CANADA-U.S. REGIONAL TRADE

THE INFLUENCE OF INDUSTRIAL AND SPATIAL STRUCTURE ON CANADA-U.S. REGIONAL TRADE

By

WILLIAM MARK BROWN, M.A.

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AUTHOR: William Mark Brown, M.A. (McMaster University)

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ABSTRACT

The purpose of this dissertation is to determine the influence of spatial and industrial structure on the volume and composition of trade among Canadian and American regions. In so doing, it is intended to provide a better understanding of the causes and effects of trade on regions, the potential for further economic integration and the policy implications thereof.

Both empirical and analytical modelling methods are used to analyse regional trade. Empirically, it is found that Canada-U.S. trade is heavily influenced by the spatial configuration of regions as well as their industrial composition. It is also established that after controlling for distance and the industrial composition, there is a strong potential for further economic integration among Canadian and American regions. However, this potential is less than other studies have suggested.

Using an analytical model, it is demonstrated that the welfare implications of economic integration depends on the relative size of the trading regions, their respective national markets and the tradeability of intermediate goods.

Finally, the analysis shows that the potential for public policy to influence the degree of integration and what form those policies might take depends crucially on the characteristics (geographic and industrial) of the trading regions.

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PREFACE

The four substantive chapters (Chapters 2-5) included in this dissertation are papers that have been submitted to several journals for publication. The names of the journals are noted at the beginning of each chapter. Chapters 2, 3 and 4 are co-authored by myself and William Anderson. In all three cases, the majority of the conceptualization, analysis and writing was undertaken by myself. William Anderson's contribution to these papers derives from numerous consultations that we had while the papers were developed as well as editorial work.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 2

CHAPTER 4

CHAPTER 5

LIST OF FIGURES

CHAPTER 1

CHAPTER 2

INTRODUCTION

"With the rise of low-cost transportation and communications, the world has shrunk but regions have grown – often spilling over national boundaries."
Silas Keehn, President, Federal Reserve Bank of Chicago and Henry K. Hanka, Chairman, Great Lakes Commission

The thesis of this dissertation is that the spatial configuration of production and industrial structure have a strong influence on the volume and composition of trade. That is, the location of regions relative to each other – their situation – and the characteristics of the industrial sectors in which they are specialized controls the degree of economic integration that we observe. As such, an understanding of why these are strong determinants of trade can help us to establish what are the potential impacts of trade, the likelihood of further economic integration and the policy implications thereof.

The geographic focus of this research is Canada and the United States and their respective regions at the scale of provinces and states. The economic relationship between these countries spans a continent, but as the reader will be constantly reminded, it is very much regional in nature. A few pairs of regions characterized by similar industrial structures and close geographic proximity tend to dominate the relationship.

One of the reasons for focussing on the trade with the United States is

Canada's growing reliance on America as a destination for its exports and as a source of imports. The origins of this trend can be traced largely to a shift in Canada's trade policy away from the high tariff barrier established under the National Policy, which forced an east-west pattern of trade on the country. Tariffs and non-tariff barriers have been reduced through successive multilateral rounds of negotiations (Kennedy, Tokyo and Uruguay) under the General Agreement on Trade and Tariffs (GATT). Under the terms of the GATT, member nations are allowed to negotiate separate preferential trade agreements (Article XXIV). Canada has taken advantage of this provision and negotiated several trade agreements with the United States. The most prominent are the 1965 Auto Pact, which led to an integrated market in cars and parts, the 1989 Canada U.S. Free Trade Agreement and the 1993 North American Free Trade Agreement, which includes Mexico (see Frankel, 1997 and WTO, 1995, cited in Frankel, for a discussion of recent trade agreements).

Canada's growing openness to world trade implies that internal trade is becoming less important. In a recent publication, Statistics Canada (1998) reports interprovincial trade rose by approximately fifty percent between 1984 and 1996. Over the same period, Canadian exports abroad rose 140% and imports by almost 150%. The implication is that Canada is becoming more integrated into the world economy, and because the United States is Canada's most important trading partner, the U.S. economy. This trend begs the question, what are the economic forces that are driving Canada's rapid integration into the American economy?

For much of this century, the discourse surrounding the causes and effects of trade has been dominated by the Heckscher-Ohlin theorem (Ohlin, 1933) or what is more broadly termed factor proportions theory. The theorem states that countries will export those goods whose production is intensive in the factors of production (e.g., labour) that they have in relative abundance compared to other nations. Essentially, comparative advantage is generated by the differences in the factor endowments of each country.

Although the Heckscher-Ohlin theorem continues to provide considerable insight into the patterns of world trade, it yields an incomplete explanation. The predictions of the theorem are inconsistent with world trade patterns in several ways, but I will focus on two here. First, based on the logic of the theorem, trade occurs because of the differences between countries. However, much of world trade is among the developed nations that have relatively similar factor endowments (at least compared with underdeveloped nations). Furthermore, per capita trade between these nations has expanded since the Second World War, even though their factor endowments have become increasingly similar over the same period (Helpman and Krugman, 1985).

