagnoli et al. (2005) use Argentine data from 2002. On average, the existing studies cover samples with less education than our more recent data, but the difference (of 0.14 years of schooling) is too small to be the source of the differences in the estimates of the returns to schooling. Also, rising trade and skill-biased technical change would have pushed our estimates upward relative to the previous estimates. Thus most of the differences in the estimates are probably due to differences in the specification of the wage equation.

unskilled worker. Coefficients range from 44 to 91 percent. Brazil shows the highest skill premium, 91.2 percent, and Colombia follows with a premium of 87.6 percent. Countries with returns to skill over 60 percent are Nicaragua, Guatemala, Costa Rica, Honduras, and Mexico. In Chile, Paraguay, Ecuador, and Uruguay the skill premium is above 50 percent. In the remaining countries –Dominican Republic, Panama, Argentina, El Salvador, and Peru– the skill premium ranges from 49 to 44 percent.

Columns 3 and 4 in Table 3 present results from equation (2), where the skill premium is split into the premium for semi-skilled workers and highly-skilled workers. Both premiums are relative to the unskilled category. Thus, in Costa Rica, semi-skilled workers earn on average 54.1 percent more than unskilled workers, and highly-skilled individuals earn 97.7 percent more than the unskilled. Across countries, the premium for semi-skilled workers ranges from 27 (in Peru) to 82.3 percent (in Brazil); the premium for highly-skilled workers ranges from 3.7 (in Peru) to over 110 percent (in Chile and Colombia). In general, countries with a high premium for the semi-skilled also exhibit a high premium for the highly-skilled. The correlation between the two measures is 0.76.

We now turn to several robustness checks. First, the samples used to obtain the results described above include workers in all sectors of the economy and the estimates consequently reveal patterns of skill premiums at the national level. Because section 3 below is about the relationship between industry-specific skill premiums and exports, we also estimated the average skill premium restricting the sample to workers employed in manufacturing sectors only. Our estimates of skill premiums do not differ much from the baseline case where all workers are included in the regressions. In 10 of the 16 countries, the national skill premium is higher than the manufacturing skill premium; in 2 cases (Chile and Colombia), there are almost no differences in those premiums, an in four countries, the premium in manufacturing is actually higher. Among these countries, the maximum difference, in Peru, is of 1.8 percentage points (5.8 percent at the national level and 7.6 percent in the manufacturing sector). In Mexico, the difference is 1.2 percentage points in favor of manufacturing. In all the other cases, the differences are relatively small. In fact, the correlation between the skill premium at the national level and the skill premium in the manufacturing sector is 0.88. To

save space, we do not report these results in the paper, but are available in Table A1 in the on-line appendix.[6]

As additional robustness tests, we restricted the sample to full time workers and experimented with a median regression, which is theoretically less sensitive to outliers. Again, results are very close to the baseline specification. We also explored regressions using the log of total monthly wage income as the dependent variable. The results, reported in Table A2 of the online appendix, remain robust. The correlation between both estimates is very high (0.995). This means that working with monthly wages or with hourly wages is not likely to affect our conclusions, either qualitatively or quantitatively.

Our results uncover considerable differences in the returns to skill across countries. One obvious explanation for the differences in skill premiums could be factor endowments. Comparing the returns to skill presented in column 1 with the skill endowments in Table 2, column 2, we find a negative association between the skill ratio and the skill premium. The correlation between the two variables is –0.63.

Another plausible explanation for the estimated cross-country differences in the average skill premium is gender differences in returns to skill, which could vary across countries as a consequence of cultural attitudes and social norms related to gender. Gender differences in the returns to schooling could also be due to country differences in industrial structure, with some industries employing relatively more (less) female workers with different skill levels. For example, export assembly operations ("maquilas") are known to employ more women than men, and these industries tend to be located in economies that are close to the U.S. market. To explore this possibility, we allow the skill premium to vary by gender by adding an interaction term to the baseline regression:

$$(3) \quad \ln w_{ijt} = \gamma Sk_{ijt} + \widetilde{\gamma} Sk_{ijt} * M_{ijt} + \mathbf{x}'_{ijt}\beta + \delta_j + \delta_t + \varepsilon_{ijt},$$

where M is a binary variable that is equal to one for males (the gender dummy is separately included in $\mathbf{x}$). The skill premium for females is given by γ, while the premium for males is given by $\gamma + \widetilde{\gamma}$, where $\widetilde{\gamma}$ represents the differential skill premium for males. In the case of

[6]The link is `http://sites.google.com/site/guidoportounlp/`.

two skill groups, the regression equation is

$$(4) \quad \ln w_{ijt} = \gamma^1 Sk^1_{ijt} + \widetilde{\gamma}^1 Sk^1_{ijt} * M_{ijt} + \gamma^2 Sk^2_{ijt} + \widetilde{\gamma}^2 Sk^2_{ijt} * M_{ijt} + \mathbf{x}'_{ijt}\beta + \delta_j + \delta_t + \varepsilon_{ijt},$$

where $\widetilde{\gamma}^1$ and $\widetilde{\gamma}^2$ are the differential premiums for semi-skilled and highly-skilled males relative to females.

Results for the differential premiums are displayed in columns 5 to 8 of Table 3.[7] We begin in column 5 with gender differences in the returns to schooling (when Sk is measured with years of education). The male premium ranges from -2 percent (in Colombia and Mexico) to 0.4 percent in Uruguay. In column 6, we report gender differences in the skill premium. They range from negative 19.7 percent (in Guatemala) to positive 15.5 percent (in Nicaragua). Countries with a positive differential for males are Brazil, Nicaragua, Costa Rica, Chile and Uruguay. In almost all other countries, with the exception of a few results that are not statistically significant, the male differential is negative and significant, which implies that the gender wage gap is lower among skilled than among unskilled workers. For most countries, splitting skilled workers into semi-skilled and highly-skilled does not affect the direction of the gender difference in skill premiums, but there are significant international differences in the gender-specific skill premiums.

Because the pattern of these gender-specific premiums is somewhat erratic across countries, our results suggest that the cross-country differences in skill premiums are more likely due to differences in relative factor endowments than to gender differences. Additional support for this conclusion comes from a simplistic regression model with the national skill premium as the dependent variable (and a corresponding sample of sixteen observations) and these two explanatory variables. The results (not reported) show that only the ratio of skilled over unskilled workers is statistically significant with a coefficient estimate of –0.791 and a corresponding p-value for the null hypothesis of 0.025. The male-specific skill premium by country is positive, 0.292, but it is not statistically significant. In fact, the estimate of the skill endowment variable changes only slightly, to –0.885, after the exclusion

[7] In Table A3 of the online appendix, we report robustness results where we run the main specification, equations (1), for a sample of only males.

of the gender-specific premium.

Another plausible explanation for the large differences in skill premiums across countries could be the composition of skill groups, because skilled workers are not homogeneous. In particular, the highly-skilled group includes individuals with tertiary education, some college, a college degree, and a postgraduate degree. Column 9 to 13 of Table 3 present the skill premiums of five groups: individuals who completed elementary school, individuals who did not finish high school, high school graduates, individuals with some college or tertiary education, and college graduates. The results are markedly different across countries even for these arguably more homogeneous groups. Moreover, the average of the five coefficients is highly correlated with the skill premium in that same country (the correlation is 0.72). Thus far, it seems that the skill endowments are our preferred country-level correlate of national skill premiums, but in subsequent exercises (reported in Table 6 and 7) we explore the role of the level of development, proxied by GDP per capita.

