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New England Economic Review

Federal Reserve Bank of Boston

Jan./Feb. 1996

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U.S. Regional Trade with Canada during the Transition to Free Trade

Jane Sneddon Little

This article examines the U.S. and Canadian responses to the early years of the U.S.-Canada Free Trade Agreement from a U.S. regional perspective. It draws on a highly detailed data base from Statistics Canada. Although the article discusses which regions enjoyed the fastest growth in trade with Canada over this period, and why, the major focus of the study is the impact of increased integration on the nature of trade and investment flows between the two countries. The author explores, for example, whether trade has expanded on the basis of comparative resource endowments or has taken the form of increased intra-industry trade, two-way trade in similar products, which largely reflects economies of large-scale production and specialization.

The author finds that, to date, U.S. and Canadian firms are emphasizing trade rather than direct investment as a means of serving the integrating market. However, the results concerning the foundations for this trade expansion are mixed. At the national level, trade has grown on the basis of comparative advantage, and the share of two-way trade is little changed. However, national data conceal a variety of regional experiences: The share of two-way trade has grown in over half the regions, and changes in the industrial composition of trade are greater within regions than the national data would suggest. Contrary to conventional wisdom, moreover, structural change was greatest where two-way trade grew most. Thus, the author ends by suggesting that the nature of the intra-*firm*—rather than the intra-*industry*—response may be the key to determining how smoothly economies adjust to increased integration. 3

State Business Tax Climate: How Should It Be Measured and How Important Is It?

Robert Tannenwald

States are more concerned than ever before about their business tax climate. Over the past two decades, profound technological and political changes have enhanced employers' geographic mobility and extended their geographic range, thereby intensifying economic competition both within the United States and throughout the world. This study ranks the business tax climate of 22 states, including the six within New England. It finds only modest differences in business tax climate among most states. Within the region, New Hampshire and Massachusetts have the most attractive business tax climates.

The study also estimates the importance of business tax climate in determining where manufacturers invest in plant and equipment. Business tax climate exerts only a small, highly uncertain effect on such investment. States may be more likely to stimulate their economy by enhancing public services valued by business. 23

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Contents

CEO Incentive Contracts, Monitoring Costs, and Corporate Performance

Stacey Tevlin

The after-tax real wage of the average worker in the United States has fallen 13 percent in the last 20 years, while the average chief executive officer has received a pay raise of over 300 percent. This glaring contrast has sparked a flood of papers analyzing CEO compensation contracts. One of the main justifications for the extraordinary pay of top CEOs is that they receive contracts that link CEO compensation to the performance of the firm. The empirical literature, however, has found little evidence that CEO contracts provide such incentives. The compensation of CEOs appears to respond very little to the performance of their firms.

This article addresses three reasons why the previous literature may have been underestimating the response of compensation to firm performance. First, only firms where monitoring the CEO is costly should have CEO compensation that is performance-sensitive. Restricting the sample to these firms yields a 67 percent increase in the performance sensitivity of compensation contracts. Second, the parameter that measures the performance sensitivity of CEO pay is negatively correlated to performance, causing it to be underestimated in standard regressions. Finally, econometricians do not observe exactly what compensation boards use as performance measures. Correcting this error shows that the elasticity of CEO pay with respect to firm performance is 10 times higher than previously believed. 39

U.S. Regional Trade with Canada during the Transition to Free Trade

Jane Sneddon Little

Senior Economist, Federal Reserve Bank of Boston. *The author is very grateful to Rachel I. Deyette for her excellent research assistance. Mitone Mendezona, Karen Simeone, and Clara Nakagawa also provided much valuable help during their internships.*

This article examines U.S. regional trade with Canada in 1988 and 1993—just before and five years after the start of the U.S.-Canada Free Trade Agreement in January 1989. Although the article discusses which regions enjoyed the fastest growth in trade with Canada over this period, and why, the major focus of this study is the impact of increased integration of the U.S. and Canadian economies on the nature of trade and investment flows between the two countries.

In theory, declines in trade barriers should encourage the production of specific goods to consolidate on one side of the border or the other. The outcome could reflect relative resource endowments[1] or firms' efforts to reap economies of large-scale production and specialization. On the other hand, firms also want to minimize transportation costs and delivery times, a need that militates against consolidation. Given the tension between these two goals, the article asks how increased integration has affected U.S. and Canadian firms' approach to their shared market. More specifically, have these firms begun to increase their reliance on trade as compared with investment? And have they changed the role of existing cross-border subsidiaries or the placement of new facilities?

The article also explores whether trade has expanded on the basis of comparative resource endowments or has taken the form of increased intra-industry trade, two-way trade in very similar products.[2] The answer matters because expansion based on comparative advantage can produce losers among the many gainers, whereas growing intra-industry trade is thought to make everyone better off, thereby easing the transition to free trade. Students of European integration have generally concluded that the formation of the single European market has led to a significant increase in intra-industry trade (IIT), a response that is widely credited with explaining Europe's smooth adjustment to trade liberalization. Are the United States and Canada replicating the European experience?

This article draws on a highly detailed data base from Statistics Canada. The key advantage of the Canadian data is the industrial and

geographic detail provided.[3] While U.S. state export data show 30 SIC-related industries and blur the distinction between computers and turbines, say, by lumping them both in industrial machinery, the Statistics Canada data, disaggregated by Harmonized Code, cover over 90 industries and thousands of products for each state.[4] These detailed data are useful for examining how the composition of merchandise trade varies across regions and how that variation has affected export and import growth. They also allow studying the impact of trade liberalization. In fact, adding the geographic dimension proves important to our conclusions about trends in intra-industry trade and the smoothness of our adjustment to increased integration.

Structural change appears to be greatest where intra-industry trade has grown most, contrary to conventional wisdom.

The article starts by briefly reviewing the major provisions of the U.S.-Canada Free Trade Agreement (USCAFTA) and the economic environment in which it took effect. It then indicates which U.S. regions have enjoyed relatively rapid growth in trade with Canada between 1988 and 1993 and discusses the extent to which industry mix accounts for the observed differences in export performance. The article then turns to the impact of trade liberalization on the choice between direct investment and trade in serving the U.S.-Canadian market. It finds that, to date, U.S. and Canadian firms are emphasizing trade rather than direct investment. While U.S.-Canadian trade has grown faster than U.S. trade with other industrial economies, bilateral foreign direct investment has grown at a below-average pace.

The article finds mixed results concerning the motivation for this trade expansion. At the national level, trade has expanded according to comparative advantage on a net basis, while the proportion of intra-industry trade has remained little changed.[5] At the national level, thus, the United States and Canada do not appear to be following the European precedent. However, the national data conceal a variety of regional experiences. IIT has actually increased in five of the nine regions, particularly in regions like New England where highly diversified, labor-intensive[6] products loom important and where firms have traditionally had strong bilateral investment links.

Similarly, the article finds that changes in the industrial composition of trade have also been greater within regions than the national data would suggest. This structural change appears to be greatest where IIT has grown most, contrary to what conventional wisdom might suggest. This link between structural change and two-way trade may reflect the fact that trade between affiliates can be expanded more quickly than trade between unaffiliated firms. This link may also help to explain why the potentially disruptive structural changes observed have stirred little complaint. Because multinational firms with fixed physical or human capital investments internalize both the cost and benefits of adjustment, they are motivated and equipped to ease the human cost of the transition to free trade. Thus, the article ends by suggesting that the nature of the intra-*firm*—rather than the intra-*industry*—response may be the key to determining how smoothly economies adjust to increased integration.

I. The Major Provisions of the U.S.-Canada Free Trade Agreement

The USCAFTA eliminates all tariffs and removes or moderates a host of other barriers to the free flow of goods, services, and capital over a 10-year period

[1] According to the theory of comparative advantage, trade patterns reflect the partners' relative production costs and, thus, their relative factor endowments. In other words, a country tends to export products embodying the factors—raw materials, labor of various skill levels, and capital—that it enjoys in relative abundance. It imports products embodying factors that are relatively scarce within its territory.

[2] This phenomenon characterizes a large and growing share of trade among the industrialized countries and intrigues economists because it reflects economies of scale and consumers' taste for variety rather than traditional comparative advantage based on the relative distribution of resources.

[3] Of course, the big *dis*advantage to the Canadian data is that they relate to just one country. Still, Canada is both the nation's and New England's largest single trading partner. In 1993, Canada accounted for over one-fifth of the country's and almost one-third of the region's merchandise exports.

[4] For example, the Canadian data allow separating hard magnetic disk drives from floppy units, or cameras for preparing printing plates from cameras for recording documents on microfilm.

[5] The index has edged up very slightly, if the already fully integrated auto industry is excluded from the calculation. The United States and Canada have enjoyed essentially free trade in autos since 1965 when the U.S.-Canada Auto Pact went into effect.

[6] As opposed to raw-materials-based.

starting on January 1, 1989.[7] Products were originally divided into three tranches according to their perceived readiness for free trade. For the first tranche, covering about 15 percent of all goods traded bilaterally and including, most importantly for New England, computer and related equipment, tariffs were eliminated with the start of the agreement on January 1, 1989. For the second tranche, covering another 35 percent of traded goods and including most machinery, telecommunications equipment, chemicals (excluding drugs and cosmetics), and paper, pulp, and printed matter, duties were to fall in five equal steps between January 1989 and January 1993. For the rest, tariffs are being phased out in 10 equal installments. Because trade barriers between the United States and Canada were relatively low and the two economies already closely linked, the consensus at the time the pact was negotiated was that the agreement involved limited risks and offered modest (mostly efficiency) gains for both countries.[8]

II. The Macroeconomic Setting

Because Canada is the smaller economy and had the higher trade barriers when the agreement went into effect, analysts generally assumed that—other things equal—Canada would gain (and risk)[9] more from free trade than the United States. In the event, between 1988 and 1993, both countries' bilateral exports grew faster than nominal GDP, but, as expected, Canadian exports to this country grew considerably faster than U.S. exports to Canada (49 percent compared with 33), and this country's traditional merchandise trade deficit with Canada deteriorated.

But other things did not remain unchanged. As Figure 1 shows, within a year after the start of the FTA, both countries had tumbled into a recession that pummeled Canada harder than the United States. Thereafter, through 1993, the U.S. recovery outpaced the Canadian upturn; nominal GDP grew 18 percent in Canada versus 29 percent here. In addition (bottom of Figure 1), the U.S. dollar appreciated slightly against the Canadian dollar over this period. Although these developments all worked to discourage U.S. exports to Canada, as Figure 2 shows, Canada was the one part of the industrial world to absorb a growing share of both U.S. and New England exports from 1990 to 1993. For U.S. exporters, then, the benefits of freer trade seemingly more than offset adverse business cycle and exchange rate trends. For U.S. firms competing with Canadian imports, declining import barriers aggravated the impact of cyclical and exchange market developments.

III. The Growth in U.S. Regional Trade with Canada since the Start of the FTA

Table 1 shows the recent growth in U.S. exports to and imports from Canada by region. As the table indicates, the regions with the fastest growth in exports to Canada were the East and West South Central. New England followed in third place. Exports grew most slowly in the East and West North Central, where trade with Canada, particularly auto trade, looms relatively large. But, of course, a free trade agreement allows increased import penetration as well as improved export growth. And Canadian traders found their best export opportunities in the West South Central and the Mountain states. Still, with U.S. imports generally growing faster than exports, the South Atlantic was the only region to enjoy a growing trade surplus with Canada over this period. New England, with above-average growth in exports, experienced below-average growth in imports—in large part, no doubt, because of the relative severity of the most recent recession in this region. On a net basis, thus, the FTA appears to have had a comparatively favorable impact on New England through 1993.

What explains the variations in regional export performance? One possible answer is differences in export product mix. Differences in product mix matter because industries vary in their sensitivity to cyclical developments and in their level of maturity within the product cycle. For example, sales of consumer durables tend to be highly sensitive to interest rates. Similarly, the demand for cutting-edge products tends to grow faster than that for mature items.

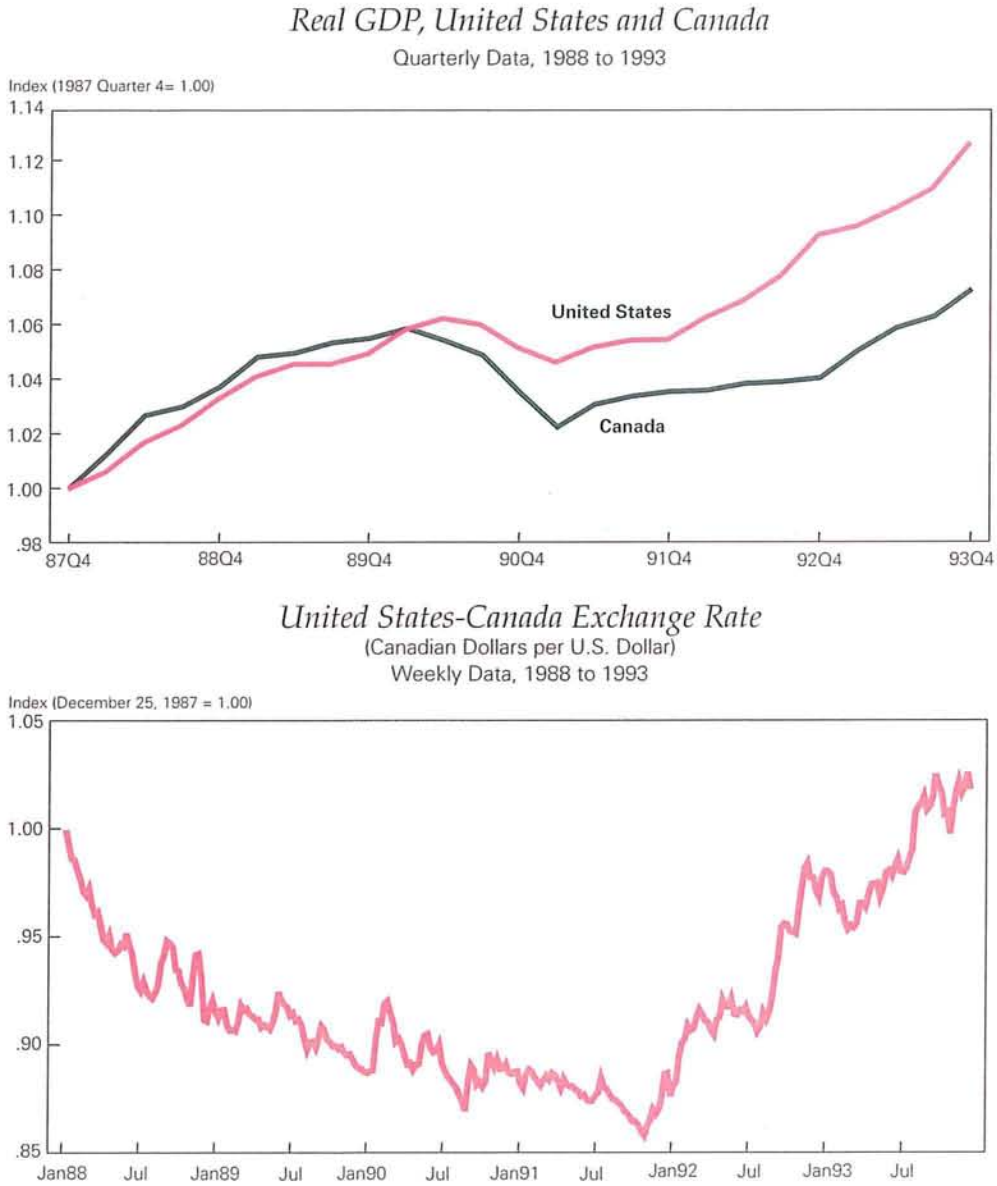
In addition, since regional trade data (from U.S. as well as Canadian sources) are reported in nominal

[7] For further background, see Stern, Trezise, and Whalley (1987), or Office of the U.S. Trade Representative (1987), or, more briefly, Little (1988).

[8] Nevertheless, even though Canada's pre-FTA tariffs looked relatively low on average, weighted-average rates tend to understate these barriers' deterrent effect since unusually high tariffs get little or no weight. And high starting rates were not uncommon: tariffs on textiles, clothing, and footwear generally ran from 20 to 25 percent, while tariffs on chemicals, paper, glass, rubber products, and electric machinery averaged around 7 to 9 percent.

[9] To the extent that structural change in an export base denotes disruption and "risk," Table 11 (below) suggests that Canadian exporters may have experienced slightly more disruption than U.S. exporters in bilateral trade transactions between 1988 and 1993.

Figure 1



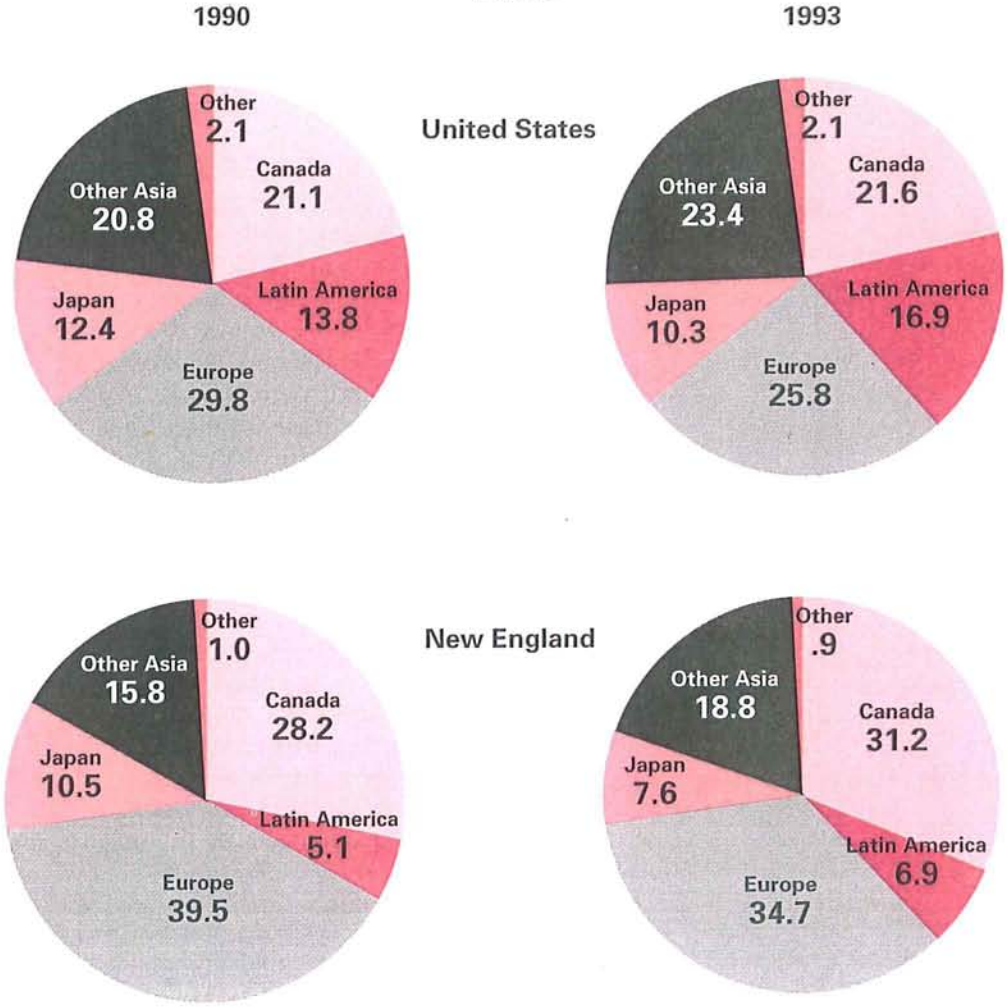
Source: Board of Governors of the Federal Reserve System.

terms, differences in price developments across industries also affect regional export and import growth. For example, between the end of 1990 and September 1995, U.S. export prices for road vehicles rose 8 percent while prices for computer equipment *fell* 25 percent. Even within industrial sectors, price trends can vary markedly. While export prices for paper and paperboard prices rose 25 percent between late 1990 and the fall of 1995, pulp and waste paper prices rose 57 percent. In addition, because of the USCAFTA, tariffs in different industries fell at different rates. Altogether then, failure to adjust for differences in product mix can lead to distorted impressions of relative export performance.

Figure 2

United States and New England Merchandise Exports by Region, 1990 and 1993

(Percent)



Source: Massachusetts Institute for Social and Economic Research.

IV. Regional Variations in the Composition of Trade

The detailed data base available from Statistics Canada permits analysts to examine and adjust for regional differences in product mix. Tables 2 and 3 show the industry share of total exports and imports for New England and the nation in 1988 and 1993. (Data for the other eight Census regions can be found in Appendix Tables 1 and 2.) The industries are grouped into 24 sectors resembling the breakdown found in the U.S. state trade data.

At this level of aggregation, three high-value-added durable goods industries—transportation, industrial machinery, and electric machinery—accounted for 40 percent of all U.S. merchandise exports to Canada in 1993. Yet the regional variation from this national norm is considerable. For example, depen-

Table 1
U.S. Trade with Canada, by Region
Billions of Canadian Dollars

	1988	1993	Change (%)	Rank
U.S. Exports				
New England	4.9	7.0	43.7	3
Mid-Atlantic	11.7	15.3	30.9	7
E. North Central	35.5	45.4	27.8	9
W. North Central	5.5	7.2	29.8	8
S. Atlantic	8.6	12.0	40.6	4
E. South Central	3.6	5.6	57.9	1
W. South Central	4.4	6.5	46.8	2
Mountain	1.9	2.5	33.6	6
Pacific	7.8	10.9	39.2	5
United States[a]	86.0	114.0	32.5	
U.S. Imports				
New England	8.3	11.1	34.7	7
Mid-Atlantic	21.4	28.2	31.6	9
E. North Central	40.0	59.7	49.3	6
W. North Central	6.0	9.7	61.6	5
S. Atlantic	7.6	10.1	33.8	8
E. South Central	3.3	5.5	65.0	4
W. South Central	2.9	6.0	104.5	1
Mountain	1.9	3.3	73.0	2
Pacific	9.1	15.2	67.2	3
United States[a]	100.9	150.7	49.4	
Balance			Change (Billions of Canadian $)	
New England	−3.4	−4.1	−.74	
Mid-Atlantic	−9.8	−12.9	−3.17	
E. North Central	−4.5	−14.3	−9.87	
W. North Central	−.5	−2.5	−2.04	
S. Atlantic	1.0	1.9	.91	
E. South Central	.3	.2	−.09	
W. South Central	1.5	.6	−.97	
Mountain	.0	−.8	−.76	
Pacific	−1.3	−4.4	−3.07	
United States[a]	−14.8	−36.7	−21.84	

Definition of regions: New England (NE) = CT, ME, MA, NH, RI, VT; Mid Atlantic (MAT) = NJ, NY, PA; East North Central (ENC) = IL, IN, MI, OH, WI; West North Central (WNC) = IA, KS, MN, MO, NE, ND, SD; South Atlantic (SAT) = DE, FL, GA, MD, NC, SC, VA, WV; East South Central (ESC) = AL, KY, MS, TN; West South Central (WSC) = AR, LA, OK, TX; Mountain (MT) = AZ, CO, ID, MT, NV, NM, UT, WY; Pacific (PAC) = AK, CA, HI, OR, WA.

