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US–Canadian Trade and US State-Level Production and Employment: An Update

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Abstract

Using a computable general equilibrium (CGE) model belonging to the class of multi-region CGE models commonly used to estimate the economy-wide and the sector-specific impacts of trade policy changes, we estimate the impact on US and state output of changes in the US–Canada trading relationship, and their resulting impacts on US jobs. We find that trade with Canada provides tangible and important economy-wide employment and income benefits to the United States and to every US state. Total trade with Canada—of goods and services, and exports as well as imports—generated US output worth $327 billion in 2005, or 2.6 percent of GDP. Output supported by total trade with Canada also support US employment levels. We estimate that trade with Canada supported more than 7.1 million net US jobs, or 4.1 percent of total US employment in 2005. Every US state registered net positive job gains from trade with Canada.

Introduction

Both the United States and Canada have experienced their shares of debates about the costs and benefits of trade. From the Canada–US Free Trade Agreement (CUSFTA) to the North American Free Trade Agreement (NAFTA) to bilateral dis-

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putes, the identification of the costs of trade, and particularly the costs of the bilateral trading relationship, seems to overshadow discussion of the benefits of the trading relationship.

Notwithstanding the history of bilateral trade disputes, the US–Canada trading relationship is clearly a case where both sides benefit in important ways. Bilateral trade between the two neighbours has been growing steadily for decades. The increasingly integrated nature of the two economies—thanks to CUSFTA and NAFTA—now has developed into a generally comfortable integrated relationship. Nevertheless, arguments persist that this integration has cost hundreds of thousands of workers their jobs. Indeed, the jobs debate overshadows the otherwise positive assessment of the impact of increased trade.

With the importance of the trade–jobs question as motivation, in this paper we update and expand on earlier research that quantifies the US employment impact of US–Canada trade. (Francois and Baughman 2004). Our earlier research found that in 2001, cross-border trade (exports and imports) in goods supported 5.2 million US jobs. The current research updates that employment estimate to 2005, and assesses the net job impact in the United States of cross-border services trade[1]. As in our earlier research, we break down the job estimates by state. We begin with an overview of US–Canada trade in goods and services, and then present our estimates of the number of US jobs supported by trade with Canada in 2005. We conclude with a summary of what our results mean for US trade policy. Appendix A details our methodology for estimating the US job impacts of US–Canada goods and services trade.

The US–Canada Trading Relationship

Canada is, not surprisingly, one of the United States' leading trading partners. It is the largest foreign market for US goods, and the largest source—exceeding even China—of US imports. It is the third most important market for US services exports, and the fourth largest source of US services imports (see Table 1,

[1]Because of the addition of services trade to the modelling exercise, results from the 2001 analysis are not comparable to the results of this analysis.

which reports the top ten markets for US exports and imports of goods, and US exports and imports of services).

While clearly much of this tendency to trade with each other is owed to geography, also important has been the success of efforts both countries have undertaken to reduce and eventually eliminate barriers to trade between them. CUSFTA went into effect on 1 January 1989, aiming to eliminate bilateral tariffs and many non-tariff barriers in most sectors of merchandise trade within 10 years. NAFTA replaced CUSFTA on 1 January 1994. By that time, most US–Canada trade was already duty-free thanks to CUSFTA. By 2005, virtually all bilateral trade in goods and services was trade-barrier free.[2]

Table 1: Leading US Trading Partners, 2005
(billions of US dollars)

	Goods		Services	
	Exports	**Imports**	**Exports**	**Imports**
Total, World	$894.60	$1,677.40	$360.50	$280.60
Canada	***212.2 (1st)***	***293.3 (1st)***	***32.8 (3rd)***	***22.5 (4th)***
United Kingdom	*37.6*	*50.5*	*45.7 (1st)*	*36.8 (1st)*
Japan	*53.3 (3rd)*	*138*	*42.5 (2nd)*	*23.8 (2nd)*
Mexico	*120.3 (2nd)*	*172.1 (3rd)*	*20.6*	*14.9*
Germany	*33.6*	*84.6*	*20.3*	*25.6 (3rd)*
France	*22.3*	*33.8*	*13.2*	*12.9*
Korea	*27.1*	*43.8*	*11*	7.9
Switzerland	10.7	13	*9.5*	*11.4*
China	*41.8*	*243.5 (2nd)*	*9.1*	*6.5*
Netherlands	*26.3*	14.8	*9.1*	*8.1*
Bermuda	0.5	nil	n.a.	14.1
Taiwan	*22.5*	*34.8*	7.8	6.7
Venezuela	6.4	*34*	*2.6*	0.6

Italics = country is among the top ten for that type of export or import.
n.a. = not available.
Source: US Department of Commerce, Bureau of Economic Analysis

[2]This is not to suggest that there are no restrictions on bilateral trade. Certain sensitive sectors in both economies continue to face bilateral trade restrictions, while antidumping and countervailing duty actions continue to result in disruption of trade for individual products.

While US goods trade with Canada has been growing over the years, Canada's importance as a trading partner in the post-FTA period has been comparatively stable. In the period 1995–2005, Canada's share of total US exports ranged from 22 to 24 percent, with a modest upward trend over the period. Canada's share of total US imports, on the other hand, declined more or less steadily over the period as lower-cost foreign suppliers, particularly in China, claimed larger shares of the US import market. Canada enjoyed a growing trade surplus with the United States over this 10-year period; however, this increase generally mirrored the total US trade balance, as Canada's share of the total US trade balance has generally averaged about 10 percent.