3 Industry-Specific Skill Premiums

After this detailed characterization of the national skill premium and its variation across Latin American countries, in what follows we explore cross-country differences in skill premiums *at the industry level*. With perfect factor mobility (and leaving aside compensating differentials), wages should equalize across sectors and there should thus be an aggregate skill premium affecting all skilled workers in the labor market. With departures from that model, including imperfect mobility of skilled labor (but also of unskilled labor), wage equalization does not follow, and skill premiums at the industry level can vary in equilibrium. To investigate this possibility, we augmented our previous model to estimate skill premiums by sector. Specifically, we multiply the skill categories, using the different definitions described above, by dummy variables for each industry code at the 2-digit International Standard Industry Classification (ISIC) Revision 3.[8] The coefficient on this interaction provides an estimate (relative to the industry of reference) of industry-specific skill premiums.

[8]For those surveys that do not use ISIC Rev.3 to classify industries, concordance tables were utilized. See Table A8 of the online Appendix for a list of sectors.

At the 2-digit level, there are 60 sectors in the ISIC Revision 3 classification. With a sample of 16 countries, we estimate approximately 960 industry-skill premiums (which are listed in Table A4, for the case of years of education, and Table A5, for the case of the skilled dummy, in the on-line Appendix). There are significant differences in the skill premiums, both across sectors for a given country and across countries for a given sector. Table 4 presents the distribution of industry-skill premiums within countries. Consistent with the estimates of the aggregate skill premiums (Table 3), there are wide differences in the average (and median) skill premium across countries that unsurprisingly mimic the patterns observed in Table 3. Figure 1 illustrates the notable dispersion in the estimated skill premiums across industries within countries. In addition, there is considerable dispersion in the average skill premium across countries (for a given industry). For instance, the cross-country averages in the skill premium range from 1.12 in sector 99 ("Extra-territorial organization and bodies") to 0.13 in sector 95 ("Private households with employed persons").[9]

3.1 Exports and Industry-Specific Skill Premiums: Theory

Skill premiums are affected by numerous factors, including demand and supply conditions, policies, and various shocks. Our interest in exports as a correlate of the skill premium is motivated by the literature on the wage premia paid by exporters. This literature, pioneered by Bernard and Jensen (1995, 1999) and later complemented by numerous researchers (see for instance the review in Bernand, Jensen, Redding, and Schott 2007), documents the better performance of exporting firms relative to non-exporting firms in terms of employment, wages, and productivity. In this article, we explore a reduced-form analysis to assess sectoral exports as a determinant of industry skill premiums.[10]

Two leading theories explain this potential link between industry exports and skill premiums. One argues that the act of exporting requires activities that are skill-intensive, although

[9] We also investigated the dispersion of skill premiums (across sectors and countries) for the semi-skilled and highly-skilled categories. There is still significant dispersion in the premiums. For the highly-skilled, for instance, the highest average premium is estimated for Chile (1.23) and the lowest for Uruguay (0.64). For the semi-skilled, the highest premium appears in Brazil (0.88) and the lowest in Peru (0.27) and Uruguay (0.24).

[10] In a related paper, Brambilla, Lederman and Porto (2010) develop a model of exports and skills tested with firm data from Argentina.

the production of the good may require unskilled labor. Exporting firms, and therefore industries with more exports in general, will thus demand higher skills and pay a higher skill premium.[11] The alternative theory argues that exporting is associated with higher profits (because more productive firms self select into exports) and these higher profits are shared with the workers via profit sharing rules.

The theory focusing on the need to engage in skill-intensive activities in order to export a product is based on Brambilla, Lederman, and Porto (2010). For our present purposes, we assume that skilled labor is imperfectly mobile, as in Goldberg and Pavcnik (2005), Ferreira et al. (2008), and Galiani and Porto (2010). Unskilled workers are perfectly mobile across sectors and earn the economy-wide competitive wage, w_u. While total labor supply in a given industry may be fixed due to labor specificity, workers can be induced to supply more effort at higher offered wages. In Figure 2, for instance, the relationship between effective skilled labor supply in industry j and skilled wages w_s is increasing (the function $L_s(w_s)$).

Exporting requires both the production of the physical units of the product and the provision of export services. These services include labeling, marketing, technical support, consumer support (webpage, email, warranty).[12] Brambilla, Lederman, and Porto (2010) assume that these export services are skill-intensive activities because they require the effort L_s of highly skilled managers and engineers. It follows that the demand for the effort of skilled labor in industry j will depend on the level of exports of the industry.[13] In Figure 2, we plot two such demand functions for two industries with different levels of exports, $Exp_H > Exp_L$; the high-export industry has a higher demand for skilled workers.

As Figure 2 shows, the high-export sector pays higher wages to their skilled workers. Since the wage offered to the unskilled workers is assumed to be the same across industries (given by the competitive national market for unskilled labor), it follows that high-export sectors pay a higher skilled premium.

An alternative theory is based on profit sharing mechanisms. In the trade literature, profit sharing originates in a fair-wage hypothesis, as in Egger and Kreickemeier (2009) and

[11] Exporters could either hire more skilled workers or provide on-the-job training.

[12] In Manasse and Turrini (2001) and Verhoogen (2008), exporting requires quality upgrades.

[13] The demand for unskilled labor may depend on exports. For illustration purposes, this is not really relevant in our discussion. See Brambilla, Lederman, and Porto (2010) for details.

Amiti and Davis (2008). In short, skilled workers demand a wage premium to exert the necessary effort because it is considered fair to share the profits of the firms. In consequence, while marginal firms pay the competitive outside wage, more profitable firms pay increasingly higher wages. In Figure 3, this is represented by the fair-wage constraint $w_s = \phi(\pi)$, where $\phi(\cdot)$ is increasing in the level of profits π.

Profits, on the other hand, are a decreasing function of the wages offered to skilled workers. This is represented by the function $\pi(w_s)$ in Figure 3. In addition, following Melitz (2003), we assume that profits are higher for exporters, and consequently the profit function $\pi(w_s)$ of high export sectors are higher, for a given level of wages, than in low export sectors. In equilibrium, high-export firms offer higher wages w_s to skilled workers. Together with competitive labor markets for unskilled labor with equilibrium wages w_u and some degree of specificity of skilled labor (as before), in the end the industry-specific skill premium is an increasing function of the level of sectoral exports.

It is worth noting that the theories described above imply that exports either demand higher skills (observed and unobserved, thus including innate worker ability) or offer higher profits, which can be shared with skilled workers. The empirical exercises that follow, however, should not be interpreted strictly as as tests of exports as causing high skill premiums. This would be the case only if exports are strictly exogenous and industry-specific demand for skilled workers does not by itself cause exports. As will become apparent, it is somewhat comforting that the effects of industry-specific exports appear correlated with skill premiums even after controlling for industry-specific effects. Still, the results must be interpreted with caution because it does not follow that skilled workers that move from an industry with low estimated premiums to another with higher premiums will receive higher wages. This is so because industries and exports may require specific skills that may not be transferable to other activities.