[a]Including transactions not allocated by region.

Source: Statistics Canada.

dence on transportation ranges from over 40 percent of total merchandise exports in the East North Central to 3 percent in New England. Likewise, industrial and electric machinery account for over 50 percent of New England's merchandise exports to Canada but for only 27 percent of exports from the East South Central.

Industrial history and the distribution of natural resources/climate clearly play a key role in determining the regional composition of exports. New England's traditional ties to the textile and leather industries help shape its export base, for instance, while its more recent dependence on computers and electronics is clearly apparent in the structure of its trade. Similarly, lumber and paper exports remain relatively important in New England, the Mid-Atlantic, and the East South Central regions. By contrast, petrochemicals and plastics play an above-average role in the West South Central and Mid-Atlantic's export mix, while vegetable products and prepared foods loom relatively large in the Pacific region.

From the Canadian side, transportation equipment accounts for 30 percent of merchandise exports to this country, followed by minerals (12 percent), industrial machinery (8 percent), and pulp/paper and base metals (7 percent each). In other words, Canadian exports continue to reflect Canada's comparative advantage in particular raw materials. It seems worth noting, however, that Canada's exports to specific regions reflect the industrial—and, thus, demand—structure within each region. For example, although electric machinery accounts for less than 5 percent of Canadian exports nationally, that industry is the leading exporter to New England where it comprises 17 percent of Canadian exports. Similarly, Canada's pulp, paper, and lumber exports loom particularly large in regions with forestry resources of their own—particularly, the South Atlantic and New England. Presumably, these two-way trade flows reflect cross-border investments by the major Canadian and U.S. firms in these industries.[10]

Although data aggregated to the 24-"industry" level give some local texture to the national trade picture, they still hide large regional differences in the composition of trade. Using Statistics Canada data at the 2- or 4-digit level,[11] Appendix Table 3 gives a sample of the sizable regional variations in industry mix within these broad categories. For each region,

[10] Disaggregating the data to the 10-digit level permits tracing some of the complementarities. For example, in 1993, newsprint and chemical wood pulp accounted for the bulk of Canadian pulp and paper exports to New England. By contrast, the largest 10-digit categories of exports from New England to Canada were technical, scientific, and professional books, coated cellulose wadding and webs, fine coated papers, and waste paper and paperboard.

[11] For the large and diverse industries included in Harmonized Codes 84 to 90 (industrial machinery, electric machinery, transportation, and scientific and measuring instruments), the data were aggregated at the 4-digit level. For the other industries, 2-digit data were used.

Table 2
Industry Share of U.S. Exports to Canada, United States and New England, 1988 and 1993
Percent

Code	Description	United States 1988	United States 1993	New England 1988	New England 1993
1-5	Animal Products	.85	1.03	1.80*	1.59*
6-14	Vegetable Products	2.27	2.24	1.11	.39
15	Fats, Oils, and Waxes	.11	.14	.04	.05
16-24	Prep. Foodstuffs, Beverages, Tobacco	1.51	2.42	.75	.97
25-27	Minerals	2.71	2.08	1.31	1.13
28-38	Chemicals and Allied Products	4.91	6.75	4.22	8.40*
39-40	Plastic and Rubber	4.40	5.29	3.99	4.90
41-43	Hides, Skins, Leather, etc.	.33	.21	.48*	.35*
44-46	Wood and Articles	1.24	1.19	3.80*	3.68*
47-49	Pulp and Paper	3.31	4.03	5.94*	6.03*
50-63	Textiles	1.70	2.36	2.35*	3.21*
64-67	Footwear	.08	.12	.46*	.36*
68-70	Stone, Ceramics, Glass	1.29	1.36	.77	.77
71	Pearls, Stones, Jewelry	1.39	1.17	2.96*	1.51*
72-83	Base Metals and Articles	6.36	6.50	5.91	4.92
84	Industrial Machinery	20.52	19.17	29.09*	24.51*
85	Electric and Electrical Machinery	9.38	10.88	21.71*	25.59*
86-89	Transportation	31.02	24.80	3.81	2.63
90	Instruments, Scientific and Measuring	2.89	3.25	5.94*	4.23*
91-92	Instruments, Photographic and Musical	.09	.08	.14*	.10*
93	Arms and Ammunition	.19	.22	.46*	.39*
94-96	Miscellaneous	1.32	2.33	1.52*	2.12
97	Works of Art	.08	.04	.06	.03
98-99	Special	2.03	2.33	1.38	2.14
Total		100.00	100.00	100.00	100.00

*Indicates New England share is above the U.S. average.
Note: Data for other U.S. regions presented in Appendix Table 1.
Source: Statistics Canada, Canadian Merchandise Trade Statistics.

this table lists the three leading export products in industrial machinery, electric machinery, transportation equipment, and chemicals, the nation's four largest export industries vis-à-vis Canada in 1993.

In industrial machinery, for example, computer disk drives, display units, printers, and parts account for over half of this sector's exports from New England, the Pacific, and the Mountain states,[12] compared with just 20 percent for the nation. Turbo jet, turbo prop, and gas engines and turbines make up another large part of New England's industrial machinery exports. Nationally, however, spark-ignition engines and parts rank second; in the East North Central, for instance, spark and computer ignition engines, parts thereof, and air conditioners comprise almost 40 percent of all industrial machinery exports.[13]

As for electric and electronic equipment, New England's biggest export sector, integrated circuits make up almost 60 percent of the region's total.[14] By contrast, integrated circuits account for just 14 percent of the nation's electronic exports. In transportation, the bulk of the nation's trade with Canada is in cars, trucks, and parts—naturally, because the Auto Pact established free trade in autos between the United States and Canada in 1965. By exception, aircraft and parts account for almost 40 percent of transportation exports from New England (and an even higher share in the Pacific). Finally, while organic products dominate the nation's chemicals exports, in New England pharmaceuticals loom most important (26 percent) and toiletries play a significant role. Altogether, thus, the Canadian data suggest that previous efforts to adjust regional export growth rates for differences in industry mix have been very incomplete.

V. Regional Export Growth Adjusted for Product Mix

Accordingly, Table 4 compares the actual export growth rate for each

[12] Indeed, in the Mountain region these computer-related exports accounted for almost 70 percent of industrial machinery exports in 1993.

[13] These data confirm the author's long-standing assumption that New England is much more dependent on relatively slow-growing exports of computer equipment than is the nation, an assumption that cannot be confirmed using U.S. data. However, the Canadian data also show that she has been wrong to suggest that New England's minicomputer firms have underperformed computer exporters nationally. In fact, the region's computer-related industrial machinery exports to Canada grew slightly faster than the nation's over this period and considerably faster than such exports from the Pacific region.

[14] Half of New England's exports of integrated circuits come from Vermont.

Table 3
Industry Share of U.S. Imports from Canada, United States and New England
Percent

Code	Description	United States 1988	United States 1993	New England 1988	New England 1993
1-5	Animal Products	2.54	2.49	12.26*	7.93*
6-14	Vegetable Products	.67	.89	1.06*	1.16*
15	Fats, Oils, and Waxes	.11	.20	.27*	.29*
16-24	Prep. Foodstuffs, Beverages, Tobacco	1.42	2.25	2.91*	3.82*
25-27	Minerals	11.25	12.26	17.51*	10.74
28-38	Chemicals and Allied Products	4.08	3.87	2.61	2.09
39-40	Plastic and Rubber	2.65	3.24	2.04	2.16
41-43	Hides, Skins, Leather, etc.	.32	.20	.36*	.33*
44-46	Wood and Articles	4.63	5.61	8.06*	7.28*
47-49	Pulp and Paper	10.71	7.41	16.60*	11.97*
50-63	Textiles	.64	1.10	.73*	2.00*
64-67	Footwear	.08	.12	.26*	.43*
68-70	Stone, Ceramics, Glass	.75	.64	1.35*	.51
71	Pearls, Stones, Jewelry	1.29	1.64	1.44*	2.24*
72-83	Base Metals and Articles	9.62	7.04	6.75	5.03
84	Industrial Machinery	9.10	8.34	8.27	13.66*
85	Electric and Electrical Machinery	3.63	4.61	7.09*	16.57*
86-89	Transportation	33.23	30.73	7.59	3.25
90	Instruments, Scientific and Measuring	.87	.83	.63	.44
91-92	Instruments, Photographic and Musical	.03	.04	.05*	.04
93	Arms and Ammunition	.04	.03	.10*	.07*
94-96	Miscellaneous	1.67	1.74	1.58	2.06*
97	Works of Art	.07	.06	.04	.05
98-99	Special	.63	4.66	.46	5.88*
Total		100.00	100.00	100.00	100.00

*Indicates New England share is above the U.S. average.
Note: Data for other U.S. regions presented in Appendix Table 2.
Source: Statistics Canada, Canadian Merchandise Trade Statistics.

U.S. region with its export growth rate adjusted for industry mix at the 2- or 4-digit level. More precisely, the table estimates what each region's export growth would have been if each industry's exports had grown at its U.S. average pace. (The table presents similar calculations for imports.) As the table shows, for recent trade with Canada, the Mid-Atlantic and New England had the most favorable export mix.[15] By contrast, the East and West North Central regions had the least favorable export base, probably because autos loom large in those regions. Trade in autos and parts grew relatively slowly between 1988 and 1993 because that sector has enjoyed free trade since 1965 and because the recession on both sides of the border had its usual adverse cyclical impact on that industry.

As the table also shows, in most cases actual and mix-adjusted growth rates differed considerably. By exception, New England and the East North Central performed just slightly better than expected, given their export base, and the Mountain states[16] just slightly worse. Generally, the regions performing as well as or considerably worse than expected, based on their industry mix, were in the Northeast or Rust Belt, while the regions doing better than expected were in the South and West. Significantly, U.S. imports also exceeded expectation most dramatically in the East and West South Central as well as the Mountain states.

Why did the East and West South Central's trade performance exceed expectation while New England's did not? As Table 5 shows, the Northeast's share of production worker employment and of value added by manufacture has fallen quite sharply in recent years, as manufacturers have shifted production west and south. This shift in domestic manufacturing activity has most likely carried export and import activity with it. Indeed, a simple correlation between regional export or import growth and the change in each region's share of total value added between 1983 and 1991 is positive (0.40 and 0.42 respectively).[17]

Changes in the location of Canadian direct investments would also affect regional export growth, because intra-firm transactions account for about one-third of all U.S. merchandise trade. Judging by the states' share of employment at Canadian affiliates (Table 6), Canadian firms are be-

[15] That is, the highest estimated growth rate, based on each region's product mix and U.S. industry growth rates.

[16] The Mountain region's export growth was distorted by large and volatile gold exports, which occurred in 1988 but not in 1993.

[17] Planned research using state data will examine the links between shifts in the location of domestic economic activity and trade growth more rigorously than the regional data used in this article allow.

Table 4
Actual and Estimated (Mix-Adjusted)[a] Growth in U.S. Exports to and Imports from Canada, 1988 and 1993
Percent

	Actual Growth		Estimated Growth[a]	
Region	U.S. Exports	U.S. Imports	U.S. Exports	U.S. Imports
New England	43.68	34.67	42.64	53.03
Mid-Atlantic	30.87	31.60	43.15	44.37
East North Central	27.75	49.33	26.23	39.31
West North Central	29.84	61.59	22.25	49.98
South Atlantic	40.58	33.83	35.51	55.17
East South Central	57.90	65.04	38.37	34.99
West South Central	46.77	104.51	37.94	42.78
Mountain	33.60	73.04	34.59	57.32
Pacific	39.18	67.23	31.89	54.11
United States	32.51	49.39		

[a]Averages of U.S. growth rates for each 2- or 4-digit industry weighted by the industry share in regional exports or imports. A 4-digit breakdown was used for industries in Harmonized Codes 84 through 90. For all other industries, calculations were based on 2-digit data.
Source: Statistics Canada, Canadian Merchandise Trade Statistics.

ginning to increase their investment ties to states in the middle and western parts of the country. By contrast, in the East Coast regions that had previously attracted a disproportionately large share of Canadian

Table 5
Regional Shares of U.S. Value Added and Production Worker Employment, 1983 and 1991
Percent

	Value Added		Production Worker Employment	
Region	1983	1991	1983	1991
New England	6.75	5.91	7.36	5.79
Mid-Atlantic	16.80	14.53	16.30	13.24
East North Central	23.32	22.26	21.59	22.46
West North Central	7.26	7.68	6.47	7.48
South Atlantic	14.16	15.85	17.16	17.45
East South Central	6.24	6.86	7.65	8.95
West South Central	9.01	9.47	8.26	8.40
Mountain	2.84	3.29	2.74	3.16
Pacific	13.62	14.14	12.46	13.07
United States	100.00	100.00	100.00	100.00

Source: U.S. Bureau of the Census, *Annual Survey of Manufactures, Geographic Area Studies*, M83 (AS)-6 and M91 (AS)-3, 1986 and 1993.

Table 6
Regional Shares of Employment at U.S. Affiliates of Canadian Parents, 1987 and 1992
Percent

Region	1987	1992
New England	7.6	6.2
Mid-Atlantic	15.4	14.5
East North Central	15.0	15.3
West North Central	6.4	7.4
South Atlantic	23.5	19.4
East South Central	5.8	6.7
West South Central	9.0	11.3
Mountain	4.1	4.9
Pacific	8.9	8.7

Note: Percentages will not add to 100 because nonallocated not included.
Source: U.S. Bureau of Economic Analysis.

affiliate jobs, compared to domestic jobs, that share has fallen.[18] These investment shifts may simply reflect the relocation of domestic economic activity. However, Canadians may also be shifting the placement of new investments because, with the USCAFTA, they can serve much of the unified market from Canadian plants or from early, tariff-jumping affiliates, which were often established in the Northeast close to the border. Now any additional facilities can be located to minimize transportation costs and delivery times in other parts of the unified market. The transformation of the USCAFTA into NAFTA may also have added to the allure of locations in the Southwest.

VI. How Have U.S. and Canadian Firms Responded to Trade Liberalization?

The previous section discussed how U.S.-Canadian bilateral trade and Canadian direct investment activities shifted toward the southern and western parts of the United States between 1988 and 1993. These changes largely reflect similar shifts in domestic economic activities, as well as the extension of the USCAFTA to include Mexico, rather than trade liberalization between the United States and Canada per se. By contrast, this section will explore how U.S. and

[18] The South Atlantic, in particular, experienced a notable drop in its share of jobs at Canadian affiliates over this period. The decline appears to have been fairly widespread, as the level of Canadian affiliate employment remained stagnant or fell in all eight states in the region (as well as in the District of Columbia).

Canadian firms have responded to the increased integration of the two economies. Have they changed the role of their foreign affiliates, for instance, or put less emphasis on direct investments as compared with trade?

In theory, declines in trade barriers are likely to encourage firms to maximize scale economies at the plant level. Thus, firms may try to consolidate production in locations determined by comparative advantage. Alternatively—especially if firms have sunk costs in affiliates created to avoid trade barriers—they may seek to restructure existing plants to supply specialized products to the entire integrated market. On the other hand, firms also need to minimize transportation costs and provide rapid customer service—goals that may conflict with maximizing plant scale economies. In addition, firms may want to cluster in a given area to take advantage of agglomeration economies, such as a specialized labor pool. As Paul Krugman has pointed out, language and other cultural differences have led Europeans to focus on plant scale economies (and, thus, trade)—at least, to date. In North America, by contrast, cultural barriers are not as strong; thus, transportation costs and agglomeration economies may prove more compelling on this continent in the long run. In this latter case, the result would be increased emphasis on direct investment.

The Choice Between Trade and Investment

To date, the evidence suggests that U.S. and Canadian firms, like the Europeans, are choosing to stress plant scale economies. The data in Tables 7 and 8 show that U.S. and Canadian firms have begun to refocus and downplay foreign affiliate activities. Many U.S. firms originally established Canadian subsidiaries to avoid trade barriers while serving the Canadian market. Now these Canadian affiliates of U.S. parents are beginning to serve the entire integrated market—as opposed to the Canadian market—to a greater extent than before. As Table 7 indicates, sales to the U.S. market rose as a share of total Canadian affiliate sales, while sales to Canadians fell as a share of that total. For affiliates of U.S. firms located in all the other areas included in Table 7, the pattern was reversed, with the host country market increasing in importance and the U.S. market declining. For example, in the fast-growing and increasingly costly Asia Pacific region (excluding Japan), affiliate sales to the United States fell from 28 to 11 percent of total sales, while sales to customers within the host country rose from 41 to 71 percent of the total.

The evidence to date suggests that U.S. and Canadian firms, like the Europeans, are choosing to stress plant scale economies and trade rather than increase foreign investment.

Table 7
Sales of Majority-Owned Foreign Affiliates[a] of U.S. Firms,[a] by Selected Customer, 1987 and 1992
Percent

	Sales to United States		Sales to Host Country		Sales to Other Foreign	
Area	1987	1992	1987	1992	1987	1992
All Countries	10.9	10.1	66.1	65.9	23.0	24.0
Canada	23.1	26.1	73.6	71.1	3.3	2.8
Europe	4.6	3.8	63.4	64.0	32.0	32.2
Latin America	20.3	19.7	62.6	64.2	17.1	16.2
Mexico	29.4	24.7	64.6	72.6	5.9	2.7
Asia Pacific	28.0	11.3	40.6	70.8	31.3	17.8
Japan	6.5	4.7	86.6	89.0	6.9	6.3

[a]Nonbank.
Source: U.S. Bureau of Economic Analysis.

In addition, U.S. and Canadian firms have increased their direct investments in each other's country at a comparatively slow pace, whether that expansion is measured by number of affiliates, assets, sales, or employment (Table 8). Indeed, employment at Canadian affiliates of U.S. firms (and at U.S. affiliates of Canadian firms) actually fell, unlike employment at affiliates in (from) other industrial countries. Since trade between the United States and Canada has grown relatively fast, the relatively slow increase in affiliate activity suggests that U.S. and Canadian firms are currently shifting the focus of their bilateral activities from direct investment to trade.

Table 8
Growth in Foreign Affiliates[a] of U.S. Parents,[a] 1987 to 1992
Percent

	No. of Affiliates	Assets	Sales	Employment
All Countries	8.7	57.3	50.0	7.3
Canada	.9	27.8	26.9	−3.9
Europe	20.7	76.8	52.5	7.0
France	20.4	87.4	47.8	13.3
Germany	16.5	55.9	56.4	5.2
United Kingdom	15.5	112.1	48.1	15.1
Japan	21.9	51.3	42.7	14.7

Growth in U.S. Affiliates[a] of Foreign Parents,[a] 1987 to 1992
Percent

	No. of Affiliates	Assets	Sales	Employment
All Countries	44.1	91.8	64.2	45.9
Canada	16.5	48.9	24.7	−.8
Europe	19.2	94.4	65.3	48.9
France	40.9	403.8	110.4	91.0
Germany	14.9	108.9	61.0	41.7
United Kingdom	15.9	84.8	52.2	48.5
Japan	169.5	128.8	79.2	104.2

[a]Nonbank.
Source: U.S. Bureau of Economic Analysis.

The Basis for Trade Growth: Comparative Advantage or Economies of Scale?

If U.S. and Canadian firms are addressing their increasingly integrated market by emphasizing trade rather than investment, is this trade based on comparative advantage or has the share of intra-industry trade, or two-way trade in very similar products, also increased? As already noted, IIT reflects economies of specialization and large-scale production as well as customer tastes for a wide variety of products, rather than traditional comparative advantage based on the relative abundance of resources. This two-way activity is thought to smooth adjustment to trade liberalization because it involves efficiency gains on both sides. When trade is based on comparative advantage, tariff reductions allow low-cost producers in the country that is relatively rich in resources (low-skilled labor, say) to expand exports, while high-cost firms in the country where unskilled labor is relatively scarce face increased competition and threats to their survival. By contrast, when two-way trade expands, firms on both sides of tariff reductions can thrive by focusing on different, complementary parts of their previous set of products—fine paper versus newsprint, for example, or different types of semiconductors. This narrowed focus allows firms in both countries to cut costs by expanding output on the basis of economies of specialization and scale. Economists have generally concluded, thus, that European adjustment problems were relatively modest because integration led to a big rise in the share of intra-industry activity in total EC trade.

Will trade liberalization produce the same outcome in North America as in the EC? The verdict is not yet in. Judging from the data in Table 9,[19] however, at the national level, U.S.-Canadian trade has generally expanded *on a net basis* as comparative advantage would suggest. Interpreting a trade surplus in a given industry as revealing comparative advantage, Table 9 indicates that the United States enjoyed an advantage over Canada in the following nine industries in 1988: vegetable products; chemicals; rubber and plastics; textiles; stone, clay and glass; industrial machinery; electrical machinery; instruments; and arms.[20] As the

[19] Data for Census regions other than New England can be found in Appendix Table 4.

[20] Clearly, exchange rate, cyclical, and relative price trends will shift the number of industries enjoying a trade surplus in any given year. However, this approach provides a rough indicator of comparative advantage in 1988 and the resulting division generally accords with the author's preconceptions.

