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TRADE LIBERALIZATION AND WAGE INEQUALITY IN MEXICO

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During the 1980s in Mexico the wage gap between skilled and unskilled workers widened. The authors assess the extent to which this increased wage inequality was associated with Mexico's sweeping trade reform in 1985. Examining data on 2,354 Mexican manufacturing plants for 1984–90 and Mexican *Industrial Census* data for 1965–88, they find that the reduction in tariff protection in 1985 disproportionately affected low-skilled industries. Goods from that sector, the authors suggest, may have fallen in price because of increased competition from economies with reserves of cheap unskilled labor larger than Mexico's. The consequent increase in the relative price of skill-intensive goods could explain the increase in wage inequality.

During the 1980s, Mexico experienced a dramatic increase in wage inequality. The wages of more-educated, more-experienced workers rose relative to those of less-educated, less-experienced workers. While such events are interesting in their own right, what makes the change in Mexico's wage structure particularly noteworthy is that it coincided with a sweeping liberalization of trade. In 1985, Mexico announced that it was joining the General Agreement on Trade and Tariffs (GATT), bringing an end to four decades of import-substitution industrialization. The government proceeded to drastically reduce most trade barriers in the following three years. It was in 1985 that wage inequality in Mexico began to rise.

In this paper, we analyze data on 2,354 Mexican manufacturing plants for 1984–90 together with Mexican *Industrial Census* data for 1965–88 to assess the extent to which the increase in the skilled-unskilled wage gap in Mexico was associated with the opening of the Mexican economy. The motivation for studying the Mexican case is to understand the apparent global trend toward greater wage inequality. Since the 1970s, the wages of skilled workers have increased relative to those of unskilled workers in the United States and in Great Brit-

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ain.[1] Several recent studies link the rise in wage inequality to the increased openness of the U.S. economy, arguing that competition from low-wage countries has reduced the relative demand for unskilled workers and caused their wages to fall relative to those of skilled workers (Leamer 1993, 1998; Wood 1994; Feenstra and Hanson 1996a). Other studies instead associate rising wage inequality with technological change (Davis and Haltiwanger 1991; Bound and Johnson 1992; Lawrence and Slaughter 1993; Berman, Bound, and Griliches 1994). The reasoning is that the advent of computer technology has made skilled workers increasingly important in the workplace.

The focus of the literature has so far been on developed economies. Wage changes in middle- and low-income countries have received little attention.[2] This is unfortunate. If trade is contributing to wage changes in developed countries, then we should observe the opposite wage movements in developing-country relative wages. If global skill-biased technical change is the cause of relative-wage changes, then we should observe similar relative wage movements in high-wage and low-wage countries. Given Mexico's proximity to the United States and its recent opening to trade, the country is an ideal candidate in which to look for such changes.

The Stolper-Samuelson Theorem

The link that standard trade theory identifies between trade and wages is embodied in the Stolper-Samuelson (1941) theorem and its generalizations (Ethier 1984). The Stolper-Samuelson logic is that trade affects relative factor rewards by changing relative prices. To explain wage changes in Mexico with this logic, we would need a succession of events such as the following. Trade liberalization causes the prices of skill-intensive goods to rise relative to those of non-skill-intensive goods. The price changes reduce the demand for labor in non-skill-intensive industries and increase the demand for labor in skill-intensive industries. The resulting shift in employment toward skill-intensive industries contributes to an increase in the relative demand for skilled workers, which causes their wages to increase relative to those of unskilled workers.

This story is consistent with either of two hypotheses. The first is that Mexico has a wealth of skilled labor and a dearth of unskilled labor relative to the rest of the world. In its reserves of skilled labor, Mexico is far behind the United States, of course, but it may have a decisive edge over low-income countries, such as China. The second hypothesis is that under import substitution Mexico extended trade protection preferentially to industries that make relatively intensive use of unskilled labor. Trade liberalization would then have a disproportionately large impact on non-skill-intensive sectors. Although such a policy would seem at odds with Mexico's presumed comparative advantage in low-skill activities, political considerations may have led the government to protect these industries. In either case, the Stolper-Samuelson explanation for the observed wage changes implies that (1) the relative prices of skill-intensive goods have increased, and (2) there has been a shift in employment toward skill-intensive sectors.

Recent literature on Mexican labor markets provides important insights into changes in the country's wage structure, but has yet to fully identify the channels through which trade affects wage inequality. Feliciano (1993) and Cragg and Epelbaum (1996), both using household-level data, found that the return to schooling increased in Mexico during the late

[1]On wage dispersion in the United States, see Davis and Haltiwanger (1991), Bound and Johnson (1992), and Katz and Murphy (1992); for international evidence, see Davis (1992).

[2]One notable exception is Robbins (1995), who found mixed evidence that trade contributes to increased wage inequality in developing countries. In Chile, Colombia, Costa Rica, and the Philippines, the relative wage of skilled workers rose following trade liberalization, while in Argentina and Malaysia wage inequality was stable or declining during periods of increased openness to trade.

1980s. Revenga (1997), using plant-level data, found that blue-collar wages and employment were more responsive to changes in trade protection than those of white-collar workers, which she attributed to the fact that blue-collar workers were relatively concentrated in industries that underwent the largest reduction in protection levels. Feenstra and Hanson (1997) found that the Mexican regions in which the relative demand for skilled labor rose most in the 1980s were those in which foreign investment was most concentrated, suggesting that foreign capital inflows may have contributed to rising wage inequality. Finally, Bell (1997) studied the impact of minimum wages on employment in Mexican manufacturing plants over the period 1984–90. Though real minimum wages fell substantially over the sample period, she found that minimum wages had no impact on manufacturing labor demand, which she attributed to the fact that the minimum wage was not binding for most manufacturing plants during the sample period. In 1984 minimum wages were 42% of the average blue-collar Mexican manufacturing wage; in 1990 the figure was 31%.[3] Bell's results are important, for they suggest that the decline in Mexican minimum wages during the late 1980s cannot account for the increase in wage inequality.

Relative Wages and Employment in Mexico

Data are available from two sources. We have annual data on 2,354 Mexican manufacturing plants for the period 1984–90 from the Secretariat of Trade and Industrial Promotion (SECOFI). The SECOFI sample is the only plant-level data source available in Mexico. It is fortunate for our purposes that the sample period spans the implementation of trade reform.

