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Relative prices and wage inequality: evidence from Mexico

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Abstract

This paper examines the link between relative goods prices and relative wages during two periods of Mexico's trade liberalization. The relative price of skill-intensive goods rose following Mexico's entrance to the General Agreement and Tariffs and Trade (GATT) in 1986, but fell after Mexico entered the North American Free Trade Agreement (NAFTA) in 1994. This paper adds a band pass filter to two established techniques to compare the relationship between prices and wages. Results from all three approaches are consistent with a positive long-run relationship between relative output prices and relative wages. The band pass filter results suggest that the relevant time frame for the relationship begins after 3–5 years.

Keywords: Trade liberalization; Wage inequality; Mexico

JEL classification: F16; J31

Although over 100 recent papers analyze the relationship between globalization and wage inequality, the theoretical and empirical link between them remains contested. Starting with the Stolper–Samuelson theorem, a standard result in trade theory that links changes in goods prices and changes in relative factor prices, this paper considers two issues that arise in the trade and wages debate. The first issue is whether changes in relative prices can explain changes in relative wages and whether changes in tariffs and trade policy explain movements in relative prices. The second is *when* changes in relative prices affect relative wages.

To examine these two questions, this paper examines Mexico's trade liberalization. Revisiting the Mexican case is important for two reasons. Studying the Mexican case may

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provide information about the link between trade liberalization and wage inequality because Mexico is more like the classical "small country" assumed in many trade models. For example, Mexico's economy is about 1/17th the size of the United States economy. While only about 9.1% of U.S. merchandise exports and imports are with Mexico, the United States accounts for 74.5% of Mexico's imports and 84.0% of Mexico's exports. The true advantage of, and evidence suggestive of, Mexico's "small country" status is that the change in relative prices is traced to the "exogenous" shock of tariff reduction. Unlike the United States, whose changes in relative prices are affected by technology and several other factors, the speed and extent of Mexico's liberalization presents a potentially more direct example of the link between trade liberalization and relative wages through changes in relative goods prices. Of course, like many Latin American countries implementing liberalization, Mexico experienced several other changes that could explain wage movements. This paper considers movements in foreign direct investment, real exchange rates, relative factor supplies, and skill-biased technological change as alternative explanations for wage changes.

Second, Mexico's liberalization can be divided into two distinct periods. Mexico first opened trade to an arguably less-skill abundant world when it joined the General Agreement and Tariffs and Trade (GATT) in 1986 (Wood, 1997). The main effect of the GATT was a dramatic reduction in tariffs.[1] Mexico further liberalized trade with skill-abundant Canada and the United States by joining the North American Free Trade Agreement (NAFTA) in 1994. NAFTA further reduced tariffs and fostered deeper North American integration by harmonizing standards, facilitating capital flows, and reducing non-tariff barriers.

This paper uses three approaches to evaluate the link between changes in relative prices and changes in relative wages in Mexico. I apply both consistency checks (Krueger, 1997; Lawrence and Slaughter, 1993; Sachs and Shatz, 1994; Schmitt and Mishel, 1996) and mandated wage equations (Baldwin and Cain, 2000; Baldwin and Hilton, 1984; Haskel and Slaughter, 2001; Krueger, 1997; Leamer, 1998) found in these price studies. To evaluate the link between tariff changes and wages directly, I apply the two-stage modification of the mandated wage approach proposed by Feenstra and Hanson (1999). I also follow Haskel and Slaughter (2001) by considering possible effects of skill-based technological change. Third, Slaughter's (2000) question, "How fast does the Stolper–Samuelson clock tick?" suggests that time series approaches are relevant for the debate. I introduce a band pass filter to provide one of the first estimates of the relevant time frame for the price–wage relationship.

This paper presents three main findings. First, this paper supports and extends earlier work on Mexico's trade liberalization (e.g. Hanson and Harrison, 1999; Revenga, 1997; Cragg and Epelbaum, 1996) and extends these papers by showing that wage inequality reversed course and began to fall after NAFTA. Second, I find that the relative price of skill-intensive goods rose following entrance to the GATT, but after NAFTA, the relative price of skill-intensive goods fell. These price changes are consistent with the change in

[1] The maximum effective tariff in manufacturing prior to the GATT was 80%. The maximum tariff prior to the NAFTA was 20%.

tariffs that occurred under the GATT and endowment-based expectations of Mexico's integration with its skill-abundant northern neighbors. Hanson and Harrison (1999) find that Mexico protected less-skill-intensive industries before entering the GATT and tariff reductions were larger for less-skill-intensive industries, but surprisingly do not find significant evidence of a link between changes in output prices and wages. Using more detailed price data, this paper finds strong and consistent evidence of the link that completes their story. Third, the band pass filter results suggest that the relationship between relative prices and relative wages emerges in 3–5 years and grows over time.

Alternative explanations for changes in wage inequality, such as changing relative factor supplies, skill-biased technological change, foreign direct investment, and real exchange rate appreciation, do not seem to move in ways consistent with theory. The supply of skilled workers moves in the same direction as the relative wage of skilled workers, and the sector bias of skill-biased technical change seems to be the opposite as required by theory to explain changes in relative wages. Real exchange rate movements, which vary greatly over the sample period, and the December, 1994 devaluation-induced crisis do not seem to explain movements in relative wages.

The paper has five sections. In Section 1, I briefly review the formal derivation of the Stolper–Samuelson theorem and discuss previous applications of this theorem in the literature. These results provide a foundation for the rest of the empirical analysis. In Section 2, I use three independent data sets to document the change in wage inequality before and after NAFTA. Section 3 illustrates two established empirical approaches and Section 4 introduces a new approach to the study the relative price–wage relationship. Section 5 concludes.

1. Relative prices and relative wages: theory and practice

The neoclassical Heckscher–Ohlin framework suggests that changes in trade policy affect relative wages (w) through changes in relative goods prices (p). The Stolper–Samuelson theorem is a standard result in trade theory and therefore is only briefly reviewed here (Stolper and Samuelson, 1941). The zero profit conditions are represented as

$$c(w) \equiv a_{ij} w_i = p_i \tag{1}$$

These conditions are totally differentiated and solved to express the change in factor prices as a function of product prices. The penultimate result is

$$\hat{p} = \Theta \hat{w} \tag{2}$$

in which Θ is the matrix of factor cost shares and the circumflexes (^) indicate percentage changes.

The *Essential Version* of the Stolper–Samuelson theorem is derived neatly when Θ is square and invertible (as in the two-good, two-factor case). Inverting Θ yields a direct relationship between exogenous domestic prices (regardless of whether prices change due to trade liberalization or other factors) and endogenous wages. Most empirical studies, however, use data from many industries while considering at most four factors. A common empirical response is to appeal to the *Correlation Version* of the Stolper–Samuelson Theorem (Deardorff, 1994). The Correlation Version suggests that goods–price changes and factor–price changes should be correlated, even though it is impossible to say exactly which factor return will rise.

Haskel and Slaughter (1998) use a CES production function to derive a specific form of Eqs. (1) and (2) above. In addition to showing how an increase in the relative price of skill-intensive goods affects wages, they also show that skill-biased technological change (SBTC) can also have a similar direct effect on relative wages (assuming away the secondary effect that SBTC may have on output prices). This approach also suggests that small changes in relative factor supplies that do not cause production to move out of the current diversification cone should not affect prices and therefore would not affect relative wages.

Three broad empirical approaches relate prices and wages in the literature. The first applies "consistency checks." The Correlation Version (and more strict interpretations) suggests that in order for output price changes to increase wage inequality, the relative price of skill-intensive goods must rise. Studies that examine the factor intensity and timing of price changes have been called "consistency checks" because positive findings suggest that changes in prices and changes in wages are consistent with the Stolper–Samuelson theorem. Haskel and Slaughter (1998) also apply consistency checks to SBTC. Their specific functional form shows that SBTC will increase the relative wage of skilled workers, and, for SBTC to be a consistent explanation for rising wage inequality, SBTC must have risen.