Table 9

U.S. Trade Balance with Canada by Industry Category, United States and New England, 1988 and 1993

Millions of Canadian Dollars

		United States		New England	
Code	Description	1988	1993	1988	1993
1-5	Animal Products	(1,826.1)	(2,585.0)	(926.9)	(772.2)
6-14	Vegetable Products	1,279.3	1,223.4	(34.2)	(101.7)
15	Fats, Oils, and Waxes	(15.5)	(141.3)	(19.8)	(28.5)
16-24	Prep. Foodstuffs, Beverages, Tobacco	(129.1)	(626.8)	(204.1)	(358.0)
25-27	Minerals	(9,009.5)	(16,098.2)	(1,384.9)	(1,116.8)
28-38	Chemicals and Allied Products	109.8	1,862.9	(10.2)	354.2
39-40	Plastic and Rubber	1,110.7	1,141.7	25.7	102.7
41-43	Hides, Skins, Leather, etc.	(35.4)	(68.1)	(6.4)	(11.7)
44-46	Wood and Articles	(3,605.3)	(7,098.5)	(481.9)	(554.2)
47-49	Pulp and Paper	(7,948.2)	(6,568.2)	(1,084.6)	(912.7)
50-63	Textiles	816.0	1,033.9	54.2	1.9
64-67	Footwear	(14.5)	(38.1)	1.0	(22.2)
68-70	Stone, Ceramics, Glass	350.8	582.5	(73.9)	(3.4)
71	Pearls, Stones, Jewelry	(102.4)	(1,134.4)	24.6	(144.4)
72-83	Base Metals and Articles	(4,224.5)	(3,195.8)	(270.1)	(216.2)
84	Industrial Machinery	8,475.7	9,296.1	731.9	191.8
85	Electric and Electrical Machinery	4,408.1	5,458.1	470.7	(56.0)
86-89	Transportation	(6,823.7)	(18,026.9)	(442.7)	(177.8)
90	Instruments, Scientific and Measuring	1,610.8	2,451.0	237.3	246.6
91-92	Instruments, Photographic and Musical	54.6	41.6	3.0	2.0
93	Arms and Ammunition	125.0	212.5	14.2	19.2
94-96	Miscellaneous	(547.8)	25.6	(56.5)	(80.7)
97	Works of Art	(.9)	(52.8)	(.5)	(3.3)
98-99	Special	1,112.0	(4,364.1)	29.2	(505.2)
Total		(14,830.2)	(36,669.1)	(3,404.9)	(4,146.4)

Note: Negative values in parentheses. Data for other U.S. regions presented in Appendix Table 4.
Source: Statistics Canada, Canadian Merchandise Trade Statistics.

table also shows, these U.S. industries generally had an even bigger surplus in 1993, while most Canadian industries with a comparative advantage over their U.S. competitors in 1988 also enjoyed net gains. The exceptions were vegetable products and photographic and musical instruments, where a U.S. surplus shrank between 1988 and 1993, and pulp and paper and base metals, where a Canadian surplus diminished.

Regionally, however, it is less clear that net trade expanded according to comparative advantage as revealed by net trade positions in 1988. In New England, for example, in over half the industries examined, a trade surplus observed in 1988 had either shrunk or shifted to the other side of the border by 1993. New England developed a new trade surplus in chemicals, for instance, while its traditional surplus in textiles and industrial machinery declined. The region's surplus in electrical machinery also vanished. While the Mid-Atlantic had an experience similar to New England's, in the Pacific, East South Central and West North Central regions, the comparative advantages demonstrated in 1988 generally became more pronounced.

Of course, even where net trade expanded according to comparative advantage, the proportion of two-way trade could also have grown. But did it? To start with the situation before the USCAFTA, over half of U.S.-Canadian trade was intra-industry in 1988 according to a weighted-average index of IIT measured nationally at the 2- and 4-digit levels (Table 10).[21] Naturally, however, at the regional level, the share of two-way trade was lower than that found nationally, since geographic aggregation, like indus-

[21] The weighted-average index of IIT was calculated according to the following formula adapted from Grubel and Lloyd (1975):

Table 10
Index of U.S.–Canadian Intra-Industry Trade,[a] All Industries and All Industries Excluding Autos, by Region

	All Industries		Excluding Autos	
Region	1988	1993	1988	1993
New England	.47	.52	.45	.52
Mid-Atlantic	.51	.56	.58	.62
East North Central	.58	.50	.55	.52
West North Central	.34	.33	.35	.34
South Atlantic	.52	.55	.52	.55
East South Central	.45	.49	.43	.46
West South Central	.53	.43	.53	.42
Mountain	.36	.42	.35	.42
Pacific	.44	.42	.42	.45
United States	.60	.57	.56	.57

[a]Averages of indexes calculated at the 2- or 4-digit levels, weighted by each industry's share of total trade between the United States and Canada. Calculations for industries in Harmonized Codes 84 through 90 were based on 4-digit data. All other calculations were based on 2-digit data.

Source: Statistics Canada, Canadian Merchandise Trade Statistics.

trial aggregation, increases measured IIT. In 1988 the regional indexes of IIT ranged from 0.34 in the West North Central to 0.58 in the East North Central.

Has the proportion of IIT increased since the USCAFTA went into effect? As the data in Table 10 indicate, in contrast to the European experience, the share of two-way trade observed at the national level fell slightly, although IIT rose moderately in five of nine regions. The four regions experiencing declines in IIT were those where resource-based goods or automotive products weigh heavily in the export base. Because the United States and Canada already enjoyed free and extensive two-way trade in autos and parts when the USCAFTA went into effect, a *relative* surge in non-auto trade in response to newly declining trade barriers (and, possibly, in response to cyclical pressures on auto sales) might explain much of the decline in IIT. Accordingly, Table 10 also presents measures of IIT calculated for all industries excluding autos. As expected, the special case of the U.S.-Canada Auto Pact explains the national decline in IIT as originally measured and contributes to the declines seen in some regions.

Nevertheless, even excluding the auto industry, the national increase in IIT is barely perceptible. However, this national aggregate hides the fact that the regional experiences varied widely. While IIT rose by 15 to 20 percent in New England and the Mountain states, for example, it fell by 20 percent in the West South Central. Significantly, computer-related products and semiconductors, which are highly differentiated and labor-intensive, and might be expected, thus, to be characterized by IIT, account for a large or growing share of total trade with Canada in New England and the Mountain states, whereas in the West South Central chemicals and other resource-based products tend to be important. Moreover, most regions with rising IIT have had substantial and long-standing direct investment links with Canada. It seems plausible, thus, that companies with existing investments on both sides of the border chose to seek economies of scale through specialization and two-way trade rather than to face the cost—financial or political—of closing existing plants. In regions with declining IIT, by contrast, firms had relatively few pre-USCAFTA direct investments, and trade has grown relatively rapidly in accord with comparative advantage based on raw materials.

Structural Change

Finally, Table 11 presents an index of structural change in U.S. exports to and imports from Canada from 1988 to 1993.[22] This index, which measures the amount of change in the industrial composition of exports (or imports) between two years, ranges from zero to 1.00. It provides one indication of the ease with which regions adjusted to trade liberalization, with a low index suggesting a relatively smooth transition. Once again, the results for the United States as a whole differ from those for the regions. At the national level, we see only a very limited amount of structural change. By contrast, the indexes of structural change

$$\sum_{i=1}^{n}\left[\frac{x_i + m_i}{\sum_{i=1}^{n}(x_i + m_i)}\right]\left[1 - \left|\frac{x_i - m_i}{x_i + m_i}\right|\right]$$

where x_i and m_i are exports and imports, respectively, of 2- or 4-digit industry i. This measure is simply a weighted-average of the two-way proportion of trade within each industry. The absolute value of the ratio of x_i minus m_i to x_i plus m_i measures the non-overlapping or one-way portion of trade; thus, 1 minus this ratio measures the two-way portion of trade.

[22] The weighted-average index of structural change was calculated according to the following, based on Lawrence (1984):

$$0.5\sum_{i=1}^{n} |a_{it_1} - a_{it_2}|$$

where a_i is the share of industry i in total exports or imports, and t_1 and t_2 are 1988 and 1993, respectively.

Table 11
Index of Structural Change[a] in the Industrial Composition of U.S. Exports to and Imports from Canada, 1988 to 1993

Region	U.S. Exports	U.S. Imports
New England	.18	.29
Mid-Atlantic	.21	.20
East North Central	.17	.13
West North Central	.20	.18
South Atlantic	.25	.37
East South Central	.29	.28
West South Central	.18	.39
Mountain	.35	.35
Pacific	.19	.23
United States	.13	.14

[a]Averages of indexes calculated at the 2- or 4-digit levels, weighted by each industry's share of total trade between the United States and Canada. Calculations for industries in Harmonized Codes 84 through 90 were based on 4-digit data. All other calculations were based on 2-digit data.

Source: Statistics Canada, Canadian Merchandise Trade Statistics.

for the individual regions were often considerably larger. The Mountain states and the East South Central experienced big shifts in the industrial composition of their exports, for example, while the import mix (and competitive pressures?) changed a good deal in the West South Central, South Atlantic, Mountain, and New England regions. In the Mountain states, a sharp decline in the share of highly volatile gold exports contributed to this change; however, a big increase in the importance of industrial machinery in both imports and exports followed the expansion of several computer firms into the region. In New England, moreover, electric machinery imports and exports jumped in importance when IBM expanded and restructured its operations in Essex, Vermont.

Clearly, then, just as modest net employment flows can disguise large gross flows, so too, modest changes in the structure of trade at the national level can hide more significant adjustments within regions. Surprisingly, moreover, the regions with rising IIT tended to experience a relatively large shift in the composition of their exports, imports, or both. By contrast, regions with declines in IIT faced somewhat less structural change. These results suggest the need to reexamine the conventional wisdom that increasing IIT automatically smooths adjustment to trade liberalization. In fact, intra-firm (and, thus, intra-industry) responses to trade liberalization may be swifter and more abrupt than would likely occur with arm's-length transactions.

Despite significant structural change in some regions, the start of the USCAFTA has stirred remarkably little adverse comment—certainly within the United States.[23] The muted U.S. reaction obviously reflects the fact that Canadian trade represents only a small fraction of total U.S. output. But, in addition, just as intra-firm responses to trade liberalization may aggravate structural change, so too, multinational firms may also smooth the required adjustments—by retraining or reassigning employees to expanding operations, for example. Accordingly, it may be the scale and style of intra-firm, rather than intra-industry, activity that determines how easily a region adjusts to trade liberalization.

VII. Conclusions

This article has explored the U.S. and Canadian responses to the early years of the USCAFTA from a U.S. regional perspective. It finds that adding this geographic dimension actually changes the conclusions concerning the extent of and trends in IIT and the ease of adjustment to trade liberalization.

Using a highly detailed data base from Statistics Canada, the article finds that New England has a very favorable export base and fared comparatively well in trade with Canada in the years studied. However, geographic shifts in U.S. industrial activity and in direct investment from Canada have played a dominant role in determining the regions' relative export performance. Thus, bilateral trade activity shifted towards the South and West between 1988 and 1993.

The article also concludes that U.S. and Canadian firms have refocused their existing foreign affiliates towards serving the integrated North American market; they have also begun to put relatively more emphasis on trade rather than direct investment. So far, in other words, they appear to be seeking econo-

[23] The limited U.S. complaints have tended to focus on raw-materials-based products, like lumber and fish, where the extent of public subsidy is often in dispute, or on cultural products not covered by the USCAFTA. This outcome is not particularly surprising given that trade growth based on comparative advantage creates losers (the owners of the relatively scarce resources in the importing country) as well as winners, whereas trade based on economies of scale tends to create winners all around. On the whole, however, firms on both sides of the border have welcomed the USCAFTA. Indeed, since the agreement went into effect, the parties have accelerated the pace of trade liberalization for selected items.

mies of scale or comparative advantage through trade, rather than reduced transportation costs and agglomeration economies through direct investment. This pattern mimics the European precedent.

In contrast with the European paradigm, however, U.S.-Canadian trade has expanded according to underlying comparative advantage on a net basis. This trend was most pronounced in the regions most dependent on exports of natural resources; it was less obvious within the Rust Belt with its long-standing investment ties with Canada. Moreover, even when auto trade is excluded from consideration, the national increase in IIT is barely perceptible. However, as the regional and industrial detail available in the Canadian data reveal, national average figures still hide the fact that IIT increased at least a bit in six of the nine regions. The increase was greatest in New England and the Mountain states, where computer-related products and semiconductors weigh heavily in the product mix.

Looking at structural change in the industrial composition of trade again demonstrates that the national average picture can be misleading. While the national data suggest little change in the structure of trade with Canada between 1988 and 1993, several regions actually faced notable shifts in the industrial composition of their exports or imports. Indeed, one theme emerging from this study is that trade data aggregated to the national level understate the amount of adjustment occurring within individual regions.

While the data generally show regional trade structures to be far less stable than the national perspective would suggest, this instability does not appear to have provoked much complaint. The muted political response to these structural changes may reflect the fact that trade expansion based on comparative advantage, which creates losers as well as winners, occurred in the fast-growing South and West; by contrast, trade based on economies of specialization and scale, which, like technological progress, benefits almost everyone, expanded primarily in the Rust Belt.

The observed link between increasing IIT and significant structural change may also have played a role in easing adjustment to increased integration. This link undoubtedly reflects the multinationals' ability to expand intra-firm trade relatively quickly. However, multinationals can also absorb some of the costs of adjusting to increased integration. Accordingly, the scale and nature of intra-*firm* activities may be as important as the scope of intra-*industry* trade in determining how smoothly economies adjust to trade liberalization.

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Appendix Table 1

Industry Share of U.S. Exports to Canada, by Selected Region, 1988 and 1993

Percent

		Mid-Atlantic		South Atlantic		East North Central		West North Central	
Code	Description	1988	1993	1988	1993	1988	1993	1988	1993
1-5	Animal Products	.59	.50	.79*	1.10*	.32	.30	2.06	3.22*
6-14	Vegetable Products	.94	.75	3.86*	3.51*	.42	.58	1.67*	1.73
15	Fats, Oils, and Waxes	.10	.12	.06	.10	.06	.10	.23*	.50*
16-24	Prep. Foodstuffs, Beverages, Tobacco	2.06*	3.27*	1.79	2.01	.87	1.34	3.56	5.05*
25-27	Minerals	3.05*	2.03	3.21*	3.45*	2.82*	1.06	1.22*	3.05*
28-38	Chemicals and Allied Products	9.13*	11.80*	6.58*	7.88*	2.53	3.27	4.11*	6.47
39-40	Plastic and Rubber	6.04*	6.38*	6.42*	7.75*	3.28	3.87	3.86*	4.92
41-43	Hides, Skins, Leather, etc.	.78*	.37*	.23	.14	.19	.11	.64	.52*
44-46	Wood and Articles	1.99*	1.86*	.80	.70	.36	.39	.94*	1.01
47-49	Pulp and Paper	7.78*	8.31*	2.92*	4.12*	2.16	2.61	2.37*	2.99
50-63	Textiles	2.50*	2.59*	7.61*	10.35*	.34	.42	.42*	.67
64-67	Footwear	.13*	.16*	.04	.05	.02	.05	.08	.12
68-70	Stone, Ceramics, Glass	2.06*	2.23*	.89	1.00	1.34*	1.48*	.76	.99
71	Pearls, Stones, Jewelry	3.24*	6.25*	1.36	.33	.18	.04	.19	.74
72-83	Base Metals and Articles	11.27*	9.55*	4.92	5.11	6.06	6.85*	4.63	5.40
84	Industrial Machinery	15.62	11.37	14.53	12.68	22.69*	23.42*	21.22*	17.60
85	Electric and Electrical Machinery	13.01*	10.14	8.41*	11.22*	6.29	7.94	5.50	6.62
86-89	Transportation	11.82	8.58	29.80	20.27	46.61*	40.79*	41.51*	30.72*
90	Instruments, Scientific and Measuring	4.75*	4.40*	2.51*	3.32*	1.31	2.29	2.71	2.72
91-92	Instruments, Photographic and Musical	.17*	.09*	.05	.06	.07	.07	.02	.04
93	Arms and Ammunition	.06	.04	.89*	.99*	.04	.06	.18	.59*
94-96	Miscellaneous	1.43*	1.67	1.27*	2.51*	1.18	2.04	1.07	2.86*
97	Works of Art	.33*	.10*	.09	.03	.01	.01	.02	.02
98-99	Special	1.17	7.43*	.95	1.30	.86	.91	1.04	1.45
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

		East South Central		West South Central		Mountain		Pacific	
Code	Description	1988	1993	1988	1993	1988	1993	1988	1993
1-5	Animal Products	1.20*	1.00	.92*	.66	1.29*	6.09*	2.02*	1.99*
6-14	Vegetable Products	.32	.38	2.23	1.91	3.65*	3.22*	12.91*	12.46*
15	Fats, Oils, and Waxes	.05	.09	.61*	.40*	.04	.04	.08	.10
16-24	Prep. Foodstuffs, Beverages, Tobacco	1.18	1.61	.69	1.32	1.26	2.69*	2.87*	6.05*
25-27	Minerals	.65	1.61	3.80*	3.29*	7.16*	5.73*	1.90	2.57*
28-38	Chemicals and Allied Products	5.11*	5.16	14.42*	16.10*	5.56*	7.80*	3.15	4.22
39-40	Plastic and Rubber	6.85*	9.44*	10.39*	12.56*	1.64	1.22	2.15	2.37
41-43	Hides, Skins, Leather, etc.	.16	.12	.21	.13	.23	.40*	.32	.18
44-46	Wood and Articles	.93	.66	.26	.37	1.26*	1.29*	4.09*	3.54*
47-49	Pulp and Paper	4.43*	5.99*	1.95	2.10	1.84	2.76	2.51	3.77
50-63	Textiles	3.59*	4.93*	.69	.87	.42	1.06	.66	1.25
64-67	Footwear	.09*	.25*	.07	.16*	.07	.09	.05	.15*
68-70	Stone, Ceramics, Glass	3.18*	1.62*	.88	1.01	.74	.43	.72	.94
71	Pearls, Stones, Jewelry	.03	.04	.06	.07	21.79**	.74**	.80	1.19*
72-83	Base Metals and Articles	7.31*	6.91*	6.16	7.06*	4.46	4.79	4.48	4.25
84	Industrial Machinery	18.38	13.69	19.69	18.82	19.32	24.88*	23.64*	20.65*
85	Electric and Electrical Machinery	12.44*	13.60*	14.65*	12.38*	13.86*	14.11*	10.19*	14.37*
86-89	Transportation	28.80	24.59	16.52	13.60	6.59	11.14	18.38	9.54
90	Instruments, Scientific and Measuring	1.46	1.54	3.39*	4.25*	5.20*	5.87*	5.84*	4.95*
91-92	Instruments, Photographic and Musical	.06	.08	.06	.08	.06	.04	.15*	.15*
93	Arms and Ammunition	.14	.03	.24*	.07	.28*	.13	.16	.18
94-96	Miscellaneous	2.50*	5.80*	1.06	1.27	1.13	3.28*	1.52*	2.72*
97	Works of Art	.01	.01	.02	.01	.12*	.12*	.12*	.09*
98-99	Special	1.14	.86	1.05	1.53	2.04*	2.09	1.28	2.30
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Indicates regional share is above the U.S. average.

**Reflects volatile gold exports.

Source: Statistics Canada, Canadian Merchandise Trade Statistics.

