
Globalization, Regional Wage Differentials and the Stolper-Samuelson Theorem: Evidence from Mexico

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1. Introduction

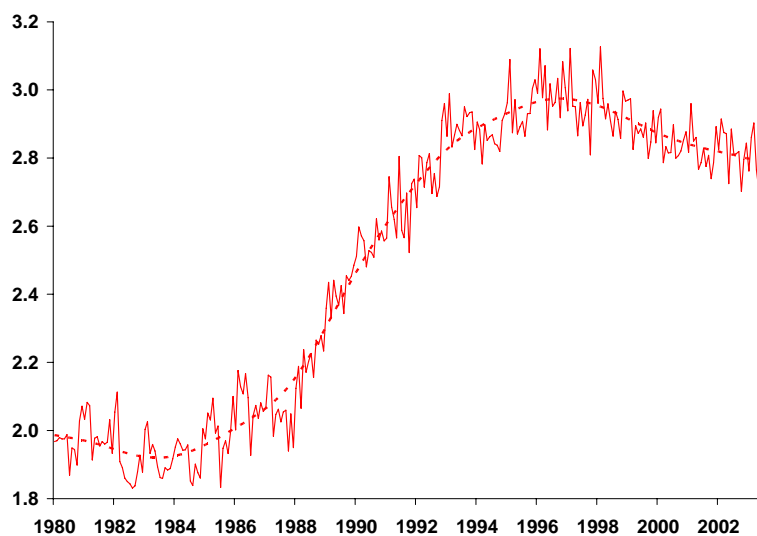
- Existing evidence suggests that returns to skill and wage inequality have risen in Mexico, as well as in other less developed countries that have liberalized to international trade (e.g. Cragg and Epelbaum, 1996; Davis, 1996; Feenstra and Hanson, 1997; Revenga and Montenegro, 1998).
- Focusing on Mexico, if this country is presumed to be abundant in unskilled labor, the apparent response of input prices to trade liberalization is inconsistent with the predictions of the Stolper-Samuelson Theorem (Harrison and Hanson, 1999).
- This puzzle has led some authors to argue that the evolution of relative wages has not been a result of trade, but of other factors (e.g. Cragg and Epelbaum, 1996; Alvarez and Robertson, 2001; Airola, 2001; Esquivel and Rodríguez-López, 2003).
- Others, however, have developed alternative trade models that, through some specific mechanisms, may imply that globalization is indeed behind the rise in Mexico's skill premium (Feenstra and Hanson, 1997; Markusen and Zahnizer, 1997).

1. Introduction

- There are, however, two shortcomings in the existing literature that may have made it difficult to identify a Stolper-Samuelson response in Mexico's input prices:
 - First, most of the existing evidence is based only on the first stage of Mexico's liberalization (late 80s-early 90s). With only a few exceptions, NAFTA's effects on input prices have not been analyzed.
 - Second, not all regions within Mexico seem to be equally linked to the international economy. If globalization may be represented as a regionally heterogeneous shock and if inputs are not perfectly mobile across regions (as suggested, for example, by Esquivel, 1999), then the response of input prices to trade liberalization may have been regionally heterogeneous, making it difficult to identify Stolper-Samuelson kind of responses using economy-wide data.