Leamer (1998) uses the term "mandated wage equations" to describe the second empirical approach. Mandated wage equations predict the change in wages that would be consistent with Stolper–Samuelson effects. The basis for this approach is the idea that product–price changes should be proportional to factor–price changes where the factor of proportion is the vector of the industry's factor shares, and, since the factor share matrix in Eq. (2) is not invertible, one can estimate Eq. (2) directly. A wage vector is estimated by regressing the vector of price changes across time on the factor share matrix. The estimated vector is then compared to actual wage changes. Feenstra and Hanson (1999) argue that when the mandated wage equation is fully specified, it becomes an identity that cannot predict any change in wages other than what actually happened. They propose a two-stage estimation procedure that can identify the change in wages that is due to changes in policy, such as tariff changes. Haskel and Slaughter (2000), for example, apply this technique to estimate the effects of tariff changes on relative wages in the United States.

Francois and Nelson (1998) and Francois et al. (1998) argue that Eq. (2) implies that prices and wages exhibit a long-run relationship. Applying cointegration techniques, they find evidence of a relationship between relative prices and relative wages through time in the United States. Equations like Eq. (2), and the Stolper–Samuelson theorem derived from them under conditions of perfect factor mobility, are probably best interpreted as statements about the long run. Unfortunately, the theory provides little help in determining the length of real time that constitutes the "long run." To approach this question, I take three steps. First, I apply several methods to determine the appropriate trend since the trend term is unknown. In the context of the appropriate trend, I find the intuitive result that relative prices and relative wages are both stationary series. Given stationarity, I then employ a band pass filter to both series to generate evidence on the relevant timeframe for the relative price–wage relationship.

2. Relative wages in Mexico 1987–1999

To illustrate the change in wage inequality before and after NAFTA, I use three sources of data provided by Mexico's National Institute of Geography, Information, and Statistics (INEGI): the Mexican Industrial Census for the manufacturing sector, the National Urban Employment Survey (or ENEU, from its Spanish acronym) from eight Mexican metropolitan areas[2] of Mexico, and the Mexican Monthly Industrial Survey (Encuesta Industrial Mensual, or EIM).

I draw from the 1986, 1989, 1995, and 1999 Mexican Industrial Censuses, which provide data from the manufacturing industry for the prior year. The Census contains information on the employment of production workers (obreros) and non-production workers (empleados), as well as aggregate payments to each type of worker. I calculate the employment-weighted non-production/production per-worker wage ratio for census years 1985, 1988, 1994, and 1998.[3] The path of relative wages is shown in Fig. 1a. Feenstra and Hanson (1997) use Mexican industrial census data to show the increase in wage inequality that followed GATT membership. Fig. 1b is consistent with their figure: wage inequality increases between 1988 and 1994. After NAFTA, however, wage inequality falls.

To examine wage inequality in manufacturing and all other sectors of the economy, I calculate both the coefficient of variation of log wages and the 90–10 log wage ratio of working-age employed males and females using the ENEU. Analogous to the United States Current Population Surveys, the Mexican ENEU is a quarterly household-level survey used to calculate unemployment statistics. Fig. 1b shows that both measures follow a path similar to that in Fig. 1a.[4]

A third source of data is the Monthly Industrial Survey (EIM). The survey includes data on production and non-production employment and wages, employment hours for each worker type, the value of production, and the value of sales. Unfortunately, the data do not include information on capital or intermediate inputs and do not include firms with fewer than six workers.[5] The survey also excludes firms in the maquiladora

[2] Mexico City, Mexico State, Monterrey, Guadalajara, Tijuana, Ciudad Juarez, Nuevo Laredo, and Matamoros.

[3] Prior to 1988, the census years were evenly divisible by 5.

[4] Evidence that trade may be linked to the change in the demand for skill may also be identified by comparing the return to education in Mexico's border region with Mexico's interior region. Robertson (2000) shows that the border region is more affected by United States labor markets than the Mexican interior, which may be due to migration, transportation costs, capital flows, or trade. The return to education estimated from Mincerian log-wage equations on a continuous education variable in the border and the interior rises and then falls in both regions, but the change in the border region occurs closer to the NAFTA date. Similar results are beginning to emerge from other data sets as well. See Airola and Juhn (2001).

[5] The data do not include information on temporary or unpaid workers. Unpaid workers include apprentices and family members. In 1988, unpaid workers made up only about 10% of manufacturing employment.

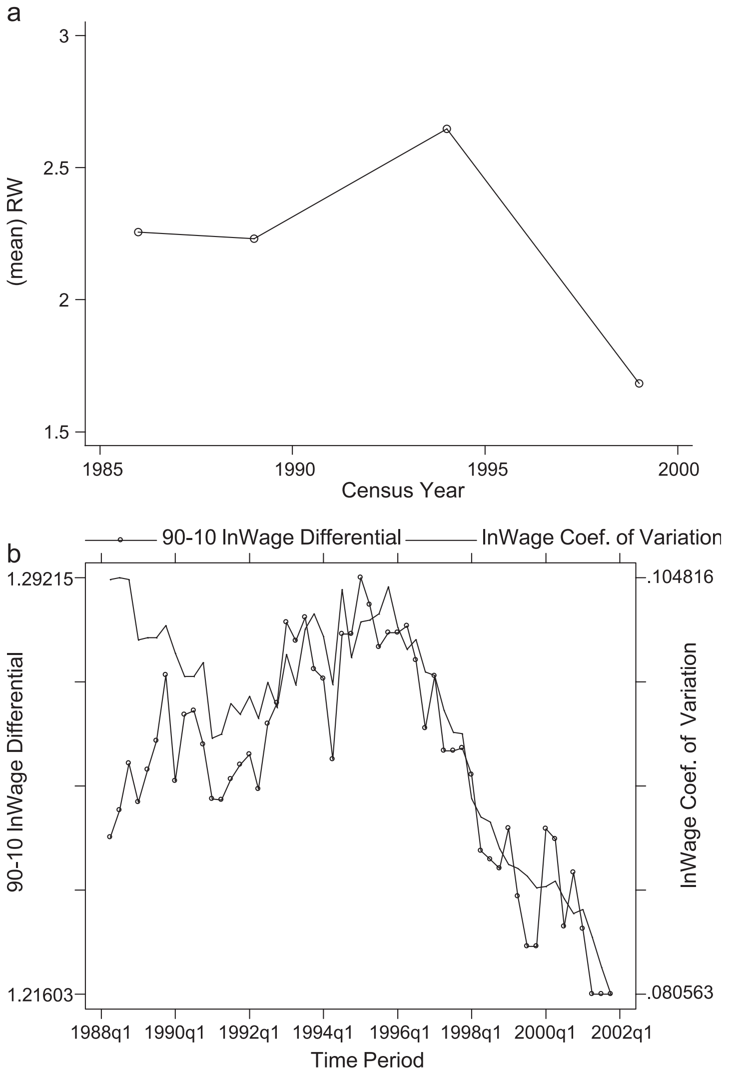

Fig. 1. (a) Relative wage of non-production workers 1986–1999. (b) Wage inequality in Mexico: 1988–2001. (a) data are from the Mexican Industrial Census and cover manufacturing only. (b) data are from the quarterly *Encuesta Nacional de Empleo Urbano* (National Urban Employment Survey) for eight cities (Tijuana, Ciudad Juarez, Matamoros, Nuevo Laredo, Monterrey, Guadalajara, Mexico State, and Mexico City).

industry.[6] As in United States industrial surveys, larger firms have a higher probability of remaining in the sample over time. Table 1 contains the summary statistics from the EIM by two-digit industry.

[6] Labor market effects from maquiladora investment, such as those described by Feenstra and Hanson (1997), should be detected in the surveys to the extent that labor markets within Mexico are integrated. Robertson (2000) finds that labor markets within Mexico are relatively integrated.