Appendix Table 2

Industry Share of U.S. Imports to Canada, by Selected Region, 1988 and 1993

Percent

		Mid-Atlantic		South Atlantic		East North Central		West North Central	
Code	Description	1988	1993	1988	1993	1988	1993	1988	1993
1-5	Animal Products	2.03	1.67	1.03	1.29	.52	.61	3.44*	5.69*
6-14	Vegetable Products	.75*	.82	.47	.71	.29	.47	2.00*	3.60*
15	Fats, Oils, and Waxes	.02	.07	.04	.21*	.04	.16	.05	.09
16-24	Prep. Foodstuffs, Beverages, Tobacco	1.83*	4.27*	1.94*	3.35*	.81	1.08	.78	1.07
25-27	Minerals	8.27	12.06	4.69	2.60	7.48	8.75	28.30*	28.54*
28-38	Chemicals and Allied Products	3.98	4.29*	4.32*	4.84*	3.03	2.54	8.75*	7.45*
39-40	Plastic and Rubber	1.97	2.83	7.61*	6.86*	1.84	2.92	3.39*	3.53*
41-43	Hides, Skins, Leather, etc.	.82*	.36*	.09	.14	.13	.13	.19	.21*
44-46	Wood and Articles	3.73	3.45	11.60*	13.60*	1.75	3.31	4.06	7.04*
47-49	Pulp and Paper	12.72*	9.15*	12.63*	10.74*	7.41	5.16	12.87*	9.49*
50-63	Textiles	.88*	1.24*	2.41*	4.80*	.24	.34	.37	.65
64-67	Footwear	.15*	.24*	.04	.06	.04	.02	.07	.13*
68-70	Stone, Ceramics, Glass	.82*	.80*	.74	.78*	.65	.62	.67	.75*
71	Pearls, Stones, Jewelry	4.50*	6.94*	.93	.68	.03	.01	.09	.07
72-83	Base Metals and Articles	15.77*	10.89*	9.50	8.09*	7.65	6.56	4.50	4.06
84	Industrial Machinery	4.85	4.88	13.50*	13.49*	9.95*	7.48	11.66*	8.64*
85	Electric and Electrical Machinery	3.14	6.63*	9.55*	4.86*	1.73	2.07	2.04	1.71
86-89	Transportation	30.26	22.65	14.25	11.26	54.14*	53.38	14.58	11.62
90	Instruments, Scientific and Measuring	1.22*	1.05*	1.39*	1.44*	.30	.58	.60	.48
91-92	Instruments, Photographic and Musical	.03*	.03	.07*	.05*	.01	.04	.01	.03
93	Arms and Ammunition	.02	.05*	.14*	.04*	.00	.00	.07*	.02
94-96	Miscellaneous	1.78*	1.83*	2.25*	3.20*	1.73*	1.58	1.22	1.35
97	Works of Art	.22*	.22*	.05	.07*	.01	.01	.02	.01
98-99	Special	.26	3.58	.78*	6.85*	.21	2.16	.28	3.77
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

		East South Central		West South Central		Mountain		Pacific	
Code	Description	1988	1993	1988	1993	1988	1993	1988	1993
1-5	Animal Products	.44	.46	.75	.41	4.45*	12.01*	5.42*	5.79*
6-14	Vegetable Products	.30	.44	.36	.27	.73*	1.46*	1.32*	1.14*
15	Fats, Oils, and Waxes	.51	.77*	.11*	.26*	.06	.19	.42*	.39*
16-24	Prep. Foodstuffs, Beverages, Tobacco	1.84*	2.36*	.93	1.70	.99	1.77	1.87*	2.40*
25-27	Minerals	8.52	17.53*	5.04	19.94*	29.25*	14.69*	22.92*	19.20*
28-38	Chemicals and Allied Products	10.11*	6.66*	10.08*	7.05*	6.00*	5.21*	2.66	4.52*
39-40	Plastic and Rubber	4.61*	6.15*	5.96*	4.82*	2.36	3.67*	2.13	2.08
41-43	Hides, Skins, Leather, etc.	.34*	.10	.52*	.31*	.26	.15	.21	.17
44-46	Wood and Articles	3.80	5.90*	3.92	5.48	10.46*	15.97*	10.17*	9.40*
47-49	Pulp and Paper	13.30*	9.15*	8.12	4.09	11.90*	5.58	11.99*	7.53*
50-63	Textiles	.65*	1.75*	.63	1.06	.41	.72	.57	.97
64-67	Footwear	.02	.16*	.05	.04	.08*	.12	.03	.07
68-70	Stone, Ceramics, Glass	.65	.90*	.87*	.83	.40	.35	.71	.35
71	Pearls, Stones, Jewelry	.07	.13	.23	.14	.15	.87	1.29	.88
72-83	Base Metals and Articles	21.28*	13.58*	15.68*	7.94*	4.35	3.11	5.08	3.37
84	Industrial Machinery	14.32*	9.16*	14.88*	17.19*	10.44*	15.02*	6.98	6.24
85	Electric and Electrical Machinery	5.17*	4.99*	8.59*	6.68*	4.53*	3.51	3.89*	3.47
86-89	Transportation	12.44	12.98	18.43	11.17	9.39	5.06	18.15	24.15
90	Instruments, Scientific and Measuring	.45	.60	2.00*	1.43*	1.22*	1.97*	2.21*	1.22*
91-92	Instruments, Photographic and Musical	.05*	.02	.07*	.05*	.03*	.02	.04*	.03
93	Arms and Ammunition	.09*	.00	.04	.02	.03	.04*	.08*	.07*
94-96	Miscellaneous	.87	1.30	2.11*	2.07*	1.65	1.62	1.15	1.47
97	Works of Art	.01	.02	.04*	.02	.06	.05	.08*	.08*
98-99	Special	.18	4.88*	.59	7.06*	.80*	6.84*	.67*	5.01*
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Indicates regional share is above the U.S. average.

Source: Statistics Canada, Canadian Merchandise Trade Statistics.

Appendix Table 3

Shares of the Three Top 4-Digit U.S. Exports to Canada within Selected U.S. Industries, 1993

Percent

	Industrial Machinery		Electric and Electronic Equipment	
Region	4-Digit Product	Share	4-Digit Product	Share
NE	Disk drive units, display units & printers	32.3	Integrated circuits	59.0
	Parts for computers & office machines	19.1	Phonog. records, magnetic tape recordings, & discs	7.4
	Turbojet, turbo prop, & gas engines	16.6	Printed circuits	5.3
MAT	Disk drive units, display units & printers	13.6	Printed circuits	23.5
	Parts for computers & office machines	8.7	Relays, switches, circuit breakers & connectors	8.8
	Turbojet, turbo prop, & gas engines	5.3	Integrated circuits	6.9
SAT	Disk drive units, display units & printers	22.8	Telephone sets & parts, faxes, modems	26.6
	Parts for computers & office machines	8.8	Relays, switches, circuit breakers & connectors	6.1
	Valves	6.5	T.V., radio transmitters, cameras	5.4
ENC	Spark ignition engines	23.6	Insulated wire, cables & conductors	14.6
	Parts for spark & computers ignit. engines	9.4	Internal combustion engines & equipment	14.1
	Air conditioners	5.7	Relays, switches, circuit breakers & connectors	11.1
WNC	Harvesters, combines, mowers	8.8	Relays, switches, circuit breakers & connectors	9.7
	Disk drive units, display units & printers	8.7	Motors and generators	9.5
	Bulldozers, rollers, scrapers, levelers	5.7	Lead-acid & nickel-cad. storage batteries and parts	7.0
ESC	Parts for spark & computer ignit. engines	8.2	Relays, switches, circuit breakers & connectors	25.6
	Disk drive units, display units & printers	8.1	Internal combustion engines & equipt.	9.8
	Hydraulic pumps	6.0	T.V. sets, receivers	8.7
WSC	Disk drive units, display units & printers	26.2	Insulated wire, cable & conductors	19.1
	Valves	11.7	Integrated circuits	18.0
	Hydraulic pumps	7.3	Carbon/graphite items	9.4
MT	Disk drive units, display units & printers	56.7	Integrated circuits	31.9
	Parts for computers & office machines	12.2	Phonog. records, magnetic tape recordings, discs	22.4
	Valves	2.8	Telephone sets & parts, faxes, modems	8.6
PAC	Disk drive units display units & printers	43.8	Phonog. records, magnetic tape recordings, discs	29.0
	Parts for computers & office machines	15.5	Integrated circuits	16.5
	Turbojet, turbo prop & gas engines	3.4	Telephone sets & parts, faxes, modems	10.5

	Transportation		Chemicals	
Region	4-Digit Product	Share	4-Digit Product	Share
NE	Vehicle/tractor bodies & parts	44.6	Pharmaceutical products	25.8
	Parts for civilian, military aircraft	37.8	Organic chemicals	16.5
	Rail, train car parts	4.4	Toiletries	13.8
MAT	Vehicle/tractor bodies & parts	39.9	Organic chemicals	21.3
	Passenger vehicles	22.3	Pharmaceutical products	17.3
	Motor vehicles w. rear cabs, trucks	7.8	Photog., cinematog. products	15.5
SAT	Passenger vehicles	50.7	Miscellaneous	24.2
	Vehicle/tractor bodies & parts	29.7	Inorganic products	12.4
	Road tractors	6.5	Dyes, paint, ink	12.2
ENC	Vehicle/tractor bodies & parts	58.4	Miscellaneous	22.2
	Passenger vehicles	27.0	Tanning, dyeing extracts, pigments	20.6
	Motor vehicles w. rear cabs, trucks	9.2	Organic products	15.6
WNC	Passenger vehicles	50.0	Miscellaneous	38.5
	Motor vehicles w. rear cabs, trucks	20.4	Organic products	18.7
	Vehicle, tractor bodies & parts	14.3	Pharmaceutical products	7.8
ESC	Vehicle, tractor bodies & parts	47.2	Organic products	30.6
	Passenger vehicles	26.2	Miscellaneous	23.7
	Road tractors	19.7	Dyes, paint, ink	11.4
WSC	Passenger vehicles	33.6	Organic products	40.3
	Parts for civilian military aircraft	25.7	Inorganic products	26.6
	Vehicle, tractor bodies & parts	17.5	Miscellaneous	17.2
MT	Vehicle, tractor bodies & parts	43.7	Photographic, cinematog. prods.	20.9
	Parts for civilian military aircraft	34.0	Fertilizers	19.8
	Trailers & semi-trailers for housing	7.1	Inorganic products	18.5
PAC	Parts for civilian, military aircraft	29.8	Miscellaneous	24.4
	Helicopters & airplanes, spacecraft	18.7	Pharmaceutical products	16.5
	Vehicle, tractor bodies & parts	16.6	Toiletries	15.5

Source: Based on data from Statistics Canada.

Appendix Table 4

U.S. Trade Balance with Canada by Industry Category, Selected Regions, 1988 and 1993

Millions of Canadian Dollars

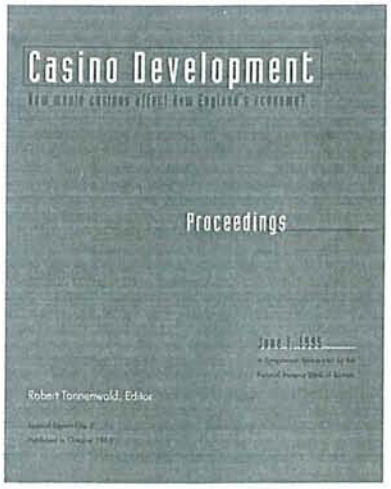
		Mid-Atlantic		South Atlantic		East North Central		West North Central	
Code	Description	1988	1993	1988	1993	1988	1993	1988	1993
1-5	Animal Products	(367.5)	(395.5)	(9.9)	1.6	(96.0)	(230.1)	(92.0)	(319.2)
6-14	Vegetable Products	(50.1)	(116.3)	295.3	351.3	30.4	(17.4)	(27.5)	(224.5)
15	Fats, Oils, and Waxes	6.6	(.8)	2.7	(9.8)	5.9	(52.2)	9.6	27.1
16-24	Prep. Foodstuffs, Beverages, Tobacco	(152.2)	(705.1)	6.2	(97.8)	(14.7)	(36.9)	149.7	258.2
25-27	Minerals	(1,416.1)	(3,092.4)	(80.8)	152.3	(1,991.8)	(4,741.0)	(1,625.5)	(2,540.2)
28-38	Chemicals and Allied Products	213.8	594.2	236.7	458.8	(313.0)	(32.9)	(296.5)	(256.4)
39-40	Plastic and Rubber	284.6	176.7	(26.5)	238.2	426.8	10.1	9.9	10.8
41-43	Hides, Skins, Leather, etc.	(84.3)	(44.0)	13.0	2.6	18.2	(25.6)	24.2	16.9
44-46	Wood and Articles	(567.5)	(690.0)	(811.1)	(1,296.4)	(571.9)	(1,800.6)	(191.0)	(607.7)
47-49	Pulp and Paper	(1,818.3)	(1,310.0)	(707.3)	(593.3)	(2,198.4)	(1,894.5)	(639.5)	(702.8)
50-63	Textiles	103.9	44.8	469.1	760.1	24.9	(14.2)	1.4	(15.4)
64-67	Footwear	(16.6)	(43.0)	.5	(.3)	(9.3)	8.4	(.2)	(4.3)
68-70	Stone, Ceramics, Glass	65.2	115.9	20.2	41.2	215.2	300.1	1.5	(1.7)
71	Pearls, Stones, Jewelry	(585.9)	(1,003.8)	45.6	(28.9)	52.1	10.3	5.1	46.2
72-83	Base Metals and Articles	(2,064.2)	(1,612.2)	(298.4)	(204.2)	(906.8)	(806.0)	(13.6)	(5.2)
84	Industrial Machinery	786.3	363.2	222.1	159.1	4,081.0	6,161.7	473.6	425.7
85	Electric and Electrical Machinery	847.3	(317.9)	(3.3)	857.6	1,542.8	2,370.4	181.5	308.6
86-89	Transportation	(5,107.2)	(5,078.3)	1,473.3	1,299.2	(5,093.2)	(13,365.3)	1,418.4	1,077.9
90	Instruments, Scientific and Measuring	293.4	377.7	109.5	253.9	345.9	693.7	113.9	148.2
91-92	Instruments, Photographic and Musical	14.8	5.6	(.7)	2.4	23.7	6.0	.5	.7
93	Arms and Ammunition	2.9	(9.0)	66.2	116.0	11.1	27.3	5.9	41.0
94-96	Miscellaneous	(215.5)	(259.9)	(61.5)	(22.2)	(272.2)	(22.8)	(13.6)	74.5
97	Works of Art	(9.4)	(46.0)	4.3	(3.0)	(.6)	(4.1)	.3	.2
98-99	Special	82.4	125.5	22.5	(538.3)	223.2	(879.6)	40.5	(259.8)
Total		(9,753.4)	(12,920.7)	987.8	(1,900.0)	(4,466.8)	(14,335.4)	(463.5)	(2,501.2)

		East South Central		West South Central		Mountain		Pacific	
Code	Description	1988	1993	1988	1993	1988	1993	1988	1993
1-5	Animal Products	28.3	31.4	18.7	18.5	(61.0)	(244.3)	(335.9)	(666.8)
6-14	Vegetable Products	1.4	(3.1)	88.5	108.3	55.3	33.5	888.8	1,181.5
15	Fats, Oils, and Waxes	(15.2)	(36.7)	24.0	10.5	(.5)	(5.3)	(31.6)	(47.7)
16-24	Prep. Foodstuffs, Beverages, Tobacco	(18.8)	(38.1)	3.8	(15.3)	5.0	9.7	53.4	295.1
25-27	Minerals	(258.7)	(866.1)	21.6	(1974.3)	(425.5)	(342.6)	(1,941.0)	(2,647.2)
28-38	Chemicals and Allied Products	(152.1)	(73.0)	346.5	629.0	(9.4)	25.1	3.6	(230.1)
39-40	Plastic and Rubber	91.8	196.0	287.6	531.5	(14.1)	(91.0)	(25.8)	(59.7)
41-43	Hides, Skins, Leather, etc.	(5.4)	1.3	(5.9)	(10.2)	(.7)	5.1	6.2	(6.3)
44-46	Wood and Articles	(92.8)	(284.8)	(103.0)	(302.8)	(177.0)	(497.9)	(607.5)	(1,048.1)
47-49	Pulp and Paper	(282.0)	(162.0)	(150.0)	106.8)	(193.6)	(115.4)	(896.6)	(737.3)
50-63	Textiles	106.4	181.9	12.3	(6.2)	.1	3.0	(.3)	(11.2)
64-67	Footwear	2.7	5.1	1.5	7.9	(.3)	(1.7)	.6	5.2
68-70	Stone, Ceramics, Glass	91.8	42.0	13.6	16.6	6.5	(.6)	(8.5)	49.1
71	Pearls, Stones, Jewelry	(1.1)	(4.8)	(4.3)	(3.8)	411.7	(10.0)	(54.8)	(5.1)
72-83	Base Metals and Articles	(443.2)	(352.2)	(183.7)	(13.2)	1.3	18.3	(113.1)	(52.3)
84	Industrial Machinery	181.8	270.5	440.5	201.6	167.0	133.3	1,210.8	1,293.2
85	Electric and Electrical Machinery	272.6	492.9	400.2	408.6	176.5	241.8	441.1	1,033.1
86-89	Transportation	615.3	675.9	196.1	220.0	(55.0)	115.0	(218.7)	(2,645.6)
90	Instruments, Scientific and Measuring	37.1	53.7	92.2	191.8	75.4	83.7	255.0	352.1
91-92	Instruments, Photographic and Musical	.4	3.3	.9	2.7	.7	.3	8.3	11.5
93	Arms and Ammunition	2.1	1.4	9.5	3.3	4.8	1.9	5.1	9.3
94-96	Miscellaneous	60.5	255.5	(14.4)	(40.6)	(10.1)	29.3	14.0	72.7
97	Works of Art	.1	(.7)	(.2)	(.4)	1.2	1.5	2.5	(1.3)
98-99	Special	35.0	(217.9)	29.5	(321.1)	23.5	(174.1)	39.3	(513.9)
Total		258.2	171.6	1,525.4	555.9	(18.1)	(781.5)	(1,305.2)	(4,373.4)

Note: Negative values in parentheses.

Source: Statistics Canada, Canadian Merchandise Trade Statistics.

Casino Development: How would casinos affect New England's economy?



In 1992, Connecticut became the first New England state to allow casino gambling within its borders. Since then, the region's other states have seriously considered whether to follow Connecticut's example. One of the most controversial, unresolved issues in these debates has been the economic effects of casino development. While interest in this issue is intense, relevant empirical evidence is scant. For this reason, the Federal Reserve Bank of Boston held a one-day Symposium on Casino Development on June 1, 1995, bringing together experts from academia, government, Native American nations, and the gaming industry. This special report summarizes the participants' remarks.

Copies of *Casino Development: How would casinos affect New England's economy?* may be obtained without charge by writing to Research Library—D, Federal Reserve Bank of Boston, P.O. Box 2076, Boston, MA 02106-2076. Or telephone (617) 973-3397.

State Business Tax Climate: How Should It Be Measured and How Important Is It?

Robert Tannenwald

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States are more concerned than ever before about their business tax climate. Over the past two decades, profound technological and political changes have enhanced employers' geographic mobility and extended their geographic range, thereby intensifying economic competition both within the United States and throughout the world. Yet, while fierce interjurisdictional rivalry is inducing states to cut taxes, demand is rising for state and local services such as education, health care, and law enforcement. Substantial impending reductions in federal aid will compound the states' fiscal dilemma.

Caught between conflicting long-run fiscal pressures, state policymakers have sought advice on how to evaluate their state's tax competitiveness and the relative cost-effectiveness of alternative competitive tactics. The advice that they have received has often been confusing and contradictory. Economists disagree on the best indicators of tax competitiveness and the best models of locational choice. Many state tax regimes are competitive according to some measures but uncompetitive according to others. Some studies find that interstate tax differences significantly influence business location; other studies find just the opposite. Studies analyzing the same tax characteristic draw opposite conclusions about whether it is a significant locational determinant.[1]

This lack of consensus may partially reflect the inaccuracy of the most closely monitored measures of tax competitiveness. With few exceptions, such measures, although easily computed, fail to focus on those tax characteristics that should matter most to profit-maximizing firms. This article attempts to correct this flaw. With an analytic framework used by two Massachusetts tax study commissions (for which the author served as director), it evaluates the tax competitiveness in 1991 of 22 states through the eyes of a rational, profit-maximizing business executive weighing alternative sites for a new facility. All six New England states and most of their principal economic rivals are included in the sample. The article then estimates the impact of interstate differences

Table 1

Frequently Cited Indicators of State Tax Competitiveness

Rank		Highest Statutory Corp. Income Tax Rate as of Sept. 1995 (%)	Rank		State and Local Corp. Income Taxes per $1000 Personal Income, Fiscal Year 1990 ($)	Rank		S. & L. Corp. Income Taxes and Property Taxes Paid by Businesses per $1000 Personal Income, FY 1990 ($)
1	Iowa	12	1	Michigan[a]	12.63	1	Wyoming	53.14
2	**Connecticut**	**11.25**	2	Kentucky	12.13	2	Montana	47.78
3	North Dakota	10.5	3	West Virginia	9.67	3	Alaska	35.34
4	Pennsylvania	9.99	4	Delaware	9.47	4	New York	31.35
5	Minnesota	9.8	5	New York	9.15	5	Michigan[a]	29.80
6	New York	9.675	6	California	8.51	6	Kansas	27.76
7	**Massachusetts**	**9.5**	**7**	**Connecticut**	**8.50**	7	Arizona	24.80
8	Alaska	9.4	8	Montana	7.08	8	West Virginia	24.23
9	California	9.3	9	Louisiana	6.96	**9**	**New Hampshire**	**22.47**
10	Arizona	9	**10**	**Massachusetts**	**6.64**	10	Louisiana	22.34
10	West Virginia	9	11	Minnesota	6.27	11	Texas	21.89
10	New Jersey	9	12	North Carolina	6.13	11	Oregon	21.89
10	**Rhode Island**	**9**	13	New Jersey	6.11	**13**	**Connecticut**	**20.83**
14	**Maine**	**8.93**	**14**	**New Hampshire**	**5.64**	14	Utah	20.69
15	Ohio	8.9	15	Wisconsin	5.45	15	South Carolina	20.29
16	Delaware	8.7	16	Pennsylvania	5.27	16	Colorado	20.18
17	Wisconsin	8.335	17	Idaho	5.23	17	California	19.87
18	Kentucky	8.25	18	North Dakota	5.22	18	Mississippi	18.81
18	**Vermont**	**8.25**	19	Kansas	5.08	19	Indiana	18.78
20	Louisiana	8	20	Ohio	4.69	20	Minnesota	18.72
20	Idaho	8	21	Georgia	4.63	21	Kentucky	18.63
20	**New Hampshire**	**8**	22	Hawaii	4.61	22	Illinois	18.46
23	Indiana	7.9	23	Tennessee	4.57	**23**	**Maine**	**18.36**
24	Nebraska	7.81	24	Iowa	4.54	24	New Jersey	18.20
25	North Carolina	7.75	25	Illinois	4.28	25	Ohio	18.20
26	New Mexico	7.6	26	Utah	4.22	26	Georgia	16.98
27	Kansas	7.375	27	Arkansas	4.20	27	North Carolina	16.65
28	Illinois	7.3	28	Mississippi	3.90	28	Idaho	16.26
29	Montana	7.25	29	Indiana	3.86	**29**	**Vermont**	**16.20**
30	Maryland	7	**30**	**Rhode Island**	**3.84**	30	Florida	15.47
31	Oregon	6.6	31	Oregon	3.29	**31**	**Massachusetts**	**15.17**
32	Arkansas	6.5	32	Alabama	3.20	32	Wisconsin	14.75
33	Hawaii	6.4	32	Arizona	3.20	33	Delaware	14.50
34	Missouri	6.25	34	South Carolina	3.15	**34**	**Rhode Island**	**14.47**
35	Virginia	6	35	South Dakota	3.14	35	Iowa	14.37
35	Georgia	6	36	Florida	3.13	36	Tennessee	14.22
35	Oklahoma	6	37	New Mexico	3.07	37	Nebraska	14.20
35	Tennessee	6	38	Maryland	2.97	38	Missouri	14.07
39	Florida	5.5	**39**	**Vermont**	**2.92**	39	Virginia	13.24
40	Colorado	5	**40**	**Maine**	**2.90**	40	North Dakota	12.82
40	Alabama	5	41	Nebraska	2.89	41	Pennsylvania	12.66
40	Mississippi	5	42	Virginia	2.65	42	Maryland	12.59
40	South Carolina	5	43	Missouri	2.63	43	Arkansas	11.45
40	Utah	5	44	Colorado	2.12	44	Oklahoma	11.38
45	Texas	n.a.	45	Oklahoma	2.10	45	South Dakota	10.68
45	South Dakota	n.a.	46	Alaska	1.62	46	Washington	10.40
45	Nevada	n.a.	47	Washington	0	47	Hawaii	10.30
45	Washington	n.a.	47	Texas	0	48	Nevada	10.26
45	Wyoming	n.a.	47	Wyoming	0	49	New Mexico	9.49
45	Michigan	n.a.	47	Nevada	0	50	Alabama	9.24

[a] The U.S. Bureau of the Census treats Michigan's Single Business Tax as an income tax, even though it is really a form of value-added tax.

n.a. = not applicable.