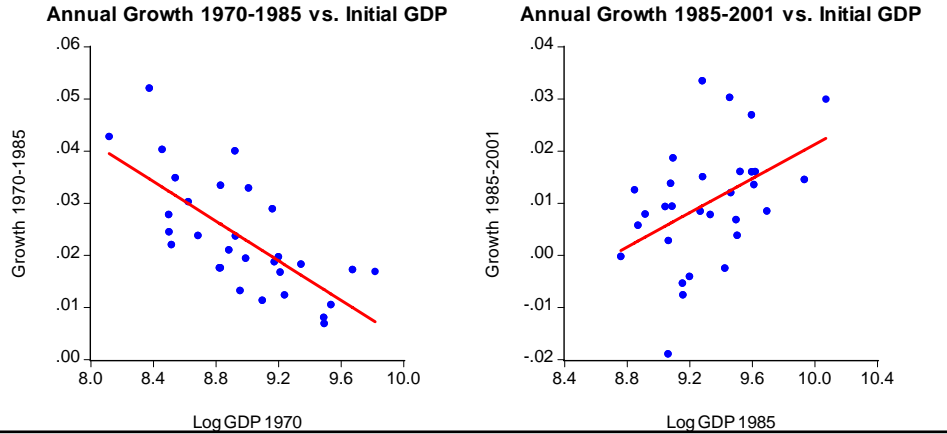
1. Introduction

Ratio of skilled to unskilled labor hourly wages in manufacturing



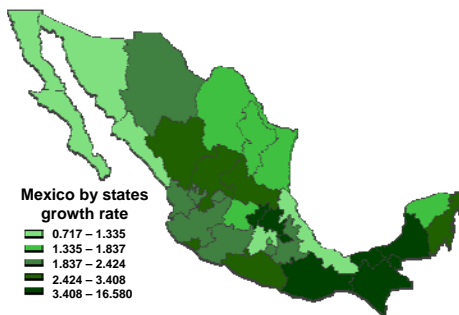
1. Introduction

According to the available evidence, globalization seems to have been indeed a regionally heterogeneous shock, leading to a loss of convergence in per-capita output levels and to an increase in the border wage premium. These findings have been formally documented, among others, by Juan-Ramon and Rivera-Batiz, 1996; Esquivel and Messmacher, 2002; Rodríguez-Pose and Sánchez-Reaza, 2002; Chiquiar, 2005; Hanson, 1996, 1997, 1998).

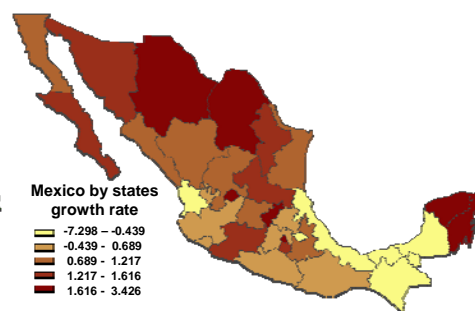


1. Introduction

Mexico: regional growth 1970-1985

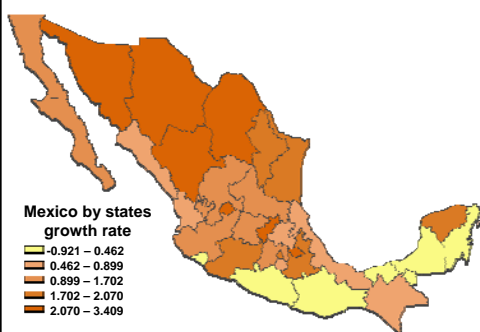


Mexico: regional growth 1985-2001

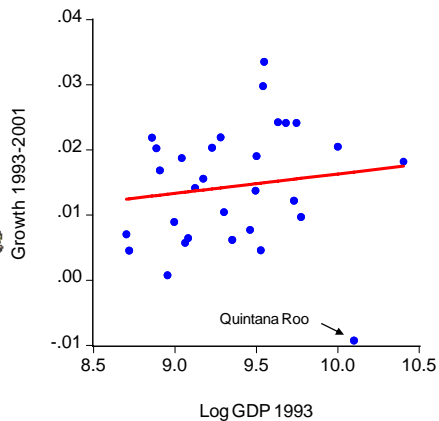


1. Introduction

Mexico: regional growth 1993-2001



Annual Growth 1993-2001 vs. Initial GDP



1. Introduction

- In this paper, I focus on the second stage of Mexico's globalization process and I exploit the regional variation in the degree of exposure to international markets to identify the effect of globalization on regional wage levels and on the skill premium.
- I use individual-level data on personal characteristics and wages of male wage-earners and state-level data on trade, foreign direct investment, international migration and other site-specific features, to study what factors determined the changes in Mexico's regional wage differentials between 1990 and 2000 and to identify the effects of NAFTA on wages and on returns to skill.
- In contrast with previous literature, which tends to use national-level data on changes in explicit tariffs and protection levels by industry, the approach in this paper uses natural barriers to trade, such as distance to the main international market, and regional variations in globalization related variables, such as foreign direct investment flows, to identify Stolper-Samuelson effects derived from Mexico's globalization.

