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U.S.-Canadian Trade and U.S. State-Level Production and Employment

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Introduction

Like a friendship of long duration, the U.S.-Canada economic relationship is essentially comfortable and periodically stormy. With time, some sectors of the two economies have become so intertwined as to be virtually borderless. Others have become increasingly sensitive to cross-border competition. This increased sensitivity has led to heightened trade tensions.

It is during such periods of conflict, in economic relationships as well as relationships between old friends, that is useful to step back and remember why we are friends in the first place. Geography of course has a lot to do with it. It is convenient to be good friends with your next-door neighbour. Also important have been trade agreements that have broken down barriers between the two economies. Rules governing fair play help to resolve many arguments before they get started. The United States has the same geographic and trade agreement relationships with Mexico but that relationship is not as deep as its relationship with Canada. So similar levels of development and a much longer history of cooperation are also important contributors to the close relationship between the two economies.

The result has been growing trade and investment flows and deepening integration of many sectors of the two econo-

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mies. But increased trade and outward investment can be an easy target for criticism in election years. In the case of the United States, the prevailing view is that exports are "good," and imports are "bad." Even imports from friends and neighbours are "bad" in the basic mercantilist calculus. Consequently, the United States and Canada have recently found themselves embroiled in trade disputes over lumber, beef, wheat, and steel, to name just a few, stemming from complaints from U.S. sectors that imports from Canada have been causing economic hardship, including job losses, in the United States.

The actual relationship between trade and employment is of course much more complex. It involves interactions across a broad range of sectors and regions, and it involves both imports and exports, as well as linkages at intermediate stages (like U.S. auto plants using Canadian-made parts, and vice-versa).

This chapter examines the impact of U.S.-Canada trade on the economies of U.S. states. Since jobs are frequently offered as a barometer of the "damage" caused by trade, we explore the question of how many U.S. jobs are linked to trade with Canada. We focus not just on jobs related to exporting, but also jobs related to importing and to the servicing of both exports and imports. In other words, how many workers manufacture goods and services that are exported to Canada, transport them there, finance their sale, wholesale and warehouse them – and, how many U.S. jobs process imports from Canada, wholesale and warehouse them, advertise them, finance them, and retail them. Moreover, since politics is ultimately local, we also examine how these jobs break down by state. In addition, we explore the related linkage between trade and state level economic activity, as measured by gross state product (GSP).

The U.S.-Canada Relationship: What Everyone Already Knows

It is worth reviewing briefly the obvious importance to the United States of the U.S.-Canada economic relationship. Canada is far and away the largest single country destination for U.S. goods exports and source of U.S. goods imports. In 2003, U.S. exports to Canada of $169.8 billion outpaced even total exports to Western Europe ($164.9 billion) (Table 1). U.S. im-

ports from Canada in 2003, totalling $224.2 billion, exceeded imports from China ($152.4 billion) and Japan ($118.0 billion).

Table 1: U.S. Goods Trade with the World, 2003, US$ billions

	Exports	Imports
Total	713.8	1,263.2
Canada	169.8	224.2
Mexico	97.5	138.1
Western Europe	164.9	266.2
Eastern Europe/Former Soviet Union	7.1	18.3
China	28.4	152.4
Japan	52.1	118.0
Other Pacific Rim	108.2	148.3
South/Central America	52.0	78.9
OPEC	17.3	68.4

Source: U.S. Department of Commerce, Bureau of Economic Analysis

U.S. goods trade with Canada has been growing over the years. On average over the last 10 years, U.S. goods exports to Canada have increased at an average annual rate of 4.6 percent, despite some decreases during the period. Canada accounts for an increasing share of total U.S. goods exports, and that share reached almost 24 percent in 2003 (Table 2). Over the last 10 years, goods import growth has averaged 5.7 percent a year. However, Canada's share of total U.S. goods imports has fallen over the last 10 years to less than 18 percent by 2003.

The aggregate data show why U.S. trade with Canada is sometimes controversial. The U.S. goods trade deficit with Canada widened substantially over the years, particularly in 2000-2003. However, Canada's share of the total U.S. goods trade deficit has actually declined since 2000.

Trends in U.S. services trade with Canada are broadly similar to those in goods trade, with both exports and imports having increased. However, the scale of the flows is much smaller and the United States maintains a surplus with Canada.