3.2 Exports and the Industry-Specific Skill Premiums: Evidence

Figure 4 summarizes our claim: The skill premium rises with exports (as a share of GDP) across Latin American manufacturing industries. The remainder of this section explores

this statistical relationship. As a first step, we assessed the role of country and industry dummies by estimating three sets of regressions where industry-country skill premiums are explained by i) country dummies alone; ii) industry dummies alone; and iii) country and industry dummies. Country dummies alone account for 32 percent of the variance of the skill premium, industry dummies alone account for 37 percent, and both sets of dummies jointly explain around 66 percent. The dummies are always jointly statistically significant. For the manufacturing sector, country dummies account for 51 percent and industry dummies for 19 percent. In contrast, country dummies account for 27 percent in the non-tradable sector, whereas industry dummies account for 48 percent. These findings suggest a stronger role of country variables for the manufacturing sector but a stronger role for industry variables in the non-tradable sector.

To study whether sectoral exports are an important determinant of the industry-specific skill premiums, we estimated several versions of the following model:

$$(5) \quad \gamma_{jc} = \alpha \ln\left(\frac{export_{jc}}{gdp_c}\right) + \mathbf{z}'_{jc}\beta + \phi_j + \phi_c + \mu_{jc}.$$

The skill premium in industry j, country c (γ_{jc}), is a function of the ratio of sector j exports in country c to GDP ($export_{jc}/gdp_c$). The coefficient of interest is α. The model can include industry effects ϕ_j, country effects, ϕ_c, as well as other country-sector characteristics ($\mathbf{z}_{jc}$). The model was estimated with weighted least squares, where the weights are the inverse of the standard errors of the sectoral skill premiums. This GLS strategy accounts for the fact that the industry-specific skill premiums are estimated (in equations (1) or (2), for instance). Note that we do not attach a causal interpretation to our estimates. In fact, our results have a reduced-form interpretation, namely to illustrate whether the data support any link between sectoral exports and the skill premiums.

Table 5 presents the results. In Panel A), the return to schooling (the coefficient of years of education) is the dependent variable γ_{jc}; and in Panel B), the coefficient of the dummy representing skilled workers is the dependent variable. Column 1 shows the estimate of the model when the skill premiums are regressed on a constant and the log of the ratio of exports over GDP. The estimate for α is positive and significant, thus suggesting that the skill

premium rises with exports. The estimates in column 1 imply that doubling a sector's share of exports over GDP (or a change in the log of exports over GDP equal to one) is associated with an increase of 0.0025 in the return to schooling (Panel A) and with an increase of 0.033 in the skill premium. The latter finding suggests that the wage differential between skilled and unskilled workers rises by 3.3 percentage points. Notice that the simulated shock of a change of 1 in the log of exports over GDP is reasonable because the standard deviation of the variable in our sample is about 2.1. Thus this association is positive and significant but it is not very large when compared to the average skill premium of 62 percent or its standard deviation of 36 percent (recall Table 4).

In columns 2 to 5 of Table 5, we perform several robustness tests. Column 2 shows the results from the estimation of (5) with industry dummies. The incidence of industry exports remains significant, with a similar magnitude as in column 1. Column 3 includes country dummies only, and the link between exports and the skill premium disappears. In Column 4, we include both sets of dummies and the partial correlation remains insignificant. Controlling for both country and industry dummies might be too restrictive, however. Country fixed effects explain about a third of the variation in skill premiums, and both country and industry dummies account for about 60 percent. This leaves little room for exports to explain the skill premium because much of the variation of the dependent variable is attenuated by the dummies.

To learn more about the role of sectoral exports, we work with a more parsimonious version of equation (5) where instead of country dummies we control for country characteristics, namely the log of per capita GDP and the ratio of skilled (high school completed) over unskilled labor. These results are reported in column 5 of Table 5. Both per capita GDP and the skill composition are statistically significant determinants of the industry-country skill premiums (using both years of education or a skilled worker dummy) with the expected signs: disparities between skilled and unskilled wages rise with GDP per capita, and countries with a greater fraction (supply) of skilled workers pay lower skill premiums. The significance of these variables supports their use in lieu of the country fixed effects. Also, the R^2 of the model remains high (at 0.485 in Panel A and 0.619 in Panel B), which is much higher than

the R^2 from the model with country dummies. Note that, in these models (column 5), the coefficient of exports as a fraction of GDP is positive and statistically significant, and the estimates are of similar magnitude as those reported in columns 1 and 2.

While these results suggest a positive partial correlation between exports and the skill premium, the fact that this correlation does not survive the inclusion of country fixed effects deserves further attention. What country characteristics that are correlated with exports and skill premiums might be lurking behind the country effects? One candidate provided by the literature is school coverage. As pointed out by Card (1991), countries with higher school coverage may also provide education of lower quality (or to students from relatively poor families) thus reducing the magnitude of estimated skill premiums. Another factor that may affect the results is the business climate, which may facilitate exports and allow firms to pay higher wages for skill labor at the same time. Using data from the World Bank's *Doing Business* database, we add two controls in our regressions, the lead time to export measured by the number of days and an index of the ease for doing business in each country. The corresponding results are reported in columns 6 and 7 of Table 5. Even after controlling for these country characteristics, the positive partial correlation between sectoral exports and the industry-country skill premium remains statistically significant. This occurs for both dependent variables, returns to schooling (Panel A) and the skill premium (Panel B).

Yet another factor that may contaminate our results is firm size.[14] If, for instance, labor turnover is an issue, larger firms may need to pay higher wages (especially to skilled workers) to retain workers. Alternatively, if larger firms offer more stable employment prospects, smaller firms may need to pay higher premiums to attract (skilled) workers. In any case, failure to control for firm size may bias our results. Unfortunately, the household surveys in Latin America do not report data on firm characteristics. However, data from UNIDO, compiled by Nicita and Olarreaga (2007), provides information to construct a measure of the average size of firms at the sector level for all countries in our sample except Uruguay. The UNIDO data includes the number of establishments and the total number of employees in each industry-country, and we use the ratio of these two variables (aggregated at the 2-digit

[14]We thank a referee for pointing this out.

level) to control for firm size. The results of the estimations that include this variable are in columns 8 and 9. We find, especially in Panel A, that firm size is negatively correlated with the skill premium (which indicates that the mechanisms outlined here could be of practical relevance). More importantly for our purposes, exports remain positive and statistically significant.

We performed two additional robustness tests. First, we estimated all model specifications reported in Table 5 but with monthly total wages as the dependent variable. Second, we estimated all the models on the skill premiums with male workers. Results are reported in Tables A6 and A7 of our online appendix, and sectoral exports are positive and statistically significant.[15]

Thus far, the most important finding in Table 5 (and in the robustness checks in the appendix) is that, after controlling for industry fixed effects, country characteristics such as per capita GDP, relative endowments, enrollment rates, export constraints, and the cost of doing business, the data still suggests a positive and statistically significant partial correlation between exports and skill premiums. We finish by studying other trade-related determinants of industry skill premiums. Unit values, which are proxies for product quality, might also be important. A model of the impact of quality upgrading on wage inequality (or increases in skill premiums) is developed and estimated by Verhoogen (2008). Product variety, measured by the dispersion of unit values within industries, might be a correlate of skill premiums. Perhaps firms in sectors with wide scope for product differentiation can exercise monopoly power, charge higher mark-ups, and perhaps pass-on those profits to their workers. Alternatively, product differentiation itself might require skilled labor.