Table 1
Summary statistics of the Mexican monthly industrial survey

Industry	Sales	Employment	Average wage (dollars per hour)		H/L	Average education (years)		
			H	L		Overall	H	L
Food	45,933.4	182,370.2	4.62	1.54	0.584	8.78	11.72	7.30
Textiles	8,218.5	108,615.4	2.98	1.36	0.323	7.92	10.96	7.28
Wood	966.4	11,389.8	2.84	1.12	0.325	7.97	11.76	7.23
Paper	9,068.5	41,139.8	4.34	1.46	0.383	8.69	11.56	7.75
Chem.	42,270.0	166,318.8	4.97	1.96	0.797	9.86	12.35	8.08
Glass	11,961.2	57,463.6	5.16	1.55	0.420	7.96	12.09	7.02
Metals	24,681.0	57,677.1	4.79	1.77	0.440	8.87	11.75	7.76
Mach.	62,851.0	268,148.3	4.54	1.62	0.512	8.91	11.92	8.07
Other	749.0	7,632.9	4.07	1.33	0.399	8.04	11.07	7.42
Mean	37,547.8	164,793.4	4.40	1.61	0.525	8.76	11.81	7.67

Food represents the food and beverage industry. Textiles includes leather products and apparel. Paper includes printing. Glass represents all non-metallic minerals (e.g. stone and clay). Metals represents basic metals. "Mach." represents Metal Products, Machinery, and Equipment, including automobiles. The first five columns of data are from the Mexican Monthly Industrial Survey. The last three columns of data are from the Mexican National Survey of Urban Employment. Sales and employment figures are the averages over time of the sums across four-digit industries within each two-digit industry. Sales figures are in thousands of new pesos. H represents non-production workers, and L represents production workers. H/L is the ratio of the number of non-production workers to the number of production workers. Average wages exclude benefits, which are not available by worker type.

Following Lawrence and Slaughter (1993), I divide the EIM industries into those that intensively use production workers and those that intensively use non-production workers. Use of the production/non-production distinction as a proxy for skill intensity has been criticized in U.S. studies. In Mexico, however, this distinction seems to capture much of the skill segregation between industries. To illustrate, the last two columns in Table 1 use ENEU data to show that production workers have less education in every industry than non-production workers. Industries with higher relative employment ratios also have higher average education levels. Both Kendall and Pearson rank-correlation tests reject the hypothesis that the two measures (education and the non-production/production ratio) are independent at the 0.0001 level. Using the production/non-production distinction to (imperfectly) classify skill intensity seems valid in the Mexican case.

The EIM also contains production values and quantities that can be used to compute unit values. There are 947 identifiable products (averaging 25 products per four-digit industry). For price data I use unit values calculated from value and volume data. Quantities for some products were not available. As a result, unit values and price indices could not be computed over all available products in the industry. In most cases, the share of the excluded products in the total industry value is relatively small. For industries missing quantities for certain goods, I constructed the price indices from available unit prices and dropped industries with no price information.[7] For each industry I then constructed both the Laspeyeres (base-year quantities) and Paasche (current quantities)

[7] INEGI constructs and publishes price indices for the two-digit industry level. To test for robustness, I also used these measures in place of the four-digit constructed price indices. The results are qualitatively similar but, as expected, the two-digit price indices exhibit much smaller variance.

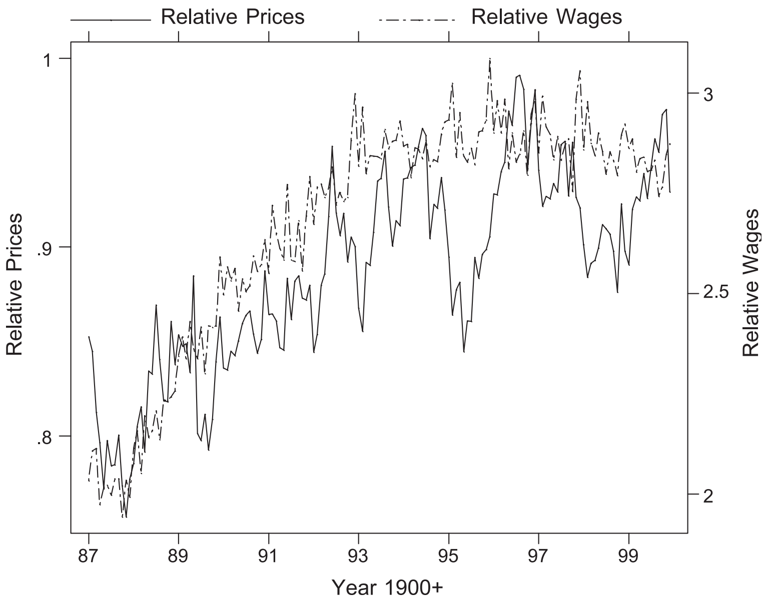

Fig. 2. Relative price and wage movements in Mexico, 1987–1999. For both series, "relative" implies the non-production/production worker ratio. Data are from the Monthly Industrial Survey, which cover manufacturing as described in the text.

price indices. There are relatively few differences between the two measures. For the empirical work in this paper I used the arithmetic average of the two indices.

I classify industries into two groups based on the median ratio of production to non-production workers.[8] Using this classification, I then calculate the production-weighted ratio of the output price indices of the two groups. Fig. 2 shows the movements of relative prices and relative wages. The employment weighted hourly non-production/production wage ratio is used to proxy for relative wages. The two series follow closely together throughout the sample. They also follow the same general path as inequality measures generated with industrial census data and household-level surveys (Fig. 1a and b).

3. Tariffs, relative prices, and wage inequality

Hanson and Harrison (1999) find that, prior to GATT, Mexico protected less-skill-intensive industries and, when Mexico joined GATT, the relative price of skill-intensive goods increased. NAFTA, signed on December 17, 1992 and began phase-in starting January 1, 1994, includes additional tariff reductions and provisions designed to facilitate capital flows, conflict resolution, harmonization of standards, and other measures designed to deepen integration. Under the agreement, Mexican tariffs on all industrial goods from the United States and Canada will be zero by 2003 (a few tariffs on agricultural products

[8] Using the top and bottom thirds of the employment ratios generates similar results.

will be phased out over 15 years). For tariff reduction purposes, the NAFTA groups United States and Canadian goods into several categories: those that became duty-free immediately as of January 1994 (Category A), those that experience five equal reductions of 20% a year so that these items were duty-free in 1998 (Category B), and those that experience 10 equal reductions of 10% a year, so that these items are duty-free in 2003 (Category C).[9] In ordered logit and probit estimation of the likelihood that a product falls into categories matched to industries in the Mexican Monthly Industrial Survey, the non-production cost share is negative and significant. In contrast to the GATT, these results imply that industries with a higher non-production worker ratio experience a more rapid decline in tariff protection. It would be consistent with the Heckscher–Ohlin framework if broader integration measures under NAFTA, such as non-tariff barriers, also helped to reduce the relative price of skill-intensive goods. The time series in Fig. 2 suggest that the relative price of skilled goods rose after the GATT but fell after NAFTA, but this period is also characterized by increasing capital flows, rising average worker skill levels, possible skill-biased technological change, and macroeconomic crisis linked to exchange rate movements. These are discussed in the next section.

3.1. Consistency checks of price movements and skill intensity

To compare price movements over the 1987–1999 period, I first divide the period using January 1994 as a break point. Following Hanson and Harrison (1999), I deflate the price data with the Mexican CPI. As in Lawrence and Slaughter (1993), I regress the change in prices ($\mathrm{d}P_j$) over each sample period on the ratio of non-production to production workers (H/L) at the beginning of each sample period:

$$\mathrm{d}P_j = a + b(H/L)_j + e_j. \tag{3}$$

Table 2 presents the regression results using Mexican industrial survey data for each period of trade liberalization.[10] Each regression is estimated using weighted least squares using the mean value of output over 1987–1998 as weights.[11] The results suggest that there is a significant and positive relationship between skill intensity and the change in the output price for the first period of liberalization (1987–1993 and 1988–1993). This evidence indicates that the relative price of non-production-worker-intensive goods rose relative to the price of production-worker-intensive goods. The results are robust to using education as a measure of skill. The second two columns suggest that the pattern of price change reverses after NAFTA. The change over the 1993–1998 period is significant at the 10% level and

[9] Category D goods were already duty-free before NAFTA, and textiles have slightly different categories. See http://www.mac.doc.gov/nafta/6000.htm.