Table 2: U.S. Trade in Goods and Services with Canada, 1994-2003

	Trade in Goods			Trade in Services		
	Exports	Imports	Balance	Exports	Imports	Balance
	Billions of US Dollars					
1994	114.7	131.1	-16.5	17.0	9.7	7.3
1995	127.4	146.9	-19.5	17.7	10.8	6.9
1996	134.3	158.5	-24.3	19.3	12.2	7.1
1997	151.9	170.1	-18.2	20.3	13.7	6.6
1998	156.7	175.8	-19.1	19.3	15.1	4.2
1999	166.7	201.3	-34.6	22.5	16.1	6.4
2000	178.9	233.7	-54.8	24.4	17.6	6.8
2001	163.3	218.7	-55.5	24.5	17.6	6.9
2002	160.9	211.8	-50.9	24.3	18.4	5.9
2003	169.8	224.2	-54.4			
	Percent					
1994	22.8	19.6	10.0	9.1	8.2	10.7
1995	22.1	19.6	11.1	8.7	8.5	9.1
1996	21.9	19.7	12.7	8.7	8.9	8.4
1997	22.4	19.4	9.2	8.5	9.1	7.6
1998	23.4	19.2	7.7	7.9	9.2	5.2
1999	24.4	19.5	10.0	8.5	8.9	7.5
2000	23.2	19.1	12.1	8.6	8.6	8.7
2001	22.7	19.1	13.0	8.9	8.7	9.4
2002	23.6	18.2	10.5	8.7	9.0	7.9
2003	23.8	17.8	9.9			

Source: U.S. Department of Commerce, Bureau of Economic Analysis

It is at the sectoral level in goods trade that the plot thickens and most of the controversy arises.

U.S. exports to and imports from Canada actually exhibit a good degree of commonality, in the sense that many of the same categories of products figure prominently in both flows. This suggests a good deal of co-production, such as that which takes place in the motor vehicle sector; the two countries' auto sectors have been deeply integrated for many years (Table 3).

Co-production, however, is not the case in every sector. Controversy has arisen in the United States over lumber imported from Canada. Canada's steel exports were included in a U.S. steel safeguard action in 2001. Controversy also has arisen

over imports of products from Canada that do not register among the top ten largest imports from Canada. These include pharmaceutical products, imports of which reached just $1.8 billion in 2003 (but as such represented a considerable increase over the $423.3 million imported in 1996); meat ($1.7 billion in imports in 2003); and cereal and flour preparations ($1.3 billion in 2003, up from $490.8 million in 1996).

Table 3: Leading Sectors in U.S. Goods Trade with Canada, 2000-2003

	2000	2001	2002	2003
	Exports (billions of US dollars)			
Vehicles (HS 87)	32.8	29.3	33.3	35.0
Non-electrical machinery (HS 84)	30.6	27.4	25.9	26.0
Electrical machinery (HS 85)	18.0	14.3	12.3	11.9
Plastics (HS 39)	6.9	6.6	6.9	7.5
Iron and steel (HS 72 & 73)	5.8	5.3	5.3	5.6
Precision instruments (HS 90)	5.8	5.3	4.7	4.8
Mineral fuels (HS 27)	2.6	3.6	2.6	4.0
Paper, paperboard, paper pulp (HS 48)	3.7	3.7	3.6	3.8
Rubber and products (HS 40)	2.8	2.6	2.6	2.6
Pharmaceuticals (HS 30)	2.0	1.9	2.1	2.4
	Imports (billions of US dollars)			
Vehicles (HS 87)	56.7	50.7	52.4	52.8
Mineral fuels (HS 27)	31.4	34.2	29.6	41.3
Non-electrical machinery (HS 84)	18.8	17.2	16.2	16.0
Wood and wood products (HS 44)	10.8	10.1	9.9	10.4
Paper, paperboard, paper pulp (HS 48)	10.1	10.1	9.3	9.0
Electrical machinery (HS 85)	16.9	11.1	9.0	8.4
Plastics and products (HS 39)	6.7	6.8	7.0	7.8
Aircraft (HS 88)	4.7	6.1	5.3	6.3
Iron and steel (HS 72 & 73)	5.7	5.0	5.6	5.5
Furniture (HS 94)	5.3	4.9	4.9	5.1

Source: Bureau of the Census

Estimating Direct and Indirect Effects

What grabs headlines in the United States and attention in political circles is the impact of imports on U.S. producers of im-

port-competing products. U.S. producers of softwood lumber, steel, cattle and wheat have been at the front of the line clamouring for U.S. policy makers to restrict access for these Canadian products to the U.S. market. A frequent lament is the negative impact of imports on U.S. jobs.

The linkages between exports and/or imports to labour demand and total output across sectors can be mapped using input-output tables. Such an approach presents several problems, however. The first is that the shares in the base data basically fix the structure of production and demand. In addition, there might be double counting, as the net effect of exports and imports is not the simple sum of export effects and import effects. Such an approach might also overestimate the effects of trade with one particular trading partner if substitution toward trade with the rest of the world is not also taken into account.