The calculation of unit values using data from the U.N. Comtrade database is not straightforward and inevitably brings measurement errors. We used three different measures for unit

[15]It is worth recalling that this finding does not necessarily mean that increasing exports, which raise skill premiums and the returns to schooling, will raise social welfare. Indeed, the results suggest that exports raise the wage gap between skilled and unskilled workers. A remaining issue is whether exports raise wage inequality above and beyond their effects on the skill premium. To explore this issue, we estimated auxiliary models with the ratio of wage-equation residuals of the 90th percentile over the bottom 10th percentile as the dependent variable, following the same structure of explanatory variables presented in Table 5. These results, available from the online appendix, suggest that exports do not robustly raise wage-residual dispersion. We are indebted to an anonymous referee for raising this issue related to wage inequality.

values to test the robustness of the partial correlation between exports and skill premiums.

Some empirical issues need to be addressed, however. First, in Comtrade, recorded transactions for a single HS code appear with different quantity codes. To address this concern, for a given HS code, we pooled data from all countries and picked the quantity code that is reported most frequently. For the calculation of unit values, we only considered those transactions that were reported in the "most frequent quantity code," to make sure that unit values for a given HS code are expressed in the same units across countries. Unit values were then aggregated to the ISIC Rev 3, 2-digit level by taking weighted averages (weights are given by the importance of a given HS code exports on total exports of the corresponding 2-digit ISIC industry). The indicator of the dispersion of unit values is the variance of unit values across HS codes within a country and 2-digit ISIC industry.

Second, unit values are highly dispersed, and therefore we used the median unit values (without any weighting) as a second measure of unit values. The corresponding indicator of dispersion is still the variance of unit values.

Third, to account for outliers we trimmed the top and bottom five percent of the observations on unit values. In turn, we calculated the weighted average within countries and 2-digit ISIC industries as in the first approach.

The regression model is similar to equation (5). That is, we regress the skill premium in industry j and country c on the measures of unit values and the variance of unit values plus industry dummies and national characteristics instead of country dummies, namely the log of per capita GDP and the ratio of skilled to unskilled endowments.[16] The main results are in Table 6. Each panel (A to C) in the table corresponds to one of the three indicators of unit values. In columns 1-3, the dependent variables is the return to years of schooling, and in columns 4-6, it is the skill premium (with skills measured with a dummy variable).

Our first conclusion is that neither unit values nor the dispersion of unit values explain the skill premium. While these results appear robust, it is always plausible that they are the consequence of noise in the unit values. For instance, in specification in which we trim the top and bottom 5% of the unit values, the dispersion in unit value becomes significant in

[16]These results are not reported for the sake of brevity.

some regressions. This result hints at the relevance of the scope for product differentiation.

Nevertheless, the key finding from Table 6 is that in all models that control for unit values, sectoral exports are *still* significant in explaining skill premiums. Also, the magnitudes of the estimates are similar to those in Table 5. This robustness test supports the view that exports significantly affect the premium paid for skills at the industry level.

4 Concluding Remarks

This paper studied the returns to schooling and the skill premium in Latin America and the Caribbean and its correlation with exports. We first estimated and described national skill premiums for over seven million workers from sixteen countries. Motivated by recent models featuring limited inter-industry factor mobility, we estimated industry-specific skill-premiums for sixty 2-digit ISIC sectors. Finally, we investigated reduced-form regressions linking these country-industry skill premiums with exports.

An interesting and previously unknown finding is that unobserved industry- and country-specific effects jointly explain over 60 percent of the observed variance in the skill premium. Each set of factors has about the same explanatory power for skill premiums in manufacturing sectors. It is thus not clear that industrial policies would succeed anymore than industry-neutral national policies in changing the skill premium. In addition, sectoral exports are related to sectoral skill premiums: sectors with higher exports pay higher skilled premiums. This evidence supports recent trade theories linking exports to wages and to skills, as in Brambilla, Lederman and Porto (2010) and Verhoogen (2008), and it highlights the need for further research to understand the mechanisms at work. However, the welfare implications of these results remain unclear, because export-driven skill premiums would raise national welfare only if there is a gap between the social and private returns to schooling. If not, raising skill premiums by raising exports would only result in an increase in wage inequality between skilled and unskilled workers.

References

Alvarez, R. and López, R.A. (2005). "Exporting and Performance: Evidence from Chilean Plants." *Canadian Journal of Economics* 38: 1384-1400.

Amiti, M. and D. Davis (2008). "Trade, Firms, and Wages: Theory and Evidence." National Bureau for Economic Research Working Paper No. 14106, Cambridge, Massachusetts.

Beine, M., F. Docquier, and H. Rapoport (2001). "Brain Drain and Economic Growth: Theory and Evidence." *Journal of Development Economics* 64(1): 275-289.

Bernard, A. and J. Jensen (1995). "Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987." *Brooking Papers on Economic Activity: Microeconomics* 1995: 67-119.

Bernard, A. and J. Jensen (1999). "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics* 47: 1-25.

Bernard, A. and J. Wagner (1997). "Exports and Success in German Manufacturing." *Weltwirtschaftliches Archiv* 133: 134-157.

Bernard, A.B. and Jensen, J.B. (2004). "Why Some Firms Export." *Review of Economics and Statistics* 86: 561-569.

Bernard, A., B. Jensen, S. Redding, and P. Schott (2007). "Firms in International Trade." *Journal of Economic Perspectives* 21(3): 105130.

Brambilla, I., D. Lederman, and G. Porto (2010). "Exports, Export Destinations and Skills." National Bureau for Economic Research Working Paper No. 15995, Cambridge, Massachusetts.

Card, D. (1999). "The Causal Effect of Education on Earnings," in A. Orley and D. Card, editors, *Handbook of Labor Economics, Vol. 3*, pp. 1801-1863. Amsterdam: Elsevier Science B.V.

Clerides, S., S. Lach, and J. Tybout (1998). "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco." *Quarterly Journal of Economics* 108(3): 903-947.

De Loecker, J. (2007). "Do Exports Generate Higher Productivity? Evidence from Slovenia." *Journal of International Economics* 73: 6998.

Dickens, W. and L. Katz (1987). "Inter-Industry Wage Differences and Industry Characteristics," in K. Lang and J. Leonard, editors, *Unemployment and the Structure of Labor Markets*. New York and Oxford: Basil Blackwell: Basil Blackwell.

Dickens, W. and K. Lang (1988). "Labor Market Segmentation and the Union Wage Premium." *Review of Economics and Statistics* 70(3): 527-530.

Egger H. and U. Kreickemeier (2009). "Firm Heterogeneity And The Labor Market Effects of Trade Liberalization." *International Economic Review* 50(1): 187-216.