[10] Using U.S. data and without controlling for the computer industry, Lawrence and Slaughter (1993) find either a negative or zero estimate for b and conclude that the relative price of non-production worker intensive goods did not increase over the sample period. Using a similar approach and U.S. data, Sachs and Shatz (1994) control for the computer industry and find a positive correlation. Krueger (1997) uses U.S. data from 1989 to 1995 and finds a positive correlation with and without controlling for the computer industry. Slaughter (2000) discusses the robustness of results found with and without computer-industry controls.

[11] Krueger (1997) uses weights and Slaughter (2000) discusses the robustness of using weights. They are appropriate for the Mexican case because of the large variance in industry employment.

Table 2
Price changes and initial skill intensities

	(1) 1987–1993	(2) 1988–1993	(3) 1993–1997	(4) 1993–1998
H/*L* 87	0.144 (0.065)**			
H/*L* 88		0.168 (0.088)*		
H/*L* 93			− 0.118 (0.086)	− 0.148 (0.084)*
Constant	− 0.373 (0.042)**	− 0.328 (0.055)**	− 0.005 (0.057)	− 0.023 (0.054)
Observations	123	123	123	123
Adj. R^2	0.031	0.016	0.007	0.017

H represents non-production workers. *L* represents production workers. Standard errors are in parentheses. Regressions are weighted by mean value of production.

* Significant at 10% level.

** Significant at 5% level.

the relevant coefficients in both columns reverse sign: they are positive in the GATT period and negative following NAFTA. These results suggest that the relative price of skill-intensive goods fell when Mexico opened to trade with relatively skill-abundant Canada and the United States. The changes in relative prices are consistent with the Stolper–Samuelson theorem in the sense that the increase in the relative wage of skilled workers was preceded by an increase in the relative price of skill-intensive goods and the decrease in relative wages occurred as the relative price of skill-intensive goods fell.

Of course, there are several other possible explanations for changes in wage inequality. One way to compare these various explanations is to briefly compare changes in each of these factors over the sample period with movements consistent with theory. Capital movements, especially in the form of direct investment, can increase the demand for skill.[12] Feenstra and Hanson (1997) argue that maquiladoras in particular increased the demand for skill in Mexico in the pre-NAFTA period. Fig. 3a shows the path of maquiladora establishments from 1990 to 2000. Both maquiladora establishments and wage inequality increase between 1990 and 1994, but following 1994 these series diverge. The rate of growth in maquiladora establishments increases while the skill premium falls, which suggests that other factors may also be at work.

Real exchange rate appreciation (and the peso crisis) may also affect the relative demand for skill. Fig. 3a includes the time path of the Mexican real exchange rate. While the real exchange rate does fall dramatically in December 1994, it quickly recovers and rises for the rest of the sample period. Robertson (2003) finds that the effect of real exchange rates on real wages is significant and depends on the degree of foreign exposure, but that it explains little of the changes in the production/non-production wage ratio over the 1987–2000 period.

Factor supplies may also affect the relative price of skill. Harrigan (2000) successfully incorporates changing factor supplies in the U.S. into a general equilibrium model. Since the time period covered in this paper is shorter than the one analyzed by Harrigan, it is more likely that factor supplies would not have changed substantially enough in Mexico to affect prices and wages. The theoretical model described above predicts that relative wages are insensitive to endowment changes as long as Mexican production remains in the same

[12] Blonigen and Slaughter (1999) find that FDI affects the demand for skill in the U.S.

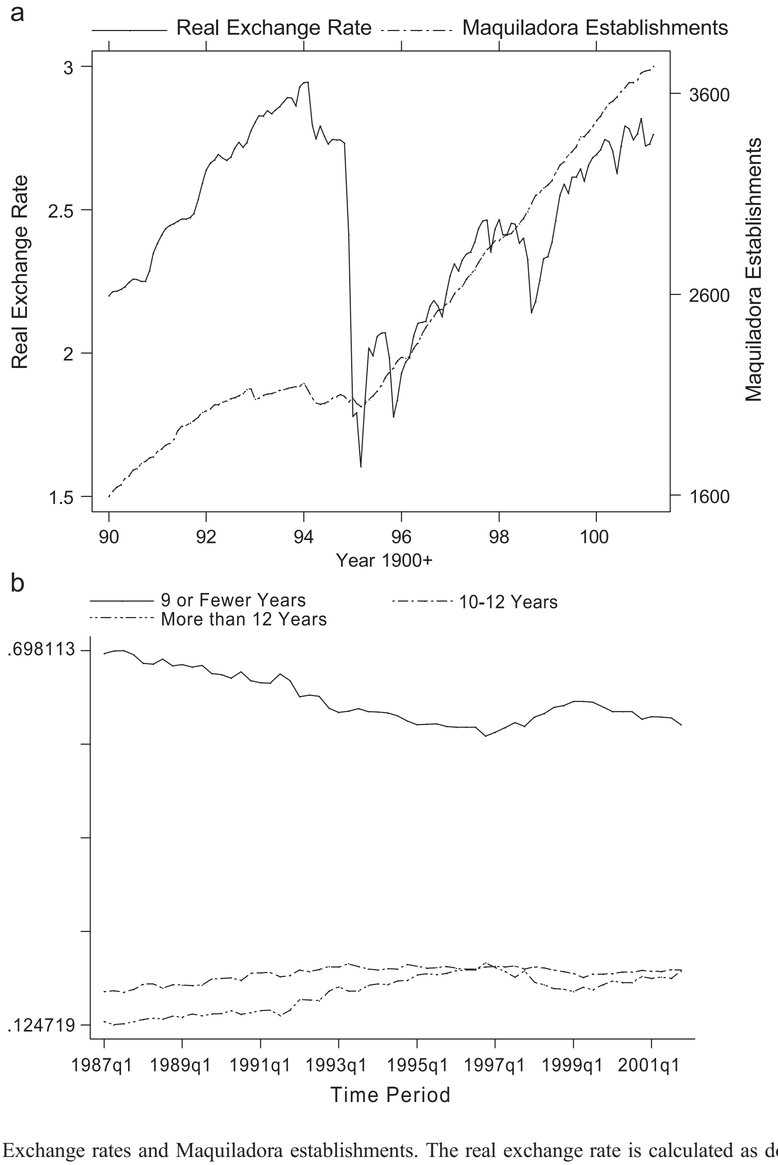

Fig. 3. (a) Exchange rates and Maquiladora establishments. The real exchange rate is calculated as dollars/peso nominal exchange rate times the Mexican CPI divided by the U.S. CPI (U.S. and Mexican CPI normalized to 1 in 1986). The maquiladora data are the sum of all establishments in Mexico. Source: http://dgcnesyp.inegi.gob.mx/bdine/bancos.htm. (b) Supply of skill in Mexico. Each line represents the share of ENEU workers in each education category.

diversification cone. For purposes of consideration, however, we allow the possibility that all of the changes in relative wages are due to changes in factor supplies, and compare the movements of factor supplies with the changes in relative wages. The relative shares of different education groups in the labor force, calculated using ENEU data, are shown in

Fig. 3b. The relative share of less-skilled workers (workers with less than 10 years of education) declines over the 1987–1997 period and then increases slightly until 2001. If anything, the time path of the supply of skilled workers moves in the opposite directions necessary to explain the observed path of wage inequality.