In this study, we address these issues by applying a multi-sector CGE model of the U.S. economy that: (i) covers all world trade and production; and (ii) includes intermediate linkages between sectors. CGE models feature input-output structures (based on regional and national input-output and employment tables) that explicitly link industries in a value-added chain from primary goods, through intermediate processing, to the final assembling of goods and services for consumption. Inter-sectoral linkages can be direct, like the input of steel in the production of transport equipment, or indirect, via intermediate use in other sectors. CGE models capture these linkages by modelling firms' use of factors and intermediate inputs.

Data on production and trade are based on national social accounting data linked through trade flows (see Reinert and Roland-Holst, 1997). These social accounting data are drawn directly from the most recent version of the *Global Trade Analysis Project* (GTAP) dataset, version 6.0 (Dimaranan and McDougall, 2002). The GTAP 6.0 dataset is benchmarked to 2001, and includes detailed national input-output, trade, and final demand structures. The basic social accounting and trade data are supplemented with U.S. Department of Labor data on state-level employment and U.S. Bureau of Economic Analysis data on state-level output. These data allow us to map nation-

wide effects to state-level changes in employment and output. Data on tariffs are taken from the WTO's integrated database; supplemental information (including on non-tariff barriers) is drawn from the World Bank's recent assessment of detailed pre- and post-Uruguay Round tariff schedules and from the UNCTAD/World Bank *World Integrated Trade Solution* (WITS) dataset. The tariff information was mapped to GTAP model sectors within the version 6 database (Table 4). The GTAP regions are aggregated into the U.S., Canada, and rest-of-world.

Aggregate demand in each region is modelled through a composite regional household, with expenditures allocated over government, personal consumption, and savings. The composite household receives income from selling its endowments of factors of production to firms, as well as from domestic taxes, tariff revenues, and rents accruing from import/export quota licenses (when applicable). Part of the income is distributed as subsidy payments to some sectors, primarily in agriculture.

On the production side, in all sectors, firms employ domestic production factors (capital, labour and land) and intermediate inputs from domestic and foreign sources to produce outputs in the most cost-efficient way that technology allows. Capital stocks are fixed at the national level. Firms are competitive, and employ capital and labour to produce goods and services subject to constant returns to scale.[1] Products from different regions are assumed to be imperfect substitutes in accordance with the so-called "Armington" assumption. The trade elasticities used to model Armington demand for imports are the standard GTAP elasticities (Table 5). The sensitivity of the results to changes in these elasticities are discussed in the results section.

[1] Compared to dynamic CGE models and models with alternative market structures, the present assumption of constant returns to scale with a fixed capital stock is closest in approach to older studies based on pure input-output modelling of trade and employment linkages. In the present context, it can be viewed as generating a lower-bound estimate of effects relative to alternative CGE modelling structures.

Table 4: Model Sectors and Mapping to GTAP Sectors

Model Sectors		Corresponding GTAP sectors
Primary		
1	Agriculture, forestry & fisheries	1 to 14
2	Mining	15, 16, 17, 18
Construction		
3	Construction	46
Manufacturing		
	Durable goods	
4	Lumber & wood	30
5	Stone, clay, glass	34
6	Primary metals	35,36
7	Fabricated metals	37
8	Industrial machinery	41
9	Electronic equipment	40
10	Motor vehicles	38
11	Other transportation equipment	39
12	Other manufacturing	42
	Non-durable goods	
13	Food, beverages, and tobacco	19-26
14	Textiles	27
15	Apparel	28
16	Paper products, publishing	31
17	Chemicals, rubber, plastics	33
18	Petroleum products	32
19	Leather products	29
Services		
	Transportation & utilities	
20	Transportation	48, 49, 50
21	Communications	51
22	Electric, gas, & sanitary	43, 44, 45
23	Trade	47
	Finance and Insurance	
24	Finance	52
25	Insurance	53
26	Other Private Services	54, 55, 57
27	Public Services	56

Source: Authors' aggregation from GTAP database.