One cause for concern is that by design the SECOFI sample covers only medium and large plants.[4] In 1986, there was an average of 321 workers per establishment in the SECOFI sample, compared to 67 across all manufacturing establishments. To ensure that the empirical regularities we identify in the SECOFI sample are representative of Mexican industry as a whole, we also use data on manufacturing establishments from the Mexico *Industrial Census*. We have *Census* data on employment, number of establishments, and total payroll by state and two-digit (ISIC) manufacturing industry for the period 1965–88, at roughly five-year intervals. To a first approximation, the SECOFI sample is representative of the overall mix of industrial activity in Mexico. Unreported results show that the distribution of employment across two-digit (ISIC) industries in the SECOFI sample and in the *Industrial Census* are nearly identical.

A final issue we need to address before turning to the data is how to measure wages. To identify the effect of trade on relative wages, we must be able to distinguish workers by skill level. The SECOFI sample and

[3]The evidence on manufacturing wages does not imply that the minimum wage was nonbinding in all sectors, as manufacturing workers tend to be relatively highly paid. Using household-level earnings data for 1988, Bell found that a substantial number of individuals, most of whom were women working in the informal sector (outside of manufacturing), earned less than the legal minimum wage, which suggests that there is a high degree of non-compliance with minimum wage law in Mexico. Widespread non-compliance is an additional reason that the fall in real minimum wages may not have had substantial labor market consequences.

[4]In 1989, the SECOFI plants accounted for 29% of total manufacturing employment, as measured by the Mexico *Industrial Census*. One additional problem with the SECOFI sample of plants is that it contains a balanced panel—we do not observe entry or exit. This is unfortunate, for it means that we cannot explore the relationship between plant mortality and the relative employment of skilled workers.

While the SECOFI sample is representative of Mexican manufacturing overall, there is one important sector that is missing in the data. The sample by design excludes off-shore assembly plants, the so-called *maquiladoras*. Maquiladoras import from abroad virtually all of the inputs they use to assemble final goods. The plants in the SECOFI sample, in contrast, are more vertically integrated establishments.

Table 1. Average Tariffs and Import-License Requirements by Two-Digit Industry, 1984–90 (Percent).

Industry		*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
31—Food Products	t	42.9	45.4	32.1	22.9	14.8	15.8	16.2
	q	100.0	80.1	62.2	33.3	20.8	20.6	16.8
32—Textiles, Apparel	t	38.6	43.2	40.4	26.6	16.8	16.6	16.7
	q	92.9	66.8	38.0	31.1	2.8	1.1	1.0
33—Wood Products	t	47.3	48.5	44.9	29.9	17.7	17.6	17.8
	q	100.0	75.6	25.7	0.0	0.0	0.0	0.0
34—Paper, Printing	t	33.7	36.5	34.8	23.7	7.7	10.1	9.9
	q	96.7	54.1	11.2	9.5	3.4	4.1	0.0
35—Chemicals	t	29.1	29.9	27.0	20.5	13.4	14.3	14.4
	q	85.7	54.0	21.1	4.8	0.0	0.0	0.0
36—Stone, Clay, Glass	t	37.1	38.5	33.8	22.4	13.8	14.3	14.3
	q	99.0	53.1	5.2	0.0	0.0	0.0	0.0
37—Basic Metals	t	13.6	16.7	18.4	13.8	7.9	11.0	11.0
	q	93.3	47.4	0.0	0.0	0.0	0.0	0.0
38—Metal Products	t	43.1	46.3	30.0	20.8	14.1	15.9	16.1
	q	90.7	74.8	54.7	51.4	42.7	44.1	44.1
39—Other Industries	t	40.9	42.9	40.5	27.5	17.1	18.1	18.4
	q	100.0	50.0	0.0	0.0	0.0	0.0	0.0

Notes: t = Production-weighted average tariff rate; q = weighted-average share of production subject to import-license requirements.
Source: Authors' calculations, SECOFI sample data.

the *Industrial Census* classify workers in two categories: *obreros*, who are equivalent to blue-collar workers, and *empleados*, who are equivalent to white-collar workers. The activities of blue-collar workers include machine operation, production supervision, repair, maintenance, and cleaning; those of white-collar workers include management, product development, administration, and general office tasks. We identify white-collar workers as skilled labor and blue-collar workers as unskilled labor. We measure earnings as the average annual salary or average hourly wage for each type of worker in a given plant. The white-collar–blue-collar distinction has obvious limitations, but the substantial wage differences between the two types of workers suggest that the division is a useful one.[5]

[5]Berman, Bound, and Griliches (1994) and Schmitt and Mishel (1996) provided evidence for the United States suggesting that the white-collar–blue-collar classification is a reasonable division of the labor force by skill.

There are no data for Mexico that provide a more detailed plant-level breakdown of employment by type and by industry.[6]

The Liberalization of Trade

To frame the discussion, we begin by considering the dimensions of trade reform in Mexico. Mexico's economy was largely closed to trade from the 1950s until the mid-1980s. The government initiated a conscious policy of trade protection in the late 1940s, when it raised tariffs and insti-

[6]A second problem with the blue-collar–white-collar classification is that neither data source breaks down non-wage compensation by worker type. Our measure of earnings excludes non-wage payments. This omission does not appear to be egregious, as wages account for the majority of payments to workers. In the SECOFI sample, the wage share of total compensation was 0.71 in 1984 and 0.69 in 1990; in the *Industrial Census*, the wage share of total compensation was 0.73 in both 1985 and 1988.

Table 2. Average Annual Real Wages in Manufacturing, 1984–1990. (Values in 1980 Pesos)

	White-Collar		*Blue-Collar*		*White-Collar/Blue-Collar*	
Year	*Annual Earnings*	*Hourly Wages*	*Annual Earnings*	*Hourly Wages*	*Annual Earnings*	*Hourly Wages*
1984	138,793	62.127	72,528	32.191	1.914	1.930
1985	143,692	63.856	74,952	32.783	1.917	1.948
1986	137,444	60.641	68,525	29.929	2.006	2.027
1987	134,474	59.014	67,559	29.243	1.991	2.018
1988	122,241	53.557	57,781	24.729	2.116	2.166
1989	145,487	64.278	62,755	26.809	2.318	2.398
1990	160,502	70.460	64,935	27.691	2.472	2.545

Source: Authors' calculations based on SECOFI sample data.

tuted a system of import licenses. Successive administrations expanded trade barriers, mainly by increasing the range of goods covered by import licenses. These licenses effectively gave the government the discretion to impose import quotas at will. The government also used export controls to direct production toward the domestic market.