Source: Author's calculations; Commerce Clearing House, *State Tax Guides*; U.S. Bureau of the Census, *State Government Finances—1992*; Tannenwald (1993, Appendix D-1, Table A-2).

in tax competitiveness on the geographic allocation of manufacturers' capital spending.

The article finds that business tax climate exerts only a small, highly uncertain effect on capital spending. States may be more likely to stimulate their economy by enhancing public services valued by businesses. These findings are consistent with those of the most recent studies examining the impact of state and local tax characteristics on economic performance (summarized in Lynch 1995).

States may be more likely to stimulate their economy by enhancing public services valued by business than by altering their business tax climate.

For 1991, the article finds considerable disparity among the New England states in business tax competitiveness. New Hampshire and Massachusetts had the best business tax climates in the region, ranking sixth and ninth, respectively, in the 22-state sample. Rhode Island's and Maine's business tax climates were average, while those of Connecticut and Vermont were relatively unattractive.

I. A Little Background

Previous studies (Pomp 1987; Tannenwald 1987, 1993, 1994) have set forth the attributes of a good indicator of tax competitiveness and critiqued many indicators frequently cited in public debate. A brief summary of this critique is provided here.

Since businesses are primarily interested in making profits, indicators of tax competitiveness should focus on those taxes that most directly affect a firm's bottom line. They should also measure such taxes' impact on the profitability of marginal business investment projects. Businesses rarely move their entire operations from one site to another just to lower their taxes. When deciding where to locate a marginal facility, however, like a new plant, taxes are more likely to be a factor.

Measures of tax competitiveness should evaluate the tax burden that a marginal facility will bear over its entire lifetime, not just during the first years of its existence. They should take into account taxes paid to all levels of government and how these taxes interact to affect a firm's rate of profit. For example, they should take into account the deductibility of taxes paid by a firm to one state from its taxable income in another state, as well as the deductibility of state and local taxes from federal taxable income. Firms do not care to whom they pay taxes; they care how much total tax they pay relative to the profits they earn.

The most frequently used indicators of state tax competitiveness generally lack these qualities. Consider, for example, three indicators cited in recent debate over business tax policy in Massachusetts: 1) the statutory corporate income tax rate, 2) state and local corporate income taxes as a percentage of statewide personal income, and 3) the sum of state and local taxes on corporate income and nonresidential property as a percentage of statewide personal income.[2] The 50 states are ranked according to each of these statistics in Table 1.

The statutory tax rate on corporate income (col. 1) fails to take into account most taxes and fees paid by businesses, such as taxes on net worth, property, payroll, and purchases of intermediate inputs. The income tax rate also fails to take into account differences across states in the definition of taxable corporate income. Some states with a high statutory rate define taxable profits narrowly, allowing relatively generous deductions and exclusions. Others permit corporations to use favorable apportionment formulas or claim generous credits against tax.

Like the statutory corporate income tax rate, the measure of corporate income tax collections as a percentage of personal income (col. 2) focuses on only a small portion (about one-tenth) of state and local taxes paid by businesses (Tannenwald 1993, Appendix Table D-2). In addition, it bears little, if any, relation to the ratio of business taxes paid to profits earned. In recent years, corporations have boosted profits by cutting costs, including payroll. Wage cuts and layoffs depress personal income. Under such conditions, corporate taxes as a percentage of personal income could

[1] For recent surveys of the literature on the impact of interstate tax differentials on economic growth, see Bartik (1991), Wasylenko (1991), Tannenwald (1993), and Lynch (1995).

[2] See Lester, Bernard, Levy, and Tripathi (1995); Massachusetts Taxpayers Foundation (1995); and DRI/McGraw Hill (1995).

be high, even if corporate taxes as a percentage of profits is average or low.[3]

The last indicator (col. 3), unlike the other two, takes into account property taxes paid by businesses (both incorporated and unincorporated). This is a significant improvement, given that property taxes account for the largest fraction (approximately one-fourth) of all state and local business taxes in the United States (Tannenwald 1993, Appendix Table D-2). Taking into account nonresidential property taxes dramatically changes the ranking of some states.

Indicators of tax competitiveness should focus on those taxes that most directly affect a firm's bottom line and measure their impact on the profitability of marginal business investment projects.

For example, in columns 1 and 2, Massachusetts ranks 7th and 10th in the nation, respectively, in business tax burden. In column 3, the Commonwealth ranks 31st.[4]

II. The Representative Firm Approach to Evaluating Business Tax Climate

Given the difficulty of evaluating states' business tax climate with available data, some economists have explored an alternative strategy—the "representative firm" approach.[5]

How the Approach Works

Hypothetical firms representative of selected industries are assumed to be located at a variety of sites around the nation. It is assumed that the firms' pretax rate of return, asset mix, capital/labor ratio, and non-tax costs are identical at all sites. The only differences across sites, therefore, are state and local tax characteristics. At every site, each firm's local, state, and federal tax liabilities and net after-tax cash flow are computed some years into the future, typically between 20 and 60 years. The analysis is not limited to taxes on corporate profits and net worth. Property taxes and, in some cases, sales taxes and unemployment insurance taxes are also taken into account.

It is then assumed that each firm builds a new facility at each site, including the firm's current site. This expansion requires the firm to invest in new equipment, structures, inventories, and financial assets and to hire more workers. As a result of the expansion, each firm makes more profits and pays more taxes. By comparing after-tax cash flows before and after expansion, one can calculate the long-run, after-tax rate of return (AFTAX) to the new facility at each site for each firm.[6]

Previous Results Generated by the Representative Firm Approach

The Commonwealth of Massachusetts used this approach to evaluate its business tax climate in 1986 and 1993. The 1986 study (Commonwealth of Massachusetts 1987) was undertaken by the Massachusetts Special Commission on Tax Reform. The 1993 study (Tannenwald 1993) was commissioned by the Massachusetts Special Commission on Business Tax Policy, chaired by Richard Syron, then president of the Federal Reserve Bank of Boston. The author served as director for both commissions. Both evaluations compared the after-tax rate of return to marginal business investment at five Massachusetts sites, 10 sites in rival states, and a fictitious site at which no state or local taxes are imposed ("Empty Site"). The evaluations were conducted for five hypothetical firms, each representative of a different manufacturing industry with a significant presence in Massachusetts. In both studies, the five industries were men's and boys' clothing, fabricated metals, computers, electronics, and scien-

[3] For example, over the course of 1992 nationwide personal income grew by 8 percent, while corporate profits grew by 22 percent. Over the course of 1993 the rate of growth in personal income slowed to 2.8 percent, while corporate profits again expanded by 22 percent. From 1985 through 1994, the annual rate of growth in personal income was negatively correlated with the annual growth rate in corporate profits.

[4] However, the denominator of the ratio, personal income, is still irrelevant to the measurement of business tax burden. Furthermore, as noted above, most states do not break down their property tax collections into residential and nonresidential components. Consequently, business property taxes by state must be estimated.

[5] Studies utilizing this approach include S. H. Brooks Co., Inc. (1993); Commonwealth of Massachusetts (1987); L. Papke (1987, 1991); Papke and Papke (1984, 1986); Connecticut Task Force on State Tax Revenue (1991); KPMG Peat Marwick (1994); and DeSeve and Vasquez (1977).

[6] A complete explanation of the method and its use in this study is provided in a detailed methodological appendix, available from the author on request.

Table 2
Indicators of Business Tax Competitiveness for Selected Manufacturing Industries (AFTAX), 1993 and 1986

	(1) 5-Industry Average				(2) Men's and Boys' Clothing				(3) Fabricated Metals			
Site	1993	Rank	1986	Rank	1993	Rank	1986	Rank	1993	Rank	1986	Rank
"Empty Site"	18.9	1	16.4	1	18.6	1	15.4	1	19.0	1	17.0	1
El Paso, TX	18.2	2	15.7	2	17.5	2	14.7	2	18.4	2	16.3	2
Hagerstown, MD	17.7	3	15.1	3	16.9	3	14.1	4	18.0	3	15.8	3
Poughkeepsie, NY	17.6	4	15.1	3	16.7	4	14.0	7	17.9	4	15.7	5
Chelmsford, MA	**17.5**	**5**	**15.0**	**8**	**16.6**	**7**	**14.0**	**7**	**17.7**	**5**	**15.6**	**8**
Foxboro, MA	**17.4**	**6**	**15.0**	**8**	**16.5**	**8**	**14.0**	**7**	**17.6**	**6**	**15.6**	**8**
Greenfield, MA	**17.4**	**6**	**15.0**	**8**	**16.5**	**8**	**14.0**	**7**	**17.6**	**6**	**15.6**	**8**
Bedford, MA	**17.3**	**8**	**15.0**	**8**	**16.4**	**12**	**14.0**	**7**	**17.5**	**8**	**15.6**	**8**
Rockford, IL	17.3	9	15.0	8	16.5	8	13.9	13	17.5	8	15.6	8
Memphis, TN	17.3	9	15.1	3	16.7	4	14.1	4	17.4	10	15.7	5
Nashua, NH	**17.2**	**11**	**15.1**	**3**	**16.7**	**4**	**14.2**	**3**	**17.4**	**10**	**15.7**	**5**
Waltham, MA	**17.2**	**11**	**14.9**	**14**	**16.3**	**15**	**13.9**	**13**	**17.4**	**10**	**15.5**	**14**
Los Angeles, CA	17.1	13	14.9	14	16.5	8	13.8	15	17.3	13	15.5	14
Stamford, CT	**17.0**	**14**	**15.0**	**8**	**16.4**	**12**	**14.0**	**7**	**17.2**	**14**	**15.6**	**8**
Greenville, NC	17.0	14	15.1	3	16.4	12	14.1	4	17.2	14	15.8	3
Bala Cynwyd, PA[a]	16.5	16	14.8	16	15.8	16	13.7	16	16.7	16	15.4	16

	(4) Computers				(5) Electronic Components				(6) Scientific Instruments			
Site	1993	Rank	1986	Rank	1993	Rank	1986	Rank	1993	Rank	1986	Rank
"Empty Site"	19.2	1	16.8	1	18.9	1	16.4	1	18.8	1	16.2	1
El Paso, TX	18.5	2	16.1	2	18.4	2	15.8	2	18.0	2	15.5	2
Hagerstown, MD	18.1	3	15.6	3	17.9	3	15.3	3	17.7	3	14.9	3
Poughkeepsie, NY	18.0	4	15.5	5	17.8	4	15.3	3	17.5	4	14.8	5
Chelmsford, MA	**17.9**	**5**	**15.4**	**8**	**17.7**	**5**	**15.1**	**9**	**17.4**	**5**	**14.8**	**5**
Foxboro, MA	**17.8**	**6**	**15.4**	**8**	**17.7**	**5**	**15.1**	**9**	**17.4**	**5**	**14.8**	**5**
Greenfield, MA	**17.8**	**6**	**15.4**	**8**	**17.6**	**7**	**15.1**	**9**	**17.3**	**7**	**14.7**	**11**
Bedford, MA	**17.7**	**8**	**15.4**	**8**	**17.6**	**7**	**15.1**	**9**	**17.2**	**8**	**14.8**	**5**
Rockford, IL	17.6	9	15.4	8	17.6	7	15.2	6	17.2	8	14.7	11
Memphis, TN	17.6	9	15.5	5	17.5	10	15.2	6	17.2	8	14.8	5
Nashua, NH	**17.5**	**12**	**15.5**	**5**	**17.4**	**12**	**15.2**	**6**	**17.1**	**11**	**14.8**	**5**
Waltham, MA	**17.6**	**9**	**15.3**	**14**	**17.5**	**10**	**15.1**	**9**	**17.1**	**11**	**14.7**	**11**
Los Angeles, CA	17.4	13	15.3	14	17.3	13	15.0	15	17.1	11	14.7	11
Stamford, CT	**17.3**	**14**	**15.4**	**8**	**17.2**	**14**	**15.1**	**9**	**16.9**	**14**	**14.7**	**11**
Greenville, NC	17.2	15	15.6	3	17.2	14	15.3	3	16.9	14	14.9	3
Bala Cynwyd, PA[a]	16.8	16	15.2	16	16.8	16	15.0	15	16.5	16	14.6	16

[a]Replaced by Lancaster, PA in the 1993 sample.
Note: See text and detailed technical appendix (available from author on request) for methodological details.
Source: Commonwealth of Massachusetts (1987); and S. H. Brooks Co., Inc. (1993).

tific instruments. With one exception, the sites used in both studies were also identical. Two of the sites outside of Massachusetts were also located in New England states: Stamford, CT and Nashua, NH.[7] The business taxes taken into account in the studies were taxes on profits, capital stock, net worth, and real estate, and unemployment compensation taxes.

One set of indicators of business tax climate generated by both studies is shown in Table 2. The hypothetical firms used in computing this set were prototypical "export-oriented" firms, those that con-

[7] In 1993, Lancaster, PA replaced Bala Cynwyd, PA because in 1993 the latter town was no longer a distinct, taxing jurisdiction.

The hypothetical investment undertaken by each representative firm was assumed to have a 60-year useful lifetime and to earn a pre-tax rate of return on working assets of 25 percent. Working assets consist of land, structures, equipment, cash, and inventories. An inflation rate of 0 percent was assumed. Within an industry,

centrate their facilities in one or two locations and sell most of their goods in either nationwide or international markets. Before expansion, each firm was assumed to produce solely at its home site and to sell 90 percent of its product in other states.

Each row in the table summarizes the results of a set of simulations in which each of the cities was assumed to be considered both a headquarters site and a potential site for expansion. For example, firms headquartered in Rockford, IL, evaluate Nashua, NH as potential expansion site. Then firms headquartered in Stamford, CT; Los Angeles, CA; Poughkeepsie, NY; and each of the other sites (including Nashua) also evaluate Nashua as a potential expansion site. As a result, for each industry-specific firm, 16 after-tax rates of return (AFTAXs) were calculated at each expansion site, one for each possible pre-expansion site. A 16-by-16 matrix of AFTAXs was thereby generated.

Local property taxes vary widely within a state, making it difficult to draw conclusions about a state's overall business tax climate from the tax burden imposed at only one site.

Each entry in sections 2 through 6 of Table 2 represents the mean of the 16 AFTAXs computed at the expansion site for each of the five industry-specific hypothetical firms. For example, in section 2 the 1993 value for "Empty Site" (18.6) is the average of the 16 AFTAXs computed for the hypothetical manufacturer of men's and boys' clothing, assuming that "Empty Site" is the sole expansion site and each of the 16 cities is an alternative headquarters site. The higher the AFTAX, the lower the tax burden on the new facility. Section 1, which provides the average for each site of the five AFTAXs reported in sections 2 though 6, is a summary measure of tax competitiveness.

The AFTAXs for 1993 were all higher than their 1986 counterparts because in 1987 the statutory federal tax rate on corporate income was reduced from 46 percent to 34 percent. In 1993, the dispersion in AFTAX across sites for a given industry was larger than in 1986 because, after the Federal Tax Reform Act of 1986, state and local taxes became a larger component of businesses' total tax liability.[8] At each site in each year, differences across industries in AFTAX reflect primarily differences in labor intensity. For example, the AFTAXs of the representative manufacturer of men's and boys' apparel are low because the industry is relatively labor-intensive. As a result, the firm's unemployment insurance taxes are high, and the benefits of capital-oriented tax incentives, such as investment tax credits, are relatively low.

In 1986, the AFTAXs at the seven New England sites were virtually identical and near the median. In 1993, Chelmsford, MA ranked 5th, Foxboro, MA and Greenfield, MA tied for 6th, Nashua, NH fell into a tie with Waltham, MA for 11th, and Stamford, CT slumped to a tie for 14th, trailed only by Lancaster, PA. Sites whose competitive standing changed markedly between the two years experienced large changes in property tax burden. Property tax burdens in Chelmsford, Foxboro, and Greenfield fell sharply, while those in Stamford and Nashua rose. The competitiveness of the Massachusetts sites also benefited from a tripling of the Commonwealth's investment tax credit in 1993. Even in 1993, however, differences among the New England sites in AFTAX were small.

Criticisms of the Analysis of Tax Competitiveness Performed by the Two Massachusetts Tax Study Commissions

The methodology used to obtain the results displayed in Table 2 is vulnerable to at least three criticisms: 1) the sample is small and biased, 2) important business tax features are not taken into account, and 3) the atypical geographic characteristics of the hypothetical firms trigger burdensome tax rules that do not apply to most businesses.

Small, biased sample. Three New England states—Maine, Rhode Island, and Vermont—are not represented in the sample. Nor are several of New England's other economic rivals, such as Alabama, Florida, Georgia, New Jersey, and South Carolina. Moreover, a majority of the sites in the sample are located in states that impose a relatively high statutory tax rate on corporate income.[9] As a result, the

differences across sites in AFTAX were found to be insensitive to the inflation assumption.

[8] Recall that, by assumption, state and local taxation is the only source of difference across sites in each representative firm's AFTAX.

[9] In 1993, the average marginal statutory corporate income tax

sample allegedly makes the AFTAXs at the three New England sites look higher than they really are relative to those at rival locations.[10]

The representativeness and accuracy of the property taxes modeled in the analysis are also open to question. Local property taxes vary widely within a state, making it difficult to draw conclusions about a state's overall business tax climate from the tax burden imposed at only one site located within its borders.[11] The analysis also assumes that only land and structures are subject to property taxation, even though many states permit their cities and towns to tax personal property, inventories, and even intangible property. As will be shown in the next section, failure to include these types of assets in the general property tax base creates significant measurement error.

Omission of important business taxes. The analysis fails to take into account, among other tax features, differences across sites in license taxes, fees and charges, sales taxes on purchases of intermediate goods, and tax credits designed to subsidize such narrowly defined expenses as training, research and development, pollution control, the provision of day care, and the wages of workers from disadvantaged backgrounds. These features are not taken into account because the data needed to do so are not readily available. Their omission biases the results against states with relatively low sales taxes on purchases of intermediate goods and generous, narrowly defined tax credits.

The potential bias from these omissions is evident from a study conducted in 1994 by KPMG Peat Marwick designed to evaluate the tax competitiveness of 10 states and two Canadian provinces (KPMG Peat Marwick 1994). The study, which used the representative firm approach, took into account sales taxes on business purchases and research and development tax credits. It found that Massachusetts had the second most attractive business tax climate among the 10 U.S. states examined. KPMG Peat Marwick attributed the Commonwealth's competitiveness to the fact that it has "kept all three of the major state-local business taxes—corporate income, property, and sales—in line with competitor states."[12] A similar study conducted by KPMG Peat Marwick for the state of North Carolina (Vlaisavljevich and Pollock 1995), which compared the marginal business tax burdens of 21 states, also found the Massachusetts business tax structure to be relatively attractive.

Atypical geographic allocation of payroll, property, and sales. Corporations with customers in several states typically have facilities located in most of those states, such as branch plants, warehouses, sales offices, and service centers. By contrast, the hypothetical firms used in the analysis locate all of their facilities and employees in one or two states but realize most of their sales elsewhere. In some states, firms with such uncommon geographic characteristics bear unusually heavy tax burdens that are not faced by typical multistate firms. Consequently, these assumed characteristics may bias the results of the analysis.

These special tax burdens arise from certain states' attempts to ensure that most of the nationwide income earned by their multistate corporate taxpayers is taxed by some state. These states identify which of their corporate taxpayers have generated out-of-state income that has escaped taxation by any state. They then determine the reason why this income has escaped taxation. There are two possible reasons. First, the state in which the income was earned does not tax corporate income. (Texas is the only state in the tax study commissions' sample that does not.) Second, the corporation lacks a physical presence within the state. Federal law prohibits a state from taxing the income of a producer or distributor of goods that has no physical presence (facilities or employees) within its territory, even if the firm sells goods to customers located there.[13] For example, Massachusetts may not tax any of the income earned by a manufacturer of scientific instruments that lacks property or employees in the Commonwealth, even if the manufacturer sells millions of dollars' worth of goods

rate for all 50 states and the District of Columbia was 7.09. The average for the 11-state sample was 8.32 (U.S. Advisory Commission on Intergovernmental Relations 1994).

[10] This allegation was made by Michael Widmer, President of the Massachusetts Taxpayers Foundation, in a letter, dated September 8, 1995, to The Honorable James Brett, House Co-Chair of the Joint Committee on Taxation of the Massachusetts legislature.

As noted in Section I, states with high statutory tax rates on corporate income do not necessarily impose high corporate income tax burdens. Many offset their high rates with investment and employment tax credits. Moreover, several states with low corporate income tax rates, or no tax on corporate income, impose alternative business taxes not found in most other states. Two prime examples are Washington's business occupation tax and Texas's net worth tax.

[11] On the other hand, statewide estimates of average business property tax burden are not available for many states.

[12] However, the KPMG Peat Marwick study did not take into account unemployment insurance taxes, which are relatively high in Massachusetts.

[13] U.S. P.L. 86-272. The law does not extend the same protection to providers of services.