Table 5: Trade Substitution Elasticities

		Trade substitution elasticity	
		upper	lower
Primary			
1	Agriculture, forestry & fisheries	2.4	4.6
2	Mining	2.8	5.6
Construction			
3	Construction	1.9	3.8
Manufacturing			
	Durable goods		
4	Lumber & wood	2.8	5.6
5	Stone, clay, glass	2.8	5.6
6	Primary metals	2.8	5.6
7	Fabricated metals	2.8	5.6
8	Industrial machinery	2.8	5.6
9	Electronic equipment	2.8	5.6
10	Motor vehicles	5.2	10.4
11	Other transportation equipment	5.2	10.4
12	Other manufacturing	2.8	5.6
	Non-durable goods		
13	Food, beverages, and tobacco	2.4	4.7
14	Textiles	2.2	4.4
15	Apparel	4.4	8.8
16	Paper products, publishing	1.8	3.6
17	Chemicals, rubber, plastics	1.9	3.8
18	Petroleum products	1.9	3.8
19	Leather products	4.4	8.8
Services			
	Transportation & utilities		
20	Transportation	1.9	3.8
21	Communications	1.9	3.8
22	Electric, gas, & sanitary	2.8	5.6
23	Trade	1.9	3.8
	Finance and Insurance		
24	Finance	1.9	3.8
25	Insurance	1.9	3.8
26	Other Private Services	1.9	3.8
27	Public Services	1.9	3.8

Source: GTAP database.

We wish to address the following question: given the current wage structure of the labour force, how many jobs in the U.S. economy are linked either directly or indirectly to trade? While our model, at the macro level, follows the basic GTAP structure (Hertel et al 1997, Hertel and Itakura 2000), we employ labour market closure (equilibrium conditions): that is, we fix wages at current levels, and force employment levels to adjust. This provides a direct estimate of the jobs supported, at current wage levels, by the current level of trade. In addition, employment and output are mapped by a set of side equations (equations added to the core model) to capture state-level effects.

Elasticities are calculated directly from our experiment results. They provide a measure of the marginal impact of U.S.-Canada trade on employment and output, mapping the impact of this relationship across states and sectors and highlighting the importance of the structure of output and employment at the state level. The formal derivation of the elasticities is given in Appendix 1.

The experiments conducted with the model involve imposing changes in U.S.-Canada trade. This allows us to deconstruct the trade relationship, tracing changes at the border as they work through the U.S. economy. We conduct three sets of experiments. The first is a reduction of U.S. exports to Canada.[2] This involves both a 1% reduction (so that we can estimate a set of employment and output elasticities) and also full elimination of trade (so that we can estimate full effects). The second is a reduction of U.S. imports from Canada.[3] This again involves both a 1% reduction (so that we can estimate a set of employment and output elasticities) and also full elimination of trade

[2] This is accomplished by making the set of bilateral tariffs with the U.S. endogenous, while making trade quantities exogenous and then reducing them by target amounts.

[3] This is accomplished by making a set of bilateral export taxes with the U.S. endogenous, while making trade quantities exogenous and then reducing them by target amounts, which is appropriate since the relevant question is the benefit of current conditions of trade.

(so that we can estimate full effects). The final experiment is a reduction of U.S. exports to Canada and imports from Canada.[4] This again involves both a 1% reduction and also full elimination of trade.

Results

The results of our experiments are reported in Tables 6 through 9. Our analysis demonstrates that trade with Canada (exports plus imports) in 2001 supported approximately $162 billion in U.S. economic activity (Table 6). Not surprisingly, from the perspective of total state output supported by trade with Canada, the largest states benefited the most. Across states, the greatest absolute output benefits from trade with Canada were enjoyed by California ($22 billion), New York ($14 billion), Texas ($10 billion) and Illinois and Florida (roughly $8 billion each). But more interestingly, on a share basis, output effects range from a low of between 0.1 and 0.6 percent of total 2001 gross state output (New Mexico and Arizona) to a high of 2.1 percent (Delaware, Michigan, Wyoming).

All of this output related to trade with Canada supports jobs, both directly (in the manufacture of goods for export, for example) and indirectly (in sectors that get the goods out the manufacturing door and across the border to Canada. Jobs related to importing also span the sectors, and include jobs related to transporting, wholesaling and warehousing, advertising, financing and retailing products imported from Canada, for example. Our analysis indicates that trade with Canada in 2001 supported 5.2 million direct and indirect American jobs (Table 7). At the state level, the largest absolute numbers of jobs supported by trade with Canada were in California (626 thousand), Texas (368 thousand), New York (348 thousand), Illinois (288

[4] This is accomplished by making the sets of bilateral instruments endogenous as discussed in notes 3 and 4, while making trade quantities exogenous and then reducing them by target amounts. The implied trading costs amount to 75% of consumer prices for imports from Canada, and 70% of consumer prices for exports to Canada.

thousand) and Florida (237 thousand). On a share basis, job effects range from 2.9 percent (Wyoming) to 3.4 percent (New York, Rhode Island, Nevada).