The government decided to open the economy to trade in 1985. It moved swiftly, drastically lowering most trade barriers within three years. In mid-1985, the national average tariff was 23.5%, and import-license requirements covered 92.2% of national production. By December 1987, import-license coverage had been reduced to 25.4% of national production and the average tariff had been reduced to 11.8%, with a maximum rate of 20%. Concurrent with reform, the government abolished export controls and devalued the nominal exchange rate.

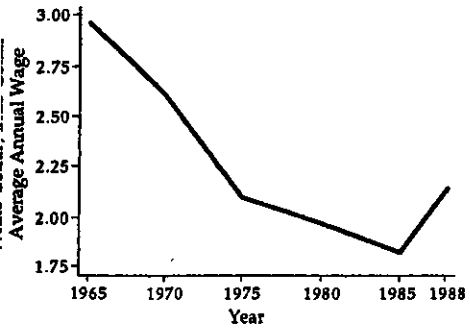
Table 1 shows annual production-weighted-average tariffs and import-license coverage by two-digit (ISIC) industry for the period 1984–90.[7] In 1984, the average tariff ranged from 13.6% in basic metals to 47.3% in wood products; import licenses were required for over 85% of products in all two-digit industries. The government first cut import-license requirements, reducing average import-license coverage to below 4% by 1988 in all industries except food products and metal products. It then proceeded to reduce tariffs; by 1990, the maximum tariff rate in any industry group was 18.4%, for "other industries." The only industry that continued to enjoy relatively high levels of protection was metal products, due to import restrictions on automobiles.

Concomitant with trade reform, the Mexican government removed many barriers to foreign investment, including limits on the foreign share of equity ownership in a Mexican firm and requirements that foreign firms obtain government approval for technology transfer from abroad and other activities (Feenstra and Hanson 1997). In 1983, following the onset of the Mexican debt crisis, there was a de facto relaxation of restrictions on foreign investment. These changes were codified into law in 1989.

In the mid-1980s, the Mexican government also launched a program to privatize state-owned firms (Lopez-de-Silanes 1997). Within manufacturing, two sectors, basic metals (iron and steel) and petroleum products, were subject to wide-scale state ownership. Privatization affected a far larger share of production in these industries than in other two-digit manufacturing indus-

[7]The tariff and import-license data we use are from unpublished records of SECOFI, available on request from the authors. These data are discussed extensively in Ten Kate (1992) and Ten Kate and de Mateo V. (1989).

Figure 1. Ratio of White-Collar to Blue-Collar Average Wages in Mexico, 1965–1988.



Source: Industrial Census.

tries.[8] Further, in iron and steel, conflicts between unions and new owners over the interpretation of pre-existing (that is, government-negotiated) collective bargaining agreements led to the virtual collapse of production in several large plants. To distinguish the effects of trade reform from those of privatization, we present some of our results excluding petroleum products, iron, and steel from the sample of manufacturing industries.[9]

Wages and Employment

Since 1984, there has been a dramatic increase in white-collar–blue-collar wage inequality among manufacturing workers in Mexico. Table 2 shows average real wages and average relative wages for the SECOFI sample of plants.[10] Between 1984 and 1990, the ratio of average hourly white-collar and blue-collar wages increased from 1.93 to 2.55; the ratio of average annual white-collar and blue-collar earnings show a similar change, increasing from 1.91 to 2.47. The rise in the skilled-unskilled wage differential was due to a combination of real-wage increases for white-collar workers and real-wage decreases for blue-collar workers. Between 1984 and 1990, average real hourly wages for white-collar workers increased by 13.4%, while those for blue-collar workers decreased by 14%.[11]

The *Industrial Census* shows similar movements in the white-collar–blue-collar wage gap. Figure 1 plots the ratio of average annual white-collar wages to average annual blue-collar wages in Mexican manufacturing for the period 1965–88. Between 1985 and 1988, the white-collar–blue-collar wage ratio rose from 1.84 to 2.16, which matches the movements in the SECOFI sample over the same time period. Of greater significance, the rise in the wage gap after 1985 appears to have halted a two-decade trend toward decreasing wage inequality.

The wages we report are average levels and do not control for changes in the composition of the labor force or for changes in the distribution of skill. In general, one should exercise caution in speculating about individual-level wage changes based on average wage changes. Nevertheless, the changes in relative wages in Table 2 are so large and occur over such a short period of time that it is extremely unlikely that they could be accounted for by compositional changes. The wage changes we report are consistent with household-level data on wage changes in Mexico over the

[8]The Mexican constitution places myriad restrictions on the ownership of subsoil resources. These restrictions prevented petroleum refineries from being privatized, but some petrochemical firms were transferred to private hands.

[9]Currie and Harrison (1997) suggested that parastatal firms behave quite differently from private firms.

[10]Real wages are calculated as nominal annual remuneration per worker or per hour worked, deflated by the June consumer price index in a given year.

[11]The total change for the period masks large real-wage swings that occurred within the period. Real white-collar wages declined by 16.1% between 1985 and 1988 and then increased sharply, surpassing their 1985 levels by 1989. What the real-wage swings may reflect is unanticipated inflation in 1986 and 1987. While unexpected inflation can perhaps account for a temporary decline in wages for both types of workers, it cannot account for the increase in the white-collar–blue-collar wage gap over the period.

Table 3. Relative Employment, All Manufacturing, 1984–1990.

	Number of Workers			*Thousands of Hours Worked*		
Year	*White-Collar*	*Blue-Collar*	*Ratio*	*White-Collar*	*Blue-Collar*	*Ratio*
1984	234,851	545,477	0.431	524,666	1,229,016	0.427
1985	239,847	560,738	0.428	539,713	1,282,056	0.421
1986	242,189	550,963	0.440	548,925	1,261,465	0.435
1987	241,528	545,937	0.442	550,368	1,261,272	0.436
1988	243,741	549,839	0.443	556,327	1,284,741	0.433
1989	248,840	566,737	0.439	563,229	1,326,644	0.425
1990	250,066	577,405	0.433	569,629	1,353,991	0.421
Log Change, 1984–90	0.063	0.057		0.082	0.097	

Source: Authors' calculations based on SECOFI sample data.

same period reported in Feliciano (1993), Cragg and Epelbaum (1996), and Bell (1997).