The Troublesome Issue of Throwback in Modeling State and Local Corporate Income Taxes

Every state that taxes corporate income uses a formula to determine its fair share of the taxable income of a multistate corporation. In most states, the formula is based on the state's shares of the firm's total payroll, property, and sales. (These three variables are usually referred to as "apportionment factors.") For example, Vermont's formula is

$$\text{Taxable income} = \frac{\dfrac{\text{payroll}_{VT}}{\text{payroll}_{TOTAL}} + \dfrac{\text{property}_{VT}}{\text{property}_{TOTAL}} + \dfrac{\text{sales}_{VT}}{\text{sales}_{TOTAL}}}{3}$$

Massachusetts now double-weights sales in order to lighten the tax on firms that produce most of their goods in-state but sell them elsewhere:

$$\text{Taxable income}_{MA} = \frac{\dfrac{\text{payroll}_{MA}}{\text{payroll}_{TOTAL}} + \dfrac{\text{property}_{MA}}{\text{property}_{TOTAL}} + \dfrac{2 \times \text{sales}_{MA}}{\text{sales}_{TOTAL}}}{4}$$

In 1995 the Commonwealth changed its apportionment formula for manufacturers to one based exclusively on sales. This change is effective immediately for defense contractors and will be phased in over several years for other manufacturers (*General Laws of Massachusetts 1995*, Chapter 281).

As an illustration of Vermont's formula, consider the scenario in which one of the hypothetical firms used in the analysis is headquartered in Vermont and also expands within Vermont. By assumption, 10 percent of the firm's sales and 100 percent of its payroll and property are sited in-state. According to the state's apportionment formula, 0.70 of the firm's total taxable income [(1.0 + 1.0 + 0.10)/3] is taxable in Vermont. The other 0.30 of taxable income is allocated among the states where the firm has customers but no property or payroll. If the firm were based in Massachusetts and expanded within the Commonwealth, then 0.55 [(1.0 + 1.0 + 2 x 0.10)/4] of the firm's income would be taxable by the Commonwealth and 0.45 apportioned to other states.

Under Massachusetts' throwback rule, the firm's sales realized in other states would be sited for tax purposes in the Commonwealth and double-weighted. As a result, throwback would raise the fraction of the firm's nationwide income taxable in Massachusetts from 0.55 to 1.0 [(1.0 + 1.0 + 2 × 1.0)/4 = 1.0]. If, like Vermont, Massachusetts only single-weighted sales, throwback would raise this fraction from 0.70 to 1.0 [(1.0 + 1.0 + 1.0)/3 = 1.0]. Throwback has especially dramatic tax effects in states that both have throwback requirements and weight sales disproportionately. Two states represented in the 1986 and 1993 sample, Massachusetts and Illinois, fit this description.

These examples illustrate how the assumed geographic dispersion of the hypothetical firms' apportionment factors, in combination with throwback requirements, exaggerates differences in business tax burdens among states. Yet, if the hypothetical firms had payroll and property in most or all of the states in which they did business (a more typical pattern), the results of the simulations would be difficult to interpret. The computed AFTAXs would reflect a complicated amalgam of the tax burdens at all the sites where the firm were taxable. The impact of differences across sites in tax burdens would be obscured.

The two Massachusetts tax study commissions resolved this dilemma by assuming in their baseline scenarios that throwback provisions are inoperative in all states. The assumption can be further justified by the relative ease with which many throwback provisions can, and are, avoided. For example, a Massachusetts-based corporation can avoid Massachusetts' throwback rules by billing customers from an office, no matter how small, located in a state that does not practice throwback.[14]

to the Commonwealth's businesses and residents every year.

If any of the corporation's out-of-state income has escaped taxation for lack of a physical presence, some states will tax this income themselves, even though it was earned outside of their territory. For example,

[14] Massachusetts' throwback provisions are easier to avoid than those of other states. In order to avoid other states' throwback rules, a company must *ship* goods from a point located outside of the state to customers located in states where the company has no payroll or property. In Massachusetts, the company need only *bill* sales to such customers from a point located outside the Commonwealth.

consider a Massachusetts-based corporation that ships products from a Massachusetts facility to customers in Connecticut. If Connecticut does not tax the income realized on these sales, Massachusetts will. This practice is known as "throwback" because the income is "thrown back" to and taxed by a state other than the one in which the income is earned.

By assumption, the income earned by the hypothetical firms in the analysis is taxable only at their home and expansion sites. Yet 90 percent of their sales are realized in states where their income is not taxable. Consequently, the firms' corporate income tax burdens are unusually high when they are based or expand in a state that imposes throwback requirements. Five of the 11 states represented in the 1986 and 1993 samples practice some form of throwback.

Thus, the unusual geographic allocation of the hypothetical firms' payroll, property, and sales has significant tax consequences not experienced by the typical firm that vary dramatically across states depending on whether they practice throwback. The resulting biases, and the manner in which the two Massachusetts' Tax Commissions dealt with them, are discussed in the box.

New Results for 1991

Mindful of the criticisms outlined above, the author modified the earlier approach to evaluate the business tax climates of 22 states in 1991. The same five industries examined by the two tax study commissions were used in the analysis. The year 1991 was chosen because the author wanted to investigate the impact of business tax climate on levels of business fixed investment. In order to perform such an analysis, one must control for factors other than taxation that affect the location of business fixed investment, such as wages, energy costs, the quality of public services, and labor productivity. Values for many of these non-tax factors are not available for years later than 1991.

Differences between the 1991 analysis and commission studies. Unlike the studies of the tax reform commissions, the 1991 analysis 1) makes the more realistic assumption that the hypothetical firms have some property and/or employees operating in all the states in which they do business (and, therefore, are not subject to throwback); 2) takes into account differences across states in the general property tax treatment of inventories, machinery and equipment, and intangible property; and 3) compares the marginal tax burdens of states rather than particular cities, in order to provide an indicator of states' "overall" manufacturing tax climate. This statewide focus required a measure of a state's average property tax burden. Details on the differences between the 1991 analysis and the commission studies are provided in Table 3 and in a detailed appendix, available from the author on request.

Criteria used in selecting sample of states. The following partially conflicting criteria were used in determining whether a given state should be included in the sample. 1) Is the state represented in the tax commissions' sample? 2) Is the state in New England? 3) If not in New England, is the state widely considered to be an economic rival of New England states? 4) Can an estimate of statewide property tax burden be obtained from the state's revenue officials or from U.S. Census Bureau data? 5) Is at least one of the five industries analyzed in the tax commissions' studies an important component of its manufacturing sector? and 6) Does the state have a relatively low statutory tax rate on corporate income? (to counter criticism that the commissions' samples were dominated by states with high tax rates).[15]

Results. The industry-specific average AFTAXs for the selected states are presented in Table 4, patterned after Table 2. The AFTAXs for each industry were lower in 1991 than in 1993 primarily because in the 1991 analysis local property tax bases are more broadly defined and all firms are subject to income taxation in every state in which they do business (except Washington or Texas, neither of which taxes corporate income).[16]

According to the 1991 analysis, the five states with the most attractive business tax climate were Alabama, Maryland, South Carolina, Florida, and New York. (As noted above, sites in Maryland and New York, the two also in the "original eleven," had relatively attractive business tax climates in the 1986 and 1993 analyses as well.) Alabama headed the list in part because it is the only state in the sample that allows its corporations to deduct their federal tax

[15] The 11 states included in the sample other than the "original 11" had an average marginal statutory income tax rate of 7.03 in 1983, 0.06 percentage point below the national average. These newly added states included those with some of the lowest statutory corporate income tax rates in the nation.

[16] By contrast, in the 1993 analysis firms are taxable only in states where they have payroll or property, and throwback provisions are assumed to be inoperative. As explained in the box, a significant portion of their income therefore escapes state taxation.

The absence in the 1991 sample of a fictitious firm with no state and local taxes also raised average AFTAXs relative to those computed in the 1993 analysis.

Table 3
Key Differences in Methodology Between Massachusetts Special Commissions' Analyses and 1991 Analysis of Tax Competitiveness

	Massachusetts Special Commissions' Analyses	1991 Analysis
State and local taxes modeled	• State taxes on corporate profits, capital stock, net worth, and gross receipts • State unemployment insurance taxes • State and local taxes on real estate	• State taxes on corporate profits, capital stock, net worth, and gross receipts • State unemployment insurance taxes • State and local taxes on all property, including real estate, inventories, and both tangible and intangible personal property
Measure of property tax burden	Property tax on land and structures as a percentage of value of land and structures of hypothetical firms, as estimated by assessor's office in each city	Property tax collections as a percentage of the fair market value of statewide taxable property, reported by state officials or the U.S. Census Bureau
Percentage of each apportionment factor in home state in pre-expansion phase	• 100 percent of property • 100 percent of payroll • 10 percent of sales	• 90 percent of property • 90 percent of payroll • 10 percent of sales
Treatment of throwback requirements	Assumed to be avoided	Not applicable because hypothetical firms are assumed to be taxable in every state in which they do business

See methodological appendix for further details, available from author on request.

payments from state taxable income.[17] All five states imposed relatively low average property taxes and unemployment insurance taxes. None had separate taxes on net worth, capital stock, or intangible property that applied to the firms.[18] All but New York also had relatively low average corporate income taxes. Although New York's average corporate income tax burden was somewhat high, the state's generous investment tax credit significantly lowered its marginal income tax burden, thereby boosting its AFTAXs.

According to the 1991 analysis, the three states with the least attractive business tax climate were Connecticut, Pennsylvania, and Washington. (Sites in Connecticut and Pennsylvania, also represented in the "original eleven," fared poorly in the 1993 rankings as well.) Connecticut and Pennsylvania had the highest 1991 average income tax burdens among the 22 states. Connecticut also suffered from higher-than-average property taxes, while Pennsylvania's competitive standing was adversely affected by its high unemployment insurance taxes. Washington's lack of tax competitiveness, even though it had no corporate income tax, was attributable to its unique gross receipts tax and high unemployment insurance tax.[19]

Among the New England states, New Hampshire and Massachusetts generally had the highest AFTAXs in 1991, followed, in order of decreasing tax competitiveness, by Maine, Rhode Island, Vermont, and Connecticut. In most industries, Massachusetts and New Hampshire ranked among the top third within the whole sample. As in 1993, Massachusetts' most

[17] Modeling this deduction required the construction of an iterative loop because state income taxes are deductible from federal taxable income. The methodological details are provided in a detailed appendix, available from the author on request.

[18] New York imposes a net worth tax, but corporations pay it as an alternative to the income tax. They pay the net worth tax if their net worth tax liability exceeds their income tax liability.

[19] For manufacturing firms based in Washington, the base of this tax consists of the firm's gross receipts from the sale of all products wherever sold. In the analysis, hypothetical firms based in Washington therefore pay tax on 100 percent of their gross receipts, including those from the sale of products manufactured at the expansion site. Firms based in another state pay the tax on gross receipts earned from sales to customers located in Washington (*Laws of Washington*, Section 82.04).

Table 4

Indicators of Business Tax Competitiveness for Selected Manufacturing Industries (AFTAX), 1991

	(1)		(2)		(3)		(4)		(5)		(6)	
State	5-Industry Average	Rank	Men's and Boys' Clothing	Rank	Fabricated Metals	Rank	Computers	Rank	Electronic Components	Rank	Scientific Instruments	Rank
AL	**16.0**	**1**	**15.5**	**1**	**16.0**	**1**	**16.1**	**1**	**16.1**	**1**	**16.0**	**1**
MD	15.7	2	15.4	2	15.7	2	15.7	2	15.7	2	15.7	2
SC	**15.5**	**3**	**15.3**	**3**	**15.6**	**3**	**15.5**	**5**	**15.7**	**2**	**15.6**	**3**
FL	**15.5**	**3**	**15.2**	**4**	**15.6**	**3**	**15.6**	**3**	**15.7**	**2**	**15.6**	**3**
NY	15.4	5	15.0	5	15.5	5	15.6	3	15.6	5	15.4	5
IL	15.3	6	14.9	7	15.4	6	15.4	6	15.5	6	15.3	6
NH	15.3	6	15.0	5	15.3	7	15.3	7	15.4	8	15.3	6
TN	15.3	6	14.9	7	15.3	7	15.2	9	15.5	6	15.3	6
MA	15.2	9	14.8	10	15.3	7	15.3	7	15.4	8	15.3	6
TX	15.2	9	14.6	13	15.2	10	15.2	9	15.4	8	15.3	6
ME	**15.1**	**11**	**14.9**	**7**	**15.2**	**10**	**15.1**	**12**	**15.3**	**11**	**15.2**	**11**
RI	**15.1**	**11**	**14.5**	**16**	**15.2**	**10**	**15.2**	**9**	**15.3**	**11**	**15.1**	**13**
GA	**15.0**	**13**	**14.6**	**13**	**15.1**	**13**	**15.1**	**12**	**15.2**	**15**	**15.2**	**11**
NC	15.0	13	14.6	13	15.1	13	15.1	12	15.2	15	15.1	13
CA	15.0	13	14.7	11	15.0	17	15.0	18	15.2	15	15.1	13
NJ	**15.0**	**13**	**14.3**	**18**	**15.1**	**13**	**15.1**	**12**	**15.3**	**11**	**15.1**	**13**
WI	**15.0**	**13**	**14.3**	**18**	**15.1**	**13**	**15.1**	**12**	**15.3**	**11**	**15.0**	**18**
VT	**14.9**	**18**	**14.7**	**11**	**15.0**	**17**	**14.9**	**19**	**15.1**	**19**	**15.0**	**18**
OH	**14.9**	**18**	**14.3**	**18**	**15.0**	**17**	**15.1**	**12**	**15.1**	**19**	**15.0**	**18**
WA	**14.8**	**20**	**14.0**	**22**	**14.7**	**20**	**14.9**	**19**	**15.2**	**15**	**15.1**	**13**
PA	14.6	21	14.2	21	14.7	20	14.7	21	14.9	21	14.7	21
CT	14.5	22	14.5	16	14.5	22	14.5	22	14.7	22	14.6	22

Note: States in bold were not in the original 1986 and 1993 sample. See text and detailed technical appendix (available from author on request) for methodological details.

competitive tax characteristics were its low property taxes and investment tax credit. New Hampshire's competitive edge could be traced to its low unemployment insurance taxes. High property tax burdens tarnished the competitive standing of Maine and Vermont.[20]

Among the original 11 states, Texas exhibited the greatest difference in rank between 1993 and 1991. While the state ranked first in 1993, it tied for 6th place with Massachusetts in 1991. Among the full 22-state sample for 1991, it ranked only slightly above the median in most industries and tied for 9th place with Massachusetts in the overall rankings. The analysis for 1993 (as well as that for 1986) exaggerated Texas' tax competitiveness by assuming away the taxation of inventories and machinery and equipment under general property tax regimes. Texas cities and towns generally subject both categories of assets to general property taxation.[21]

AFTAX rankings could have changed again since 1993, because a wide variety of extensive business tax reductions have been enacted both within New England and throughout the country. For example, within New England, Connecticut is gradually reduc-

[20] In the 1993 analysis, Massachusetts generally ranked higher than New Hampshire because it offered a 3 percent investment tax credit. In 1991, the Commonwealth's investment tax credit was only 1 percent. Connecticut's competitive standing was especially depressed in 1991 because it imposed a surtax on corporate income. The surtax raised the corporate income tax rate from 11.5 percent to 13.8 percent, by far the highest in the nation.

[21] The assumption that inventories are exempt from general property taxation is accurate for firms located in El Paso, but not for Texas manufacturers as a whole. Many of El Paso's manufacturers have "sister" plants in Mexico, known as "macquiladoras," that assemble products for them. The products are then shipped to El Paso facilities, stored there for less than 175 days, and then shipped to other states and abroad. Texas' "free port" exemption applies to inventories shipped to Texas from another location and staying in Texas for such a short period of time.

ing its statutory corporate income tax rate to 7.5 percent by the year 2000. Massachusetts' unemployment insurance taxes rose sharply after 1991, but the Commonwealth has recently adopted an apportionment formula for manufacturers that will reduce corporate income taxes for companies that sell most of their output out-of-state.[22] Maine has enacted a generous jobs tax credit for large firms. Furthermore, it is increasingly difficult to compute a single, state-specific AFTAX for a given industry because more and more states are granting large tax incentives to specific firms in order to induce them to locate within their borders.

III. Does Business Tax Climate Affect Levels of Capital Spending?

Empirical evidence bearing on this issue is inconclusive. The vast bulk of studies conducted between 1950 and 1980 examining the impact of interstate tax differences on economic performance detected little or no effect. The results of more recent studies have been mixed; while some have found the impact of tax differences to be insignificant, others have found their impact to be substantial. Some follow-up studies, reestimating models used in earlier analyses with more recent data, have produced results that contradict previous findings (for example, see Carroll and Wasylenko 1994).

Papke's Estimates

Only one economist, Leslie Papke (1991), has evaluated the impact of business tax climate on capital spending using measures of tax climate derived from the representative firm approach.[23] Papke used the approach to evaluate the business tax climates of 20 states for 10 industries in 1978, creating 200 state/industry observations.[24] From the assumption that a firm's sole goal is to maximize profits, she derived and estimated the following linear model of a firm's level of capital spending:

$$NK_{ij} = B_0 + B_1 LPROD_{ij} + B_2 AFTAX_{ij} + B_3 AVGWG_{ij} + B_4 ECOST_j + B_5 FIREPC_j + \Sigma B_i D_i + E_{ij}$$

where:

NK = new capital expenditures per production worker[25]
LPROD = average productivity of labor
AFTAX = the after-tax rate of return to marginal investment, as estimated by the AFTAX approach
AVGWG= average wage of production workers
ECOST = statewide average cost of a million BTUs of fossil fuels and electric energy[26]
FIREPC = statewide average per capita expenditures on fire and police protection at the local level[26]
D = industry dummy variable
i = ith industry
j = jth state
E = error term

Labor productivity was included as an explanatory variable in part to control for differences across industries in technological processes. Spending on fire and police protection is a proxy for the quality of public services of most concern to businesses. One would expect the coefficient on both of these variables to be positive.[27] Since energy is usually complementary to capital in production, one would expect the coefficient on energy costs to be negative. Since AFTAX is inversely related to tax burden, one would expect the coefficient on this variable to be positive.

The expected sign of the coefficient on the wage variable is ambiguous. On the one hand, high wages might deter businesses from building a new plant, depressing both employment and capital spending.

[22] Specifically, Massachusetts adopted single-factor apportionment based on sales for manufacturers.

[23] The author (Tannenwald 1995) presented preliminary results of the analysis reported in this article at the Eighty-Seventh Annual Meetings of the National Tax Association in Charleston, South Carolina in November 1994. In those preliminary results, only the original 11 states were used, observations from both 1986 and 1991 were pooled, each state's tax characteristics other than property taxes were assumed to be the same in 1991 as in 1993, assumptions about the allocation of apportionment factors were identical to those used in the commissions' studies, and no attempt was made to model the general property taxation of inventories, machinery and equipment, and intangibles. In that analysis the author found very large, positive, statistically significant coefficients on AFTAX.

[24] L. Papke (1991) also used the representative firm approach to estimate the impact of interstate differences in marginal business tax burdens on interstate differences in the rate of business formation.

[25] Capital expenditures are divided by the number of production workers in order to scale for the size of the industry in the state. As Papke points out, this variable should not be interpreted as an indicator of the industry/state's capital intensity. Such a measure would have capital stock, not capital spending, in the numerator.

[26] Only statewide values, not industry-specific values, exist for these variables.

[27] Indeed, one would expect an estimate of the relationship between the dependent variable, capital spending per production worker, and labor productivity, defined as value added per production worker, to be simultaneously determined.

On the other hand, high wages should induce the substitution of capital for labor.[28]

Papke estimated her model in both linear and log-log form.[29] When the model is estimated in log-log form, the coefficients can be interpreted as elasticities. Elasticities indicate the percentage change in one variable that results from a 1 percent change in another variable, other things equal. Thus, the coefficient on AFTAX indicates the percentage change in capital spending per worker that would result from a 1 percent change in AFTAX, controlling for the impact of other explanatory variables.

Papke's log-log results are shown in column 5 of Table 5. The AFTAX coefficient is positive and statistically significant. It implies that a 1 percent increase in AFTAX results in approximately a 1.8 percent increase in capital spending per capita. This tax variable had by far the largest coefficient of any of her explanatory variables. She also found, as expected, positive, statistically significant coefficients on labor productivity and on outlays for fire and police protection. The coefficient on the average wage variable was negative (although statistically insignificant), suggesting that high wages at a location deter expansion. The coefficient on energy costs was virtually zero, suggesting that interstate differences in energy costs had no impact on differences in levels of capital spending in 1978.

Reestimation of Papke's Model Using 1991 Sample

The author reestimated Papke's model using the AFTAX estimates from the 22-state sample and 1991 data on nontax variables. The data used in the reestimation are more current than Papke's. However, the sample is smaller because it includes fewer industries. The only departure from her model was the definition of energy cost. Papke used average cost per million BTUs of fossil fuels and electric energy for both residences and businesses. This measure was replaced by average cost per million BTUs from all forms of fuel for the industrial sector only. This was considered to be a more appropriate measure since the sample is limited to firms representative of manufacturing industries. The model was also estimated using an energy cost measure almost identical to Papke's.[30]

The results of the reestimations are presented in Columns 1 and 2 of Table 5. Like Papke's, they show a positive tax effect, but smaller and not statistically significant. The estimated elasticities of capital spending with respect to AFTAX are 0.36 and 0.72, depending on which measure of energy cost is used, between 20 percent and 40 percent of Papke's 1.8.

The elasticity with respect to the average wage variable is very close to zero, much smaller than Papke's estimate and statistically insignificant. The elasticities with respect to labor productivity and spending on police and fire protection, approximately 1.1 and 0.6, respectively, are much larger than Papke's and statistically significant. The latter estimate suggests that, in choosing where to expand, businesses care about the level of certain public services. The estimated elasticity with respect to public service levels is roughly the same size as the estimated AFTAX elasticities, but statistically significant. Finally, unlike Papke's finding, the elasticity with respect to energy costs is large, negative, and statistically significant.

This study finds that business tax climate exerts only a small, highly uncertain effect on capital spending.

Accounting for Differences between the 1991 Results and Papke's 1978 Results

The 1991 results might be different because they are based on a model that takes into account a wider array of business taxes and assumes a more realistic geographic allocation of apportionment factors.[31] Furthermore, unlike the two Massachusetts tax study commissions, Papke assumes that throwback is oper-

[28] One would also expect an upward simultaneity bias, in that capital spending per capita raises worker productivity, which in turn raises their wages.