2. Preview of findings

- The main driving force behind the changes observed in regional wage differentials across the country during the nineties seems to be related to globalization.

- The results support the presence of Stolper-Samuelson type of responses during Mexico's globalization process, at least during its second stage:
 - Overall wages in general, and unskilled wages in particular, increased in regions that exhibit stronger links with the U.S. market, as compared to regions that do not exhibit such an integration with the U.S.

 - In this context, the nation-wide rise in the skill premium observed after Mexico's globalization may have been a response to factors not directly related to trade.

2. Preview of findings

- The results also suggest that globalization has an important spatial dimension that is usually neglected in traditional trade models.
 - Wage differentials between regions close to the U.S. border and the rest of the country, for similar individuals, tended to increase during the nineties.

 - As a consequence, workers with similar characteristics fared differently in response to Mexico's trade liberalization depending on their geographical location.

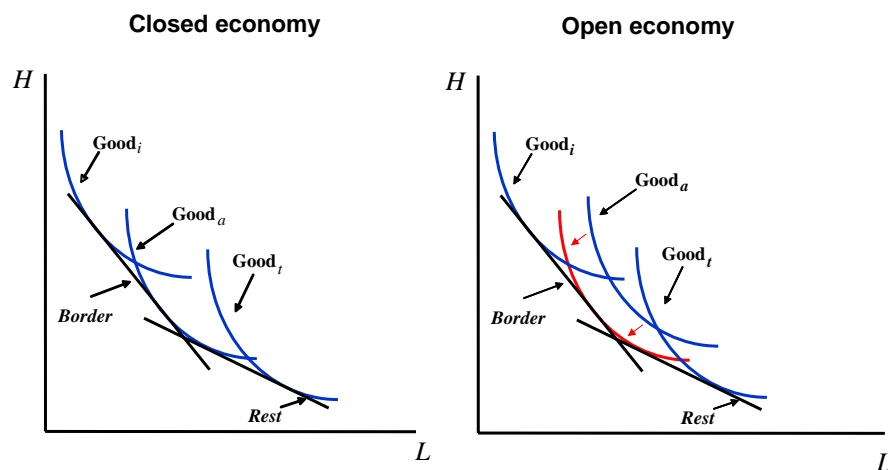
 - Thus, globalization of a skill-scarce country may lead to increases in wage inequality, once its spatial dimension is taken into account.

3. Theory

- The size of the regionally heterogeneous (labor demand) shock suffered by Mexico during the nineties appears to have been large, as compared to the speed of adjustment of labor supply to this shock. This gives the rationale for the presence of large and persistent changes in regional wage differentials as a consequence of the shock.
- When we allow for imperfect mobility of factors, then heterogeneity in endowments and differences in the geographic location of each region with respect to large markets become important determinants of local input prices:
 - Heterogeneity in endowments may lead to different patterns of specialization and, thus, to different responses of input prices to output price changes.
 - Venables and Limão (2002): sites that are closest to the large (foreign) market tend to specialize in exporting goods that are sensitive to transport costs. If these goods are relatively intensive in unskilled labor, real wages of this input will tend to be decreasing as we move away from the foreign market.

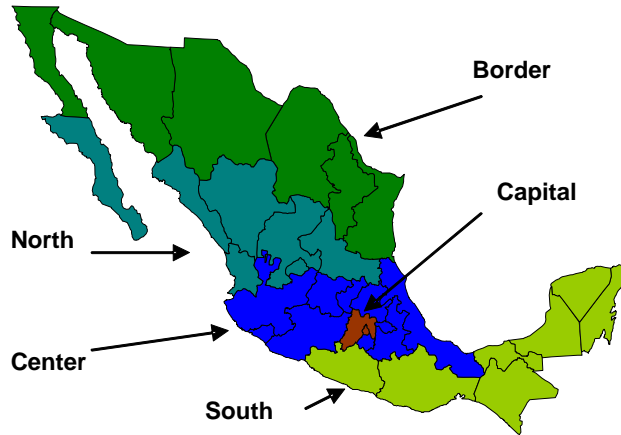
3. Theory

Two region model



4. Summary statistics

- For the analysis, the country is divided in 5 regions:



4. Summary statistics

25-65 year old working males

	1990					
	Total	Border	North	Center	Capital	South
% in cities with 100,000 or more	51.80	63.82	39.45	35.87	83.37	23.80
Average schooling years	6.97	7.75	6.47	6.13	8.47	5.53
% Agriculture	22.21	15.27	31.11	29.29	4.46	41.02
% Manufactures	21.09	23.55	14.39	20.93	27.88	10.47
% Other Industries	11.98	14.40	12.29	12.48	9.82	11.41
% Services	44.70	46.79	42.22	37.31	57.84	37.10
Log Wage per hour	7.81	8.02	7.78	7.73	7.97	7.42

	2000					
	Total	Border	North	Center	Capital	South
% in cities with 100,000 or more	56.72	70.95	46.33	39.55	81.10	35.47
Average schooling years	8.34	8.83	8.08	7.62	9.33	7.58
% Agriculture	13.44	8.89	20.64	19.06	2.93	22.42
% Manufactures	20.20	25.70	15.07	20.66	22.06	10.36
% Other Industries	14.71	15.55	15.69	15.31	11.88	16.94
% Services	51.65	49.86	48.59	44.97	63.12	50.27
Log Wage per hour	7.74	7.99	7.71	7.65	7.79	7.47

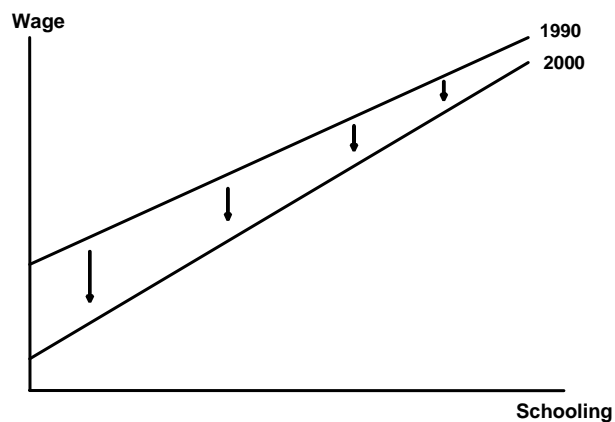
4. Summary statistics

Regional Exposure to International Markets

	Foreign Direct Investment								
	Total (% of regional GDP)		Manufacturing (% of regional GDP)		Others (% of regional GDP)		Maquiladora Employment (% of employment in manufactures)		Migration (% of 1960 population)
	1990	2000	1990	2000	1990	2000	1990	1999	1955-1959
Border	2.43	4.33	2.21	3.27	0.22	1.06	45.99	60.07	2.04
North	0.43	1.26	0.23	0.94	0.20	0.31	5.26	22.84	3.16
Center	0.42	1.52	0.27	1.03	0.16	0.49	1.71	8.92	1.52
Capital	6.04	5.02	3.04	2.07	3.00	2.95	0.22	1.68	0.23
South	0.24	0.40	0.01	0.07	0.24	0.33	2.88	21.54	0.59
Total	2.75	3.21	1.60	1.81	1.15	1.40	14.91	29.41	1.40

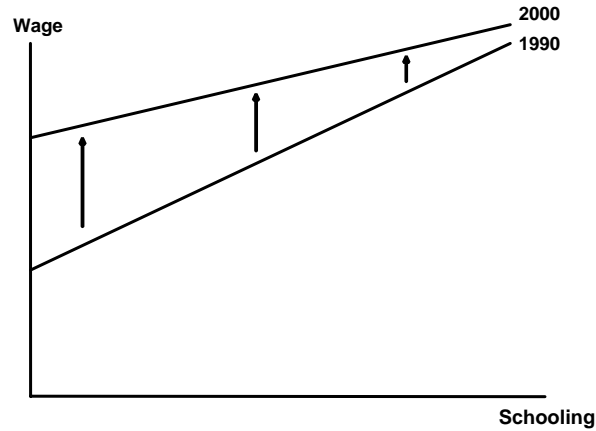
5. Regional Wage Differentials

- At the economy-wide level, the wage profile appears to have suffered two changes between 1990 and 2000: i) a fall in the base (zero-schooling) wage; and, ii) an increase in returns to schooling.