Second, a large proportion of trade is in the same types of products or intra-industry trade (Grubel and Lloyd, 1975 and Helpman and Krugman, 1985). The Heckscher-Ohlin theorem predicts that countries would have a comparative advantage across whole industries. For example, China exports clothing because its relatively large pool of labour provides it with a comparative advantage in goods that are labour intensive to produce. We would not expect China to import clothing.

The inability of the Heckscher-Ohlin theorem to explain such a large proportion of world trade led scholars in the late 1970's and early 1980's to turn to increasing returns as an additional explanation for trade (see Grubel and Lloyd, 1975; and Krugman, 1979 and 1980). When firms operate under conditions of increasing returns they find that as output increases the cost of producing a unit of output falls. Therefore, if we have two plants, one in Canada and one in the United States, producing different varieties of the same product (e.g., cars), both firms would find it beneficial to sell to the other market, generating intra-industry trade.

Recognizing the presence of increasing returns also implies that production must be concentrated in space. If the size of the plant had no effect on unit costs, we could produce everything everywhere. In fact, this is what the Heckscher-Ohlin theorem assumes – the whole economy could take place in everyone's backyard (Krugman, 1995).

The friction of distance when combined with increasing returns generates the basis for industrial agglomeration. That is, the larger the accessible market, the lower the costs that firms incur. Therefore, firms producing both final and intermediate goods would want to be close to their customers (Venebles, 1996). In turn, consumers, be they people or firms, would want to be close to where the products are produced.

Factor markets act against industrial agglomeration. As firms cluster in the same place factor prices tend to be bid upwards. At some point the benefits of being close to suppliers and customers, which are generated by increasing returns and the friction of distance, are overwhelmed and production may disperse. The interaction between factors markets, increasing returns, and the friction of distance can influence whether industry will be concentrated or dispersed (Krugman and Venebles, 1995; Venebles, 1996).

Together, these factors also determine, at least in part, the impact of trade on regions. That is, if production is concentrated in and differentiated over space, the impacts of trade will necessarily vary over space. If there are external economies associated with the agglomeration of industry these economies may spill over the border, potentially inducing large volumes of trade in intermediate goods. On the other hand, if these external returns are spatially circumscribed they may provide a cost advantage to the region with a large home market.

There are several research questions that follow from the empirical trends noted above and the theoretical progress made over the past twenty or so years. First, what is the pattern and composition of Canada-U.S. interregional trade? That is, to what degree does spatial proximity influence the volume of trade and the types of goods that are traded? If intra-industry trade is driven by increasing returns, this trade may be more sensitive to the friction of distance since it is far easier to replicate the benefits of increasing returns than the advantages that accrue from factor endowments.

Second, under what circumstances might economic integration positively or negatively affect regions and their respective countries? The geographic proximity of regions that have specialized in similar industries to serve their respective national markets may allow them to benefit from external returns that spill over the border. Intermediate goods producers in both regions may specialize to serve downstream firms on both sides of the border. However, if these regions are located too far apart, distance related costs may outweigh the benefits of specialization on the part of intermediate goods producers. Therefore, if one region is smaller than the other it may be put at a competitive disadvantage if trade barriers are eliminated.

Third, how do variation in the demand for goods, distance related costs and the border affect the pattern of trade? As will be argued in the text below, the effect of the border on trade flows can be taken as a measure of the potential for increased interregional trade across the Canada-U.S. frontier. If the volume of trade is influenced by the spatial configuration of production and variations in industrial demand across regions, so will be the potential for increased trade among Canadian and American regions. Furthermore, if increased economic integration leads to production efficiencies, then any measure of potential may also be a rudimentary measure of variations in the benefits of trade.

If the potential for trade varies over space, what is the role of trade policy at the scale of states and provinces? Given that national governments have relinquished control over their borders, the role of trade policy and its geographic focus has shifted to the scale of states and provinces and the control that they exercise over their economic environment.

The dissertation is organized into four papers, which address each of the four questions outlined above in order. Although each paper can stand on its own, they are all closely connected with each other and the thesis. Taken as a whole, the papers can be thought of as follows. The first paper, which is empirical in nature, directly addresses the thesis that industrial structure and spatial structure influence the pattern and composition of Canada-U.S. trade. It shows that they do have a strong influence and that if we are to understand the economic relationship between Canada and the United States a regional approach is necessary. The second paper takes some of the stylized facts from the first and asks how liberalized trade might affect regions and their respective countries. It shows using an analytical model that the impact of trade on regions depends on the geographic pattern of production prior to free trade and the size of the two national economies. If the pattern of production is such that intermediate goods are tradeable among regions that specialize in the same industries, trade may lead to substantial welfare gains at the regional scale. However, if intermediates are non-tradeable, the small nation's region may suffer a large loss of welfare, even though the small nation as a whole may benefit. Therefore, there may be a divergence between the national and regional interests.

The third paper attempts to quantify the influence of the friction of distance, other factors that affect costs, the location of demand and Canada as an origin on trade. It applies a theoretically derived trade flow model to province-to-state flows of goods as well as state-to-state flows. By using state to state flows as a benchmark of economic integration, the influence of Canada as an origin can be measured. If the model is able to account for all relevant variables affecting trade, the influence of the border can be taken as a measure of trade potential.