Table 2: US Goods Trade with Canada, 1995–2005

	Exports	**Imports**	**Balance**
	Value (billions of US dollars)		
1995	$127.4	$146.9	-$19.5
1996	134.3	158.5	-24.3
1997	151.9	170.1	-18.2
1998	156.7	175.8	-19.1
1999	166.7	201.3	-34.6
2000	178.9	233.7	-54.8
2001	163.3	218.7	-55.5
2002	160.9	211.8	-50.9
2003	169.8	224.2	-54.4
2004	190.0	259.0	-69.0
2005	212.2	293.3	-81.1
	Share of Total US (percent)		
1995	22.1	19.6	11.2
1996	21.9	19.7	12.7
1997	22.3	19.4	9.2
1998	23.3	19.2	7.7
1999	24.4	19.5	10.0
2000	23.2	19.1	12.1
2001	22.4	19.1	13.0
2002	23.6	18.2	10.6
2003	23.8	17.8	9.9
2004	23.5	17.6	10.4
2005	23.7	17.5	10.4

Source: US Department of Commerce, Bureau of Economic Analysis

While Canada enjoys a goods trade surplus with the United States, the United States enjoys a services trade surplus with Canada (Table 3). Trends in US services exports and imports with Canada mirror those of goods, but on a much smaller scale. Canada's share of total US services exports has been increasing since 1998, while its share of total US services imports has been declining over that period.

Table 3: US Services Trade with Canada, 1995–2005

	Exports	Imports	Balance
	Value (billions of US dollars)		
1995	$18.1	$11.2	$6.9
1996	19.6	12.6	7.0
1997	20.6	14.0	6.6
1998	19.6	15.3	4.3
1999	22.8	16.4	6.4
2000	24.7	18.0	6.7
2001	24.5	17.5	7.0
2002	25.1	18.0	7.1
2003	27.4	19.5	7.9
2004	29.7	21.1	8.6
2005	32.8	22.5	10.3
	Share of Total US (percent)		
1995	8.2	7.9	8.8
1996	8.2	8.2	8.2
1997	8.0	8.4	8.2
1998	7.5	8.5	7.9
1999	8.1	8.2	8.1
2000	8.3	8.1	8.2
2001	8.6	7.9	8.3
2002	8.6	7.8	8.2
2003	9.1	7.8	8.5
2004	8.6	7.3	8.0
2005	8.6	7.2	8.0

Source: US Department of Commerce, Bureau of Economic Analysis

Overall, US trade with Canada is huge and growing. Total trade (goods plus services, exports plus imports) reached $561 billion in 2005 and reflected average annual increases of 6.5 percent over the previous decade (Table 4). Similarly, total

goods trade (exports plus imports) has been growing at an average annual rate of 6.5 percent, and total services trade by even more: 6.7 percent per year.

Table 4: Total* Goods and Services Trade, 1995–2005
(billions of US dollars and percent)

	Total Goods	Total Services	Total Trade	Goods' % Share of Total
1995	$274.3	$29.3	$303.6	90.4
1996	292.8	32.2	325.0	90.1
1997	322.0	34.6	356.5	90.3
1998	332.6	34.9	367.4	90.5
1999	368.0	39.2	407.2	90.4
2000	455.3	42.8	455.3	90.6
2001	424.0	42.0	424.0	90.1
2002	415.8	43.1	415.8	89.6
2003	441.1	46.9	441.1	89.4
2004	499.8	50.8	499.8	89.8
2005	505.5	55.3	560.8	90.1

*Exports plus imports.
Source: Bureau of the Census

From a sectoral perspective, many categories of goods show up as both leading exports to and imports from Canada, suggesting co-production between producers in both countries (Table 5). This co-production is most obvious in the case of the motor vehicle sector, where the two countries' auto sectors have been integrated for many years. At the same time, Canada is an important source of raw materials to the US market, most notably petroleum (mineral fuels, which took the lead in 2005). Also important are wood and wood products.

In services trade, transportation-related services exports and imports are roughly comparable in size, although more Canadian passengers travel to the United States than US passengers to Canada. Trade in other private services trade has been the main source of growth in services trade, with US exports to Canada doubling over the period and US imports from Canada rising by a factor of more than 2½. The United States has a significant and growing bilateral surplus in royalties and license fees.

Table 5: Leading Sectors in US Trade with Canada, 1995, 2000, 2005 (billions of US dollars)

Goods Exports	**1995**	**2000**	**2005**
Vehicles (HS 87)	$25.7	$32.8	$40.9
Non-electrical machinery (HS 84)	21.9	30.6	30.9
Electrical machinery (HS 85)	12.8	18.0	13.9
Plastics (HS 39)	4.4	6.9	9.4
Iron and steel (HS 72 & 73)	3.9	5.8	8.7
Mineral fuels (27)	1.4	2.6	8.1
Precision instruments (HS 90)	3.7	5.8	5.3
Paper, paperboard, paper pulp (HS 48)	2.5	3.7	4.3
Organic chemicals (HS 29)	1.6	2.2	3.3
Rubber and rubber products (HS 40)	1.9	2.8	3.0
Goods Imports			
Mineral fuels (HS 27)	$13.6	$31.4	$65.4
Vehicles (HS 87)	40.7	56.1	61.7
Non-electrical machinery (HS 84)	13.4	18.8	19.7
Wood and wood products (HS 44)	7.1	10.8	14.2
Electrical machinery (85)	6.9	16.9	10.8
Plastics and products (HS 39)	3.8	6.7	10.5
Paper, paperboard, paper pulp (HS 48)	9.0	10.1	10.4
Aluminium and aluminium products (76)	3.9	4.5	6.9
Aircraft (HS 88)	1.5	4.7	6.0
Furniture (HS 94)	1.2	5.3	5.8
Services Exports			
Transportation-related services	$9.8	$11.4	$14.6
Travel	*6.2*	*7.2*	*9.0*
Passenger fares	*1.3*	*1.6*	*2.6*
Other transportation	*2.3*	*2.6*	*3.0*
Other private services	6.7	10.7	13.4
Royalties and license fees	1.4	2.8	4.4
Services Imports			
Transportation-related services	$7.1	$10.7	$11.6
Travel	*4.3*	*6.2*	*7.0*
Passenger fares	*0.3*	*0.8*	*0.3*
Other transportation	*2.5*	*3.7*	*4.3*
Other private services	3.7	6.0	9.5
Royalties and license fees	0.2	1.0	0.8

Source: Bureau of the Census

The US–Canada Economic Relationship: What It Means for US Output and Jobs

The economic impacts of trade are one of the biggest concerns of policy-makers on both sides of the border. Polling results suggest that large percentages of the American public believe that trade expansion, and particularly increases in trade deficits, result in domestic job losses. This belief is so longstanding and prevalent that it is widely accepted as fact, and often left unchallenged in political debates.