Ferreira, F., P. Leite and M. Wai-Poi (2007). "Trade Liberalization, Employment Flows, and Wage Inequality in Brazil." World Bank Policy Research Working Paper No. 4108, Washington, DC.

Galiani, S. and G. Porto (2010). "Trends in Tariff Reforms and in the Structure of Wages." *The Review of Economics and Statistics* 92(3): 482-494.

Gibbons, R. and L. Katz (1992). "Does Unmeasured Ability Explain Inter-Industry Wage Differentials?" *Review of Economic Studies* 59: 515-35.

Giovagnoli, P., A. Fizsbein and H. Patrinos. 2005. "Estimating the Returns to Education in Argentina: 1992-2002." World Bank Policy Research Working Paper No. 3715, Washington, DC.

Goldberg, P. and N. Pavcnik (2005). "Trade, Wages, and the Political Economy of Trade Protection: Evidence from the Colombian Trade Reforms." *Journal of International Economics* 66: 75-105.

Goldberg, P. and N. Pavcnik (2006). "Distributional Effects of Globalization in Developing Countries." *Journal of Economic Literature* 45(1): 39-82.

Griliches, Z. (1977). "Estimating the Returns to Schooling: Some Econometric Problems." *Econometrica* 45: 1-22.

Hausmann, R., J. Hwang, and D. Rodrik (2005). "What You Export Matters." *Journal of Economic Growth* 12: 1-25.

Isgut, A. (2001). "What's Different about Exporters? Evidence from Colombian Manufacturing." *Journal of Development Studies* 37(5): 57-82.

Krueger, A. B., and M. Lindahl (2001). "Education for Growth: Why and For Whom?" *Journal of Economic Literature* 39(4) 1101-36.

Krueger, A. B., and L. H. Summers (1988). "Efficiency Wages and Inter-Industry Wage Structure." *Econometrica* 56(2) 259-93.

Manasse, P. and A. Turrini (2001). "Trade, Wages, and 'Superstars'." *Journal of International Economics* 54: 97-117.

Melitz, M. (2003). "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71(6): 1695-1725.

Nicita, A. and M. Olarreaga (2007). "Trade, Production, and Protections Database, 1976-2004." *World Bank Economic Review* 21: 165-171.

Park, A., D. Yang, X. Shi, and Y. Jiang (2010). "Exporting and Firm Performance: Chinese Exporters and the Asian Financial Crisis." *The Review of Economics and Statistics* 92(4): 822-42.

Pavcnik, N. (2002). "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants." *Review of Economic Studies* 69(1): 245-76.

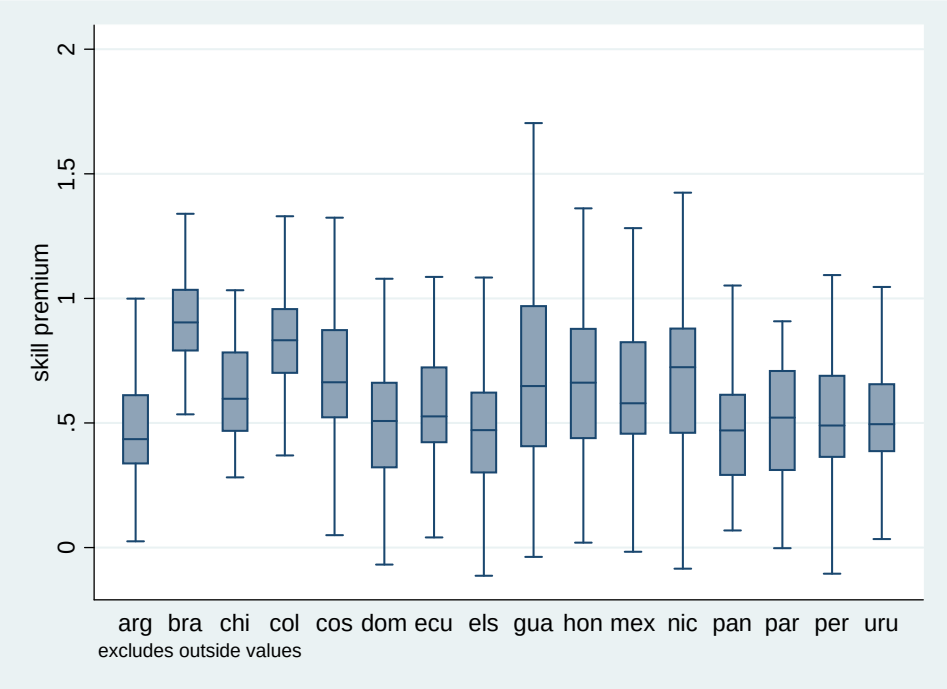
Pavcnik, N., A. Blom, P. Goldberg, and N. Schady (2004). "Trade Liberalization and Industry Wage Structure: Evidence from Brazil." *World Bank Economic Review* 18(3): 319-44.

Sanroman, G. (2006). "Returns to Schooling in Uruguay." Working Paper No. 1406, Departamento de Economia, Universidad de la Republica, Uruguay.

Schank, T., C. Schnabel, and J. Wagner (2007). "Do Exporters Really Pay Higher Wages? First Evidence from German Linked Employer-Employee Data." *Journal of International Economics* 72(1): 52-74.

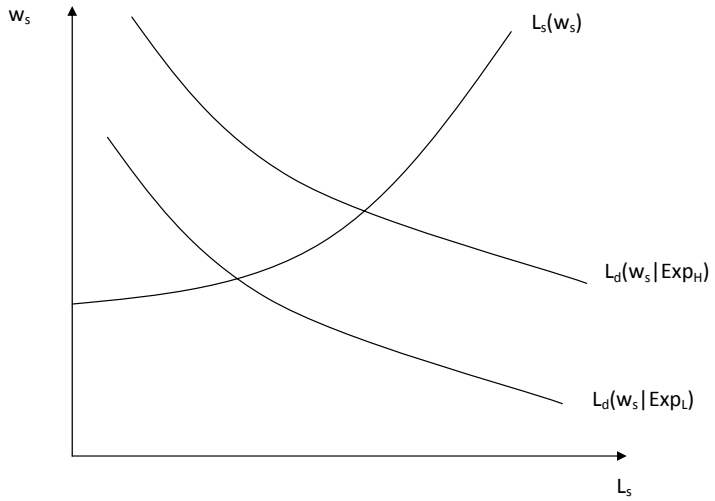
Verhoogen, E. (2008). "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector." *Quarterly Journal of Economics* 123(2): 489-530.

Figure 1
Skill Premium by Industry



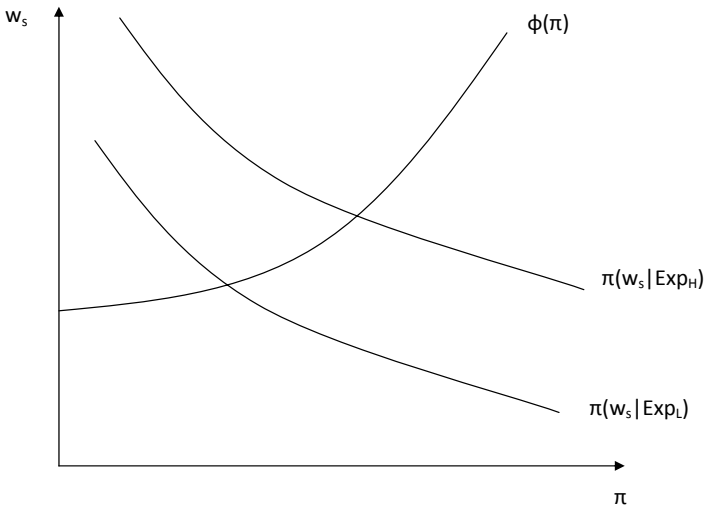
Graph displays skill premiums that are industry and country specific.