The fourth paper takes advantage of this characteristic of the trade flow model, and asks how the potential for trade varies over space. Based on these measures, it is possible to infer between which regions the potential for increased trade is the greatest. This can be used as a means to identify transnational regions and what policies might assist in their development.

The three empirical papers (first, third and fourth) take advantage of a unique data base developed by Statistics Canada that measures flows between Canadian and American regions with a very high level of commodity detail (Statistics Canada, 1996). These data allow the analysis of flows with a sufficient degree of geographic and commodity detail to address many of the research questions posed in these papers. Furthermore, when combined with data collected by the Bureau of the Census (1997) on commodity flows among U.S. states, which can be used as a benchmark of economic integration, further insight can be gained into the causes of these flows and the potential for further integration of Canada into the American economy.

In closing, this dissertation is the product of three important factors. The first is the development of trade models over the past twenty years, and in particular during the 1990s, that are able to take into account increasing returns and the friction of distance. Although many of the ideas presented in these models are not new, they are addressed with a degree of rigour that allows them to make more forceful arguments and, at times, generate genuine insights. The second factor is the very rapid integration of the Canadian and American economies that has taken place over the past ten years. This trend makes the study of the causes and impacts of trade, especially at the regional scale, timely and I hope informative. Finally, without the availability of interregional trade flow data in Canada and the United States, which did not exist just a few years ago, the research presented below would not have been possible.

CHAPTER 2

The Influence of Industrial and Spatial Structure on Canada-U.S. Regional Trade[1]

Introduction

Over the past twenty years, there has been a growing recognition that, in addition to relative differences in factor endowments (Ohlin, 1933), increasing returns to scale may also provide an explanation for trade (Helpman and Krugman, 1985). The primary purpose of this paper is to explore how these forces interact to produce the spatial pattern of trade flows observed between Canadian and American regions. We find, not surprisingly, that regions that are in close proximity have the most highly integrated economies. However, some variations in the level of integration between regions appears to be independent of their relative locations. These inconsistencies are related, at least in part, to the relationship between the supply and demand for intermediate inputs. Trade is strongest between regions with similar industrial structures, but this trade tends to be limited to regions in close geographic proximity. As the distance between regions increases, trade based on different but

[1]This paper has been accepted for publication in *Growth and Change* under the following citation: Brown, W. M. and W. P. Anderson (1999) The Influence of Spatial and Industrial Structure on Canada-U.S. Regional Trade. *Growth and Change*. forthcoming.

complementary industrial structures becomes increasingly dominant. Ultimately, the analysis leads us to the conclusion that there are important relationships among industrial structure, the geographic configuration of production, and the volume and composition of trade.

The remainder of the paper is organized as follows. First, we outline the theoretical context in which the paper is set. Following this, we describe the geographically and sectorally detailed U.S.- Canada trade data set employed in our analysis. After presenting some aggregate flows, we calculate an index that measures the degree of integration between pairs of Canadian and American regions. Our analysis then focuses on intermediates goods trade, which accounts for much of the variability in integration. We calculate a second index which measures the importance of intra-industry (as opposed to inter-industry) trade and observe that this index appears to decline with distance. We then examine some data for individual industries to ensure that this relationship is not simply an artifact of variations in industrial structure. In the concluding section, we discuss some of the theoretical and policy implications of the analysis and some future research directions.

Theoretical context

For much of this century, the discourse surrounding international trade has been dominated by the Heckscher-Ohlin (H-O) theorem. The theorem is based on the principle that a country will export those goods whose production is intensive in the factors of production that it has in relative abundance (Ohlin, 1933). Although the H-O theorem continues to be a useful tool to understand world trade, it leaves a significant proportion of it unexplained. The predictions of the theorem are inconsistent with the patterns of world trade in several ways. We will focus, however, on just two here. First, based on the logic of the theory, trade occurs because of the inherent differences between countries. Much of world trade, however, is among the developed nations, which have relatively similar factor endowments, at least compared to less developed countries. Furthermore, per capita trade between these nations has expanded since the Second World War, even though they have become increasingly similar over the same period. Second, a large proportion of world trade consists of bidirectional flows of the same types of products, what is often referred to as intra-industry trade. The H-O theorem predicts that a country would have a comparative advantage across whole industries, and as such, is unable to explain this type of trade (Helpman and Krugman, 1985).

These inconsistencies led scholars in the late 1970's and early 1980's to turn, or what may be more aptly termed return (Buchanan and Yoon, 1994), to increasing returns to scale as an additional explanation for trade (see Krugman, 1979, 1980 and Helpman and Krugman, 1985). Based on this model, expanding markets allowed firms to produce fewer varieties with longer production runs, which results in lower unit costs because of reduced down time and the application of more specialized equipment (Grubel and Lloyd, 1975)[2]. The potential savings that result from the specialization of production within plants has long been identified as a reason for countries with small internal markets, like Canada, to push for trade liberalization (see Wonnacott and Wonnacott, 1967).

Recognizing the presence of increasing returns also implies that production must be concentrated in space. That is, if increasing returns are significant, markets may only be efficiently served by a few plants and by implication only a few places (Krugman, 1991a). In contrast, under conditions of constant returns, which is one of the underlying assumptions of the H-O theorem, the scale of production has no effect on costs – production can take place everywhere and at any scale.