Table 6: Impact of Trade on Gross State Product, 2001
US$ millions

	Total	Exports	Imports		Total	Exports	Imports
Alabama	1,894	1,051	1,345	Montana	346	184	251
Alaska	350	215	249	Nebraska	971	479	722
Arizona	2,445	949	1,986	Nevada	1,262	647	928
Arkansas	1,019	557	727	New Hampshire	733	350	553
California	21,836	10,378	16,440	New Jersey	6,012	3,165	4,307
Colorado	2,604	1,294	1,938	New Mexico	666	287	527
Connecticut	2,790	1,242	2,160	New York	14,151	7,247	10,336
Delaware	754	411	533	North Carolina	4,525	2,382	3,242
DC	1,369	693	1,006	North Dakota	283	151	205
Florida	7,829	3,861	5,820	Ohio	6,233	3,459	4,419
Georgia	4,624	2,388	3,374	Oklahoma	1,354	722	985
Hawaii	796	398	589	Oregon	1,699	588	1,398
Idaho	551	271	403	Pennsylvania	6,577	3,472	4,741
Illinois	7,913	4,158	5,696	Rhode Island	625	293	474
Indiana	3,267	1,839	2,316	South Carolina	1,899	1,058	1,325
Iowa	1,476	809	1,040	South Dakota	385	198	280
Kansas	1,270	587	980	Tennessee	3,126	1,683	2,242
Kentucky	2,038	1,225	1,409	Texas	10,165	5,275	7,487
Louisiana	1,408	985	928	Utah	1,149	580	853
Maine	584	286	438	Vermont	300	139	228
Maryland	3,351	1,689	2,464	Virginia	4,648	2,411	3,380
Massachusetts	4,798	2,316	3,586	Washington	3,532	1,508	2,797
Michigan	5,590	3,197	3,937	West Virginia	581	347	401
Minnesota	3,042	1,604	2,198	Wisconsin	2,865	1,583	2,020
Mississippi	1,059	532	783	Wyoming	166	132	102
Missouri	2,980	1,560	2,171	**United States**	161,893	82,834	118,719

Source: Authors' estimates.

Table 7: Impact of Trade on State Employment (Number of jobs)

	Total	Exports	Imports		Total	Exports	Imports
Alabama	71,523	37,568	51,983	Montana	16,375	8,796	11,765
Alaska	13,104	6,946	9,494	Nebraska	35,507	18,633	25,725
Arizona	88,894	44,965	65,535	Nevada	43,179	22,622	31,352
Arkansas	44,750	23,793	32,328	New Hamp.	23,743	12,034	17,444
California	626,044	319,005	459,619	New Jersey	153,333	80,025	111,260
Colorado	92,585	47,850	67,574	New Mexico	29,603	15,558	21,482
Connecticut	66,844	33,474	49,498	New York	347,817	180,236	253,522
Delaware	16,368	8,434	11,955	North Carolina	150,635	77,374	110,138
DC	28,987	15,148	21,034	North Dakota	12,550	6,733	9,000
Florida	288,804	149,617	210,561	Ohio	212,049	114,733	151,918
Georgia	152,330	80,034	110,352	Oklahoma	58,386	31,858	41,704
Hawaii	25,564	13,292	18,613	Oregon	63,245	33,131	45,896
Idaho	22,861	11,975	16,559	Pennsylvania	219,130	114,571	159,252
Illinois	236,625	125,426	170,660	Rhode Island	18,850	9,619	13,827
Indiana	111,693	60,556	80,153	South Carolina	69,114	35,709	50,363
Iowa	55,453	29,081	40,190	South Dakota	14,796	7,789	10,698
Kansas	50,958	25,459	37,873	Tennessee	107,857	57,183	77,968
Kentucky	68,634	37,375	49,126	Texas	368,765	194,312	267,314
Louisiana	73,441	39,016	53,104	Utah	43,611	22,232	32,072
Maine	23,923	12,362	17,495	Vermont	12,308	6,290	9,019
Maryland	100,935	52,513	73,387	Virginia	141,273	72,899	103,203
Mass.	134,197	68,385	98,371	Washington	107,555	53,375	80,096
Michigan	174,360	95,182	124,766	West Virginia	25,495	14,073	18,152
Minnesota	102,710	53,995	74,313	Wisconsin	103,171	55,975	73,638
Mississippi	43,328	22,337	31,755	Wyoming	9,227	5,132	6,564
Missouri	107,569	56,867	77,820	**United States**	5,210,057	2,727,265	3,782,634

Source: Authors' estimates.