One source of relative-wage changes is shifts in the demand for different skill categories. An increase in the relative demand for skilled labor would cause an increase in both the wages and employment levels of skilled workers relative to those of unskilled workers.[12] Table 3 shows the ratio of white-collar to blue-collar employment for the SECOFI sample. Between 1984 and 1990, there was virtually no aggregate change in relative employment. The ratio of white-collar to blue-collar employment increased from 0.431 to 0.433; the ratio of white-collar to blue-collar hours worked decreased from 0.427 to 0.421. Industry-level data also fail to indicate substantial changes in relative employment. Unreported figures show that four (of nine) two-digit industries experienced an increase in the relative employment of white-collar labor, while five two-digit industries experienced a decline. No industry showed large changes in either direction.[13]

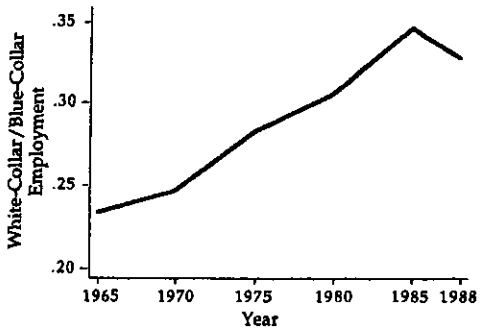
The *Industrial Census* shows somewhat larger changes in relative employment. Figure 2 plots the ratio of white-collar employment to blue-collar employment for the period 1965–88. The ratio fell from 0.346 in 1985 to 0.328 in 1988. The relative-employment movements after 1985 arrested a two-decade trend toward greater relative employment of white-collar workers. We also calculate relative employment by two-digit industry for the *Industrial Census* in 1985 and 1988 (not shown). Seven (of nine) industries show a decline in relative white-collar employment, while two show an increase.

One possible explanation for the rising skill premium and the declining use of skilled labor is that the supply of skilled labor shifted to other sectors or migrated abroad. This could account for both a reduction in the share of skilled employment and an increase in the skilled wage. There is no evidence suggesting that the composition of Mexican emigrants changed over the 1980s. Borjas (1994) found that the average education level of Mexican immigrants in the United States arriving between 1980 and 1990 was the same as that

[12]There is considerable evidence that rising wage inequality in the United States is due to an increase in the relative demand for skilled labor (Bound and Johnson 1992; Katz and Murphy 1992).

[13]One explanation for the lack of relative employment changes is that the supply of skilled labor is inelastic in the short to medium run. While this idea is plausible, it would require a high degree of immobility between manufacturing and other sectors on the part of skilled labor. The secular increase in relative white-collar employment from 1965 to 1985, which is evident in Figure 2, suggests that skilled labor is relatively mobile.

Figure 2. Ratio of White-Collar to Blue-Collar Employment in Mexico, 1965–1988.



Source: Industrial Census.

of pre–1980 arrivals. The average educational level of Mexican immigrants to the United States is lower than that of immigrants from any other major source country. Borjas also found that during the 1980s the wages of Mexican immigrants in the United States declined relative to those of ethnically similar U.S. natives. This suggests that, if anything, there was an increase in the relative emigration of *unskilled* workers from Mexico during the 1980s. There is also little evidence of a shift of employment out of manufacturing into other sectors. The manufacturing share of the total labor force increased during the 1980s, rising from 16.7% in 1980 to 19.9% in 1988.

The Heckscher-Ohlin Model: Prices, Industry Composition, and Wages

The data show a substantial increase in the skilled-unskilled wage gap in Mexico following the liberalization of trade, but little change in the relative employment of skilled labor. One explanation for this pattern, consistent with the Stolper-Samuelson theorem, would be that trade increased the relative price of skill-intensive products. In this section, we search for evidence of Stolper-Samuelson effects.

Relative prices and skill intensity. To determine if relative price changes correspond to the observed relative-wage changes, we consider the correlation between relative-price changes and relative skill intensity. In a many-good, many-factor world, there is no general definition of relative factor intensity. The crude measure of skill intensity that we use is the log ratio of white-collar to blue-collar employment. If relative price increases in skill-intensive sectors account for increasing returns to skill, then we should see a positive relationship between skill-intensity and price increases in the 1980s.

Table 4 reports regressions of the log change in output prices on the log ratio of white-collar to blue-collar employment over the 1984–90 period. The unit of observation is the four-digit manufacturing industry.[14] We measure employment as the average annual number of workers by skill type. Since we are looking at discrete, rather than infinitesimal, price changes, we average log relative white-collar employment over the first and last period. We use two measures of prices: gross output prices, measured using a four-digit producer price index, and value-added prices, calculated using the output price index, input price indices, and input cost shares.[15] We also

[14]The four-digit industry classification code we use is that in the SECOFI data, which is based on Mexico's *Industrial Census.* It is similar to the SIC code used in the United States.

[15]We can write the log change in the industry gross output price between 1984 and 1990 as

$$\Delta\text{logPPI} = vashare * \Delta\text{logPVA} + matshare * \Delta\text{logPMAT} + energyshare * \Delta\text{logPENERGY},$$

where PPI is the industry producer price index, PVA is the price of value-added, PMAT is the price index for material inputs, PENERGY is the price index for energy, and Δ indicates the change over 1984–90. The shares of value-added, materials, and energy in total costs are given by *vashare, matshare,* and *energyshare,* where the shares are averaged over the first and last period. Given this equation, we can calculate the log change in the value-added price as

$$\Delta\text{logPVA} = (1/vashare)(\Delta\text{logPPI} - matshare * \Delta\text{logPMAT} - energyshare * \Delta\text{logPENERGY}).$$

Table 4. Relative Price Changes and Skill Intensity. (Dependent Variable: Change in Log Price, 1984–1990)

Prices	*Log Ratio of White-Collar Employment to Blue-Collar Employment*	*N*	*R-Square*
All Sectors			
Gross-Output Prices	0.039 (0.76)	125	0.006
Value-Added Prices	–0.003 (–0.02)	125	0.000
Excluding Petroleum Products, Iron, and Steel			
Gross-Output Prices	–0.011 (–0.25)	119	0.001
Value-Added Prices	–0.129 (–0.99)	119	0.010

Notes: Observations are all four-digit Mexican manufacturing industries in the SECOFI sample. All regressions are weighted by the average industry share of total manufacturing output in 1984 and 1990. T-statistics, based on heteroskedasticity-consistent standard errors, are reported in parentheses. Log relative white-collar employment is the average for 1984 and 1990. Coefficient estimates for constant terms are not shown.