Combining the friction of distance with increasing returns generates the basis for industrial agglomeration. That is, if increasing returns in the production of intermediate goods are passed on as external returns to downstream industry, and there are costs associated with the movement of intermediate goods, those external returns may be spatially circumscribed. As such, they provide an incentive for regional specialization (see Krugman and Venebles, 1995; Venebles, 1996). Both upstream and downstream firms would want to be close to each other (Venebles, 1996).

If these external returns stretch over an international border, they may also form a basis for regional economic integration. That is, intermediate input suppliers

[2]We should note that the presence of fixed costs in production are essential for this argument. If the demand for each variety is low, it is to the firms advantage to produce a large number of varieties in its plant in order to have enough sales to cover fixed costs. Without fixed costs to overcome, each variety would be produced in its own small plant.

may specialize in order to supply industry on both sides of the border. What this implies is that we would expect integration to be greatest among regions with similar industrial structures. The extensive trade in auto parts that we observe between Ontario and the Great Lakes states is an example of this form of cross-border economic integration.

The expectation that trade is greatest between regions with similar industrial structures contradicts the usual expectation that trade in intermediates is greatest between regions that specialize in different industries with strong input-output relationships (e.g., textiles and apparel). If regional specialization is the result of relative differences in factor endowments, this trade is consistent with the H-O theorem. As we will show, we find trade patterns that are consistent with both types of regional relationships.

We can take the logic that we have described so far a step further and argue that trade in intermediate goods between regions with similar industrial structures is more likely to occur if they are in close geographic proximity and, on the other hand, trade between regions with dissimilar industrial structures will be far less sensitive to the geographic proximity of the trading regions. This is based on the principle that increasing returns are often easier to replicate than factor advantages. That is, unless increasing returns are particularly strong and/or the friction of distance is fairly low, it may be more cost effective for downstream industry to buy from local suppliers than to import from far away[3]. On the other hand, factor advantages are not as easily replicated. Often they are location specific (e.g., natural resource inputs) or take a considerable amount of time to move over space (e.g., labor). Therefore, they are potentially much less sensitive to distance. In the language of spatial interaction theory, there are fewer intervening opportunities (Ullman, 1980).

A conceptual view of cross-border trade in intermediate goods that is based on the hypothesis described above (and is consistent with the findings presented below) is summarized by Figure 1. It describes the relationship between industrial structure, the geographic configuration of regions, and the composition and volume of regional trade. The shaded triangles represent different industries that supply inputs to the final goods industry (the circles). They are relatively far away from the final goods industry because their locations provide them with some advantage (i.e., lower factor costs or access to raw materials) specific to their production technologies. Therefore, trade is being driven by the differences of the factor endowments of these regions.

[3] The presence of strong increasing returns and a high friction of distance does not preclude trade between similar regions if they are in close geographic proximity. It may, however, ensure other regions are not competitive in that particular sector.

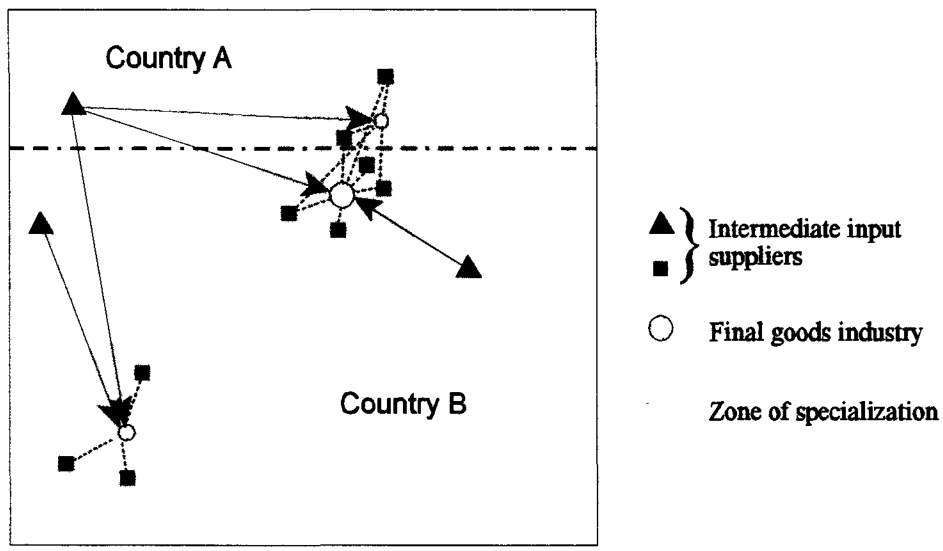

Figure 1: The influence of industrial and geographic structure on trade

Around each final goods industry is a shaded area that defines the zone within which another category of intermediate goods firms locate (shown as squares). For these firms, the most important locational criterion is accessibility to the downstream firms they supply. Outside the shaded zone, transportation or other distance related costs would make suppliers uncompetitive. If similar downstream industries are located adjacent to each other along the border, the zones may overlap (see Figure 1). The larger market available to intermediate input suppliers will lead to specialization, and therefore, a large volume of intra-industry trade. By definition, beyond the boundaries of this region distance related costs outweigh the savings associated with more specialized production. Therefore, we do not see intermediate goods trade between firms located next to the final goods industry located in the far south western corner of *Country B* and the final goods producers found along the border.