The data actually support the opposite conclusion: trade (both exports and imports) creates output, which is job-supporting. Because of the role of Canadian inputs in integrated production processes in the United States, increased trade—including increasing imports—contributes to increased domestic output and related jobs. This includes manufacturing jobs.

Our earlier analysis of the US output and job impacts of US–Canada goods trade found that cross-border trade in goods in 2001 supported approximately $162 billion in US economic activity and 5.2 million net jobs (job gains net of job losses). These estimates understated the true value of the US–Canada trading relationship to the United States for two reasons. First, it measured the impact during a recession year, when trade flows were lower than they otherwise would have been had both economies been healthier. Goods trade dropped in 2001 from 2000 levels, and did not recover for several years, until 2004 (see Table 4). Second, the earlier research looked only at the impacts of cross-border trade in goods, rather than goods and services. Given the importance of services to both economies, the output and employment impacts of total trade would necessarily be understated.

In this paper we examine the output and employment impacts of the bilateral trading relationship for a year (2005) that more accurately reflects the robust nature of that relationship, and include total services trade as well. We use the same methodology we followed in our earlier research: a computable general equilibrium (CGE) model that examines the up- and downstream impacts of trade on the US economy.

A Brief Description of the Model

CGE models are commonly used today to estimate the economy-wide and the sector-specific impacts of a trade policy change. A global model in wide use today is the Global Trade Analysis Project (GTAP) model. Working with a version of this model (with the modifications and updates described below), we estimate the impact of US–Canada trade on US production, consumption, trade, prices and welfare.

Briefly, we have updated our core dataset (version 6.2) from 2001 to 2005, and focused on 14 sectors, four regions (the United States, Canada, Mexico, and the rest of the world), and fixed capital: in other words, our analysis is static. The model's structure assumes perfect competition and constant returns to scale. More details are provided in Appendix A. These structural features are appropriate given the current application.

To estimate the impacts on the United States in 2005 of exports and imports of goods and services, we posit the following counterfactual: suppose those exports and imports were simply eliminated as the result of the imposition of a prohibitive tariff on US imports from Canada, and the simultaneous imposition of a prohibitive tariff on Canadian imports from the United States. The losses in US output provide a measure of the opposite: the gains in US output linked to trade.[3] We then take these

[3]It is important to note that these estimates show what the level of US output and employment would have been in 2005 if US–Canadian bilateral trade were reduced to zero, with the rest of the world continuing and filling in where possible for the lost US–Canada trade. For example, in the counterfactual scenario some US imports of lumber for the housing sector from Canada would have been replaced by imports of lumber from other countries, and the impact would be felt in terms of the higher cost of the alternative sources of inputs. Accordingly, the reported estimates show the gains that the United States makes in jobs and output from being able to trade directly with Canada as well as with the rest of the world. There would, of course, be greater impacts of a full border closure (i.e., one that reduced to zero imports from all trading partners and exports to all trading partners). In addition, a permanent trade-related border closure (simply stopping all trade) can be quite different in effect from one limited temporarily to physical movement of persons and goods (and not, for example, electronic services).

national estimates (detailed by sector) and distribute them to states according to published sector-specific data for state output. Finally, we compute the jobs related to that output using state- and sector-specific production-to-employment ratios.

Our approach examines the impact of bilateral trade on US output and employment by accounting for the effects of both total exports and of total imports, rather than simply looking at the impact of net flows (the so-called trade deficit[4]). This approach better permits us to capture the full contribution of trade to the efficiency of US output and to employment. Exports and imports both support jobs directly, jobs tied to manufacturing goods for export, transporting goods (exports as well as imports) to and from ports (and manufacturing the trucks to transport them), warehousing traded goods (and manufacturing the materials used to build the warehouses), financing them, advertising them, etc. In addition, exports and imports make an economy more efficient and that efficiency in turn generates additional indirect output and related jobs. These latter impacts are likely to exceed the direct impacts. But net flows (the trade deficit) only capture a small piece of what creates output and related jobs.

Results

Impact on output of total trade

The impact of US–Canada trade on US national and state output is significant. Table 6 shows that trade with Canada boosted national output by $327 billion, or 2.6 percent of total GDP. Services sector output is heavily linked to trade with Canada. This includes not only services output related to services exports and imports, but also services output related to goods exports and imports (for example, wholesaling and retailing goods exported to or imported from Canada).

[4]The trade deficit is simply an accounting identity: exports less imports. What matters for evaluating the full impact of trade on any economy is not this net piece of the GDP total, but the impact of total exports and imports directly as well as indirectly on the economy as a whole.

Table 6: US National Output Related to Trade with Canada, 2005 (billions of US dollars)

Total	**$327.0**
Primary Sectors (agriculture, forestry, fishing, mining)	0.4
Construction	10.9
Manufacturing	37.8
Services	278.0
Transportation and utilities	*9.2*
Wholesale and retail trade	*52.3*
Finance and insurance	*37.7*
Other services	*178.8*
Information	*15.8*
Professional and technical	*24.1*
Management	*6.4*
Rental, leasing and real estate	*59.4*
Accommodation and food	*12.7*
Other consumer and public services	*60.3*

Source: authors' estimates

Trade with Canada also accounted for important shares of US state-level output for many states (Table 7). Not surprisingly, the states with the largest populations recorded the largest values of output related to trade with Canada: California, $43 billion (13.3 percent of the national total), Texas, $24 billion (7.3 percent of the total), New York, $26 billion (nearly 8 percent of the total), and Florida, $17 billion (5.1 percent of the total). Together these four states accounted for one-third of total national output related to trade with Canada. States for which trade with Canada accounted for relatively large shares of state output included Indiana, Delaware and Washington (2.9 percent each), and Connecticut, Iowa, Kansas, Michigan, North Carolina, Ohio and Wisconsin (2.8 percent each).