[29] A log-log form suggests that the relationship between capital spending per production worker and its determinants is multiplicative.

[30] This measure was the average cost per million BTUs from all forms of fuel for both residences and businesses, not from just electricity and fossil fuels.

[31] Papke's AFTAX estimates do not take into account unemployment insurance taxes. Furthermore, she assumes, as did the two Massachusetts tax commissions, that all representative firms confine their payroll and property to either their home or expansion site, even though they sell most of their output at other sites throughout the nation.

Table 5

Estimates of Log-Log Equations Explaining Capital Spending Per Production Worker, 1991

Explanatory Variable	(1)	(2)	(3)	(4)	Papke's 1978 Results (5)
Average wage ln (AVGWG)	.030 (.142)	−.018 (.132)	.084 (.148)	.046 (.139)	−.203 (.335)
Energy cost—industrial sector ln(ECOSTIND)	—	−.758 (.263)**	—	−.561 (.317)*	−.001 (.143)
Energy cost—statewide ln(ENRGY4)	−1.152 (.393)***	—	−.791 (.480)	—	—
Police and fire spending per capita ln(POLFIRE)	.647 (.221)***	.552 (.218)**	.677 (.220)***	.632 (.214)***	.208 (.096)**
Labor productivity ln(LPROD)	1.093 (.149)***	1.122 (.150)***	1.179 (.140)***	1.204 (.138)***	.566 (.126)***
Index of change in number of production workers from 1987 to 1991[a] ln(PWINDEX)	—	—	.341 (.278)	.318 (.273)	—
AFTAX ln(AFTAX)	.355 (1.828)	.723 (1.771)	1.124 (1.727)	1.352 (1.669)	1.831 (.843)**
Industry dummy SIC 232	−1.013 (.201)***	−.994 (.204)***	−.846 (.196)***	−.820 (.184)***	N/R
Industry dummy SIC 342	−.187 (.150)	−.166 (.150)	−.230 (.146)	−.208 (.147)	N/R
Industry dummy SIC 357	−.112 (.204)	−.118 (.208)	−.173 (.200)	−.180 (.205)	N/R
Industry dummy SIC 367	.585 (.138)***	.594 (.132)***	.513 (.129)***	.527 (.126)***	N/R
Constant	−4.996 (5.198)	−6.586 (4.979)	−9.845 (5.291)*	−10.830 (4.830)**	−4.760 (2.224)**
R-Squared	87.8%	88.0%	88.7%	88.9%	N/R
Number of observations	65	65	63	63	200

[a] This index was constructed by setting the index equal to 100 for the number of production workers in 1987. Thus an index value of 90 would indicate that employment declined by 10 percent between 1987 and 1991.

Note: Numbers in parentheses are heteroskedastic-consistent standard errors (White 1984). N/R: Not reported.

*Significant at the .01 level, two-tail test.

**Significant at the 0.05 level, two-tail test.

***Significant at the 0.005 level, two-tail test.

Source: U.S. Bureau of the Census, *Annual Survey of Manufactures, 1991*; U.S. Bureau of the Census, *Census of Manufactures, 1987*; U.S. Bureau of the Census, *Government Finances, 1985–86* and *1990–91*; unpublished data from various state tax equalization boards; Commonwealth of Massachusetts (1987); S. H. Brooks Co., Inc. (1993); and L. Papke (1991).

ative. This assumption significantly affects her AFTAX estimates.

The discrepancy in results of the two studies may also be partially attributable to the difference in the general condition of the national economy between 1978 and 1991 and the mix of states and industries represented in each sample. Both sets of results may also be biased by a failure to control for differences in economic conditions across states and industries.

The general condition of the national economy. While the national economy was expanding in 1978, it

was contracting in 1991. Capital spending per production worker may be more sensitive to marginal business tax burdens during economic expansions than during recessions. In recessions, business income is depressed, reducing or eliminating many firms' liability for profits taxes. The types of investment projects most likely to be undertaken during a recession may be less influenced by interstate tax differences than those most likely to be undertaken during an expansion.[32]

Mix of industries. Papke used a broader array of industries than those represented in the 1991 sample, as well as a lower level of disaggregation. The industries represented in her sample but absent from the 1991 sample may be more footloose and, therefore, more sensitive to interstate differences in tax burdens.[33]

Mix of states. So many differences across states may affect interstate variation in levels of capital spending per production worker that it is difficult to control for all of them. Consequently, Papke's results may diverge from those obtained from the 1991 sample because she examined a different set of states.[34]

Failure to control for differences in business conditions across states and industries. Since the severity of a recession varies by state and industry, so does the magnitude of cuts in employment. However, there might be much less interstate and interindustry variation in the severity of reductions in capital spending because depreciated plant and equipment require continual maintenance and renovation. Consequently, in 1991 the relative severity of the economic contraction experienced by a state or industry may have influenced its capital spending per worker. Failure to control for interstate and interindustry differences in general business conditions might therefore have biased estimates of the AFTAX coefficients.

In order to control for this possible bias, the author included a measure of employment growth between 1987 and 1991 (PWINDEX) as an additional explanatory variable and reestimated the model (Table 5, columns 3 and 4). The reestimated AFTAX elasticities, although larger and more precise than those reported in columns 1 and 2, are still statistically insignificant.

IV. Conclusion

This study of the impact of state and local tax burden on business's capital spending in 1991 found a small effect that was statistically insignificant. This finding buttresses existing empirical evidence that the effectiveness of state and local tax policy as an instrument of economic development is uncertain. While tax characteristics may affect a state's competitiveness, policymakers should view with caution claims that changes in tax policy will dramatically improve their state's economy. Enhancing public services valued by firms may be a more effective economic development strategy.

Regardless of their views on the extent to which state and local taxes "matter," policymakers need better indicators of their state's tax competitiveness. Too often, the measures used, although simple to calculate, are inaccurate. The indicator developed and reported in this article, although difficult to compute, provides a more accurate, comprehensive evaluation of a jurisdiction's tax climate from the perspective of a rational, well-informed, profit-maximizing business executive.

Many states with a relatively attractive business tax climate according to this measure rate poorly according to those indicators most frequently cited in public debate. In New England, the most dramatic example is Massachusetts, still called "Taxachusetts" by many observers. The analysis presented in this article affirms the conclusion of tax reform commissions that have evaluated the Commonwealth's tax competitiveness in recent years: Taxachusetts is a vestigial nickname that does the Commonwealth an injustice.

[32] Cooper and Haltiwanger (1993) argue that, during recessions, businesses tend to undertake acutely needed "retooling" of obsolete facilities because factor productivity is low and, therefore, the opportunity costs of reducing production during renovation and modernization are thereby minimized. These investment projects may be less influenced by tax considerations because their profitability is relatively clear-cut.

[33] Evidence presented by L. Papke (1987) casts doubt on this hypothesis. She estimated separate AFTAX elasticities for the industries represented in her sample. Four of these industries—apparel (SIC23), computers (SIC357), electronic components and accessories (SIC367), and instruments of measurement and control (SIC382) are similar or identical to those represented in the 1991 sample. In Papke's sample the AFTAX elasticities of these four industries ranked 1st, 17th, 10th, and 3rd, respectively.

[34] In fact, when the states represented in the 1991 sample are limited to those also represented in Papke's, the estimated AFTAX elasticity rises to 1.0 or 1.3, depending on the measure of energy cost used. However, in both cases, the standard error is more than three times the estimate. Ideally, the difference between the two studies in the representation of each state in the sample should also be taken into account. Papke weighted each state equally. The 1991 sample weights some states more than others. However, since some states in the 1991 sample have only one observation, equal weighting would reduce the sample size to 22, the number of states. With so few degrees of freedom, estimated elasticities would be prohibitively imprecise.

Vigorous interstate tax competition will probably continue into the foreseeable future. The analysis presented in this article suggests that other competitive tactics may be more effective and highlights the need for further research into the measurement and economic significance of tax competitiveness.

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CEO Incentive Contracts, Monitoring Costs, and Corporate Performance

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The after-tax real wage of the average worker in the United States has fallen 13 percent in the last 20 years, while the average chief executive officer (CEO) has received a pay raise of over 300 percent.[1] This glaring contrast has sparked a flood of papers analyzing CEO compensation contracts. One of the main justifications for the extraordinary pay of top CEOs is that they receive performance-based contracts. In theory, having CEO pay depend on the performance of the firm is the optimal solution to the moral hazard problem that exists because shareholders do not observe the actions of the CEO. Because the shareholders have less information than the CEO about the actions of the CEO and how they affect the health of the firm, the CEO takes actions in his or her own best interests, which do not necessarily coincide with the best interests of shareholders. Designing compensation contracts that link CEO compensation to the performance of the firm is one way to get around this difficulty. The empirical literature, however, has found little evidence that CEO contracts provide such incentives. The compensation of CEOs appears to respond very little to the performance of their firms.

This article addresses three reasons why the previous literature may have been underestimating the response of compensation to firm performance. First, only firms where monitoring the CEO is costly should have CEO compensation that is performance-sensitive. Restricting the sample to these firms yields a 67 percent increase in the performance sensitivity of compensation contracts. Second, the parameter that measures the performance sensitivity of CEO pay is negatively correlated to performance, causing it to be underestimated in standard regressions. Finally, econometricians do not observe exactly what compensation boards use as performance measures. This mismeasurement causes estimates of the effect of corporate performance on compensation to be too low. Correcting this error shows that the elasticity of CEO pay with respect to firm performance is 10 times higher than previously believed.

I. Theory and the Empirical Literature

The information asymmetry that exists between the shareholders and the chief executive officer of a firm is generally considered to be a classic example of a principal–agent problem. In the basic principal–agent model, the agent (the CEO) is working on behalf of the principal (the shareholders), who does not observe the actions of the agent. The compensation contract is chosen to elicit the actions by the agent that maximize the principal's utility, subject to two constraints: individual rationality (the CEO would rather take the job than not) and incentive compatibility (the action that maximizes the agent's utility also maximizes the principal's utility). Because of information constraints, the first-best solution cannot be obtained. The second-best solution is analyzed here.

The solution has two parts. First, the principal specifies a contract relating levels of compensation to various outcomes. Then, the agent chooses an action. The shareholders choose a contract, such that the action that is optimal to the CEO will also minimize the net cost of compensation. Payroll costs rise with the degree to which corporate performance affects CEO pay in the contract, because a risk-averse CEO will only accept an increase in risk if expected compensation increases. Expected performance should also increase. The solution occurs when incremental corporate performance balances the cost of higher average compensation.

In theory, having CEO pay depend on the performance of the firm is the optimal solution to the moral hazard problem that exists because shareholders do not observe the actions of the CEO.

Early empirical attempts to estimate the relationship between firm performance and CEO compensation were based on cross-sectional analyses that suffered from a serious omitted variables bias because of an inability to control for individual firm effects. In the past decade, however, a number of studies have documented a significant positive effect of corporate performance on CEO compensation, using panel data. Coughlan and Schmidt (1985), Kostiuk (1986), Murphy (1985, 1986), and Deckop (1988) find a significant response to sales, profits, stock prices, or rate of return. Antle and Smith (1986) and Gibbons and Murphy (1990) find a significant response of the real rate of return even when controlling for industry measures of success, and Gilson and Vetsuypens (1993) document sensitivity when looking specifically at firms in financial distress.

The most comprehensive study is that of Jensen and Murphy (1990). They look at a wide variety of compensation measures and control for the probability of dismissal and still show that CEO wealth increases only $3.25 for every $1,000 increase in shareholder wealth. When looking only at salary and bonuses, a $1,000 increase in shareholder wealth yields only an extra 2 cents for the CEO. They compare the pay variability of CEOs with that of randomly chosen non-CEO workers and conclude that CEO compensation is not significantly more variable. While CEO compensation is statistically sensitive to measures of firm performance, the implied correlation is surprisingly small.

Jensen and Murphy suggest political forces are driving the small estimates they find. They argue that since managerial contracts are public information, they are subject to the scrutiny of employees, labor unions, consumer groups, the Congress, and the media. The press is filled with stories about executive compensation each spring (during proxy season), and lawsuits are filed against board members. Jensen and Murphy conclude that "it is natural that well-intentioned but risk-averse board members will resist innovative incentive contracts" (1990, p. 254). To support their hypothesis, they use two pieces of evidence. First, pay-performance sensitivity was higher in the 1930s when regulatory pressure was less in evidence. Second, large visible firms have a lower pay-performance sensitivity. These facts are suggestive but hardly conclusive, and they do not explain why boards would be so easily swayed to act unprofitably.

Another possible explanation for the small performance-sensitivity estimates that previous authors have found is that the asymmetry of information between the shareholder and the CEO is not as large as assumed. Lazear (1986) shows that contingent, performance-based managerial compensation contracts are optimal only when the cost of direct moni-

[1] Crystal (1991, p. 27). Using the sample and measure of compensation used in this paper, real CEO compensation has gone up 91 percent.

toring of the agent's actions is prohibitive. When a comparatively inexpensive monitoring system is available, both CEOs and shareholders benefit from more traditional compensation systems. The ease with which stockholders monitor is related to ownership structure. When stockholders are relatively dispersed, an individual holder has neither the incentive nor the power to influence the CEO's actions. The social benefit to monitoring the CEO is much higher than the private benefit. On the other hand, when a few dominant shareholders control the company, the return to monitoring is greatly increased. If this is the case, CEO contracts should be less sensitive to performance when the ownership of the corporation is very concentrated. Monitoring and incentive contracts are substitute methods for influencing the actions of the agent.

A number of studies have documented a significant positive effect of corporate performance on CEO compensation.

Douglas and Santerre (1990), Arnould (1985), and Dyl (1988) have found an inverse relationship between the effect of shareholder concentration and CEO compensation. Because the overall cost of a compensation contract must increase with increased performance sensitivity and, thus, risk to the CEO, these results are consistent with the hypothesis that increased monitoring in highly concentrated firms leads to less sensitivity in the compensation contract.[2]

None of the above studies looks directly at the degree of performance sensitivity in CEO compensation contracts across groups with different monitoring costs. However, Kaplan (1992) investigates the sensitivity of Japanese CEO contracts relative to U.S. contracts. The Japanese corporate governance structure is generally believed to include much more direct monitoring by banks and other major shareholders. Japanese firms should therefore be less subject to the information asymmetry of the principal–agent problem, and CEO contracts should thus be less sensitive to measures of performance. Kaplan finds no significant difference between the degree of sensitivity in U.S. and Japanese compensation systems. He concludes, however, not that monitoring is an unimportant aspect of the principal–agent setup, but that the Japanese and U.S. corporate governance systems are not so different after all. Kaplan exploits neither the exogenous splitting of Japanese firms into high versus low monitoring-cost groups due to the *keiretsu* system nor the recent liberalization in Japan's corporate governance system, which may provide a natural experiment.

This article explores another way to distinguish groups with differing monitoring costs, by comparing the performance sensitivity of firms with concentrated ownership structures to that of firms with more dispersed ownership structures. The results show that they differ significantly. This evidence raises concerns that previous studies found little sensitivity because their samples included firms where a basic assumption of agency theory may have been violated.

The evidence that different groups use incentive-based compensation systems to varying degrees brings up another problematic issue. Some firms are more likely to use performance-sensitive compensation systems than others. The parameter that measures the effect of performance on compensation may also vary across time as a result of trends in compensation or the regulatory environment. As long as contract differences are unrelated to firm performance, ordinary least squares results can be used to find the average sensitivity of firms. If the heterogeneity is systematic, however, modeling the incentive parameter is necessary. This issue is taken up in Section IV.

Another potential problem with the previous empirical literature is that the performance regressor may not fit the requirements of ordinary least squares (OLS) regression. The performance measures used in this paper and others are not necessarily the same as those used by compensation committees. Econometricians can guess at the definitions used, but they will always be measuring performance with error. The solution to this problem is an instrumental variables approach.

[2] Other studies look at growth rates of firms to infer information about the ease of monitoring. They suggest that managers in high-growth firms are more likely to have inside information because high-growth firms are characterized by new products, which may have long development cycles. Bizjak, Brickley, and Coles (1993) use this assumption to look at incentive compensation and investment behavior. Kole (1991), Clinch (1991), and Gaver and Gaver (1993) look at whether firms have incentive plans, and their results are consistent with the theory that high-growth firms are more likely to have incentive contracts because they are more difficult to monitor. High-growth firms are not a very clean indicator of monitoring costs, however, because these firms may differ in many ways from other firms. For instance, firms with innovative approaches may be characterized by both high growth and incentive-based contracts without the two necessarily being linked.

This paper uses information from the input-output table of the U.S. manufacturing sector to create demand-shift instruments for 52 CEOs in the sample. The consistent estimates yield interesting results. Exogenous demand shocks cause movements in current performance measures that identify performance-sensitivity estimates 10 times as large as the OLS estimates.

The next section explains the data to be used. Section III investigates the role of monitoring costs. Section IV examines the heterogeneity in the sensitivity parameter. Measurement error of the performance variable is handled in Section V. Some brief conclusions are drawn in the final section.

II. The Data

The basic data set is an unbalanced panel that combines compensation and performance measures from two sources. The compensation data were gathered from the annual *Forbes* magazine CEO salary lists. The data comprise roughly 400 CEOs each year for the period 1972 to 1989. The variables include salaries and bonuses, deferred compensation earned for a given fiscal year but paid out later, and director's fees. SIC codes and the name of the CEO were also obtained from this source. For the 1980–89 period, information is also available on stock awards, fringe benefits, accruals to pensions, and the value of cash or stock of exercised options. However, the second group of variables does not capture the ex ante value of stock options and therefore is not accurately measuring compensation. Only the first group of variables is used in this study. In the first part of the study, whether the CEO is a major shareholder is considered part of the monitoring costs classification, so that CEO holdings are not ignored. In the second part, not enough observations are present to restrict the analysis to only the 1980–89 period. For this reason, even if the second group of variables were accurate, it would be unusable.

This study compares the performance sensitivity of firms with concentrated ownership structures to that of firms with more dispersed ownership structures and finds that they differ significantly.

The data on firm performance are taken from Compustat for fiscal years 1971 to 1989, based on the 1991 industrial and historical research files. The Compustat data were matched with the *Forbes* data by company name and any uncertainties were double-checked in Moody's Industrial and Financial News Reports. For companies with name changes, a complete history was documented to see if *Forbes* information was consistent with data from Compustat. The performance variables in this paper are total shareholder return, sales, and the stock price. Total shareholder return is a market measure, the annual return per share of common stock. The numerator is dividends and capital gains and the denominator is the previous year's closing price. Sales are taken directly from Compustat and the stock price is the closing price. These values have all been adjusted to reflect stock splits and stock dividends during the year.

The data on shareholder concentration and CEO share holdings were taken from the Corporate Data Exchange (CDE). The CDE publishes stock ownership directories that include shareholder concentration at the 5, 10, 15, and 20 shareholder levels. In addition, the CDE Stock Ownership Directory also includes the names of all the major shareholders of the companies it profiles. These were matched with the names of the CEOs from the *Forbes* data. The CDE publishes directories on the *Fortune 500* companies as well as the transportation, banking and finance, energy, and agribusiness industries.

III. Ownership Concentration

If monitoring costs are low, both the principal and the agent prefer a contract that is not contingent on performance. This section explores whether the contingency of the contract varies across groups with different monitoring costs. When shareholders are relatively dispersed, monitoring of the CEO is more costly to individual shareholders. Firms with low shareholder concentration are defined as those where the share of the stock held by the top five shareholders is below the five-shareholder concentration level for the median firm. A family complex—defined as all known family members and family-controlled trusts, foundations, and corporations—is classified as a single holder. While this classification can identify firms

Table 1
Summary Statistics by Monitoring Class

	Mean	Standard Deviation	Number of Observations
Total Sample			
Salary and Bonus ($)	517,500	406,208	11,430
Shareholder Return (%)	9.98	35.8	10,933
Assets ($)	1,189,888	2,199,729	9,195
CEO Tenure (years)	8.1	7.2	12,471
Low Shareholder Concentrations			
Salary and Bonus ($)	605,897	304,028	3,001
Shareholder Return (%)	9.31	31.9	3,040
Assets ($)	1,945,671	2,597,699	2,296
CEO Tenure (years)	6.8	5.6	3,298
CEO Not a Shareholder			
Salary and Bonus ($)	617,654	324,266	1,525
Shareholder Return (%)	9.33	30.6	1,531
Assets ($)	2,063,116	2,655,897	1,156
CEO Tenure (years)	6.7	4.6	1,588

with dispersed shareholders, CEOs may still be major shareholders in these firms. For example, in 1980 the top five shareholders of Teledyne held only 16.2 percent of the stock, making it a relatively unconcentrated ownership structure. Forty percent of that, however, was held by the CEO. Teledyne suffered less, therefore, from an informational asymmetry between its top five shareholders and its CEO. To take care of these cases, only firms that have both low shareholder concentration *and* a CEO who is not a major stockholder are classified as high-monitoring-cost firms.

Some summary statistics about the various sample groups are given in Table 1. Firms with high monitoring costs appear to be somewhat larger than other firms and pay their CEOs more. This is not particularly surprising, since firms where it is easy for the owners to monitor the management tend to be small, family-held firms. High-monitoring-cost firms also have slightly lower performance as measured by total shareholder return. The relative number of observations between the high-monitoring-cost firms and the total sample do not indicate the share of all firms that have high monitoring costs, because information on both shareholder concentration and CEO shares were available for only one-third of the entire sample.[3]

The specification of the compensation equation used in this section is similar to that used by others.[4]

$$\Delta C_{it} = \beta TSR_{it} + \eta_{it} \qquad (1)$$

ΔC is the first difference of compensation and TSR is real total shareholder return. Compensation is first-differenced because its level is non-stationary, but the same is not true of shareholder return. By its very nature, shareholder return is not in levels. Equation (1) is similar to a regression of compensation on shareholder wealth that has been differenced. First-differencing is one way to deal with the omitted variables that differ across CEO and firm but do not vary across time.[5] Since this equation is not technically completely first-differenced, it was also run including a dummy variable for each CEO, and the hypothesis that the intercept is the same for all cross-sectional units was not rejected.[6] Year dummies were included in all the regressions to control for business cycle effects and stock price movements that are common to all firms.[7]

The results from equation (1) are given in Table 2. The first column shows that compensation is significantly positively related to total shareholder return. When the total shareholder return is 10 percent, a CEO receives on average $8,300 more per year. The significant intercept in this regression indicates that a firm with a zero return would increase the pay of its CEO by $24,700, while a firm with a 10 percent return would increase the pay of its CEO by $33,000. For the CEO with the mean compensation, this amounts to a 4.7 percent real increase in pay as opposed to a 6.4 percent increase: a difference of 1.7 percentage points. These magnitudes are similar to those found by previous authors.