The point here is that the regional pattern and composition of trade is heavily influenced by the geographic pattern of production. Therefore, the historical processes that lead to the initial location of an industrial complex may have a strong influence on the volume and composition of trade once artificial trade barriers are removed. To the extent that growth in intra-industry trade leads to production efficiencies, the production zone in the Northeast corner of the diagram will benefit more from trade liberalization than the one in the Southwest corner.

There is one further point to be made regarding Figure 1. Note that even though two of the intermediate input suppliers denoted by the triangles are located adjacent to each other, there is in this case no basis for trade. Their location is the result of forces that have nothing to do with a trading relationship between them. As McCann (1995) has noted, there are many cases where the geographic proximity of producers cannot be related to any economic linkage between them.

Trade flow data

Until recently, little was known of the regional pattern of trade between Canada and the United States. Although several studies have looked at the regional trade between the two countries (Erickson and Hayward, 1991; Warf and Cox, 1993; Warf and Randall, 1994; and Hayward and Erickson, 1995), their focus was on the influence of trade on American states. The origins and destinations of trade within

Canada were unknown. Only McCallum (1995) and Helliwell (1996) have used data that describe province-state trade[4].

The data presented in this paper are from a data base published by Statistics Canada (1996) that reports, *inter alia*, merchandise trade flows between Canadian provinces and U.S. states in 1992.[5] It does not, however, report service trade. Exports are defined by state or province of *origin* and imports by state of *destination* or province of *clearance*. There is always a concern when using trade flow data that the reported origins and destinations of flows are not associated with economic activity occurring in those places, but are rather a result of the reporting process itself. This case is no different.

Statistics Canada defines the place of origin as where the good was manufactured, extracted or grown. If goods do not begin their journey at the factory gate, however, there is no guarantee that they will be attributed to their correct state or province of origin.[6] In order to minimize this bias, we have aggregated American states and, to a lesser degree, Canadian provinces into regions (see Figure 2)[7]. The

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[4]Although McCallum (1995) and Helliwell (1996) analyze province-state trade, their primary objective was to determine the influence of the border on trade, rather than its pattern and composition.

[5]We chose 1992 because it was the latest year for which state GDP data, which are required for the calculation of indices below, were available from the Bureau of Economic Analysis at the time the analysis was undertaken.

[6]We have observed several cases where it was obvious that exports for some states were clearly overestimated.

[7]U.S. Regions: New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont); Mid Atlantic (Delaware, Maryland, New Jersey, New York, Pennsylvania); South Atlantic (District of Columbia, Florida, Georgia, North Carolina, South Carolina, Virginia, West Virginia); Great Lakes (Illinois, Indiana, Michigan, Ohio, Wisconsin);

American regions are taken from Smith (1989), who groups states with similar industrial structures that are in close proximity to major shipping ports. The assumption is that if a good is sent from its point of production to a central warehouse or a distributor, it will probably be in a nearby state, and in particular a state that contains similar types of firms and/or a major transportation facility.

Among the more intractable problems is relating imports to the actual locations of their ultimate purchasers. There are two primary sources of error. First, Canadian imports are reported by province of clearance. In the case of the Atlantic provinces this is problematic because only one of them, New Brunswick, has a land border with the United States. Although a considerable amount of trade is cleared through the other three provinces, New Brunswick's trade would tend to be inflated. Furthermore, exports from the Midwest to Québec and the Atlantic Provinces are underestimated because they are often cleared through customs at Ontario border crossings. This would also tend to inflate the value of Ontario's imports.

Second, even if the destination is reported, it is not guaranteed to be the location of consumption or where value is added. For example, goods sold to wholesalers in one state may be eventually distributed to other states. In addition, it is obvious that in a limited number of cases flows are being allocated to corporate

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South Central (Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Tennessee); Plains (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota); Rocky Mountains (Colorado, Idaho, Montana, Utah, Wyoming); South West (Arizona, Oklahoma, New Mexico, Texas); and West (California, Nevada, Oregon, Washington)

Canadian Regions: Atlantic (Nova Scotia, New Brunswick, Prince Edward Island, Newfoundland); Quebec; Ontario; Prairies (Manitoba, Saskatchewan); B.C. - Alberta (British Columbia, Alberta).

headquarters rather than their actual destination.

Some, but not all, of these problems are addressed by using aggregate regions rather than individual states or provinces. By aggregating the Atlantic Provinces together we eliminate the problem of New Brunswick's potentially inflated imports. This does not, however, eliminate the problem of Ontario's inflated import totals from the Midwest. The aggregation of states also addresses, in part, the consolidation of imports in some states. However, since consolidation is more likely to take place in regions that border with Canada, their imports may be biased upwards.

We made one adjustment to the data to correct for an obvious misallocation of imports. The data base allocates imports of Canadian finished automobiles and light trucks primarily to Michigan, New York and California. These flows seem to be heavily influenced by the distribution system and/or the location of corporate headquarters. Since automobiles are such an important component of Canadian exports, we felt it necessary to redistribute them on the basis of state retail sales. Little bias is introduced by adjusting the data in this manner because the automobile and light truck market is arguably continental in scope.[8] In our judgement, further adjustments to the data would potentially introduce more bias than they would eliminate.