Table 7: State Output Related to Trade with Canada, 2005
(millions of US dollars)

	Value of Output	Share of Total Output	State Share of Total Output Related to Trade		Value of Output	Share of Total Output	State Share of Total Output Related to Trade
Alabama	$4,008	2.64%	1.23%	Montana	$672	2.25%	0.21%
Alaska	646	1.64	0.20	Nebraska	1,765	2.50	0.54
Arizona	5,574	2.57	1.70	Nevada	3,000	2.69	0.92
Arkansas	2,326	2.68	0.71	New Hampshire	1,496	2.72	0.46
California	43,564	2.69	13.32	New Jersey	11,737	2.72	3.59
Colorado	5.412	2.50	1.66	New Mexico	1,487	2.16	0.45
Connecticut	5,387	2.78	1.65	New York	25,697	2.68	7.86
Delaware	1,617	2.86	0.49	North Carolina	9,786	2.82	2.99
D.C.	1,848	2.26	0.57	North Dakota	566	2.32	0.17
Florida	16,946	2.52	5.18	Ohio	12,201	2.77	3.73
Georgia	9,758	2.68	2.98	Oklahoma	2,636	2.17	0.81
Hawaii	1,335	2.47	0.41	Oregon	3,956	2.74	1.21
Idaho	1,222	2.59	0.37	Pennsylvania	12,986	2.66	3.97
Illinois	15,352	2.74	4.70	Rhode Island	1,159	2.65	0.35
Indiana	6,993	2.93	2.14	South Carolina	3,811	2.72	1.17
Iowa	3,186	2.81	0.97	South Dakota	784	2.54	0.24
Kansas	2,710	2.81	0.97	Tennessee	6,142	2.66	1.88
Kentucky	3,696	2.63	1.13	Texas	23,985	2.42	7.34
Louisiana	4,036	2.40	1.23	Utah	2,330	2.57	0.71
Maine	1,152	2.56	0.35	Vermont	598	2.59	0.18
Maryland	6,240	2.53	1.91	Virginia	9,242	2.63	2.83
Massachusetts	8,722	2.68	2.67	Washington	6,943	2.90	2.12
Michigan	10,360	2.75	3.17	West Virginia	1,209	2.28	0.37
Minnesota	6,324	2.70	1.93	Wisconsin	6,047	2.80	1.85
Mississippi	2,088	2.57	0.64	Wyoming	459	1.68	0.14
Missouri	5,788	2.68	1.77	US Total	326,984	2.63	100.0

Source: authors' estimates

Impact of total trade on US jobs

As a result of the boost Canadian trade gives to US output, US jobs are also supported, both directly (in the manufacture of goods or production of services for export, for example) and indirectly (in sectors that get the goods and services out the door and

across the border to Canada). Jobs related to importing also span the service sectors, and include jobs related to transporting, wholesaling, warehousing, advertising, financing and retailing products imported from Canada, for example. In addition, it is important to note that producer services are also key inputs to manufacturing, so that goods exports indirectly support services. Our model incorporates the impact of job losses due to import competition; thus the results are net of any negative impacts of imports.

We report our estimates in Table 8. The results indicate that trade with Canada in 2005 supported 7.1 million net direct and indirect American jobs. More than half a million of these jobs are in the manufacturing sector. Services sectors account for the largest share of jobs related to trade with Canada, including such high-wage occupations as finance and insurance, legal, managerial, advertising and other professional services.

Table 8: National Employment Related to Trade with Canada, 2005

Total	**7,111,714**
Primary Sectors (agriculture, forestry, fishing, mining)	266,746
Construction	55,464
Manufacturing	522,864
Services	6,266,641
Transportation and utilities	*271,359*
Wholesale and retail trade	*235,832*
Finance and insurance	*328,202*
Other services	*5,431,247*
Information	*193,433*
Professional and technical	*391,731*
Management	*63,187*
Rental, leasing and real estate	*325,219*
Accommodation and food	*550,104*
Other consumer and public services	*3,907,573*

Source: authors' estimates, based on CGE results discussed in Appendix A

At the state level, every state experiences positive job effects from trade (exports and imports) with Canada (Table 9). The largest absolute net numbers of jobs supported by trade

with Canada were in California (832,000), Texas (522,000), New York (469,000) and Florida (405,000). Collectively, across these four states we estimate 2.2 million jobs supported by trade with Canada. For individual states, the job gains are generally in a range of 4 to 5 percent of total state-wide employment.

Table 9: State Employment Related to Trade with Canada, 2005

	Number of Jobs	Share of Total Jobs	State Share of Total Jobs Related to Trade		Number of Jobs	Share of Total Jobs	State Share of Total Jobs Related to Trade
Alabama	100,486	4.00%	1.41%	Montana	24,368	3.97%	0.34%
Alaska	19,332	4.42	0.27	Nebraska	49,697	4.09	0.86
Arizona	128,862	3.98	1.81	Nevada	61,219	4.01	0.92
Arkansas	63,323	4.07	0.89	New Hamp-shire	32,668	3.91	0.46
California	832,178	4.05	11.70	New Jersey	206,778	4.14	2.91
Colorado	123,794	4.03	1.74	New Mexico	44,418	4.18	0.62
Connecticut	90,192	4.15	1.27	New York	468,703	4.36	6.59
Delaware	21,332	4.04	0.30	North Caro-lina	208,480	4.08	2.93
D.C.	39,999	5.03	0.56	North Dakota	18,798	3.98	0.26
Florida	404,713	3.99	5.69	Ohio	276,621	4.07	3.89
Georgia	211,676	4.07	2.98	Oklahoma	81,177	3.97	1.16
Hawaii	36,893	4.42	0.52	Oregon	88,649	3.98	1.25
Idaho	33,601	3.87	0.47	Pennsylvania	295,230	4.14	4.15
Illinois	304,514	4.10	4.28	Rhode Island	25,876	4.25	0.36
Indiana	147,794	4.02	2.08	South Caro-lina	95,329	4.03	1.34
Iowa	77,912	3.96	1.10	South Dakota	21,426	3.98	0.30
Kansas	72,844	4.04	1.02	Tennessee	145,932	4.02	2.05
Kentucky	95,928	4.03	1.35	Texas	521,759	3.99	7.34
Louisiana	101,947	4.14	1.43	Utah	61,309	4.06	0.86
Maine	33,289	4.05	0.47	Vermont	17,410	4.11	0.24
Maryland	140,334	4.22	1.97	Virginia	197,038	4.17	2.77
Massachusetts	172,253	4.19	2.42	Washington	152,914	4.10	2.15
Michigan	221,492	4.02	3.11	West Virginia	36,925	4.06	0.52
Minnesota	141,194	4.03	1.99	Wisconsin	141,404	4.00	1.99
Mississippi	61,759	4.10	0.87	Wyoming	14,095	3.91	0.20
Missouri	144,851	4.05	2.04	US Total	7,111,714	4.08	100.0