Table 5. Trade Protection and Skill Intensity.

Trade Law	*Log Ratio of White-Collar to Blue-Collar Employment*	
	All Industries	*Excluding Petroleum Products, Iron, and Steel*
Tariff 1984	–0.136	–0.184**
Import License 1984	–0.006	–0.003
Tariff Change, 1984–90	0.150*	0.195**
Import License Change, 1984–90	–0.076	–0.087

Notes: The table shows raw correlations of the log ratio of white-collar to blue-collar employment averaged in 1984 and 1990, the average industry tariff in 1984, the average industry import-license coverage rate in 1984, the change in industry tariff from 1984 to 1990, and the change in industry import-license coverage rate from 1984 to 1990. Observations are for either the 125 four-digit Mexican manufacturing industries or the 119 industries excluding petroleum products, iron, and steel. Correlations are weighted by the average industry share of total manufacturing output in 1984 and 1990.

*Statistically significant at the .10 level; **at the .05 level.

redo the analysis excluding petroleum products, iron, and steel industries, where state-owned firms initially played a large role and where substantial privatization occurred. To be consistent with the four-digit definitions of output prices, tariffs, and import-license coverage rates (all of which the Mexican government constructs by applying output weights to more disaggregated data), we weight all regressions by the industry share of total manufacturing output; results using employment weights are similar.

We find no significant correlation, positive or negative, between price changes and relative white-collar employment using either gross output prices or value-added prices. Excluding petroleum products, iron, and steel leaves the results unaffected.

Although the findings do not support Stolper-Samuelson effects, there are several possible explanations. One problem is that changes in product prices reflect many changes in the economy in addition to trade reform, such as privatization and deregulation. Industry-wide price changes may thus be a poor measure of changes in trade policy. A more serious problem is that industry price changes may be a poor measure of actual price changes. Price indices capture changes in the prices of goods firms actually produce, rather than price changes for a fixed set of goods. If trade causes firms to alter the mix of goods they manufacture (Feenstra and Hanson 1996b), then our measure of product price changes will confound pure price changes with compositional effects. One indication of problems in using product price data is that correlations between price changes and skill intensity for the United States are sensitive to changes in either the time period or the sample of industries (Lawrence and Slaughter 1993; Krueger 1995; Schmitt and Mishel 1996).

An alternative price-based measure of changes in trade policy is tariffs. Indeed, for a small open economy, which is a reasonable description of post–trade reform Mexico, changes in tariffs fully capture trade policy–induced changes in product prices. We examine whether the pattern of tariffs and import licenses varied across industries according to the skill intensity of production. Table 5 presents raw correlations of industry tariffs and import-license coverage rates in 1984, changes in these variables over the 1984–90 period, and the log ratio of white-collar to blue-collar employment for four-digit manufacturing industries.

In light of the wide range of trade protection measures used in the literature, it is worth describing our measures in detail. The tariff for a four-digit industry is the production-weighted average administrative ad valorem tariff across all products within the industry. The import-license coverage rate for a four-digit industry is the fraction of output within the industry that is subject to import-license requirements. Both tariffs and coverage rates are thus percentage values. We calculate changes in these variables as the time difference over the 1984–90 period. Import-license coverage rates are somewhat difficult to interpret, as they are an indirect indication of quantity restrictions on trade. While import licenses give the government the discretion to impose quotas, we have no information on where quotas were actually binding.

Pre–trade reform tariff levels appear to have been lower in skill-intensive industries than in non–skill-intensive industries. Relative white-collar employment is negatively correlated with 1984 tariffs. This correlation is not statistically significant for all manufacturing industries, but it is significant once petroleum products, iron, and steel are excluded. More important, it also appears that tariff reductions were smaller in skill-intensive industries. There is a positive correlation between relative white-collar employment and the change in tariffs over 1984–90. This correlation is statistically significant at the 10% level for all industries and significant at the 5% level when we exclude petroleum products, iron, and steel.[16] In both samples of industries, relative white-collar employment is negatively correlated with import-license coverage rates in 1984 and with the change in coverage rates over 1984–90, but neither correlation is statistically significant.

The correlations between tariffs and skill intensity in Mexico are supportive of Stolper-Samuelson effects. Skill-intensive sectors were less protected and consequently had smaller reductions in tariff levels. Why Mexico protected low-skill industries is a puzzle, given the country's presumed comparative advantage in these sectors. Similar patterns of protection have been reported for other developing countries. Currie and Harrison (1997) found that in Morocco protection was significantly higher in sectors with a higher share of unskilled workers, such as textiles and clothing. They also found these sectors to be the most export-intensive. Paradoxically, the Moroccan government gave greater protection to the sectors in which it had the highest comparative advantage, if comparative advantage can be measured by export orientation. For Mexico, Revenga (1994, 1995) also found that the pattern of protection was skewed toward export-intensive sectors. The evidence suggests that developing countries often protect sectors in which they are likely to have a comparative advantage, such as the sectors with a high share of unskilled workers. In this light, it is not surprising that increasing wage inequality is observed in developing countries undergoing trade reforms.

The results presented in Tables 4 and 5 suggest that while changes in trade policy are consistent with Stolper-Samuelson effects, changes in product prices are not. Since Mexico historically protected sectors with more unskilled workers, tariffs fell less in sectors with more skilled workers. In a

[16]At the plant level, we also find a positive and statistically significant correlation between relative white-collar employment and either the initial tariff level or the change in tariffs.

Stolper-Samuelson framework, this translates into an increase in the relative wage of skilled workers. Below, we explore the extent to which price changes and commercial policy were correlated during the 1980s.