Note that the elasticities in Tables 8 and 9 are as defined by equations (5), (6), (13), (14), (17), and (18). They provide a rough sense of the percent of GSP and the labour force at the national, state, and sector level supported by the entire trade relationship. Hence extrapolation from the value for employment for the U.S. as a whole in Table 9 implies that the full trade relationship supports 3.27 percent of total employment.[5] This is less than the sum suggested by the import and export elasticities (0.0219 and 0.0229), highlighting the importance of examining the trade effects jointly, rather than relying on export and import effects separately to estimate the total effect. As such, this also highlights the advantage of using a CGE model over simple input-output matrix calculations to estimate joint effects for all bilateral trade. At the state level, the employment elasticity tables again show total effects from both imports and exports. These import and export elasticities are relatively similar at the aggregate level. The overall similarity is a consequence of the similar relative values of U.S.-Canada trade on the import and export side. Since the estimated gains from trade on both the import and export side are based on comparable trade flows, the aggregate effects of each are similar. This similarity gives way to differences as we move to the state level.

State results vary due to differences in the sector composition of the local economies, in terms of both employment and production. Making calculations from the elasticities in Table 9, on a share basis, total job effects range from around 2.9 percent (Wyoming) to 3.4 percent (New York, Rhode Island, Nevada). From the elasticities in Table 8, on a share basis, output effects range from a low of between 0.1 and 0.6 percent (New Mexico and Arizona) to a high of 2.1 percent (Delaware, Michigan, Wyoming).

[5] It is important to recall the working definition of jobs at current wage levels. When all trade is eliminated, the exact estimate of employment is actually 3.1 percent, close to the value suggested by the employment elasticity.

Table 8: Percent Impact of Trade on Gross State Product (elasticities)

	All Trade	Exports	Imports		All Trade	Exports	Imports
Alabama	0.0183	0.0127	0.0126	Montana	0.0176	0.0121	0.0124
Alaska	0.0118	0.0096	0.0084	Nebraska	0.0182	0.0119	0.013
Arizona	0.0173	0.0101	0.0131	Nevada	0.0179	0.012	0.0127
Arkansas	0.0178	0.0123	0.0123	New Hampshire	0.0182	0.0116	0.0131
California	0.0182	0.0116	0.0131	New Jersey	0.0191	0.0129	0.0133
Colorado	0.0178	0.0117	0.0128	New Mexico	0.0141	0.0091	0.0104
Connecticut	0.0183	0.0113	0.0134	New York	0.0187	0.0124	0.0132
Delaware	0.0196	0.0133	0.0135	North Carolina	0.0185	0.0124	0.0128
DC	0.0206	0.0135	0.0147	North Dakota	0.0175	0.012	0.0122
Florida	0.0187	0.0122	0.0134	Ohio	0.019	0.0129	0.0131
Georgia	0.0184	0.0122	0.013	Oklahoma	0.017	0.0117	0.012
Hawaii	0.0195	0.0128	0.014	Oregon	0.0161	0.0089	0.0121
Idaho	0.0175	0.0114	0.0122	Pennsylvania	0.0183	0.0124	0.0127
Illinois	0.0187	0.0126	0.013	Rhode Island	0.0187	0.0119	0.0135
Indiana	0.0189	0.0129	0.0131	South Carolina	0.0193	0.0133	0.0131
Iowa	0.0184	0.0126	0.0126	South Dakota	0.0182	0.0122	0.0128
Kansas	0.0174	0.0111	0.0127	Tennessee	0.019	0.0127	0.0132
Kentucky	0.0187	0.0131	0.0127	Texas	0.0162	0.0112	0.0116
Louisiana	0.012	0.0101	0.0081	Utah	0.0182	0.0121	0.013
Maine	0.0181	0.0119	0.013	Vermont	0.0179	0.0114	0.0129
Maryland	0.0192	0.0126	0.0136	Virginia	0.0189	0.0126	0.0133
Massachusetts	0.0184	0.0119	0.0132	Washington	0.0178	0.0109	0.0134
Michigan	0.0197	0.0133	0.0136	West Virginia	0.0167	0.0124	0.0114
Minnesota	0.0185	0.0124	0.0129	Wisconsin	0.0182	0.0126	0.0124
Mississippi	0.0183	0.0121	0.013	Wyoming	0.0102	0.0097	0.0066
Missouri	0.0187	0.0124	0.0132	**United States**	0.0182	0.0121	0.0128

Source: Authors' estimates.