Source: authors' estimates

Services sector income and employment

Close inspection of Tables 6 and 8 shows that most of our income and employment estimates are concentrated in services. There are four main reasons that, combined, lead to this outcome. The first is, quite simply, that the US economy is largely a services economy. In 2005, according to data from the US Bureau of Economic Analysis (Department of Commerce), services (including construction) accounted for 83 percent of non-farm private employment and 75 percent of private gross product. Trade with Canada means a more efficient overall US economy, and hence a general increase in economic activity, including services. Any increase in activity and employment will be largely focused on services. Second is that we are modeling direct trade in services. We capture direct linkages between exports to Canada and services production in the United States. Services are an important part of overall trade between the United States and Canada. The third reason is that manufacturing in the United States is actually quite services-intensive (Francois and Woerz 2007), so that a boost to manufacturing activity from exports to Canada has important implications for demand for intermediate services. Fourth, because we are looking at general equilibrium effects, our estimates include income linkages to services demand. This means that higher incomes lead to more demand for (and jobs linked to) consumer services. This last effect is missing from analyses that just focus on production-based input–output linkages.

Impact of changes in trade volumes and costs

Given, then, that trade supports output and jobs, it stands to reason that changes in trade and trade costs would have an impact on output and jobs. Table 10 shows the impact that a 1 percent change in trade volumes or trade costs would have on employment (or output) (referred to as "elasticities"; more detailed estimates are provided in Appendix B).

The trade-volume elasticities can be interpreted as follows. From the first row, a 1 percent increase in trade with Canada supports a 0.038 percent increase in US employment. At the same time, a 1 percent change in trade implies that total income rises by 0.026 percent across the United States. From the values reported in Table B-1 of Appendix B, for California a 1 percent increase in trade implies a 0.037 percent increase in state employment and a 0.027 percent increase in state income.

The trade-cost elasticities in the tables in Appendix B have a similar interpretation. From Table 10, a 1 percent increase in the cost of cross-border trade between the United States and Canada implies a 0.156 percent loss in employment and a 0.103 percent loss of state income. A more detailed set of trade-cost elasticities at the state level is provided in the tables in Appendix B.

Table 10: The Marginal Impact of Changes in Trade Volumes and Costs (Percent)

	Change in total state employment	Change in total Gross State Product
1% increase in trade volumes	0.038%	0.026%
1% increase in cost of trade	-0.156%	-0.103%

Conclusion

In this paper, we have explored the impact of US trade with Canada on the pattern of employment and output across US states. This has been accomplished by using a multi-region, global CGE model to estimate the economy-wide impact of US–Canadian trade. The results of this analysis indicate that the trade relationship between the United States and Canada is a definite net plus for the United States[5]. Accordingly, policies that reduce the flow of goods and services between Canada and the United States result in adverse impacts on jobs and growth in the United States, impacts that are felt in every US state. For example, policy actions that have the effect of reducing US exports of goods or

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

services to Canada would directly reduce US goods and services output, and related jobs. Perhaps less expected by policy-makers is the finding that actions that reduce US imports of goods and services from Canada would also have a negative net impact on US output and related employment. This should not be surprising, given the integrated nature of North American manufacturing industries and the important role of services in these continental industries. The results reported here suggest that these broader impacts should be factored into policy considerations with likely impacts on trade flows.

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Appendix A: Methodology

Different options are available to estimate trade linkages to employment and output. One involves manipulation of input–output tables to map the linkages between exports and/or imports to labour demand and total output across sectors. 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. Second, there may be double counting, as the net effect of exports and imports is not the simple sum of export effects and import effects. Third, such an approach may also overestimate effects unless the impact of substitution toward trade with the rest of the world is also included.

To address these various issues, we applied a computable multi-sector model of the US economy. Computable general equilibrium (CGE) models are characterized by an input–output structure (based on regional and national input–output and employment tables) that explicitly link industries in a value-added chain from primary goods, over continuously higher stages of intermediate processing, to the final assembling of goods and services for consumption. Inter-sectoral linkages are direct, like the input of steel in the production of transport equipment, and indirect, via intermediate use in other sectors. The model captures these linkages by modelling firms' use of factors of production (labour and capital) and intermediate inputs. The most important aspects of the model can be summarized as follows: it covers all world trade and production, and it includes intermediate linkages between sectors.

Data

Our data come from a number of sources. Data on production and trade are based on national social-accounting data linked through trade flows (see Reinert and Roland-Holst 1997). The input–output structure of our data is drawn from the most recent version of the Global Trade Analysis Project dataset, version 6.2 (Dimaranan and McDougall 2006). In this version of the

dataset, the underlying input–output table for the United States is for the year 2004. (Earlier versions of GTAP 6 are based on 1992 input–output tables.) The GTAP version 6.2 dataset itself is benchmarked to 2001 values (where the social-accounting data have been rebalanced based on the input–output coefficients, combined with values of production, wages, and output in 2001, and also 2001 trade values). Because the data are structured to reflect the value flows in the US economy in 2001, we built a modified database that reflects the US and Canadian economies (production and trade) in 2005. Our 2005 database includes detailed national input–output flows (from the GTAP tables combined with 2005 value data), trade, and final demand structures. The basic social-accounting and trade data are supplemented with trade policy data, including additional data on tariffs and non-tariff barriers. The data are further supplemented with data from the US Department of Labor on state-level employment and from the US Bureau of Economic Analysis on state-level output. These data allow us to map nationwide effects to state-level changes in employment and output.