Correlations between price changes and trade policy changes. We present correlations between product price changes and commercial policy in Table 6. We again use two measures of product prices, gross output prices and value added prices. We include an interaction term between tariffs and import-license coverage rates to account for the fact that the application of tariffs and quotas may be correlated across industries. Since the interaction term makes it difficult to evaluate the impact of an individual policy using the reported coefficient estimates, we report the net impact of tariffs and import licenses on product price changes at sample means for tariffs and licenses. To control for possible nonlinearities in how import licenses translate into trade protection, we include two additional indicator variables. In regressions using initial protection levels as regressors, we include a dummy variable for whether import licenses covered 100% of goods produced in the industry, which may indicate cases in which binding quotas were more likely. In regressions using the change in protection levels as regressors, we include a dummy variable for whether import licenses were completely eliminated in the industry, which may indicate cases in which the reduction in quotas was most significant.

First, consider the correlation between price changes and initial levels of trade protection. For either measure of prices and for either sample of industries, the coefficients on tariffs and import-license coverage rates are negative and statistically significant, while the coefficient on the interaction term between tariffs and import licenses is positive and statistically significant. The net impact of policy changes shows that for gross-output prices (column 1) the impact of initial tariffs on price changes is negative, suggesting that prices fell more in sectors with higher initial tariffs. We obtain a similar result excluding petroleum products, iron, and steel (column 5). When we use value-added prices instead of gross-output prices (columns 3 and 7), the net impact of initial tariffs is reversed. Price changes appear to be higher in industries with higher initial tariffs. It is important to note, however, that in all cases the net impact of initial tariffs on price changes is very small relative to mean price changes for the sample period.

For import licenses, the findings are more consistent. For either price measure, the net impact of initial import licenses on price changes is positive (columns 1, 3, 5, 7), suggesting that relative price changes were higher in sectors with higher initial license coverage. As with tariffs, the net impact of import licenses is very small relative to mean price changes for the period. Despite the statistical significance of the coefficients, initial levels of trade protection appear to say little about the magnitude of price changes over the sample period.

Next, consider the correlation between price changes and changes in protection (columns 2, 4, 6, 8). In all regressions, price changes are positively correlated with the change in tariffs and the change in import-license coverage rates but negatively correlated with the interaction between tariffs and import licenses. These correlations, however, are statistically significant at the 10% level only for gross-output prices, excluding petroleum products, iron, and steel (column 6). Despite the lack of statistical significance, it is worth considering the net impact of changes in trade policy on product price changes. In all regressions, the net impact of either the change in tariffs or the change in import licenses on price changes is positive, providing weak evidence that relative prices rose in sectors that experienced the smallest reductions in trade protection.[17] It is again the case that the net impact of changes in trade policy

[17]Somewhat in contrast to these results, relative prices appear to have increased in sectors that completely eliminated import licenses.

Table 6. Relative Price Changes and Trade Policy.
(Dependent Variable: Change in Log Prices, 1984–90)

	All Industries				*Excluding Petroleum Products, Iron, and Steel*			
Independent Variable	*Dependent Variable: Gross-Output Prices (mean = 2.85)*		*Dependent Variable: Value-Added Prices (mean = 2.69)*		*Dependent Variable: Gross-Output Prices (mean = 2.85)*		*Dependent Variable: Value-Added Prices (mean = 2.70)*	
Tariffs	−0.030	—	−0.085	—	−0.030	—	−0.085	—
	(−2.90)		(−2.40)		(−3.14)		(−2.46)	
Import Licenses	−0.010	—	−0.032	—	−0.009	—	−0.030	—
	(−2.27)		(−2.25)		(−2.27)		(−2.22)	
Tariffs*Licenses	0.0003	—	0.001	—	0.0003	—	0.001	—
	(2.86)		(2.46)		(3.10)		(2.51)	
Complete License Coverage	0.043	—	0.080	—	−0.042	—	−0.066	—
	(0.48)		(0.36)		(−0.58)		(−0.32)	
Change in Tariffs	—	0.009	—	0.021	—	0.009	—	0.021
		(1.58)		(1.34)		(1.65)		(1.39)
Change in Licenses	—	0.002	—	0.006	—	0.002	—	0.006
		(1.48)		(1.09)		(1.77)		(1.17)
Change in Tariffs* Licenses	—	0.0001	—	0.0002	—	−0.0001	—	−0.0002
		(−1.56)		(−1.53)		(−1.61)		(−1.52)
Eliminated Licenses	—	0.157	—	0.581	—	0.165	—	0.598
		(2.89)		(1.79)		(2.94)		(1.85)
Net Impact of Policy:								
Tariffs	−0.002	0.017	0.009	0.037	−0.002	0.017	0.008	0.037
Licenses	0.001	0.004	0.004	0.010	0.003	0.004	0.009	0.011
N	125	125	125	125	119	119	119	119
R^2	0.040	0.047	0.050	0.085	0.090	0.075	0.069	0.101

Notes: Observations are four-digit Mexican manufacturing industries. All regressions are weighted by the average industry share of total manufacturing output in 1984 and 1990. T-statistics, based on heteroskedasticity-consistent standard errors, are reported in parentheses. See text for description of tariffs and import-license coverage rates. Complete License Coverage is a dummy variable equal to one if 100% of goods in the industry were subject to import-license requirements in 1984. Eliminated Licenses is a dummy variable equal to one if the industry eliminated all import-license requirements between 1984 and 1990. The Net Impact of Policy is calculated at mean values for tariffs and import-license coverage rates, whether in levels or changes. Coefficient estimates for constant terms are not shown.