A fourth alternative is skill-biased technological change (SBTC). Endogenous technological change could explain changes in inequality if it was significant and changed in ways consistent with observed changes in inequality. In 1992, INEGI conducted a survey of 5071 manufacturing firms that inquired about technology investment and acquisition.[13] According to the survey, the average share of revenues allocated for research and development was 0.6% in 1992 while the average share of revenues allocated for technology purchases was 3.1% in 1992 (up from 2.5% in 1989). Only 2.6% of all firms in the survey reported using a "cutting-edge" productive process, with the rest having either a "mature" or "older" process. Developed countries experience relatively more technological change than Mexico.[14]

While the extent of technological change in Mexico may be debatable, Cañonero and Werner (2002) argue that SBTC is relevant for Mexico in the first period. Haskel and Slaughter (1998) [HS] argue that SBTC is not sufficient to explain wage inequality: it is the *sector bias* of SBTC that explains changes in relative wages.[15] Therefore, I first estimate skill-biased technological change with Mexican industrial census data and the methodological approach described by [HS] for industries indexed by k:

$$\Delta S_k = a_0 + a_1 \Delta log(w_h/w_l)_k + a_2 \Delta(K/Y)_k + \varepsilon_k, \tag{4}$$

in which ΔS_k is the change in the non-production employment share in the total wage bill, w_i represents the wage of each worker type, K is capital, and Y is real value-added output, and the final term is the error. [HS] suggest that skill biased technological change in sector k can be represented by positive values of $a_0 + \varepsilon_k$. Estimated values from the Mexican census data are all positive, suggesting that all industries in all periods experienced SBTC (consistent with Cañonero and Werner, 2002). To evaluate the sector bias, [HS] regress their estimates of SBTC on the initial value of the non-production–production employment ratio. For this analysis I assume, like [HS], that technology does not affect prices.

The results, available upon request, suggest that the relationship between skill intensity and SBTC is weakly positive between 1986 and 1989, negative between 1989 and 1994, and strongly positive from 1994 to 1999. Like the supply of skill, the sector bias of SBTC is in the opposite direction as would be expected if sector bias matters and SBTC were to explain the changes in wage inequality.[16]

[13] The National Survey of Employment, Salaries, Technology, and Training in the Manufacturing Sector (Encuesta Nacional de Empleo, Salarios, tecnología y Capacitación en el Sector manufacturero, 1992) was a joint project between INEGI, Mexico's Labor Secretariat, and the OIT.

[14] For comparison, on average, U.S. industry spent 3.1% of net sales on R&D in 1989 (National Science Foundation, 1992).

[15] Xu (2001) finds that the elasticity of substitution may affect these results.

[16] Several studies have suggesting that decomposing the change in demand for skill into within industry and between industry components is helpful. Using industrial survey data, the values for this decomposition between 1987 and 1994 are $0.028 = 0.016 + 0.012$ and for the 1993–1998 period are $-0.028 = -0.019 - 0.009$, suggesting changes both between and within industries over each period.

Of the possible explanations considered (capital flows, exchange rate movements, supply of education, skill-biased technological change, and changes in relative output prices), changes in relative output prices are the only ones that move in ways consistent with theory.[17] These findings only indirectly support the relationship represented in Eq. (2). The mandated wage approach provides a potentially more direct alternative.

3.2. The mandated wage approach

To test the long-run relationship between wages and prices, the mandated wage approach estimates Eq. (2) and compares predicted changes in wages with actual changes. Baldwin and Cain (2000) implement Eq. (2) with the following regression equation:

$$\hat{p}_j = \alpha + \sum_i \hat{w}_i \theta_{ij} + e_j \tag{5}$$

in which i is the factor index and θ_{ij} is the share of factor i employed in industry j. The variables p_j and w_i represent the output price in industry j and the economy-wide return to factor i, respectively.[18] The estimation deviates from a strict interpretation of the theory in that the factor shares are the independent variables and the prices are the endogenous variables. The estimated parameters are the predicted changes in the wages (over the sample period). A match between the predicted changes and actual changes suggests support for Stolper–Samuelson effects. A poor match suggests other explanations, such as changes in technology or an omitted-variable bias.

The U.S. literature identifies four key estimation issues. The first concerns the exogeneity of price changes. If technology is changing, and technology affects prices, then failure to account for technology leads to biased results. One advantage of studying the Mexican case is that prices may be more likely to be exogenous than they are in the United States in the sense that prices are determined on the world market, trade policy shocks were relatively large, and technology changes were relatively small. I therefore maintain the assumption that technology does not have a secondary effect on prices.

The second estimation issue involves value-added prices. Slaughter (2000) shows that intermediate inputs make up large and growing shares of production in the U.S. Accounting for the prices of intermediate inputs is especially important when intermediate inputs are imported since changes in the prices of intermediate inputs are passed through to product prices and can thus affect factor prices (Woodland, 1982). Unfortunately, the industrial survey data do not include information on intermediate inputs. Thus, when using

[17] Bell (1997) finds that minimum wages are not binding in Mexico and therefore may not contribute to the explanation. Maloney and Ribeiro (1999) suggest that unions have little wage-setting power in Mexico. Other possibilities include other institutional factors, such as the *Pactos* established in 1987, but a thorough analysis of these factors seems beyond the scope defined in this paper and is left for future research.

[18] Here we assume that labor market adjustment costs are small such that factors are perfectly mobile between industries and, therefore, wages are equalized across industries. Robertson and Dutkowsky (2002) find that labor market adjustment costs in Mexico are about 1/10 of estimated adjustment costs in the U.S.

the industrial survey data, I am forced to use "gross" output prices rather than "net" output prices.[19]

Feenstra and Hanson (1999) introduce two additional estimation issues. First, they argue that when the mandated wage equation includes inter-industry wage differentials and productivity, the equation becomes an identity and therefore the estimated coefficients in Eq. (5) cannot reveal anything about the change in wages other than that which actually occurred. In Haskel and Slaughter's (2001) study of U.K. wage inequality, they argue that inter-industry wage differentials are stable in Great Britain and so do not affect the analysis. Abuhadba and Romaguera (1993) compare individual level data for Chile, Uruguay, and Brazil and find "more similarities than differences" with inter-industry wage differentials observed in U.S. data aggregated over workers, suggesting that inter-industry wage differentials may be stable in Latin America as well. If inter-industry wage differentials are stable and technology does not affect prices, then the mandated wage approach may be appropriate for Mexico.

Second, Feenstra and Hanson (1999) present a two-stage approach to identify the contribution of the tariff changes on relative wages that I follow below. To begin, however, I first estimate Eq. (5) for the period following the GATT and again for the period following the NAFTA. In the first case, I use the average factor shares in 1987 and 1988 and the change in the output price index for each industry over the period 1987–1993 and 1998–1993. In the second case, I use average factor shares from 1993 and 1996 and the change in the output price index for each industry over the period 1993–1998 and 1996–1999. I examine the 1996–1999 period because a deep recession began with the collapse of the peso in December 1994 and began to end in 1996. Following Baldwin and Cain (2000), I use the value of industry output as regression weights.

The actual changes in average hourly wages and the results from Eq. (5) are found in Table 3. Although imprecise,[20] all of the point estimates are consistent with the Stolper–Samuelson theorem and the predicted changes are similar to the actual changes. The predicted changes in wages are larger than the actual changes. In only one case are the predicted changes statistically different from the actual changes (production workers over the 1988–1995 period). In this case, the predicted change in wages is large and negative, while the actual change is close to zero. While the large standard errors make the null hypothesis (that predicted changes and actual changes are similar) difficult to reject, the actual wage change for non-production workers is outside the 95% confidence interval for the predicted wage of production workers in all four cases.

The relative magnitudes reverse following NAFTA, suggesting a predicted fall in wage inequality. In the period following the crisis, the predicted wage change for both types of workers is negative. The predicted changes match the actual change in wages in that both

[19] To check the robustness of these results, I introduce information on intermediate inputs from the Mexican Industrial Census. The correlation between the value-added price changes and the gross–output price changes is 0.9033. The findings are qualitatively robust to using value-added prices and accounting for intermediate inputs, although are less precise due to aggregation in the census.

[20] The R^2 values are generally smaller than those found in U.S. studies. Even for given sample sizes, Mexican data tend to contain more noise than comparable U.S. data which makes the results somewhat sensitive to sample and specification.