5. Regional Wage Differentials

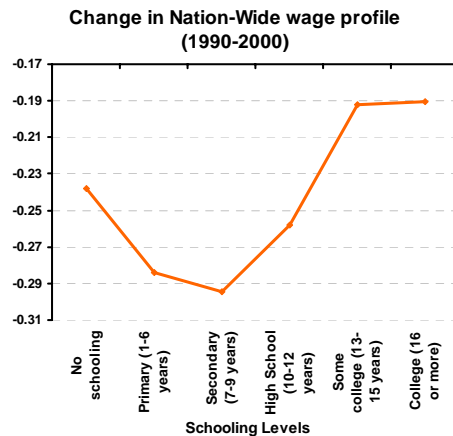
- However, relative to the changes at a national level, the wage profile in regions more exposed to international markets seems to have behaved as below:



5. Regional Wage Differentials

Nation-wide Log Wage Regression

	Coefficient	t-stat
Constant	7.154	345.25
Dummy (2000)	-0.238	8.44
Experience	0.020	21.15
Experience * Dummy (2000)	-0.005	4.28
Experience squared	-0.029	18.65
Experience squared * Dummy (2000)	0.006	3.07
Primary (1-6 years)	0.142	15.66
Secondary (7-9 years)	0.295	25.70
High School (10-12 years)	0.472	36.23
Some college (13-15 years)	0.646	38.07
College (16 or more years)	0.855	53.88
Primary * Dummy (2000)	-0.046	3.34
Secondary * Dummy (2000)	-0.056	3.42
High School * Dummy (2000)	-0.020	1.08
Some college * Dummy (2000)	0.046	1.92
College * Dummy (2000)	0.048	2.17
R ²	0.3458	



5. Regional Wage Differentials



6. Individual level wage regressions

Results of the individual level wage regressions

Relative changes in wage profile with respect to the Center	(a)	(b)	(c)	(d)	(e)
Change 1990-2000 in Zero-Schooling Wage of Border	0.061 (6.19)	0.099 (5.14)	0.137 (7.33)	0.244 (8.67)	-0.008 (0.18)
Change 1990-2000 in Zero-Schooling Wage of North	-0.004 (0.29)	-0.005 (0.21)	0.013 (0.64)	0.062 (2.69)	-0.016 (0.61)
Change 1990-2000 in Zero-Schooling Wage of Capital	-0.070 (7.86)	-0.147 (8.31)	-0.055 (3.20)	-0.113 (4.38)	-0.008 (0.25)
Change 1990-2000 in Zero-Schooling Wage of South	0.095 (7.92)	0.134 (6.80)	0.090 (4.89)	0.060 (2.67)	0.140 (5.61)
Change 1990-2000 in Returns to Schooling Border		-0.004 (1.96)	-0.008 (3.87)	-0.009 (4.82)	-0.009 (4.76)
Change 1990-2000 in Returns to Schooling North		0.002 (0.66)	-0.002 (0.85)	-0.003 (1.27)	-0.003 (1.09)
Change 1990-2000 in Returns to Schooling Capital		0.008 (4.02)	0.001 (0.51)	0.000 (0.17)	-0.001 (0.76)
Change 1990-2000 in Returns to Schooling South		-0.009 (3.88)	-0.008 (3.61)	-0.007 (2.93)	-0.007 (3.32)
Controls for age and marital status	Yes	Yes	Yes	Yes	Yes
Controls for sector, occupation and position	No	No	Yes	Yes	Yes
Controls for region specific factors	No	No	No	Yes	Yes
Controls for exposure to international markets	No	No	No	No	Yes

7. The effects of Globalization on Wage profiles

- The procedure entails two steps:
 1. I estimate state-specific changes in wage levels and in the skill premium from 1990 to 2000. These are allowed to vary between urban and rural environments within each state. I use three different definitions of skill: i) schooling years; ii) 9 or more years of schooling; iii) 12 or more years of schooling.
 2. I regress these changes on site-specific characteristics and on indicators related to the degree of exposure of each state to globalization.