Figure 2
Industry Exports and Industry Skill Premium
Skill Intensive Tasks



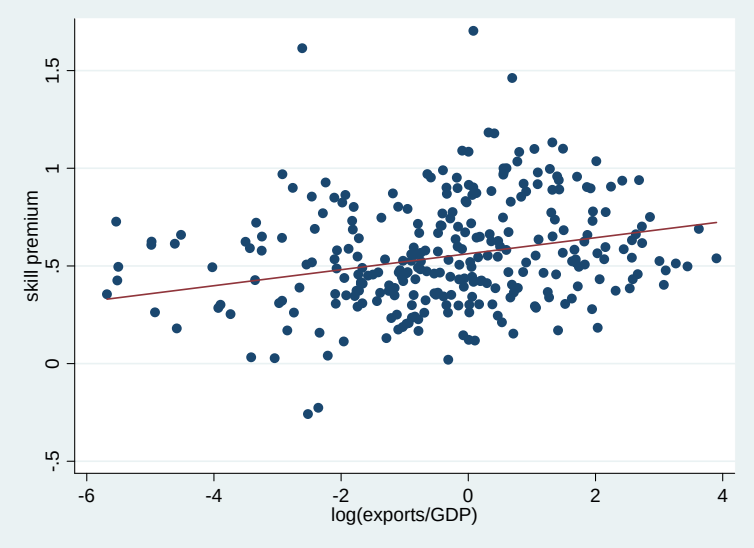
Note: Equilibrium wages for skilled workers in industries with different levels of exports in a model of skill-intensive exports. The curve $L_s(w_s)$ is the supply of skilled labor. The curve $L_d(w_s)$ is the industry demand for skilled labor, which depends positively on the level of sectoral exports.

Figure 3
Industry Exports and Industry Skill Premium
Fair Wages and Profit Sharing



Note: Equilibrium wages for skilled workers in industries with different levels of exports in a model of fair-wages. The curve $\phi(\pi)$ is the supply of effort of skilled workers. The curve $\phi(w_s|\cdot)$ shows that profits are decreasing in wages. For a given w_s, profits are increasing in the level of exports.

Figure 4
Industry Exports and Industry Skill Premium
Cross-Latin American Correlation



Note: Scatter plot and linear fit of the skill-premium (at 2-digit level) and the level of sectoral exports (relative to GDP).

TABLE 1. Description of Household Surveys

Country	Name of Survey	Survey years	Obs.
Argentina	Encuesta Permanente de Hogares (EPH-C) semestre II	2003, 2004, 2005, 2006	339,884
Brazil	Pesquisa Nacional por Amostra de Domicilios (PNAD)	2002, 2003, 2004, 2005, 2006, 2007	1,742,448
Chile	Encuesta de Caracterización Socioeconómica Nacional (CASEN)	2000, 2003, 2006	778,698
Colombia	Encuesta Continua de Hogares (ECH)	2001, 2003, 2004, 2006	436,111
Costa Rica	Encuesta de Hogares de Propósitos Múltiples (HPM)	2001, 2002, 2003, 2004, 2005, 2006, 2007	308,502
Dominican Rep.	Encuesta Nacional de Fuerza de Trabajo (ENFT) onda Octubre	2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007	213,080
Ecuador	Encuesta de Empleo, Desempleo y Subempleo (ENEMDU)	2003, 2004, 2005, 2006, 2007	397,296
El Salvador	Encuesta de Hogares de Propósitos Múltiples (EHPM)	2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007	546,543
Guatemala	Encuesta Nacional de Empleo e Ingresos (ENEI)	2002, 2003, 2004	91,343
Honduras	Encuesta Permanente de Hogares de Propósitos Múltiples (EPHPM)	2001, 2003, 2004, 2005, 2006	312,118
Mexico	Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH)	2000, 2002, 2004, 2005, 2006	384,168
Nicaragua	Encuesta Nacional de Hogares sobre Medición de Nivel de Vida (EMNV)	2001, 2005	59,424
Panama	Encuesta de Hogares (EH)	2001, 2002, 2003, 2004, 2005, 2006	314,531
Paraguay	Encuesta Permanente de Hogares (EPH)	2002, 2003, 2004, 2005, 2006, 2007	158,762
Peru	Encuesta Nacional de Hogares (ENAHO)	2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007	595,917
Uruguay	Encuesta Continua de Hogares (ECH)	2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007	657,911

Table lists the surveys used in the estimation of the national-level and industry-specific skil premiums

TABLE 2. Skill Endowments

Country	Average years of education	Share of skilled workers[a]			Share of highly-skilled workers[b]		
		All	Male	Female	All	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Argentina	10.73	0.52	0.49	0.54	0.24	0.24	0.24
Brazil	7.37	0.15	0.13	0.17	0.25	0.29	0.22
Chile	9.10	0.40	0.39	0.41	0.24	0.25	0.24
Colombia	8.55	0.20	0.21	0.19	0.55	0.55	0.54
Costa Rica	7.68	0.18	0.18	0.18	0.34	0.35	0.32
Dominican Rep.	8.02	0.30	0.28	0.33	0.34	0.34	0.34
Ecuador	8.06	0.32	0.32	0.32	0.33	0.33	0.32
El Salvador	6.20	0.23	0.24	0.22	0.22	0.21	0.17
Guatemala	5.70	0.19	0.22	0.16	0.27	0.32	0.22
Honduras	5.92	0.19	0.19	0.20	0.30	0.37	0.24
Mexico	7.94	0.27	0.28	0.26	0.41	0.45	0.37
Nicaragua	5.31	0.09	0.09	0.09	0.46	0.49	0.42
Panama	8.97	0.37	0.34	0.40	0.31	0.28	0.34
Paraguay	7.45	0.25	0.25	0.26	0.23	0.23	0.23
Peru	7.98	0.23	0.24	0.21	0.45	0.45	0.46
Uruguay	9.68	0.33	0.30	0.35	0.35	0.32	0.37

(a): Share of workers with a high school diploma or more (skilled) in the total number of workers. (Semi-skilled + Highly-skilled)/(Unskilled + Semi-skilled + Highly-skilled).
Summay statistics for the skill premium. Based on estimates from a low age regression on a skill dummy (column (2) of Table 3).