The first column of Table 2, however, includes firms where monitoring costs may be very low and performance-sensitive contracts may be unnecessary.

[3] Since shareholder concentration is defined as being below the median, 50 percent of the firms with shareholder concentration data are low-concentration firms. Of the firms that have available shareholder data in the CDE, 48 percent of their CEOs were not shareholders.

[4] Murphy (1986) and Abowd (1990) are two examples.

[5] Another reason to control for fixed effects is because in levels the relationship may merely be capturing the fact that some firms attract higher-quality CEOs than others and they are paid what they are worth. Since this ability to attract high-quality CEOs presumably does not change over time, it is a fixed effect for each firm and first-differencing takes care of it.

[6] Regressing the level of compensation on total shareholder return as well as CEO and year dummies did not qualitatively alter the basic results, either.

[7] The fact that they are significant indicates that CEOs are being compensated to some extent for movements outside their control. This is not terribly surprising, since CEO compensation—like that of other workers—should depend on the tightness of the labor market to some extent.

Table 2
CEO Compensation and Monitoring Costs

	Δ (Salary and Bonus)			
Shareholder Return	.83 (12.7)	.84 (7.56)	.70 (4.80)	.76 (5.65)
Low Shareholder Concentration		.35 (2.27)		
CEO Not a Shareholder			.55 (2.41)	
High Monitoring Costs				.63 (2.30)
Year Dummies	Yes	Yes	Yes	Yes
Constant	24.7 (2.86)	12.4 (.941)	−18.6 (−.671)	−18.6 (−.670)
Number of Observations	9,879	5,605	3,312	3,312

Note: t-statistics in parentheses.

Columns 2, 3, and 4 include interactive terms to test for differences in the performance sensitivity across groups.[8] In column 2, total shareholder return is interacted with a dummy for low shareholder concentration.[9] The significance of the variable shows that firms with low concentration have a sensitivity parameter that is 0.35 higher than the total sample. This indicates that lumping these firms in with the rest of the sample masks the fact that high monitoring costs yield more performance-sensitive compensation. In column 3, the interactive term is between total shareholder return and a dummy that equals one when the CEO is not a major stockholder of the firm. These firms have a performance sensitivity that is 0.55 higher than the rest of the sample.[10]

The strictest definition of high monitoring costs is in column 4. Shareholder return is interacted with a dummy for firms that have both low shareholder concentration and a CEO who is not a major shareholder. In this case, the high-monitoring-costs group has a sensitivity parameter that is 0.63 higher than the others, for a total sensitivity of 1.39. That high monitoring costs are associated with more performance-sensitive compensation is consistent with the theory that contingent contracts and monitoring are substitutes. According to this regression, there is no increase in real CEO pay for a total shareholder return that is equal to zero. A 10 percent shareholder return, however, yields an extra $13,900 for the CEO. For the average CEO, this is an increase of 2.1 percent.

While restricting the sample to those firms that fit the assumptions of the standard principal–agent problem increases the sensitivity parameter by 67 percent, the resulting increase in CEO compensation due to changes in performance does not change the basic results of previous studies that conclude that performance sensitivity is not as high as would be expected. This section has proved, however, that the sensitivity parameter can differ in systematic ways across groups, a difficulty taken up in more detail in the next section.

IV. Heterogeneity

Section III discussed how the degree of contingency in compensation contracts can vary across groups. It may also vary across time. This heterogeneity is a problem only if the incentive parameter (pay-performance sensitivity) is correlated to the regressor (performance). Given that the groups in the previous section that had higher pay-performance sensitivity also had lower performance, this may be the case. Certain firms may be more likely to adopt incentive-based plans, and firms may be more likely to change their compensation schemes when performance changes. The heterogeneity in the incentive parameter can be modeled as:

$$C_{it} = \beta_{it} P_{it} + \xi_{it} \qquad (2)$$

where C is the compensation measure, P is the firm performance measure, β is the incentive parameter, and ξ is the error term. Since most studies are concerned with the average degree of performance sensitivity, they test:

$$C_{it} = \beta P_{it} + \eta_{it} \qquad (3)$$

Assuming equation (2) is the true equation, η is a function of the regressor,

$$\eta_{it} = (\beta_{it} - \beta) P_{it} + \xi_{it} \qquad (4)$$

[8] These columns have fewer observations because information on concentration and major share holdings was unavailable for some firms.

[9] The comparable results obtained when the definition of low concentration is modified to be all firms whose 15-shareholder concentration is below the median are shown in columns 1 and 2 of Table 4, below. The result from low concentration in this case becomes less significant but still has the same sign and magnitude.

[10] When the CEO is a major shareholder, salary and bonus is less sensitive, but total compensation may not be. Whether a CEO's shares are considered compensation or a reduction in monitoring costs is merely a difference in definitions.

Table 3
CEO Compensation, Monitoring Costs, and Heterogeneity

	Δ (Salary and Bonus)			
Shareholder Return	1.06 (13.3)	1.07 (8.11)	.89 (4.94)	.95 (5.69)
(Shareholder Return)^2	−.002 (−4.98)	−.002 (−3.23)	−.001 (−1.78)	−.001 (−1.96)
Low Concentration		.30 (1.89)		
CEO Not a Shareholder			.45 (1.93)	
High Monitoring Costs				.55 (1.98)
Year Dummies	Yes	Yes	Yes	Yes
Constant	22.6 (2.60)	10.3 (.783)	−20.7 (−.745)	−20.9 (−.753)
Number of Observations	9879	5605	3312	3312

Note: t-statistics in parentheses.

Table 4
15-Shareholder Concentration Ratio

	Δ (Salary and Bonus)			
Shareholder Return	.87 (7.48)	.77 (5.74)	1.11 (8.16)	.97 (5.82)
(Shareholder Return)^2			−.002 (−3.36)	−.001 (−2.4)
Low Concentration	.23 (1.49)		.19 (1.23)	
High Monitoring Costs		.55 (1.97)		.47 (1.64)
Year Dummies	Yes	Yes	Yes	Yes
Constant	13.3 (1.01)	−18.2 (−.655)	11.0 (.832)	−20.6 (−.742)
Number of Observations	5,605	3,312	5,605	3,312

Note: t-statistics in parentheses.

As long as P_{it} and β_{it} are uncorrelated, ordinary least squares will continue to yield consistent estimates. However, if β_{it} and P_{it} are correlated, OLS estimates and even instrumental variable estimates are inconsistent. One way to deal with the problem is to model β_{it} as a linear function of P_{it}.

$$\beta_{it} = \beta_0 + \beta_1 P_{it} \tag{5}$$

Plugging this into equation (2) yields:

$$C_{it} = \beta_0 P_{it} + \beta_1 P_{it}^2 + \xi_{it} \tag{6}$$

Adding the squared performance term allows β to vary with the performance of a firm.

The results from adding squared performance terms to the regressions are shown in Table 3. The coefficient on total shareholder return is again positive and significant, but now it is even higher. The squared performance term is significantly negative, though small. These results indicate that the performance-sensitivity parameter was biased downward before because it decreases with performance. The interactive terms continue to be positive and significant; however, both the estimates and the t-statistics on these terms are somewhat smaller than they were in Table 2.[11] This suggests that some of the effect attributed to high monitoring costs may have been due to the link between high monitoring costs and low performance, given that performance varies inversely with pay-performance sensitivity.

Column 4 of Table 3 implies that while a firm with a zero return will increase its CEO's pay by nothing, a firm with a 10 percent return will increase CEO pay by \$14,900 (= \$9,500 + \$5,500 − \$100). For the average CEO, this is only a 2.9 percent increase. So while there is evidence that allowing for the heterogeneity in the sensitivity parameter increases the overall response of compensation to performance, it is not enough to greatly alter the results.

V. Measurement Error

The first two issues addressed in this article, monitoring costs and heterogeneity, have yielded significant differences that were not very large. This section takes up the issue of measurement error, with more interesting results.

The assumption that the econometrician can accurately measure the performance variable being used by the compensation board is crucial for the consistency of the estimates. Consider the basic equation that is usually specified:

[11] The comparable results obtained when the definition of low concentration is modified to be all firms whose 15-shareholder concentration is below the median are shown in columns 3 and 4 of Table 4.

$$C = P^*\beta + \eta \quad (7)$$

where P^* is the measure used by the compensation board. The performance measure used by the econometrician, P, is the true measure plus some error:

$$P = P^* + \epsilon \quad (8)$$

Equation (7) becomes:

$$C = (P - \epsilon)\beta + \eta = P\beta + (\eta - \epsilon\beta) \quad (9)$$

Running a regression on the performance measure with error causes the regressor to be correlated to the error term. Standard ordinary least squares estimates of β are underestimating the true value.

The solution to the measurement error problem is to find an instrumental variable that is correlated to the true performance measure that compensation committees use, but is not correlated to the error term in equation (8).

Instruments

The instruments used in this analysis are obtained using the methodology of Shea (1993). Shea uses information from the input-output tables to choose variables that should be correlated with demand shocks to a particular industry. Output of sector j is a good demand-shifter for sector i if sector j demands a large share of sector i's output, but sector i and other sectors closely related to it comprise a small share of the production costs to sector j. The first condition is to ensure that output of sector j is relevant for identifying demand shocks. The second condition is to minimize the possible sensitivity of the output of sector j to price variations in sector i.

Shea (1991) shows that the asymptotic bias in the instrumental variable estimates of the supply elasticity obtained using the input-output approach to select instruments is decreasing, in the ratio of the demand share of sector j, DS, to the cost share of sector i, CS. For a given ratio, increases in DS increase the correlation between the final and intermediate outputs. Using Monte Carlo simulations, Shea shows that, over a certain range, the increased correlation improves the small-sample properties of his estimates. Variables with high DS/CS ratios are therefore good exogenous demand shocks.

To minimize the influence of common supply shocks between sector i and sector j, industries within the same 2-digit SIC code are not eligible to be used as instruments. The same restriction is also true for industries that are subject to the same supply shocks: apparel and textiles, primary and fabricated metals, and machinery and electrical machinery. The entire list of industries that have good demand shifters according to the above criteria is given in Shea (1992). Many industries have more than one candidate instrument. In those cases, the instrument that maximized DS/CS was chosen.

The correlation between industry j and industry i may still be caused by responses to the business cycle. If the instrument candidate moves closely with the business cycle, it may not represent exogenous shocks to sector i, because sector i's cost variables may respond to the business cycle as well. To minimize the possibility that the correlation between sector j and sector i is driven by the business cycle, instruments were further screened and only those variables that maintained a positive correlation to the regressor, controlling for aggregate manufacturing price and production movements, were included as instruments.

Shea develops instruments for 2-, 3-, and 4-digit industries, while the variables in this paper are firm-level. Under the assumption that firms have input-output structures that are similar to the industries to which they belong, Shea's instruments work here as well. For firms with 4-digit SIC codes that did not have instruments, the 2- and 3-digit SIC instruments were not used because, at the level of aggregation closest to firm level, the DS/CS level was not high enough and either exogeneity or instrument relevance would have been sacrificed.

Results

The specification in this section differs from that of Section III in a number of ways. While total shareholder return is a good way to measure performance of the firm, it is not easily instrumented for. The demand-shifting instruments described in the previous subsection are best for performance measures that stress current performance of the firm. So for this section, performance is split into two variables: sales, to measure the current performance of the firm; and the stock price, to measure expectations of the firm's future performance. The equation to be estimated is:

$$\Delta \log C_{it} = \beta_1 \Delta \log SA_{it} + \beta_2 \Delta \log ST_{it} + \eta_{it} \quad (10)$$

SA represents sales and ST represents the stock price. Unlike total shareholder return, sales and the stock price do not take on negative values and are not stationary. This equation, therefore, is first-differenced

Firms and Their Instruments

Name of CEO's Company	Instrument
Armstrong Cork	New construction
Carborundum	New construction
Certainteed	New construction
Georgia-Pacific	New construction
Great Northern Nekoosa	Animal fats and other food products
Hoerner Waldorf	Animal fats and other food products
Inland Container	Animal fats and other food products
International Paper	Animal fats and other food products
Johns-Mansville	New construction
Lafarge	New construction
Longview Fibre	Animal fats and other food products
Louisiana-Pacific	New construction
Masonite	New construction
Mead	Animal fats and other food products
Norton	New construction
Olinkraft	Animal fats and other food products
Owens-Corning	New construction
Parker Hannifin	Federal defense spending
Square D	New construction
Sundstrand	Federal defense spending
Textron	Federal defense spending
United States Gypsum	New construction
Weyerhaeuser	Animal fats and other food products

and can be represented in logs. The constant is insignificant throughout this section.

The sample to be used in the two-stage least squares regressions is much smaller than that used thus far. Many industries for which CEO data are available simply did not have good exogenous demand shifters. The list of 23 firms included in the smaller sample is shown in the box, along with the instruments used. Summary statistics comparing the two samples are given in Table 5. Sales and the stock price are slightly higher in the large sample but not significantly so. The compensation variable is very similar across the two samples; however, the standard deviations of both sales and the stock price differ strongly across the groups. In the case of the stock price, this is because only manufacturing industries are included in the small sample. The manufacturing sector as a whole has a stock price standard deviation of 25.3. The difference in the variability of sales is apparently driven by a long upper tail. Excluding only the top 1 percent (which does not include any firms with instruments) brings the standard deviation down to $3,680,087. Excluding the top 5 percent brings it down to the standard deviation of the small sample.

Table 5
Summary Statistics

	Mean	Standard Deviation	Number of Observations
Large Sample			
Stock Price ($)	31.4	123.9	12,502
Sales ($)	3,133,936	6,736,477	9,918
Salary and Bonus ($)	517,499	406,207	11,430
Small Sample			
Stock Price ($)	28.2	16.9	309
Sales ($)	2,410,491	1,769,393	309
Salary and Bonus ($)	545,631	339,151	283

While contemporaneous demand shocks are good exogenous instruments for sales, the stock price will be best instrumented for by expected future demand shocks. Information on expectations is difficult to come by, but assuming that the market sometimes correctly anticipates demand shocks, leads of the instruments used for sales can be used to instrument for the stock price. The first-stage regression results are given in Table 6. Demand shocks should be correlated to sales, but the magnitude of the correlation will be determined by the slope of the supply curve. Future demand shocks should be correlated to the current stock price, but the accuracy of expectations and the supply curve will determine the extent. The $\overline{R}^2$ given in the last row indicates that sales is better instrumented for than the stock price. Includ-

Table 6
First-Stage Regression Results

	Δ log (Sales)	Δ log (Stock Price)	Δ log (Salary + Bonus)
Δ log (Demand Shock)	.48	−.35	.95
	(3.05)	(−.79)	(.95)
Δ log (Demand Shock) (+1)	.10	.65	.67
	(.62)	(1.48)	(1.20)
Year Dummies	Yes	Yes	Yes
Number of Observations	252	252	228
$\overline{R}^2$	.46	.33	.10

Note: t-statistics in parentheses.

Table 7
CEO Compensation, Performance, and Measurement Error

	Δ log (Salary and Bonus)								
	Large Sample			Small Sample					
	OLS	OLS	OLS	OLS	OLS	OLS	Instrumental Variables (IV)		
Δlog (Sales)	.26	.23	.22	.42	.48	.35	2.44	1.16	2.52
	(15.6)	(40.0)	(12.9)	(2.02)	(2.97)	(1.63)	(2.03)	(2.61)	(2.05)
Δlog (Stock Price)		.12	.15		.07	.12		.56	.42
		(16.2)	(16.5)		(1.10)	(1.56)		(2.14)	(.36)
Year Dummies	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Number of Observations	9,847	9,847	9,847	253	253	253	253	228	228

Note: t-statistics in parentheses.

ing more leads of the instruments did not improve the fit.

The results from the OLS regressions on the large sample are given in the first three columns of Table 7. In column 3, an elasticity of compensation with respect to sales of 0.22 is consistent with what the previous literature has found. The compensation-stock price elasticity of 0.15 is also quite familiar. Columns 1 and 2 show the results from regressions run omitting the stock price variable and year dummies, respectively. While both are significant and should be included, leaving them out gives some indication of what happens to the coefficient on sales when they are removed.

Before turning to the instrumental variable results, it is worth looking at the ordinary least squares results from the smaller sample, given in columns 4, 5, and 6 of Table 7. The huge reduction in observations causes a decrease in significance, but the point estimates of the parameters are not greatly changed.

The last column of Table 7 shows the results obtained from using two-stage, least-squares estimation on equation (10) including year dummies. One result is a huge increase in the performance sensitivity estimate on sales. Holding the stock price constant, a 10 percent increase in sales now yields a 25 percent increase in the compensation of the CEO. This result is 10 times as large as the estimates found here and in other studies.[12] The coefficient on the stock price is insignificant, however. This result may be due to the fact that the instruments are not as good for expected future performance as they are for current performance. The standard error is too large to say anything about the stock price measure. Including or excluding it, however, does not alter the large jump in the parameter on sales.

The results indicate that previous empirical studies were underestimating the performance-sensitivity parameter. Although with just one performance variable, measurement error is known to bias the variable downward, with more than one regressor the sign of the bias is unknown and must be discovered empirically.

In Table 8, squared terms of both performance variables are included. The heterogeneity that was evident in Table 3 is no longer apparent. The squared terms are insignificant throughout. Their inclusion has two effects: The coefficient on stock price is insignificant in the small sample, and everything is insignificant when both year dummies and instrumental variables are used.[13] Excluding year dummies, the instrumental variable estimate of the coefficient on sales (Table 8, column 6) is not significantly different from its counterpart in Table 7 (column 8). However, it also is only significantly different from zero with 85 percent confidence. The conclusion obtained from Table 8 is that the heterogeneity that is a problem when performance is measured by total shareholder return does not emerge when performance is measured by sales and the stock price.

[12] Studies that look at the cumulative response rather than the contemporaneous response of pay to performance also find higher estimates. See Boschen and Smith (1995) and Joskow and Rose (1994).

[13] These regressions also include the squares of the instruments as additional instruments.

Table 8
CEO Compensation and the Heterogeneity of Performance Measures

	Δ log (Salary and Bonus)					
	Large Sample		Small Sample			
	OLS	OLS	OLS	OLS	IV	IV
Δlog (Sales)	.22	.23	.28	.45	5.38	.97
	(12.3)	(13.4)	(1.25)	(2.71)	(.237)	(1.51)
$(\Delta\log(\text{Sales}))^2$	.01	−.01	.88	.64	−42.2	−3.99
	(.20)	(−.17)	(.94)	(.72)	(−.19)	(−.34)
Δlog (Stock Price)	.12	.10	.12	.12	−3.97	−1.81
	(5.05)	(4.01)	(.50)	(.51)	(−.48)	(−.36)
$(\Delta\log(\text{Stock Price}))^2$	.00	.00	.00	−.00	.63	.36
	(1.10)	(.94)	(.02)	(−.24)	(.57)	(.49)
Year Dummies	Yes	No	Yes	No	Yes	No
Number of Observations	9,847	9,847	253	253	228	228

Note: t-statistics in parentheses.

VI. Conclusions

This paper has highlighted three problems with the earlier literature on CEO compensation. First, many samples include firms that may not fit the basic assumption of the principal–agent model, that monitoring costs must be prohibitively high. Focusing only on the high-monitoring-cost firms yields a parameter that is higher, but not high enough to make the results consistent with agency theory. Second, firms with low performance may be more likely to change their CEO incentive structure. Other firms may change CEO contracts in response to trends in compensation or the regulatory environment. Controlling for changes in the incentive parameters that vary with firm performance shows that previous results were biased downward, but not by a large enough magnitude to change the qualitative results.

Third, mismeasurement of performance has been largely ignored until now. Using exogenous demand instruments, this study yields the result that previous estimates have been biased downward. CEO contracts are apparently much more sensitive to the performance of the firm than has been previously thought. This result is more in line with the principal–agent theory, which proposes that CEOs who are difficult to monitor should have a higher compensation elasticity with respect to performance than the average worker does.

The study, however, has several shortcomings. Complete measures of compensation, including stock awards and options, fringe benefits, and pension accruals, would add to the instrumental variable analysis. Combining the analyses in the first and second parts of the article would also be desirable. In this study, the small number of firms with good instruments prevents the instrumental variable technique used in Section V from being used only on those firms with high monitoring costs. Further research should also identify good instruments for the stock price or total shareholder wealth, in order to generate results that are more comparable to the previous literature.

Despite these problems, the finding remains that performance of the firm has a very large effect on CEO compensation. By rewarding CEOs for increased performance, shareholders align the interests of the CEO with their own and ensure that the CEO is choosing actions that optimize performance for both. Incentive-based contracts are costly, however, and only worth the increase in compensation if aligning the CEO's interests with the shareholders' yields a substantial subsequent increase in shareholders' wealth. Higher firm performance resulting from the incentive contracts of CEOs has not yet been demonstrated, and further research is needed before CEO pay packages can be justified on the grounds that they are performance-based.

Acknowledgments: The author thanks Marcello Estevão and Beth Anne Wilson for many helpful discussions; Guy Debelle, Steve Pischke, and Bob Solow for useful comments; and the Federal Reserve Bank of Boston for financial support. Thanks go to Paul Joskow, Nancy Rose, and Andrea Shepard for hiring the author to work on the data set used in this paper. All errors are the author's. The views expressed are those of the author and do not necessarily reflect the official positions of the Federal Reserve Bank of Boston, the Board of Governors, or the Federal Reserve System.

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