7. The effects of Globalization on Wage profiles

Results: Returns to Schooling

	Wage level				Skill premium			
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
Constant	-0.166 (2.57)	-0.474 (4.54)	-0.713 (2.84)	-0.410 (1.77)	0.013 (2.58)	0.036 (5.05)	0.050 (1.50)	0.041 (1.79)
Agriculture share in GDP (1993-2000)			0.478 (1.24)	0.304 (0.94)			-0.042 (0.84)	-0.052 (1.45)
Manufacturing share in GDP (1993-2000)			1.116 (3.81)	0.860 (4.68)			-0.050 (1.48)	-0.048 (2.36)
1990 average schooling years			-0.011 (0.33)	-0.041 (1.43)			0.000 (0.05)	0.000 (0.17)
Log(Distance to US)	-0.025 (2.63)	0.014 (0.98)	0.033 (1.59)	0.037 (2.02)	0.000 (0.05)	-0.003 (2.96)	-0.005 (2.01)	-0.005 (2.21)
Maquiladora employment share (1990-1999)			-0.207 (0.29)	-0.851 (1.56)			0.043 (0.51)	0.074 (1.18)
Tradeables FDI Share in GDP			4.471 (0.95)	7.699 (2.00)			-0.540 (0.96)	-0.738 (1.60)
Non-tradeables FDI Share in GDP			14.704 (1.67)	7.353 (1.27)			-0.324 (0.30)	0.054 (0.08)
Historical migration rates (1955-1959)			2.754 (3.58)	2.448 (3.88)			0.051 (0.53)	0.056 (0.72)
Border dummy		0.170 (2.58)	-0.004 (0.03)			-0.013 (3.28)	-0.006 (0.38)	
North dummy		0.075 (1.68)	0.007 (0.13)			-0.005 (1.52)	-0.003 (0.43)	
Capital dummy		-0.084 (1.24)	-0.179 (2.17)			0.008 (0.97)	0.007 (0.68)	
South dummy		0.020 (0.40)	0.055 (0.87)			-0.001 (0.31)	-0.001 (0.12)	
R ²	0.063	0.199	0.586	0.558	0.120	0.233	0.367	0.361
F test for Regional dummies=0 prob.	-	2.67 0.041	0.95 0.445	-	-	3.19 0.020	0.14 0.968	-
Chi-squared test for over-identifying restrictions prob.	-	-	8.22 0.223	10.64 0.386	-	-	12.29 0.056	11.57 0.315

7. The effects of Globalization on Wage profiles

Results: Skill premium (9 or more schooling years)

	Wage level				Skill premium			
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
Constant	-0.184 (3.38)	-0.393 (3.96)	-0.584 (2.89)	-0.310 (1.57)	0.063 (1.31)	0.263 (3.89)	0.434 (1.54)	0.367 (1.65)
Agriculture share in GDP (1993-2000)			0.312 (0.87)	0.046 (0.17)			-0.397 (0.76)	-0.394 (1.00)
Manufacturing share in GDP (1993-2000)			0.857 (3.80)	0.591 (3.94)			-0.478 (1.61)	-0.329 (2.40)
1990 average schooling years in state			-0.009 (0.38)	-0.042 (1.93)			0.004 (0.12)	0.007 (0.30)
Log(Distance to US)	-0.020 (2.63)	0.006 (0.43)	0.020 (1.22)	0.027 (1.71)	-0.007 (0.98)	-0.032 (3.48)	-0.057 (2.30)	-0.064 (3.02)
Maquiladora employment share (1990-1999)			-0.248 (0.58)	-0.704 (1.81)			0.582 (0.75)	0.805 (1.36)
Tradeables FDI Share in GDP			4.120 (1.37)	6.604 (2.44)			-7.967 (1.40)	-10.257 (2.27)
Non-tradeables FDI Share in GDP			11.946 (2.21)	6.610 (1.65)			0.688 (0.07)	1.398 (0.22)
Historical migration rates (1955-1959)			3.053 (4.44)	2.701 (4.49)			0.209 (0.25)	0.234 (0.31)
Border dummy		0.118 (1.96)	-0.021 (0.23)			-0.116 (2.99)	-0.031 (0.20)	
North dummy		0.052 (1.35)	-0.009 (0.22)			-0.052 (1.58)	-0.035 (0.56)	
Capital dummy		-0.046 (1.17)	-0.141 (3.25)			0.049 (0.63)	0.029 (0.35)	
South dummy		0.022 (0.59)	0.066 (1.27)			-0.029 (0.75)	-0.057 (0.93)	
R ²	0.076	0.172	0.625	0.588	0.020	0.131	0.320	0.304
F test for Region dummies = 0	-	2.12	1.71	-	-	2.54	0.32	-
prob.	-	0.090	0.163	-	-	0.050	0.862	-
Chi-squared test for over-identifying restricti	-	-	9.53	15.18	-	-	7.48	8.95
prob.	-	-	0.146	0.126	-	-	0.279	0.537