Table 9: Percent Impact of Trade on State Employment (elasticities)

	All Trade	Exports	Imports		All Trade	Exports	Imports
Alabama	0.0318	0.0214	0.0224	Montana	0.0312	0.0213	0.0217
Alaska	0.0323	0.0219	0.0227	Nebraska	0.0313	0.0210	0.0219
Arizona	0.0328	0.0216	0.0233	Nevada	0.0340	0.0228	0.0239
Arkansas	0.0309	0.0209	0.0216	New Hamp.	0.0329	0.0217	0.0232
California	0.0329	0.0217	0.0232	New Jersey	0.0340	0.0227	0.0238
Colorado	0.0328	0.0219	0.0231	New Mexico	0.0318	0.0215	0.0223
Connecticut	0.0332	0.0217	0.0236	New York	0.0340	0.0226	0.0239
Delaware	0.0336	0.0223	0.0236	North Carolina	0.0323	0.0214	0.0227
Dist. of Columbia	0.0358	0.0239	0.0251	North Dakota	0.0303	0.0207	0.0211
Florida	0.0337	0.0225	0.0237	Ohio	0.0331	0.0225	0.0230
Georgia	0.0329	0.0221	0.0230	Oklahoma	0.0306	0.0211	0.0212
Hawaii	0.0337	0.0225	0.0237	Oregon	0.0319	0.0214	0.0223
Idaho	0.0308	0.0207	0.0215	Pennsylvania	0.0330	0.0221	0.0231
Illinois	0.0333	0.0224	0.0232	Rhode Island	0.0340	0.0225	0.0240
Indiana	0.0324	0.0220	0.0226	South Carolina	0.0324	0.0216	0.0227
Iowa	0.0310	0.0209	0.0217	South Dakota	0.0307	0.0207	0.0214
Kansas	0.0306	0.0202	0.0219	Tennessee	0.0322	0.0217	0.0225
Kentucky	0.0310	0.0212	0.0215	Texas	0.0317	0.0214	0.0222
Louisiana	0.0316	0.0215	0.0222	Utah	0.0325	0.0215	0.0230
Maine	0.0322	0.0215	0.0227	Vermont	0.0322	0.0213	0.0226
Maryland	0.0337	0.0225	0.0237	Virginia	0.0330	0.0219	0.0232
Massachusetts	0.0338	0.0223	0.0239	Washington	0.0318	0.0208	0.0228
Michigan	0.0334	0.0226	0.0232	West Virginia	0.0312	0.0217	0.0216
Minnesota	0.0324	0.0218	0.0226	Wisconsin	0.0320	0.0219	0.0221
Mississippi	0.0309	0.0206	0.0218	Wyoming	0.0291	0.0205	0.0202
Missouri	0.0324	0.0218	0.0227	**United States**	0.0327	0.0219	0.0229

The estimates reported here are, of course, sensitive to the parameters used in the model. The most important of these are the trade substitution elasticities in Table 5. To explore this issue, Table 10 reports a range of estimates for macroeconomic effects, under alternative sets of higher and lower trade elasticities. The exact magnitude of effects depends on these values, while the basic pattern of results remains the same. The results in Tables 6 through 9 correspond to the mid-point estimates.

Table 10: Sensitivity Analysis with Respect to Trade Elasticities, "All Trade" Results

	A = (1-.25)*B	B	C = (1+.25)*B
	Low elasticities	GTAP elasticities	High elasticities
GDP, %	3.0	2.1	1.6
Total Employment, %	4.4	3.1	2.4
Total State Employment, jobs	7,422,762	5,210,057	4,033,086
Real household income, %	3.93	2.74	2.11
Investment, %	4.07	2.84	2.18
Trading cost share of consumer			
▪ price for imports from Canada	83.9	74.6	66.6
▪ price for exports to Canada	79.5	69.6	61.5

Note: Trading costs are the value generated endogenously in the experiment that closes down essentially all trade (as defined in the text). Other values then represent the estimated effects of current trade levels.
Source: Authors' estimates.

Summary and Conclusion

We have examined the impact of the U.S.-Canadian trade relationship on the economies of U.S. states. To do this, we have employed a computable general equilibrium (CGE) model of the U.S. and Canadian economies. This allows us to focus on jobs related to the complex interaction between exporting, importing, and the servicing of trade. In addition, we have examined the related linkage between trade and state level economic activity, as measured by gross state product (GSP). Our results are summarized in a set of state-level employment and output elasticities linking trade volumes to economic activity at the state level. These point to a significant contribution by trade to employment in the United States. The results also demonstrate the benefits of general equilibrium analysis over simple input-output or multiplier analysis. The latter approaches can overstate the actual labour market impact, as there is scope for double counting of export and import effects (since they actually interact), and also because one misses adjustment to trade patterns with the rest of the world.