[8]For exports of cars and light trucks from the U.S. a further adjustment had to be made to the data. In 1992 most automobile and light truck exports were not allocated by state. We therefore assumed that the share of exports of American regions in these goods was the same as in 1993 when the flows were reported by state.

Figure 2: Canadian and American regions

Analysis

Tables 1 and 2 show the regional origins and destinations for exports from Canada and the U.S. respectively. In both cases Ontario accounts for over half of Canadian trade. It is also evident that Ontario and the Great Lakes are the most important trading regions. Ontario is the origin and destination for 66% of Canadian trade with the United States and the Great Lakes accounts for 33% of total American trade with Canada. Furthermore, their bilateral relationship makes up a quarter of all trade between the two countries. By comparison, the second most important bilateral relationship, Ontario-Mid Atlantic, comprises only 12% of total trade. Ontario's dominance can be attributed, in part, to the strength of its manufacturing economy, which creates a large supply of and demand for intermediate goods and machinery and equipment. However, Ontario may also be acting as a distribution center for imports destined to other provinces, particularly for high value final goods that can easily withstand transportation costs. Finally, as noted in the last section, the Ontario numbers may reflect trade destined for Québec and the Atlantic Provinces that are cleared at Ontario border points. The fairly low import total for these regions from the Great Lakes states is evidence of this effect (see Table 2). All of these factors would tend to inflate Ontario's trade while suppressing the trade of other Canadian regions.

Table 1: Exports from Canadian regions (C$ millions) - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	*Canada*
New England	2,224	4,606	3,316	79	403	10,628
Mid Atlantic	670	5,751	13,725	238	2,389	22,772
Great Lakes	317	3,340	22,345	1,375	5,664	33,041
South Central	57	595	4,299	1,974	2,409	9,335
South Atlantic	175	1,157	4,113	174	1,438	7,058
Plains	312	1,747	7,977	136	885	11,058
South West	19	139	1,128	181	1,332	2,800
Rocky Mountains	149	877	4,485	267	908	6,687
West	130	799	6,232	382	6,010	13,554
United States	4,053	19,013	67,620	4,807	21,439	116,932

Source: Statistics Canada (1996)

Table 2: Exports from American regions (C$ millions) - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	*Canada*
New England	290	2,576	3,180	104	283	6,433
Mid Atlantic	224	3,206	10,509	386	795	15,119
Great Lakes	285	1,424	31,847	1,631	1,826	37,013
South Central	85	579	3,607	1,152	736	6,158
South Atlantic	101	583	4,126	296	501	5,607
Plains	399	1,300	5,569	349	687	8,304
South West	14	163	639	72	462	1,350
Rocky Mountains	83	570	2,934	223	965	4,775
West	147	920	4,776	292	3,998	10,132
United States	1,628	11,320	67,185	4,506	10,253	94,893

Source: Statistics Canada (1996)

Importance of Canadian and American regional markets

Although the trade flows presented in Tables 1 and 2 illustrate the absolute strength of regional trading relationships, they don't provide any perspective on the relative significance of Canadian and American regional markets. In order to address this, we measure the significance of regional markets by taking exports as a percentage of gross domestic product (GDP) of each region (see Tables 3 and 4). These numbers should be interpreted with caution because what is reportedly produced in one year may not be sold but added to inventories. This means that in a post recession year, like 1992, exports may be drawn from inventories built up the previous year(s), rather than from that year's output, which means the importance of trade may be overestimated.

The Canadian demand for American goods accounts for only 1.32% of U.S. GDP. However, the significance of Canadian regional markets varies considerably across American regions (see Table 3). For example, the Canadian market is more important to the Great Lakes and New England, than the U.S. as a whole. Ontario dominates most trading relationships and is only rivaled by the Québec–New England and Alberta-BC–West pairs.

Table 3: Percentage of GDP exported to Canadian regions - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	*Canada*†
New England	0.07	0.62	0.77	0.03	0.07	1.55
Mid Atlantic	0.02	0.24	0.77	0.03	0.06	1.11
Great Lakes	0.02	0.12	2.71	0.14	0.16	3.15
South Central	0.02	0.11	0.76	0.05	0.09	1.04
South Atlantic	0.04	0.12	0.53	0.03	0.06	0.78
Plains	0.02	0.12	0.74	0.24	0.15	1.26
South West	0.01	0.08	0.42	0.03	0.14	0.69
Rocky Mountains	0.01	0.08	0.32	0.04	0.23	0.67
West	0.01	0.07	0.39	0.02	0.33	0.83
United States*	0.02	0.16	0.94	0.06	0.14	1.32

*Excludes Alaska and Hawaii
†Excludes the Yukon and Northwest Territories
Source: Statistics Canada (1996) and Bureau of Economic Analysis (1995)

The significance of the American market for Canadian exports is dramatically higher. For every Canadian region, exports to the U.S. accounts for 10% or more of GDP (see Table 4). There is a tendency for all the Canadian regions to be oriented towards their neighboring U.S. regions. For example, 8.21% of Atlantic Canada's output is sold to New England and 7.90 % of Ontario's output is sold to the Great Lakes states. Our first instinct was to attribute the strength of border ties to the consolidation of shipments in border states. However, upon closer inspection of the data this did not appear to be a major source of error. In most cases, exports can be attributed to logical economic relationships. For example, refined petroleum exports from Atlantic Canada to New England (27.2% of exports), can be explained by Atlantic Canada's large refining capacity and a local oil company with retail outlets in the New England market. Similarly, exports of auto parts from Ontario to the Great Lakes states (25.8% of exports) is obviously related to the large concentration of assembly plants in those states.