TABLE 3. Skill Premium

Country	Years of Education	Average Premium			Gender Differences								
		Skill Premium	Semi-skilled	Highly-skilled	Years of Education	Skill Premium	Semi-Skilled	Highly-Skilled	Element.	Some HS	HS Diploma	Some College	College Degree
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Argentina	**0.078*** **	**0.481*** **	**0.383*** **	**0.819*** **	**-0.008*** **	**-0.075*** **	**-0.076*** **	**-0.040*** **	**0.187*** **	**0.324*** **	**0.523*** **	**0.716*** **	**1.030*** **
	(0.001)	(0.005)	(0.005)	(0.008)	(0.001)	(0.010)	(0.011)	(0.014)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)
Brazil	**0.097*** **	**0.912*** **	**0.823*** **	**1.008*** **	**-0.002*** **	**0.128*** **	**0.106*** **	**0.128*** **	**0.263*** **	**0.308*** **	**0.532*** **	**0.926*** **	**1.396*** **
	(0.000)	(0.002)	(0.003)	(0.004)	(0.000)	(0.005)	(0.005)	(0.008)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)
Chile	**0.111*** **	**0.574*** **	**0.373*** **	**1.102*** **	**-0.001*** **	**0.014*** **	**-0.023*** **	**0.053*** **	**0.151*** **	**0.247*** **	**0.489*** **	**0.827*** **	**1.317*** **
	(0.000)	(0.004)	(0.004)	(0.005)	(0.001)	(0.007)	(0.007)	(0.009)	(0.006)	(0.005)	(0.005)	(0.007)	(0.006)
Colombia	**0.089*** **	**0.876*** **	**0.569*** **	**1.130*** **	**-0.020*** **	**-0.067*** **	**-0.088*** **	**-0.051*** **	**0.186*** **	**0.308*** **	**0.518*** **	**0.916*** **	**1.358*** **
	(0.001)	(0.007)	(0.009)	(0.008)	(0.001)	(0.012)	(0.017)	(0.014)	(0.007)	(0.007)	(0.008)	(0.012)	(0.009)
Costa Rica	**0.086*** **	**0.700*** **	**0.541*** **	**0.977*** **	**-0.005*** **	**0.029*** **	**-0.014*** **	**0.069*** **	**0.135*** **	**0.285*** **	**0.487*** **	**0.941*** **	**1.353*** **
	(0.001)	(0.009)	(0.010)	(0.013)	(0.002)	(0.017)	(0.020)	(0.025)	(0.011)	(0.013)	(0.014)	(0.014)	(0.022)
Dominican Rep.	**0.061*** **	**0.489*** **	**0.282*** **	**0.908*** **	**-0.008*** **	**-0.055*** **	**-0.064*** **	**0.013*** **	**0.130*** **	**0.185*** **	**0.302*** **	**0.491*** **	**1.019*** **
	(0.001)	(0.007)	(0.007)	(0.009)	(0.001)	(0.012)	(0.014)	(0.016)	(0.009)	(0.009)	(0.009)	(0.011)	(0.010)
Ecuador	**0.071*** **	**0.508*** **	**0.363*** **	**0.890*** **	**-0.011*** **	**-0.110*** **	**-0.152*** **	**-0.033*** **	**0.195*** **	**0.300*** **	**0.499*** **	**0.785*** **	**1.126*** **
	(0.001)	(0.006)	(0.006)	(0.008)	(0.001)	(0.010)	(0.011)	(0.014)	(0.007)	(0.009)	(0.009)	(0.010)	(0.010)
El Salvador	**0.058*** **	**0.472*** **	**0.339*** **	**0.788*** **	**0.000*** **	**-0.032*** **	**-0.078*** **	**-0.066*** **	**0.132*** **	**0.184*** **	**0.336*** **	**0.603*** **	**1.016*** **
	(0.001)	(0.006)	(0.006)	(0.009)	(0.001)	(0.010)	(0.011)	(0.009)	(0.006)	(0.011)	(0.006)	(0.009)	(0.009)
Guatemala	**0.081*** **	**0.744*** **	**0.619*** **	**1.066*** **	**-0.016*** **	**-0.197*** **	**-0.192*** **	**-0.318*** **	**0.259*** **	**0.367*** **	**0.777*** **	**0.988*** **	**1.362*** **
	(0.002)	(0.020)	(0.022)	(0.032)	(0.003)	(0.036)	(0.040)	(0.063)	(0.017)	(0.023)	(0.022)	(0.037)	(0.034)
Summay statistics f	**0.083*** **	**0.716*** **	**0.552*** **	**1.021*** **	**-0.006*** **	**-0.001*** **	**-0.071*** **	**-0.068*** **	**0.235*** **	**0.426*** **	**0.730*** **	**0.949*** **	**1.476*** **
Mexico	**0.087*** **	**0.676*** **	**0.464*** **	**1.033*** **	**-0.021*** **	**-0.138*** **	**-0.283*** **	**-0.056*** **	**0.237*** **	**0.396*** **	**0.697*** **	**0.975*** **	**1.320*** **
	(0.001)	(0.012)	(0.014)	(0.016)	(0.002)	(0.022)	(0.026)	(0.029)	(0.015)	(0.015)	(0.018)	(0.023)	(0.020)
Nicaragua	**0.065*** **	**0.735*** **	**0.447*** **	**1.023*** **	**0.000*** **	**0.155*** **	**0.024*** **	**0.221*** **	**0.129*** **	**0.278*** **	**0.413*** **	**0.613*** **	**1.174*** **
	(0.002)	(0.023)	(0.030)	(0.030)	(0.003)	(0.042)	(0.057)	(0.055)	(0.021)	(0.020)	(0.026)	(0.039)	(0.031)
Panama	**0.078*** **	**0.487*** **	**0.340*** **	**0.889*** **	**-0.013*** **	**-0.124*** **	**-0.136*** **	**0.017*** **	**0.194*** **	**0.327*** **	**0.526*** **	**0.823*** **	**1.234*** **
	(0.001)	(0.006)	(0.006)	(0.008)	(0.001)	(0.011)	(0.012)	(0.014)	(0.009)	(0.009)	(0.010)	(0.011)	(0.011)
Paraguay	**0.077*** **	**0.528*** **	**0.432*** **	**0.926*** **	**-0.001*** **	**-0.069*** **	**-0.072*** **	**0.009*** **	**0.165*** **	**0.355*** **	**0.545*** **	**0.731*** **	**1.107*** **
	(0.001)	(0.011)	(0.012)	(0.018)	(0.002)	(0.019)	(0.021)	(0.032)	(0.012)	(0.013)	(0.017)	(0.017)	(0.019)
Peru	**0.058*** **	**0.442*** **	**0.270*** **	**0.737*** **	**-0.009*** **	**-0.137*** **	**-0.153*** **	**-0.130*** **	**0.165*** **	**0.258*** **	**0.331*** **	**0.506*** **	**0.800*** **
	(0.001)	(0.006)	(0.006)	(0.008)	(0.001)	(0.010)	(0.012)	(0.013)	(0.007)	(0.008)	(0.007)	(0.010)	(0.008)
Uruguay	**0.086*** **	**0.539*** **	**0.411*** **	**0.834*** **	**0.004*** **	**0.037*** **	**0.024*** **	**0.112*** **	**0.186*** **	**0.416*** **	**0.658*** **	**0.812*** **	**1.196*** **
	(0.000)	(0.003)	(0.004)	(0.005)	(0.001)	(0.006)	(0.007)	(0.009)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)

Column (1): Log wage regression on years of education (returns to schooling); Columns (2): Low wage regression with skill dummy (returns to skill); Columns (3)-(4): Log wage regression with a semi-skilled and highly-skilled dummies. All resuts are relative to unskilled dummy (the omitted category). Columns (5)-(8) display differences in skill premium between males and females. Columns (9)-(13): Log wage regressions on five different educational attainment variables. Standard errors in brackets. All results are significant at the 1 percent level (***).