The data on tariffs are taken from the World Trade Organization's integrated database, with supplemental information from the World Bank's recent assessment of detailed pre- and post-Uruguay Round tariff schedules and from the UNCTAD/World Bank WITS dataset. All of this tariff information has been concorded to GTAP model sectors within the version 6.2 database. The sectors in the model are shown in Table A-1. Regions are aggregated into the United States, Canada, Mexico, and rest-of-world.

Table A-1: Model Sectors

Model Sectors	Corresponding GTAP Sectors
1. Agriculture, forestry, and fisheries	1–14
2. Mining	15, 16, 17, 18
3. Utilities	43–45
4. Construction	46
5. Durable goods manufacturing	30,34–42
6. Nondurable goods manufacturing	19–29,31-33
7. Wholesale and retail trade	47
8. Transportation	48, 49, 50
9. Information services	51
10. Finance and insurance	52–53
11. Other business services	54
12. Other consumer services	55
13. Real estate	57
14. Public services	56

The Model

Single representative, composite households comprise each region, with expenditures allocated over personal consumption and savings. The composite household owns endowments of the factors of production and receives income by selling them to firms. It also receives income from tariff revenue and rents accruing from import and 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 a national level. Firms are competitive, and employ capital and labour to produce goods and services subject to constant returns to scale[6]. Products from different regions are

[6]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

assumed to be imperfect substitutes in accordance with the so-called Armington assumption. Table A-2 shows the trade elasticities used to model Armington demand for imports[7].

Table A-2: Substitution Elasticities

		Substitution Elasticities		
		Between competing sources of imports	Between domestic products and imports	Between capital and labour (i.e. value added)
		A	B	C
1.	Agriculture, forestry, fisheries	13.44	6.72	0.20
2.	Mining	5.60	2.80	1.26
3.	Utilities	3.80	1.90	1.40
4.	Construction	7.63	3.82	1.26
5.	Durable goods manufacturing	6.26	3.13	1.22
6.	Nondurable goods manufacturing	3.80	1.90	1.68
7.	Trade	3.80	1.90	1.68
8.	Transportation services	3.80	1.90	1.26
9.	Information services	3.80	1.90	1.26
10.	Finance and insurance	3.80	1.90	1.26
11.	Other business services	3.80	1.90	1.26
12.	Other consumer services	3.80	1.90	1.26
13.	Real estate	3.80	1.90	1.26
14.	Public services	13.44	6.72	0.20

Source: GTAP database, version 6.2

The trade substitution elasticities reported in Table A-2 show the ease with which imports can be substituted for each other (column A), and the ease with which they can be substituted for domestic goods (column B). For example, for durable goods a 1 percent increase in the price of Canadian imports

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can be viewed as generating a lower-bound estimate of effects relative to alternative CGE modelling structures.

[7]Model results depend on the assumptions made concerning the underlying trade elasticities. The elasticities used here are the standard set of elasticities for the Global Trade Analysis Project database. We performed a sensitivity analysis to show the impact of varying these assumptions; the results are shown in Table A-3.

causes a 7.63 percent increase in the ratio of imports of non-Canadian to Canadian-source imports. Similarly, a 1 percent increase in the price of imports of durable goods leads to a 3.82 percent increase in the ratio of domestic to imported consumption. In other words, elasticities quantify the degree to which firms and consumers shift between imports and domestic goods as relative prices change.

We were interested in the impact of trade with Canada on state economies given the current US wage structure. To quantify these linkages, we employ a labour-market closure (equilibrium condition); under this approach, 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.

Experiments

The experiments conducted with the model involve imposing changes in US–Canada trade. This allows us to trace changes at the border as they work through the US economy. Our experiment involved one change to 2005 trade flows: a shut-down of Canadian goods and services exports to the United States simultaneously with a shutdown in US goods and services exports to Canada[8].

[8]This is accomplished by making a set of bilateral export taxes 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.

Table A-3: Sensitivity Analysis with Respect to Trade Elasticities: Ranging One Standard Deviation above and below Mean Values

	state employment			gross state product		
	lower	mean	upper	lower	mean	upper
United States	2,948,103	7,111,714	11,275,326	135,548	326,984	518,419
Alabama	41,631	100,486	159,340	1,660	4,008	6,355
Alaska	7,965	19,332	30,698	266	646	1,026
Arizona	53,442	128,862	204,282	2,311	5,574	8,836
Arkansas	26,057	63,323	100,590	957	2,326	3,694
California	345,296	832,178	1,319,060	18,076	43,564	69,052
Colorado	51,275	123,794	196,314	2,242	5,412	8,582
Connecticut	37,558	90,192	142,826	2,243	5,387	8,531
Delaware	8,890	21,332	33,774	674	1,617	2,560
District of Columbia	16,832	39,999	63,165	778	1,848	2,919
Florida	168,169	404,713	641,256	7,042	16,946	26,851
Georgia	87,758	211,676	335,593	4,045	9,758	15,470
Hawaii	15,418	36,893	58,368	558	1,335	2,112
Idaho	13,845	33,601	53,356	503	1,222	1,940
Illinois	126,169	304,514	482,859	6,361	15,352	24,343
Indiana	61,058	147,794	234,530	2,889	6,993	11,096
Iowa	32,140	77,912	123,685	1,314	3,186	5,058
Kansas	30,021	72,844	115,668	1,117	2,710	4,304
Kentucky	39,411	95,928	152,445	1,518	3,696	5,874
Louisiana	42,078	101,947	161,817	1,666	4,036	6,406
Maine	13,868	33,289	52,709	480	1,152	1,825
Maryland	58,576	140,334	222,093	2,605	6,240	9,876
Massachusetts	71,799	172,253	272,707	3,636	8,722	13,808
Michigan	91,792	221,492	351,193	4,293	10,360	16,427
Minnesota	58,496	141,194	223,892	2,620	6,324	10,028
Mississippi	25,523	61,759	97,996	863	2,088	3,313
Missouri	59,997	144,851	229,704	2,397	5,788	9,178
Montana	10,054	24,368	38,682	277	672	1,067
Nebraska	20,494	49,697	78,900	728	1,765	2,802
Nevada	25,377	61,219	97,060	1,244	3,000	4,757
New Hampshire	13,600	32,668	51,736	623	1,496	2,370
New Jersey	85,993	206,778	327,564	4,881	11,737	18,592
New Mexico	18,382	44,418	70,453	616	1,487	2,359
New York	195,849	468,703	741,556	10,738	25,697	40,657
North Carolina	86,632	208,480	330,329	4,067	9,786	15,506
North Dakota	7,735	18,798	29,860	233	566	900
Ohio	114,639	276,621	438,604	5,056	12,201	19,345
Oklahoma	33,569	82,177	130,785	1,077	2,636	4,195
Oregon	36,649	88,649	140,649	1,635	3,956	6,276
Penn- sylvania	122,627	295,230	467,832	5,394	12,986	20,578
Rhode Island	10,807	25,876	40,944	484	1,159	1,835
South Carolina	39,642	95,329	151,015	1,585	3,811	6,036
South Dakota	8,865	21,426	33,987	324	784	1,243
Tennessee	60,248	145,932	231,616	2,536	6,142	9,749
Texas	214,502	521,759	829,016	9,860	23,985	38,109
Utah	25,392	61,309	97,226	965	2,330	3,696
Vermont	7,248	17,410	27,572	249	598	948
Virginia	81,904	197,038	312,172	3,842	9,242	14,643
Washington	63,483	152,914	242,345	2,882	6,943	11,003
West Virginia	15,175	36,925	58,676	497	1,209	1,921
Wisconsin	58,465	141,404	224,344	2,500	6,047	9,594
Wyoming	5,670	14,095	22,521	185	459	733