Table 4: Percentage of GDP exported to American regions - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	*Canada*†
New England	8.21	2.93	1.17	0.18	0.25	1.59
Mid Atlantic	2.47	3.65	4.85	0.54	1.50	3.40
Great Lakes	1.17	2.12	7.90	3.11	3.56	4.93
South Central	0.65	0.74	1.45	0.40	0.90	1.05
South Atlantic	1.15	1.11	2.82	0.31	0.56	1.65
Plains	0.21	0.38	1.52	4.49	1.52	1.39
South West	0.55	0.56	1.59	0.61	0.57	1.00
Rocky Mountains	0.07	0.09	0.4	0.41	0.84	0.42
West	0.48	0.51	2.2	0.87	3.78	2.02
United States*	14.96	12.08	23.91	10.92	13.49	17.45

*Excludes Alaska and Hawaii
†Excludes the Yukon and Northwest Territories
Source: Statistics Canada (1996 and 1992a)

Economic integration among Canadian and American regions

We define economic integration as the relative strength of one region's economy as a supplier of trade goods to another region. Exports as a proportion of regional GDP is an inadequate measure of integration because it does not control for the size of both trading partners. For example, we know from Table 3 that the proportion of the West's output sold to Ontario is greater than that sold to Alberta-BC (0.39% vs 0.33%). We could conclude from this that the West is more highly integrated into Ontario's economy. However, the relative size of the Ontario and Alberta-BC economies are not taken into account. The potential market in Ontario is far greater than Alberta-BC, and therefore, it may be unrealistic to expect Alberta-BC to account for a larger share of the West's output.

These problems can be circumvented by developing an index of economic integration that accounts for the relative size of both trading partners. Consider two regions that are part of a larger continental economy like that of Canada and the United States. If in all regions firms were specialized and served the continental market, they would sell only their share of total continental demand at home and the rest to the continental market. Therefore, if the demand (both consumer and industrial) were spread evenly across space and there were no friction of distance, we would expect inter-regional trade to be strictly a function of the productive and consumptive capacities of each pair of regions.

Based on this principle, a multilateral index of economic integration can be defined as follows. Assume there are two trading regions, *a* and *b*. By multiplying *a*'s output (GDP) by *b*'s share of total continental output the expected upper bound of exports from *a* to *b* can be determined. The expected value of exports is given by[9]:

$$\bar{X}_{ab} = Y_a \cdot \frac{Y_b}{Y_A + Y_B}. \qquad (1)$$

Where Y_a and Y_b are the outputs of regions *a* and *b* and Y_A and Y_B are the outputs of nations *A* and *B*. We should add that (1) also implies trade between *a* and *b* is balanced ($\bar{X}_{ab} = \bar{X}_{ba}$), and therefore, the expected level of trade would be the same regardless of the relative size of the trading partners. Dividing (1) into the actual

[9]Note that if we treat (1) as a two nation case, it can be derived directly from Krugman (1979), which implies it is consistent with trade generated by increasing returns to scale.

exports from a to b (X_{ab}) will provide an index of economic integration:

$$I_{ab} = \frac{X_{ab}}{\bar{X}_{ab}} \cdot 100 = \frac{X_{ab}(Y_A + Y_B)}{Y_a Y_b} \cdot 100. \tag{2}$$

If I_{ab} has a value of 0, there is no economic integration of a into b's market. An index value of 100 only has meaning in the sense that it is the value that we would expect if complete integration occurred across all regions. This expectation is based on the restricted assumptions noted above, which, of course, do not hold in reality. Regions are never completely specialized. Demand is often spread unevenly over space, which means the index may approach or possibly exceed 100. Nevertheless, since we are primarily concerned with comparing integration across regions, rather than its absolute degree, these problems are of no particular concern. To reiterate, the index only controls for the relative size of the trading partner's economies.

We have calculated the index for each American and Canadian region (see Tables 5 and 6, respectively). It is assumed that Canada and the United States together form a closed economy. Of course, this is not entirely true, and so the index may underestimate the degree of integration for regions that have stronger ties to markets outside of North America (e.g., Alberta-BC or the West). However, Canada's dependence on the American market and the relatively small share of output that the U.S. exports abroad should ensure that most errors are small.

At the beginning of this section we noted that the West (based on exports as a proportion of GDP) appeared to be more integrated into the Ontario market than

Alberta-BC. However, based on the index (see Table 5), the West is more integrated with the Alberta-BC economy than Ontario. Therefore, we would have concluded erroneously using exports as a percentage of GDP that the West is more integrated into Ontario's economy, and therefore, the location of the West relative to Alberta-BC and Ontario has little influence on the degree of integration.