Our analysis demonstrates that the trade relationship between the United States and Canada is a definite "plus" for the

United States.[6] The fuller picture must of course be weighed by policy makers in evaluating pleas for protection from competition from Canadian exporters.

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[6] We speculate that a similar analysis for Canada would demonstrate parallel benefits to Canadian output and employment.

Appendix 1: Derivation of elasticities

Formally, export elasticities are defined as follows. For employment E and Gross State Product (GSP) G in state j in sector i, the impact of a percent change in exports X to Canada $\%\Delta E$ involves the sector export elasticity $\varepsilon_{i,j}$:

$$\varepsilon_{i,j}^{emp} = \frac{\%\Delta E_{i,j}}{\%\Delta X} \quad (1)$$

$$\varepsilon_{i,j}^{GSP} = \frac{\%\Delta G_{i,j}}{\%\Delta X} \quad (2)$$

Building from these effects, and given that total state employment is $E_j = \sum_i E_{i,j}$ and GSP is $G_j = \sum_i G_{i,j}$, it follows that that the total state employment and GSP elasticities are:

$$\varepsilon_j^{emp} = \frac{\%\Delta E_j}{\%\Delta X} = \sum_i \theta_{i,j}^{emp} \varepsilon_{i,j}^{emp} \quad (3)$$

$$\varepsilon_j^{GSP} = \frac{\%\Delta G_j}{\%\Delta X} = \sum_i \theta_{i,j}^{GSP} \varepsilon_{i,j}^{GSP} \quad (4)$$

where $\theta_{i,j}$ is the state employment or GSP share of sector i. The national employment and GSP effects then follow from underlying state and sector components.

$$\varepsilon^{emp} = \frac{\%\Delta E}{\%\Delta X} = \sum_j \sum_i \phi_{i,j}^{emp} \theta_{i,j}^{emp} \varepsilon_{i,j}^{emp} \qquad (5)$$

$$\varepsilon^{GSP} = \frac{\%\Delta G}{\%\Delta X} = \sum_j \sum_i \phi_{i,j}^{GSP} \theta_{i,j}^{GSP} \varepsilon_{i,j}^{GSP} \qquad (6)$$

where $\phi_{i,j}$ is the state *i* share of employment or GSP in sector *j*.

A similar set of relationships holds for changes in imports *M* and changes in total trade *T*=*M*+*X*, yielding a set of import elasticities μ and total trade elasticities τ.

$$\mu_{i,j}^{emp} = \frac{\%\Delta E_{i,j}}{\%\Delta M} \qquad \mu_{i,j}^{GSP} = \frac{\%\Delta G_{i,j}}{\%\Delta M} \qquad (7,8)$$

$$\mu_j^{emp} = \frac{\%\Delta E_j}{\%\Delta M} = \sum_i \theta_{i,j}^{emp} \mu_{i,j}^{emp} \qquad \mu_j^{GSP} = \frac{\%\Delta G_j}{\%\Delta M} = \sum_i \theta_{i,j}^{GSP} \mu_{i,j}^{GSP} \qquad (9,10)$$

$$\mu^{emp} = \frac{\%\Delta E}{\%\Delta M} = \sum_j \sum_i \phi_{i,j}^{emp} \theta_{i,j}^{emp} \mu_{i,j}^{emp} \qquad \mu^{GSP} = \frac{\%\Delta G}{\%\Delta M} = \sum_j \sum_i \phi_{i,j}^{GSP} \theta_{i,j}^{GSP} \mu_{i,j}^{GSP} \qquad (11,12)$$

$$\tau_{i,j}^{emp} = \frac{\%\Delta E_{i,j}}{\%\Delta (M+E)} \qquad \tau_{i,j}^{GSP} = \frac{\%G_{i,j}}{\%\Delta (M+E)} \qquad (13,14)$$

$$\tau_j^{emp} = \frac{\%\Delta E_j}{\%\Delta(M+E)} = \sum_i \theta_{i,j}^{emp}\,\tau_{i,j}^{emp} \qquad \tau_j^{GSP} = \frac{\%\Delta E_j}{\%\Delta(M+E)} = \sum_i \theta_{i,j}^{GSP}\,\tau_{i,j}^{GSP} \tag{15,16}$$

$$\tau^{emp} = \frac{\%\Delta E}{\%\Delta(M+E)} = \sum_j \sum_i \phi_{i,j}^{emp}\,\theta_{i,j}^{emp}\,\tau_{i,j}^{emp} \qquad \tau^{GSP} = \frac{\%\Delta E}{\%\Delta(M+E)} = \sum_j \sum_i \phi_{i,j}^{GSP}\,\theta_{i,} \tag{17,18}$$