Based on Gaussian quadrature, where standard error=0.5*elasticity and where nesting is imposed so that the lower-level Armington elasticity = ½ the upper-level Armington elasticity. Given the actual uncertainty surrounding GTAP trade elasticities, we have overestimated the confidence bounds.

Appendix B: Marginal Impact of Trade on Jobs and GSP: Elasticities Analysis

The first two columns in Table B-1 at the end of this Appendix B provide estimates of the marginal impact of trade on state-level employment and gross state product (GSP). Technically, the numbers in the table are elasticities. This means that they measure the percentage change in employment (or GSP) associated with a 1 percent change in trade. The output and employment elasticities are defined as follows:

Output elasticity = %ΔGSP / %ΔTrade	(1)
Employment elasticity = %ΔEmployment / %ΔTrade	(2)

Columns 2 and 3 in Table B1 report the results. For total US GSP across all states, the output elasticity is 0.026 (top row, column 3). This means that a 10 percent drop in trade maps to a 10%*0.026=0.26 percent drop in total state GSP. For a full closure of trade, the value is approximately 100%*0.026=2.6%. From Table 6 of the main text, our exact estimate is 2.63%, approximated by the value implied by the elasticity in the Table B-1. The same relationships hold with all values in Tables B-1, B-2 and B-3.

Similarly, for total US employment across all states, the employment elasticity is 0.038 (top row, column 2). This implies that a 10 percent increase (or reduction) in trade would imply a 0.38 percent increase (or drop) in US jobs.

The state-level impacts are interpreted in a similar fashion. Thus, for California, a 1 percent increase in trade implies a 0.037 percent increase in state employment and a 0.027 percent increase in state income.

Columns 4 and 5 of Table B-1 focus on a different aspect of the same issue. They also report elasticities. However, these involve changes in state employment and GSP that result from a 1 percent increase in trade costs (the cost of delivering goods

across the border, measured as a share of the price of goods and services traded.) From the table, a 1 percent increase in the cost of trade implies a 0.156 percent drop in US employment and a 0.103 percent drop in incomes at the state level. Choosing California again as an example, this means that an increase in border costs equal to 1 percent (10 percent) of the price of traded goods and services implies a 0.155 percent (1.55 percent) drop in state employment in California and a 0.104 percent (1.04 percent) drop in state income.

Table B-2 provides a state breakdown for employment by broad sectors. The values in the table are again elasticities. However, this time they are reported for primary, manufacturing, and service sector employment linked to the level of trade with Canada.

Finally, Table B-3 provides a breakdown for state-level GSP by broad sectors.

Table B-1: State Employment and GSP Elasticities: Trade with Canada

	% impact of 1% change in trade volumes		% impact of 1% change in cost of trade	
	jobs	GSP	jobs	GSP
United States	0.038	0.026	-0.156	-0.103
Alabama	0.037	0.026	-0.154	-0.103
Alaska	0.041	0.017	-0.170	-0.062
Arizona	0.037	0.026	-0.152	-0.099
Arkansas	0.038	0.026	-0.156	-0.105
California	0.037	0.027	-0.155	-0.104
Colorado	0.037	0.026	-0.154	-0.096
Connecticut	0.038	0.028	-0.159	-0.109
Delaware	0.037	0.028	-0.155	-0.113
District of Columbia	0.047	0.024	-0.194	-0.086
Florida	0.037	0.026	-0.153	-0.097
Georgia	0.038	0.027	-0.156	-0.106
Hawaii	0.041	0.026	-0.169	-0.095
Idaho	0.036	0.026	-0.148	-0.099
Illinois	0.038	0.027	-0.157	-0.107
Indiana	0.037	0.028	-0.154	-0.115
Iowa	0.037	0.027	-0.151	-0.110
Kansas	0.038	0.026	-0.155	-0.099
Kentucky	0.038	0.026	-0.154	-0.103
Louisiana	0.038	0.024	-0.159	-0.096
Maine	0.038	0.026	-0.155	-0.100
Maryland	0.039	0.026	-0.162	-0.099
Massachusetts	0.039	0.027	-0.161	-0.104
Michigan	0.037	0.027	-0.154	-0.106
Minnesota	0.038	0.027	-0.154	-0.105
Mississippi	0.038	0.026	-0.157	-0.100
Missouri	0.038	0.027	-0.155	-0.105
Mon- tana	0.037	0.023	-0.152	-0.086
Nebraska	0.038	0.025	-0.156	-0.097
Nevada	0.036	0.028	-0.153	-0.103
New Hampshire	0.036	0.027	-0.150	-0.106
New Jersey	0.038	0.027	-0.159	-0.108
New Mexico	0.039	0.022	-0.160	-0.082
New York	0.040	0.027	-0.167	-0.105
North Carolina	0.038	0.028	-0.157	-0.113
North Dakota	0.037	0.023	-0.152	-0.089
Ohio	0.038	0.027	-0.156	-0.108
Oklahoma	0.037	0.022	-0.152	-0.084
Oregon	0.037	0.027	-0.152	-0.105
Penn- sylvania	0.038	0.026	-0.159	-0.105
Rhode Island	0.039	0.026	-0.163	-0.103
South Carolina	0.037	0.027	-0.155	-0.107
South Dakota	0.037	0.025	-0.152	-0.097
Tennessee	0.037	0.026	-0.154	-0.105
Texas	0.037	0.024	-0.152	-0.095
Utah	0.038	0.026	-0.155	-0.099
Vermont	0.038	0.026	-0.157	-0.100
Virginia	0.038	0.027	-0.160	-0.103
Washington	0.038	0.026	-0.157	-0.100
West Virginia	0.038	0.023	-0.156	-0.089
Wisconsin	0.037	0.027	-0.153	-0.110
Wyoming	0.036	0.018	-0.149	-0.064