Table 3
Mandated wage equation results

$$\hat{p}_j = \alpha + \sum_i \hat{w}_i \theta_{ij} + e_j$$

		Change in prices over period:			
		1987–1993	1988–93	1993–1998	1996–1999
Production workers	predicted	−1.062 (0.816)	−1.189 (0.876)	−0.679 (1.019)	1.230 (0.669)
	actual	0.005	0.164	−0.243	0.072
	p-value	0.193	0.125	0.670	0.086
Non-production workers	predicted	2.257 (1.060)	2.134 (1.031)	−1.662 (0.865)	1.190 (0.412)
	actual	0.583	0.548	−0.237	0.039
	p-value	0.117	0.126	0.102	0.006
	N	127	127	127	127
	Adj. R^2	0.021	0.018	0.046	0.132

Value of industry production used as weights. Residual input shares (capital, land, and material) were not included in these regressions. Regressions that included residual input shares produced similar results. Standard errors are in parentheses.

suggest that the relative wage of skilled workers fell following NAFTA. The negative wage changes are not surprising given the peso-induced recession. The predicted changes for the 1996–1999 recovery period are positive but again the predicted changes match the actual wage changes in suggesting a fall in wage inequality. This may be consistent with the idea that the effects of prices on wages take some time to emerge.

Feenstra and Hanson (1999) argue that a two-stage procedure is necessary to estimate the contribution of the tariff changes on wages. I follow their approach for the GATT period using the change in prices over the 1987–1993 period and the 1988–1993 period as the dependent variable in the first stage regression. Using only the change in tariffs between 1985 and 1988 for each industry included in the monthly industrial survey as the independent variable in the first stage, the second stage regression results suggest that the change in tariffs increased wage inequality.[21] The estimated magnitudes are smaller than both the estimates found in Table 3 and the actual changes. Compared to the actual changes of non-production worker wages, the results suggest that tariffs explain about a third of the rise in the non-production worker wage. I analyzed the NAFTA period using 874 product-level prices matched to product-level tariffs. The results from the second stage regressions suggest that tariffs had a much smaller effect on prices in the NAFTA period than in the GATT period. Thus, although the fall in the relative price of skilled goods that followed NAFTA is consistent with the difference in relative endowment of skill, tariffs on manufactured goods may not have been the primary force driving the change in relative prices. It is noteworthy, however, that none of the other candidates (capital flows and SBTC, for example) reverse course after NAFTA in the same way that relative prices do. It is also possible that we do not know when prices and wages should be related. The next section generates some results that suggest a timeframe for the relationship between relative prices and wages.

[21] Results available from the author upon request.

4. The timing of adjustment

Classifying workers as either skilled or unskilled, Francois et al. (1998) circumvent the dimensionality problem inherent in Eq. (2) by dividing industries into two groups based on factor intensity. They follow Borjas and Ramey (1994) and Baldwin and Cain (2000) when constructing their relative wage series and when computing relative prices. Since there are only two factors (skilled and unskilled workers) and only two goods (based on factor intensity), the factor share matrix in Eq. (2) can be inverted to yield

$$\hat{w} = \Theta^{-1}\hat{p}, \tag{6}$$

which Francois et al. (1998) interpret as representing the relationship between relative prices and relative wages over time. They then test the hypothesis that relative wages and relative prices are cointegrated. The first of two necessary conditions for cointegration is that both series must exhibit a unit root. Although there is little intuitive support for the idea that *relative* wages and *relative* prices should be non-stationary, thoroughness dictates that we consider this first condition. Only if the first condition is satisfied would we consider whether the difference between the two series is stationary.

Using the root mean squared error of the regression (RMSE), Akaike's Information Criterion (AIC), Amemiya's Prediction Criterion (PC), and Schwarz's Information Criterion (SC), I find that the optimal lag length for prices is 3 and for wages is 4. A Dickey–Fuller unit root test with these lag lengths and a linear trend fails to reject the unit root hypothesis for each series.[22]

The linear trend, however, may not be appropriate for the series shown in Fig. 2. In fact, the appropriate trend is not known. Since the actual trend is not known, and since it may affect the unit root tests, I apply strategy S1 suggested by Ayat and Burridge (2000). They suggest estimating the following equation(s) in which t represents a time trend and y represents wages or prices:

$$\Delta y_t = (\rho - 1)y_{t-1} + \alpha_1 + \alpha_2 t + \alpha_3 t^2 + \sum_{j=1}^{s} a_j \Delta y_{t-j} + e_t \tag{7}$$

These results are presented in Table 4. Since the null of a unit root is rejected, Ayat and Burridge (2000) suggest next testing the significance of the coefficient on the trend terms using standard tables to evaluate the t-statistics on the α_2 terms. These results are also shown in Table 4. Since the unit root is rejected and the quadratic trend term is not rejected, we stop, since this test is "the only one available which is invariant to the maintained quadratic trend" (Ayat and Burridge, 2000, p. 78).

Instead of a quadratic trend, one may consider that the series are better characterized by a breaking linear trend. The actual date for this break is unknown, and therefore we are interested in testing for a unit root in a series with an unknown break. A relatively large literature addresses this problem. Vogelsang and Perron (1998) refine the methodology for

[22] The test statistics (p-values) are -2.11 (0.242) and -2.39 (0.145).

Table 4
Unit root test results

$$\Delta y_t = (\rho - 1)y_{t-1} + \alpha_1 + \alpha_2 t + \alpha_3 t^2 + \sum_{j=1}^{s} a_j \Delta y_{t-j} + e_t$$

	Prices	Prices	Prices	Wages	Wages	Wages
$(\rho - 1)$	− 0.089	− 0.123	− 0.272	− 0.048	− 0.058	− 0.874
	(2.345)	(2.543)	(3.952)	(2.527)	(1.581)	(6.324)
α_1	0.079	0.047	− 4.998	0.139	0.075	− 91.699
	(2.365)	(1.102)	(2.942)	(2.713)	(0.384)	(6.073)
α_2		0.001	0.110		0.001	1.956
		(1.130)	(2.988)		(0.337)	(6.081)
α_3 (×10)			− 0.001			− 0.010
			(2.971)			(6.078)
a_1	− 0.291	− 0.240	− 0.039	− 0.826	− 0.787	0.691
	(1.615)	(1.290)	(0.204)	(3.266)	(2.831)	(1.985)
a_2	0.003	− 0.036	− 0.183	0.145	0.094	− 1.490
	(0.016)	(0.173)	(0.877)	(0.332)	(0.204)	(3.051)
a_3	0.055	0.066	0.106	− 0.039	− 0.011	0.867
	(0.671)	(0.803)	(1.307)	(0.127)	(0.034)	(2.702)
a_4				0.051	0.045	− 0.150
				(0.626)	(0.537)	(1.851)
Observations	152	152	152	151	151	151
Adj. R^2	0.098	0.100	0.145	0.404	0.400	0.520

Absolute values of t-statistics are in parentheses. The absolute value for the 5% DF test statistic is 2.89 without a trend term and 3.45 with a trend term. The absolute value for the 5% test statistic with a quadratic trend is between 3.48 and 3.61.

identifying an unknown break and testing for unit roots. They consider several different models. Of these, I apply the following model using the time trend t:

$$y_t = \mu + \beta t + \theta \mathrm{DU}_t + \gamma \mathrm{DT}_t + \tilde{y}_t^2$$
$$\tilde{y}_t^2 = \sum_{i=0}^{k} \omega_i D(T_b)_{t-i} + \alpha \tilde{y}_{t-1}^2 + \sum_{i=0}^{k} c_i \Delta \tilde{y}_{t-i}^2 + u_t, \quad (8)$$

in which DU = $1(t>T_b)$, DT = $1(t>T_b)(t - T_b)$, and $D(T_b) = 1(t = T_b + 1)$. I choose this model because the unit root tests are sensitive to the assumption of a gradual vs. a sharp trend break, and this problem is magnified when the break in the trend is large (as in the present case). Using the break points found by minimizing the negative value of γ,[23] the 5% critical value for the unit root test of $\alpha = 1$ is − 4.28. The t-value on the test that $\alpha = 1$ for the relative wage series is − 5.06 and for the relative price series is − 4.51. These results suggest that considering a breaking trend rather than the quadratic trend does not qualitatively affect the unit root results described earlier. I find no robust evidence of nonstationarity, so the cointegration approach is not appropriate. I therefore introduce a new approach to the literature: the band pass filter.