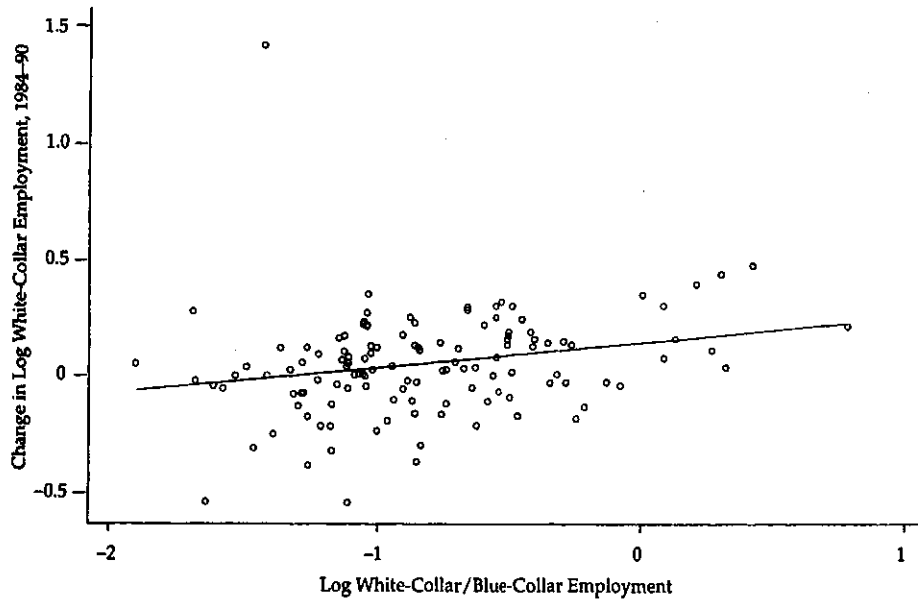
on product prices is very small relative to mean values for price changes over the 1984–90 period.

Regressions of product price changes on tariffs and import licenses provide weak support for the Stolper-Samuelson theorem. We do find that relative price increases were higher in sectors with smaller reductions in trade barriers, which, coupled with our finding that skill-intensive sectors had the lowest reductions in tariffs, would be consistent with Stolper-Samuelson, but this correlation is neither statistically significant nor economically significant. The weak correlation between price changes and changes in trade policy again suggests that aggregate price indices may be poor measures of actual product price changes.

Reallocation of employment and skill intensity. Strictly speaking, Stolper-Samuelson does not require that trade reallocate labor across industries. Relative price changes alone may generate changes in relative factor awards. Nevertheless, if the relative prices of skill-intensive goods rose, we would expect reallocation of labor toward those sectors.

Despite the magnitude of trade reform, there was little employment reallocation across industries. In unreported results, we

Figure 3. Relationship between White-Collar Employment Growth and Skill Intensity in Mexico, 1984–1990.

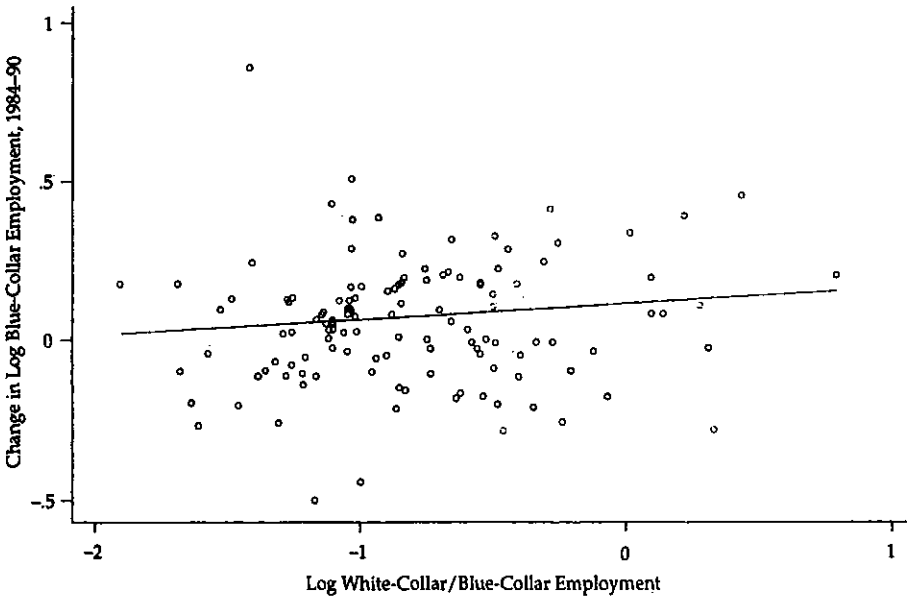


Source: SECOFI.

construct industry shares of national employment by type of worker for 1984 and 1990. The largest relative-employment declines occurred in textiles and apparel (ISIC 32), whose share of total manufacturing employment fell from 0.128 to 0.112, and iron and steel (ISIC 37), whose employment share fell from 0.075 to 0.061; these two industries also experienced a decline in absolute employment over the period. The largest relative employment increases occurred in food products (ISIC 31), whose employment share increased from 0.195 to 0.214, and metal products (ISIC 38), whose employment share increased from 0.266 to 0.280; these two industries experienced absolute employment growth over the period. The changes in industry employment shares resulted almost entirely from changes in relative blue-collar employment; the distribution of white-collar employment across industries stayed nearly constant over the period.

Even though changes in industrial composition following trade reform were small, we want to know if the industries that experienced the most employment growth are those that are relatively intensive in the use of skilled labor. To see if there was a shift in employment toward skill-intensive sectors, we ask whether employment growth was higher in sectors that employed a relatively high share of white-collar workers. Figure 3 plots the change in log employment of white-collar workers between 1984 and 1990 against the average log ratio of white-collar to blue-collar employment in 1984 and 1990 by four-digit industry. The relationship between skill intensity and employment growth is positive and statistically significant, suggesting employment growth was higher in skill-intensive sectors.

Figure 4. Relationship between Blue Collar Employment Growth and Skill Intensity in Mexico, . 1984–1990.



Source: SECOFI.

Figure 4 shows that there is also a positive, though weaker, correlation between blue-collar employment growth and skill intensity. Hence, there is evidence that employment growth was relatively high in skill-intensive sectors.

The role of foreign direct investment. We have found that skill-intensive sectors were less protected than non–skill-intensive sectors and thus had smaller reductions in trade barriers (Table 5), which suggests that trade reform may have contributed to an increase in the white-collar–blue-collar wage gap. While there is weak evidence linking changes in trade protection to changes in product prices (Table 6), there is no direct evidence linking relative price increases to skill-intensive sectors (Table 4). One possibility is that changes in commercial policy are a more precise measure of how trade reform affected product prices in Mexico than are changes in aggregate price indices.

A second possibility is that changes in trade policy are correlated with other changes in the Mexican economy, which affected skill-intensive sectors positively. Feenstra and Hanson (1997) suggested one such possibility. They examined whether foreign outsourcing influences the demand for skilled and unskilled labor in Mexico. Outsourcing by U.S. firms to Mexico increased dramatically during the 1980s, following Mexico's relaxation of restrictions on foreign direct investment. At the level of regional manufacturing industries, they found that the relative demand for skilled labor was positively correlated with the change in the number of foreign off-shore assembly plants, which suggests that foreign direct investment may have contributed to increasing wage inequality in Mexico.