Note: all elasticities are significant at the 5% level, based on Gaussian quadrature sensitivity analysis of estimates with respect to uncertainty about values of trade elasticities.

Table B-2: Detailed State Employment Elasticities: Trade with Canada

	% impact of a 1% change in trade volumes on employment		
	primary	manufacturing	services
United States	0.043	0.034	0.039
Alabama	0.050	0.034	0.038
Alaska	0.011	0.038	0.043
Arizona	0.028	0.032	0.037
Arkansas	0.061	0.035	0.040
California	0.036	0.034	0.038
Colorado	0.029	0.033	0.038
Connecticut	0.054	0.033	0.039
Delaware	0.066	0.036	0.038
District of Columbia	0.019	0.037	0.047
Florida	0.034	0.033	0.037
Georgia	0.054	0.035	0.038
Hawaii	0.069	0.037	0.041
Idaho	0.058	0.034	0.038
Illinois	0.070	0.034	0.039
Indiana	0.091	0.033	0.039
Iowa	0.155	0.034	0.039
Kansas	0.059	0.034	0.040
Kentucky	0.059	0.034	0.040
Louisiana	0.015	0.035	0.040
Maine	0.031	0.035	0.039
Maryland	0.047	0.035	0.039
Massachusetts	0.028	0.033	0.039
Michigan	0.060	0.032	0.038
Minnesota	0.109	0.034	0.039
Mississippi	0.052	0.033	0.040
Missouri	0.128	0.034	0.039
Montana	0.048	0.034	0.039
Nebraska	0.125	0.035	0.040
Nevada	0.009	0.033	0.037
New Hampshire	0.038	0.032	0.037
New Jersey	0.050	0.036	0.039
New Mexico	0.022	0.033	0.040
New York	0.047	0.034	0.041
North Carolina	0.061	0.035	0.039
North Dakota	0.088	0.033	0.040
Ohio	0.066	0.033	0.039
Oklahoma	0.029	0.033	0.040
Oregon	0.053	0.033	0.039
Pennsylvania	0.043	0.034	0.039
Rhode Island	0.025	0.033	0.040
South Carolina	0.057	0.035	0.038
South Dakota	0.147	0.033	0.039
Tennessee	0.130	0.034	0.039
Texas	0.022	0.034	0.038
Utah	0.035	0.033	0.039
Vermont	0.056	0.033	0.039
Virginia	0.056	0.034	0.039
Washington	0.044	0.033	0.039
West Virginia	0.015	0.034	0.040
Wisconsin	0.119	0.034	0.039
Wyoming	0.010	0.034	0.040

Table B-3: Detailed GSP Elasticities: Trade with Canada

	% impact of a 1% change in trade volumes on GSP		
	primary	manufacturing	services
United States	0.004	0.020	0.025
Alabama	0.005	0.020	0.024
Alaska	0.000	0.020	0.023
Arizona	0.005	0.020	0.025
Arkansas	0.007	0.020	0.024
California	0.007	0.020	0.026
Colorado	0.002	0.020	0.026
Connecticut	0.008	0.020	0.026
Delaware	0.010	0.020	0.027
District of Columbia	0.005	0.020	0.023
Florida	0.009	0.020	0.025
Georgia	0.007	0.020	0.025
Hawaii	0.009	0.020	0.025
Idaho	0.009	0.020	0.025
Illinois	0.006	0.020	0.025
Indiana	0.006	0.020	0.024
Iowa	0.009	0.020	0.024
Kansas	0.006	0.020	0.024
Kentucky	0.004	0.020	0.023
Louisiana	0.001	0.020	0.024
Maine	0.010	0.020	0.024
Maryland	0.007	0.020	0.025
Massachusetts	0.008	0.020	0.025
Michigan	0.007	0.020	0.025
Minnesota	0.008	0.020	0.025
Mississippi	0.005	0.020	0.024
Missouri	0.007	0.020	0.025
Montana	0.005	0.020	0.024
Nebraska	0.010	0.020	0.024
Nevada	0.001	0.020	0.028
New Hampshire	0.008	0.020	0.026
New Jersey	0.007	0.020	0.026
New Mexico	0.001	0.020	0.024
New York	0.007	0.020	0.026
North Carolina	0.009	0.020	0.025
North Dakota	0.006	0.020	0.024
Ohio	0.005	0.020	0.024
Oklahoma	0.001	0.020	0.024
Oregon	0.010	0.020	0.025
Pennsylvania	0.004	0.020	0.024
Rhode Island	0.008	0.020	0.025
South Carolina	0.008	0.020	0.024
South Dakota	0.009	0.020	0.025
Tennessee	0.007	0.020	0.024
Texas	0.001	0.020	0.025
Utah	0.002	0.020	0.025
Vermont	0.008	0.020	0.024
Virginia	0.005	0.020	0.025
Washington	0.010	0.020	0.025
West Virginia	0.001	0.020	0.023
Wisconsin	0.009	0.020	0.024
Wyoming	0.000	0.020	0.025