To get an idea of the frequency at which prices and wages are related, we appeal to the theory of spectral analysis of time series. This theory has been applied primarily in

[23] We seek the largest negative t-statistic for the γ parameter because we know that the break is negative.

macroeconomics to separate "short run" relationships (high frequency) from "long run" relationships (low frequency). A tool used to isolate the different frequency components in time series is the ideal band pass filter. The ideal band pass filter applies a linear transformation to a series that removes all variation except that which occurs at the frequency of interest. The ideal band pass filter, unfortunately, requires an infinite series. Christiano and Fitzgerald (1999) present an approximation to the ideal band pass filter and apply this approximation to various macroeconomic time series to illustrate whether series are related in the short or long term.

The filter uses raw data (such as that represented by a series x of actual length T) to isolate the frequency component y by estimating the B parameters in the following equations (Eqs. (1.2) and (1.3) in Christiano and Fitzgerald, 1999):

$$\hat{y}_t = B_0 x_t + B_1 x_{t+1} + \ldots + B_{T-1-t} x_{T-1} + B_{T-t} x_t + B_1 x_{t-1} + \ldots + B_{t-2} x_2 + B_{t-1} x_1 \tag{9}$$

in which[24]

$$B_j = \frac{\sin(jb) - \sin(ja)}{\pi j};\; j \geq 1$$

$$B_0 = \frac{b-a}{\pi};\; a = \frac{2\pi}{p_u};\; b = \frac{2\pi}{p_l}. \tag{10}$$

The first step is to detrend the two series. I then use the band pass filter to isolate the components of relative wages and relative prices that occur at 6–12 months, 1–3 years, and 3–5 years. I compare these results with the quadratic trends estimated over the whole sample. The quadratic-detrended series and the components that occur at the 6–12 month frequency (the latter derived using the filter) show no clear relationship between relative wages and relative prices. This is not surprising. As Magee (1980) suggests, the Stolper–Samuelson theorem probably does not hold in the short run. Since the Stolper–Samuelson theorem assumes that adjustment costs are zero, it is essentially a "long-run" theorem.

Fig. 4a shows the 1–3 year frequency components of the detrended price and wage series. Again, there is no clear relationship between the series at these frequencies. Fig. 4b shows the 3–5 year component of the two series. The series move closely together. Relative wages are more volatile than relative prices. The contrast between Fig. 4a and b is consistent with the idea that relative wages and relative prices are related in the long run and that the long run is about 3–5 years.

To examine the relationship between the decomposed series in more detail, Table 5 contains the results from a regression of relative wages on relative prices. Columns 1–3 show that at the monthly and 6–12 month frequencies, there is no statistically significant relationship between the two series. At the 1–3 year frequency, the relationship between the two series is negative and significant—a result that is consistent with significant adjustment time in the labor market[25] and the two-stage mandated wage equation results from the

[24] The B_{T-t} and B_{T-1} are linear functions of the other B_j terms, as described by Christiano and Fitzgerald (1999).

[25] Heckman and Páges-Serra (2000) find significant effects of job security regulations that affect employers' ability to adjust employment. Their analysis, however, does not include Mexico.

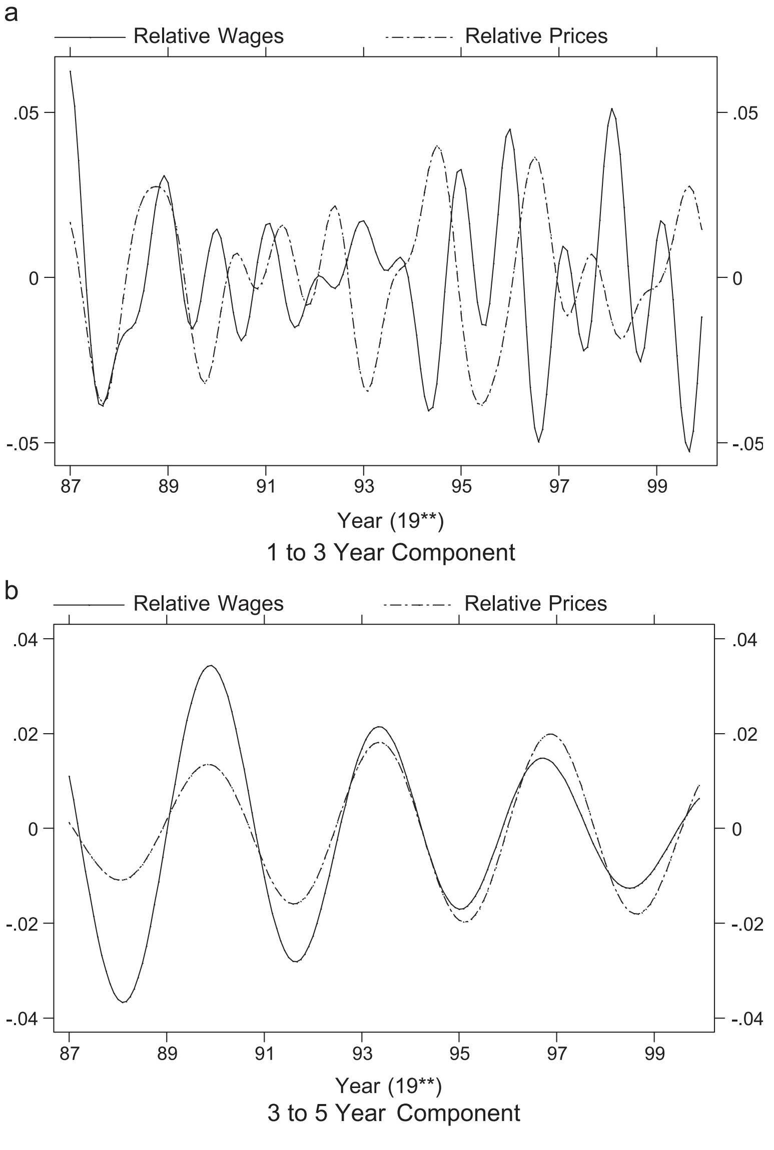

Fig. 4. (a,b) Relative price and wage movements in Mexico, 1987–1999, band pass filter results. For both series, "relative" implies the non-production/production worker ratio. Data are from the Monthly Industrial Survey, which cover manufacturing as described in the text.

immediate post-NAFTA period. Although the coefficient on relative prices is significant, the adjusted R^2 is less than 0.05. In contrast to the short-run frequencies, the 3–5 year components of relative prices and relative wages are significantly positively related. Relative prices explain a great deal of the movement in relative wages, as suggested by the adjusted R^2 of over 0.65.

Table 5
Bivariate regressions of wages on prices
$\hat{w} = \Theta^{-1}\hat{p}$

	Detrended series	6–12 months	12–36 months	36–60 months
Θ^{-1}	0.185 (1.024)	− 0.183 (0.738)	− 0.245 (2.630)	1.146 (17.859)
Adj. R^2	0.000	− 0.003	0.037	0.672
N	156	156	156	156

Absolute value of t-statistics in parentheses.

To explore robustness, I also examined alternative frequencies, such as 2–4 years. Frequencies below the 3–5 year range do not generate any significant positive relationship. Another alternative is to consider two periods—a "short" run of 1–3 years and a "long" run of greater than 3 years. Subtracting the "short" run variation from the original detrended series generates the "long" run series. As in the earlier figures, the "short" run graphs generate no clear relationship between prices and wages. The "long" run series, however, exhibit a much closer relationship as shown in Fig. 5. These results suggest that the 3–5 year frequency is a lower bound to the time frame in which the price and wage relationship emerges in Mexico. The adjusted R^2 in the regression of the quadratic trend of wages on the quadratic trend of prices is over 0.90. These results suggest that the relationship between relative prices and relative wages first emerges over the 3–5 year period and grows over time.