TABLE 4. Skill Premium by Industry: Summary Statistics

	mean	median	standard deviation	10th percentile	90th percentile	obs
All Countries	0.62	0.59	0.36	0.26	1.01	795
Argentina	0.46	0.44	0.24	0.17	0.74	54
Brazil	0.92	0.90	0.24	0.64	1.20	57
Chile	0.68	0.60	0.33	0.38	1.03	54
Colombia	0.84	0.83	0.29	0.53	1.23	57
Costa Rica	0.66	0.66	0.39	0.37	1.01	54
Dominican Rep.	0.53	0.51	0.30	0.19	0.81	50
Ecuador	0.56	0.53	0.27	0.26	0.93	57
El Salvador	0.41	0.47	0.58	0.15	0.73	46
Guatemala	0.69	0.65	0.42	0.12	1.14	36
Honduras	0.71	0.66	0.44	0.34	1.16	50
Mexico	0.62	0.58	0.28	0.27	1.03	47
Nicaragua	0.71	0.72	0.45	0.24	1.41	33
Panama	0.48	0.47	0.23	0.20	0.78	50
Paraguay	0.49	0.52	0.24	0.19	0.78	43
Peru	0.51	0.49	0.24	0.23	0.79	51
Uruguay	0.54	0.50	0.24	0.31	0.89	56

Summay statistics for the skill premium. Based on estimates from a log wage regression on a skill dummy (column (2) of Table 3.

TABLE 5. Exports and the Industry-Skill Premium

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A) Return to Schooling									
log Exports/GDP	0.00250***	0.00342***	0.00025	-0.00027	0.00252***	0.00309***	0.00261**	0.00249**	0.00238**
	[0.00091]	[0.00096]	[0.00099]	[0.00120]	[0.00093]	[0.00102]	[0.00104]	[0.00113]	[0.00113]
log GDP_pc					0.01943***	0.01340***	0.01439***	0.02057***	0.01968***
					[0.00344]	[0.00512]	[0.00509]	[0.00592]	[0.00601]
log Skilled/Unskilled					-0.01131***	-0.00923***	-0.01247***	-0.00710**	-0.00899**
					[0.00320]	[0.00336]	[0.00363]	[0.00351]	[0.00411]
enrollment rate						0.00032*	0.00021	0.00021	0.00018
						[0.00018]	[0.00019]	[0.00020]	[0.00020]
export constraints						0.00401	0.00228	0.00628	0.00501
						[0.00425]	[0.00429]	[0.00454]	[0.00476]
doing business index							-0.00010**		-0.00005
							[0.00005]		[0.00005]
average firm size								-0.09317**	-0.07769*
								[0.03803]	[0.04188]
Country Dummies	No	No	Yes	Yes	No	No	No	No	No
Industry Dummies	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	287	287	287	287	287	287	287	261	261
Summay statistics for the	0.026	0.419	0.273	0.608	0.485	0.493	0.502	0.506	0.507
B) Skill Premium									
log Exports/GDP	0.03292***	0.03330***	0.02187***	0.00375	0.00997	0.01707**	0.01817**	0.01997**	0.02098**
	[0.00798]	[0.00968]	[0.00687]	[0.00913]	[0.00714]	[0.00788]	[0.00808]	[0.00883]	[0.00891]
log GDP_pc					0.17993***	0.12134***	0.11874***	0.13265***	0.13921***
					[0.02762]	[0.03959]	[0.03985]	[0.04683]	[0.04741]
log Skilled/Unskilled					-0.42187***	-0.41095***	-0.40506***	-0.40962***	-0.39591***
					[0.02687]	[0.02791]	[0.02948]	[0.02947]	[0.03314]
enrollment rate						0.00290**	0.00317**	0.00262	0.00289*
						[0.00145]	[0.00151]	[0.00159]	[0.00162]
export constraints						-0.02069	-0.01805	-0.01319	-0.00466
						[0.03309]	[0.03340]	[0.03606]	[0.03727]
doing business index							0.00022		0.00038
							[0.00035]		[0.00042]
average firm size								0.02015	-0.10155
								[0.27825]	[0.30904]
Country Dummies	No	No	Yes	Yes	No	No	No	No	No
Industry Dummies	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	285	285	285	285	285	285	285	259	259
R-squared	0.057	0.256	0.562	0.722	0.619	0.626	0.626	0.624	0.625

Resuls from the second stage regression of the skill premium (and the returns to schooling) on sectoral exports (and other controls). Standard errors in parenthesis. Significance at 1, 5 and 10 percent denoted by ***, ** and *

TABLE 6. Export Unit Values and the Skill Premium

	Years of Education			Skilled Dummy		
	(1)	(2)	(3)	(4)	(5)	(6)
PANEL A						
Log Unit value	0.0006		-0.0001	0.0037		-0.009
	[0.0009]		[0.001]	[0.006]		[0.01]
log Var(Unit_value)		0.00031	0.0003		0.003	0.006
		[0.0003]	[0.0007]		[0.003]	[0.006]
log Exports/GDP	0.0024**	0.0024**	0.0024**	0.017**	0.016*	0.016*
	[0.001]	[0.001]	[0.001]	[0.008]	[0.008]	[0.008]
Observations	287	287	287	285	285	285
R-squared	0.5	0.5	0.5	0.63	0.63	0.63
PANEL B						
Log Unit value	-0.0002		-0.0006	0.024		0.021
	[0.002]		[0.003]	[0.023]		[0.023]
log Var(Unit_value)		0.0003	0.0003		0.0029	0.0025
		[0.0003]	[0.0003]		[0.0029]	[0.0029]
log Exports/GDP	0.0026**	0.0024**	0.0024**	0.017**	0.016*	0.015*
	[0.001]	[0.001]	[0.001]	[0.008]	[0.008]	[0.008]
Observations	287	287	287	285	285	285
R-squared	0.5	0.5	0.5	0.628	0.628	0.629
Log Unit value	0.0011		-0.0009	0.005		-0.004
	[0.0009]		[0.001]	[0.007]		[0.014]
log Var(Unit_value)		0.0007*	0.001		0.003	0.004
		[0.0004]	[0.0008]		[0.003]	[0.006]
log Exports/GDP	0.0023**	0.0022**	0.0024**	0.017**	0.016**	0.016**
	[0.001]	[0.001]	[0.001]	[0.008]	[0.008]	[0.008]
Observations	287	287	287	285	285	285
R-squared	0.5	0.5	0.5	0.63	0.63	0.63

Panel A): dispersion in unit values measured with the variance of unit values across Harmonized System codes within a country and 2-digit ISIC industry. Panel B): median of the unit values. Panel C): variance of unit values across HS codes, after trimming for ourliers. Standard errors in parenthesis. Significance at 1, 5 and 10 percent denoted by ***, ** and *