Table 7. Foreign Direct Investment, Skill Intensity, and Trade Policy. (Dependent Variable: Change in the Log Stock of Foreign Capital, 1984–90)

	All Industries		*Excluding Petroleum Products, Iron, and Steel*	
Independent Variable	*(1)*	*(2)*	*(3)*	*(4)*
Log Ratio of White-Collar to Blue-Collar Employment	0.052 (1.28)	0.065 (1.75)	0.027 (0.75)	0.048 (1.22)
Tariffs	0.010 (0.56)	—	0.010 (0.56)	—
Import Licenses	0.006 (0.95)	—	0.008 (1.39)	—
Tariffs*Licenses	–.0001 (–0.53)	—	–0.0001 (–0.58)	—
Complete License Coverage	0.101 (0.85)	—	–0.023 (–0.37)	—
Change in Tariffs	—	0.008 (0.98)	—	0.006 (0.74)
Change in Licenses	—	0.001 (0.39)	—	0.0002 (0.11)
Change in Tariffs*Licenses	—	–0.0001 (–1.08)	—	0.0001 (–0.75)
Eliminated Licenses	—	–0.280 (–4.83)	—	–0.249 (–4.06)
N	115	115	109	109
R^2	0.149	0.216	0.140	0.198

Notes: Observations are four-digit Mexican manufacturing industries. All regressions are weighted by the average industry share of total manufacturing output in 1984 and 1990. T-statistics, based on heteroskedasticity-consistent standard errors, are reported in parentheses. See text for description of tariffs, import-license coverage rates, and the measure of foreign capital. See notes to Tables 5 and 6 for other variable definitions. Coefficient estimates for constant terms are not shown.

To pursue this issue, we examine whether the correlation that we find between trade policy and skill intensity could be proxying for the correlation between foreign investment and skill intensity. In Table 7, we report regressions of the change in the stock of foreign capital on relative white-collar employment and either the level of or change in trade protection in Mexico.

There are no published data on the aggregate stock of foreign capital by industry in Mexico. We use the SECOFI data to generate such a measure. For each plant, the data indicate the share of equity ownership by foreign agents, as well as the value of fixed capital at year-end replacement cost. For a given four-digit industry, we measure the change in the stock of foreign capital as the change in the value of fixed capital in plants that have a foreign equity ownership share of at least 5%.[18]

One problem with this measure is that the share of foreign equity ownership is only available in 1990, while the value of fixed capital is available in all sample years. Our measure is thus the change in the capital stock over 1984–90 in plants that were at least 5% foreign-owned in 1990.[19]

[18]In 1990, 24.8% of the plants had a foreign equity ownership share of at least 5%. Aitken, Hanson, and Harrison (1997) showed that most foreign investment in Mexico is from the United States.

[19]Feenstra and Hanson (1997) measured the change in the foreign capital stock as the change in the number of off-shore assembly plants, which are the agents of foreign outsourcing in Mexico, at the region (and not industry) level. The SECOFI sample

Since foreign investment in Mexican manufacturing increased over the sample period, our measure likely over-estimates the industry change in the foreign capital stock (since more plants were foreign-owned at the end of the period than at the beginning). To examine whether upward bias in the change in the foreign capital stock contaminates the regression results, we tried alternative minimum foreign equity ownership shares (10%, 20%, 30%, 50%) to calculate the change in the foreign capital stock. Results using these alternative measures are very similar to those reported in Table 7.

It does not appear that foreign investment can account for the observed correlation between skill intensity and trade protection. In Table 7, the correlation between the change in the log foreign capital stock and log relative white-collar employment, while positive in all cases, is statistically significant at the 10% level in only one regression. There is also no statistically significant correlation between changes in the foreign capital stock and either the initial level of or the change in tariffs or import-license coverage rates. The only statistically significant correlation between foreign investment and trade protection is a negative relationship between growth in foreign capital stock and the complete elimination of import licenses in a sector (columns 2 and 4). This provides support for tariff-jumping explanations of foreign investment. Foreign firms seem to have avoided sectors from which all quota protection was removed.

There is some contrast between our results and those in Feenstra and Hanson (1997), but this may be attributable to the different definitions of foreign capital used in the two papers. Feenstra and Hanson measured changes in the foreign capital stock by the change in the number of foreign off-shore assembly plants, which follows from their emphasis on foreign outsourcing. The SECOFI sample, however, excludes these plants by design (see notes 4 and 19). Thus, we find a weak positive correlation between foreign investment and skill intensity, excluding plants that are dedicated exclusively to foreign outsourcing.

To summarize our findings, over the period 1984–90 Mexico experienced an increase in the white-collar–blue-collar wage gap; little change in the ratio of white-collar to blue-collar employment; a fall in trade barriers, with evidence that initial tariff levels and reductions in tariffs were lower in skill-intensive sectors than in non-skill-intensive sectors; higher employment growth in skill-intensive sectors; and higher foreign investment in sectors that maintained import quotas than in sectors that dropped them. We do not find that relative prices rose in skill-intensive sectors, although industry price indices may be noisy measures of product-price changes.

Conclusion

We have examined changes in the relative wages and relative employment of skilled and unskilled workers in Mexico that followed the country's 1985 trade reform. Since the enactment of trade reform, there has been a dramatic increase in the skilled-unskilled wage gap. The relative-wage changes have occurred without large changes in relative employment. One of our primary concerns has been to search for the effects of trade reform on relative prices and the sectoral distribution of labor that could explain the relative-wage changes.

While we do not find a positive correlation between skill intensity and relative product price changes during the 1980s, we do find that Mexico offered relatively high trade protection to low-skill industries. The reduction in trade barriers was most dramatic in these sectors, which suggests that trade reform affected unskilled

of plants that we use excludes off-shore assembly plants by design (see note 4). Thus, we measure the change in the foreign capital stock using a non-overlapping sample of plants (and we measure foreign capital at the industry rather than region level).

labor disproportionately. This finding is consistent with a world in which Mexico has an intermediate abundance of skilled labor. The exposure of Mexico to competition from China and other countries that have abundant unskilled labor appears to have contributed to a decrease in the relative wages of unskilled workers.

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