Fig. 5. Relative price and wage Movements in Mexico, 1987–1999, band pass filter results. For both series, "relative" implies the non-production/production worker ratio. Data are from the Monthly Industrial Survey, which cover manufacturing as described in the text.

5. Conclusions

One area of debate in the trade and wages literature is whether changes in product prices can explain changes in wage inequality as trade theory predicts. Mexico, a small, recently liberalized economy, offers two different policy changes. First, Mexico liberalized trade with an arguably less-skill abundant world when it joined the GATT in 1986. Prior to GATT, Mexico protected less-skill intensive industries. Following entrance to the GATT, the relative price of skill-intensive goods rose and, consistent with the predictions of the Stolper–Samuelson theorem, the relative wage of skilled workers rose. Second, when Mexico further liberalized trade with Canada and the United States, two nations that are skill abundant relative to Mexico, the relative price of skill-intensive goods fell. Again, consistent with the predictions of the Stolper–Samuelson theorem, the relative wage of skilled workers fell after NAFTA.

To examine the link between changes in relative prices and changes in relative wages, this paper applies two techniques found in the literature and adds a new time-series approach. All three techniques generate consistent results that suggest that changes in relative prices and changes in relative wages are related. The third approach, the band pass filter, provides some of the first evidence about the timing of the Stolper–Samuelson effects. The band pass filter results suggest that the relationship between prices and wages begins to emerge in the 3–5-year range and grows stronger over time.

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References

Abuhadba, M., Romaguera, P., 1993. Inter-industry wage differentials: evidence from Latin American countries. Journal of Development Studies 301, 190–205.

Airola, J., Juhn, C., 2001. Income and Consumption Inequality in Post Reform Mexico. Paper presented at the 2001 Latin American and Caribbean Economic Society Meetings.

Ayat, L., Burridge, P., 2000. Unit root tests in the presence of uncertainty about the non-stochastic trend. Journal of Econometrics 951, 71–96.

Baldwin, R.E., Cain, G.G., 2000. Shifts in relative U.S. wages: the role of trade, technology, and factor endowments. Review of Economics and Statistics 824, 580–595.

Baldwin, R., Hilton, R., 1984. A technique for indicating comparative costs and predicting changes in trade ratios. Review of Economics and Statistics 661, 105–110.

Bell, L., 1997. The impact of minimum wages in Mexico and Colombia. Journal of Labor Economics 153 (Pt. 2), S102–S135.

Blonigen, B., Slaughter, M., 1999. Foreign-Affiliate Activity and U.S. Skill Upgrading. NBER Working Paper No. W7040.

Borjas, G., Ramey, V., 1994. Time-series evidence on the sources of trends in wage inequality American. Economic Review 842, 10–16.

Cañonero, G., Werner, A., 2002. Salarios Relativos y Liberación del Comercio en México. El Trimestre Económico 69273, 123–142.

Christiano, L.J., Fitzgerald, T. J., 1999. The Band Pass Filter. NBER Working Paper No. W7257.

Cragg, M., Epelbaum, M., 1996. Why has wage dispersion grown in Mexico? Is it the incidence of reforms or the growing demand for skills? Journal of Development Economics 51, 99–116.

Deardorff, A., 1994. Overview of the Stolper–Samuelson Theorem. In: Deardorff, A., Stern, R. (Eds.), The Stolper–Samuelson Theorem: A Golden Jubilee. University of Michigan Press, Ann Arbor, pp. 7–34.

Feenstra, R.C., Hanson, G.H., 1997. Foreign direct investment and relative wages: evidence from Mexico's maquiladoras. Journal of International Economics 42, 371–393.

Feenstra, R.C., Hanson, G.H., 1999. The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979–1990. Quarterly Journal of Economics 1143, 907–940.

Francois, J.F., Nelson, D., 1998. Trade, technology, and wages: general equilibrium mechanics. Economic Journal 108450, 1483–1499.

Francois, J., Navia, R., Nelson, D., 1998. Treating the SS theorem Seriously: The Long-Run Relationship between Relative Commodity Prices and Relative Factor Prices. Mimeo, Erasmus University.

Hanson, G.H., Harrison, A., 1999. Trade, technology, and wage inequality. Industrial and Labor Relations Review 522, 271–288.

Harrigan, J., 2000. International trade and American wages in general equilibrium, 1967–1995. In: Feenstra, R.C. (Ed.), The Impact of International Trade on Wages NBER Conference Report Series. University of Chicago Press, Chicago, pp. 171–193.

Haskel, J., Slaughter, M.J., 1998. Does the Sector Bias of Skill-Biased Technical Change Explain Changing Wage Inequality? NBER Working Paper No. 6565.

Haskel, J., Slaughter, M.J., 2000. Have Falling Tariffs and Transportation Costs Raised U.S. Wage Inequality? NBER Working Paper No. 7539.

Haskel, J., Slaughter, M.J., 2001. Trade, technology and U.K. wage inequality. Economic Journal 111468, 163–187.

Heckman, J., Páges-Serra, C., 2000. The cost of job security regulation: evidence from Latin American labor markets. Economia 11, 109–144.

Krueger, A., 1997. Labor Market Shifts and the Price Puzzle Revisited. NBER Working Paper No. 5924.

Lawrence, R., Slaughter, M., 1993. International trade and American wages in the 1980s: giant sucking sound or small hiccup? Brookings Papers: Microeconomics 2, 161–226.

Leamer, E.E., 1998. In search of Stolper–Samuelson linkages between trade and lower wages. In: Collins, S. (Ed.), Imports, Exports, and the American Worker. Brookings Institute Press, Washington, DC, pp. 141–202.

Magee, S., 1980. Three simple tests of the Stolper–Samuelson Theorem as found. In: Deardorff, A., Stern, R. (Eds.), The Stolper–Samuelson theorem: A Golden Jubilee. Studies in International Trade Policy. University of Michigan Press, Ann Arbor, pp. 185–200.

Maloney, W.F., Ribeiro, E.P., 1999. Efficiency Wage and Union Effects in Labor Demand and Wage Structure in Mexico: An Application of Quantile Analysis. World Bank Policy Research Working Paper 2131.

National Science Foundation, 1992. Research and Development in Industry, 1989. NSF 92-307. Washington, DC, Government Printing Office.

Revenga, A., 1997. Employment and wage effects of trade liberalization: the case of Mexican manufacturing. Journal of Labor Economics 153 (Pt. 2), S20–S43.

Robertson, R., 2000. Wage shocks and North American labor-market integration. American Economic Review 904, 742–764.

Robertson, R., 2003. Exchange rates and relative wages: evidence from Mexico. The North American Journal of Economics and Finance 141, 25–48.

Robertson, R., Dutkowsky, D.H., 2002. Labor adjustment costs in a destination country: the case of Mexico. Journal of Development Economics 671, 29–54.

Sachs, J., Shatz, H., 1994. Trade and jobs in U.S. Manufacturing. Brookings Papers on Economic Activity I, 1–84.

Schmitt, J., Mishel, L., 1996. Did International Trade Lower Less-Skilled Wages During the 1980s? Standard Trade Theory and Evidence Economic Policy Institute. Technical Paper No. 213.

Slaughter, M., 2000. What are the results of product–price studies and what can we learn from their differences? In: Feenstra, R.C. (Ed.), The Impact of International Trade on Wages. National Bureau of Economic Research Conference, vol. 2000, pp. 129–170.

Stolper, W., Samuelson, P., 1941. Protection and real wages. Review of Economic Studies 9, 58–73.

Vogelsang, T., Perron, P., 1998. Additional tests for a unit root allowing for a break in the trend function at an unknown time. International Economic Review 39 (4), 1073–1100.

Wood, A., 1997. Openness and wage inequality in developing countries: the Latin American challenge to East Asian conventional wisdom. World Bank Economic Review 111, 33–57.

Woodland, A.D., 1982. International Trade and Resource Allocation. North-Holland, Amsterdam.

Xu, B., 2001. Factor bias, sector bias, and the effects of technical progress on relative factor prices. Journal of International Economics 541, 5–25.