7. The effects of Globalization on Wage profiles

Results: Skill premium (12 or more schooling years)

	Wage level				Skill premium			
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
Constant	-0.153 (3.02)	-0.330 (3.15)	-0.465 (2.38)	-0.225 (1.21)	0.010 (0.16)	0.223 (2.04)	0.456 (1.16)	0.421 (1.29)
Agriculture share in GDP (1993-2000)			0.105 (0.33)	-0.041 (0.16)			-0.335 (0.61)	-0.545 (1.13)
Manufacturing share in GDP (1993-2000)			0.882 (4.04)	0.647 (4.30)			-0.562 (1.42)	-0.412 (1.89)
1990 average schooling years in state			-0.024 (1.09)	-0.048 (2.25)			0.026 (0.61)	0.015 (0.41)
Log(Distance to US)	-0.023 (3.17)	-0.001 (0.07)	0.012 (0.79)	0.017 (1.25)	0.007 (0.74)	-0.018 (1.21)	-0.062 (1.73)	-0.066 (2.27)
Maquiladora employment share (1990-1999)			0.065 (0.18)	-0.449 (1.37)			0.351 (0.45)	0.810 (1.25)
Tradeables FDI Share in GDP			1.982 (0.85)	4.847 (2.07)			-9.718 (1.53)	-13.187 (2.26)
Non-tradeables FDI Share in GDP			15.542 (3.50)	10.203 (3.27)			-2.181 (0.24)	-0.936 (0.17)
Historical migration rates (1955-1959)			3.062 (4.36)	2.828 (4.63)			0.933 (0.82)	0.695 (0.64)
Border dummy		0.103 (1.59)	-0.001 (0.01)			-0.124 (2.25)	-0.053 (0.32)	
North dummy		0.046 (1.13)	0.012 (0.29)			-0.058 (1.38)	-0.082 (1.02)	
Capital dummy		0.001 (0.02)	-0.136 (2.99)			-0.007 (0.12)	0.044 (0.40)	
South dummy		0.023 (0.63)	0.057 (1.18)			-0.027 (0.56)	-0.050 (0.61)	
R ²	0.098	0.154	0.639	0.608	0.007	0.071	0.302	0.28
F test for Region dummies = 0	-	1.20	1.41	-	-	1.46	0.25	-
prob.	-	0.323	0.246	-	-	0.226	0.907	-
Chi-squared test for over-identifying restricti	-	-	9.10	14.07	-	-	5.38	7.32
prob.	-	-	0.168	0.17	-	-	0.496	0.695

8. Conclusions

- States with stronger links to the international economy exhibited larger increases in wage levels and a decrease in returns to schooling, as compared with the rest of the country.
- This supports the idea that Stolper-Samuelson type of effects may have been present during Mexico's trade liberalization.
- However, since these effects appear to have been felt more strongly in regions that are more integrated with the global economy, the results suggest the existence of a new, spatial dimension to globalization that is usually neglected in the Heckscher-Ohlin framework.
- The regionally heterogeneous response of input prices to globalization seems to have led to a widening of the wage differentials observed for similar workers located in different regions.