Although we have controlled for the size of the trading partners, it is still the case that Canadian regions, with a few notable exceptions, are more integrated into the American economy than their American counterparts into the Canadian economy.[10] For example, the Atlantic provinces are far more integrated into the New England market ($I = 90.7$) than New England is integrated into the Atlantic provinces' market ($I = 11.9$). The one major exception is the Great Lakes region, which is more integrated into Ontario's economy than *vice versa*. This is the opposite conclusion than we would have drawn based on exports as a percentage of GDP.

In general, American regions are more highly integrated into the Ontario economy ($I = 21.7$) than into the economies of other Canadian regions. The most highly integrated American region is the Great Lakes, whose total integration index value of 33.4 is more than double the national index of 15.2. It is also the only American regions that is more integrated into the Canadian economy vice versa ($I = 33.4$ vs 29.8). For the most part, this high degree of integration is related to exports of auto related products from the Great Lakes to Canada. The high degree of

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[10]Since the ratio of indices for each pair of regions reduces to the ratio of their exports to each other, this result simply reflects the fact that most Canadian regions have a trade surplus with their American counterparts.

integration of the Great Lakes with Ontario ($I = 70.1$) is partly a reflection of this. We should add, however, this value also reflects imports cleared through Ontario border crossings destined for Quebec and Atlantic Canada.

American regions tend to be most integrated with Canadian regions that are in close proximity (e.g., New England–Québec, Great Lakes–Ontario, and West–Alberta-BC). The significance of proximity can be overstated, however. The South Atlantic region is the second most integrated American region even though it does not border on Canada. It is more integrated into the Atlantic provinces ($I = 13.4$) economy than is New England ($I = 11.9$) and is the second most integrated economy into Ontario ($I = 28.5$).

Of all the Canadian regions (see Table 6), Ontario is the most highly integrated into the entire U.S. economy ($I = 26.4$). Obviously, as we noted above, this is due to the large presence of the auto industry in Ontario. As with American regions, Canadian regions tend to be the most integrated with those regions that are in close proximity: the Atlantic Provinces and Québec with New England, the Prairies with the Plains states, and Alberta-BC with the Rocky Mountains. However, this is not always the case. For example, Alberta-BC is as integrated into the Great Lakes region as the West. This is largely because of resource exports from Alberta-BC to the Great lakes (e.g., crude oil and natural gas).

Table 5: Multilateral index of economic integration based on U.S. exports - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	Total
New England	11.9	28.8	19.8	4.2	3.1	16.4
Mid Atlantic	2.8	10.9	19.9	4.7	2.7	11.8
Great Lakes	4.1	5.6	70.1	23.1	7.1	33.4
South Central	3.2	5.0	19.7	9.1	4.3	11.0
South Atlantic	13.4	12.0	28.5	11.5	6.3	17.4
Plains	3.0	5.5	19.1	39.5	6.9	13.4
South West	2.0	3.8	10.8	5.3	6.3	7.2
Rocky Mountains	1.2	3.7	8.2	5.9	10.5	7.1
West	2.0	3.5	10.1	3.9	15.0	8.8
Total	3.5	6.6	21.7	9.4	5.9	15.2

Source: Statistics Canada (1996 and 1992a) and Bureau of Economic Analysis (1995)

Table 6: Multilateral index of economic integration based on Canadian exports - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	Total
New England	90.7	51.5	20.6	3.2	4.5	27.1
Mid Atlantic	8.3	19.6	26.0	2.9	8.1	17.7
Great Lakes	4.6	13.2	49.2	19.4	22.2	29.8
South Central	5.5	9.9	19.7	5.4	12.2	13.8
South Atlantic	10.5	16.1	40.8	4.5	8.1	23.2
Plains	2.0	5.7	22.8	67.3	22.7	20.3
South West	3.6	5.8	16.4	6.3	5.9	10.1
Rocky Mountains	1.6	3.2	14.4	14.9	30.3	14.7
West	1.8	3.0	13.1	5.2	22.5	11.7
Total	10.4	13.3	26.4	12.1	14.9	18.7

Source: Statistics Canada (1996 and 1992a) and Bureau of Economic Analysis (1995)

Broadly speaking, Tables 5 and 6 demonstrate that integration is greatest between regions that are in close proximity. However, considerable variation remains. It is unlikely that this variation is the result of differences in consumer demand. That is, since per capita incomes in Canadian and American regions are similar, we expect demand patterns to be similar as well (Linder, 1961)[11]. We cannot make the same argument regarding industrial demand. It is well known that regions tend to be specialized in different industrial sectors. Therefore, there may be considerable regional variations in industrial demand. Wonnacott and Wonnacott (1967) find strong evidence to this effect in their analysis of the potential for trade between Canada and the United States. The rest of the paper focuses on how the structure of regional industrial production and demand can help to explain the regional pattern of trade between the United States and Canada.

Regional pattern of intermediate goods trade

In order for variations in industrial structure to influence the volume of trade between regions, intermediate goods must account for a significant portion of that trade. For the purposes of this study, we define intermediate goods rather narrowly. They are goods that have been transformed significantly from their raw form and are sold *primarily* to other firms who transform them further or assemble them into new products.[12] Therefore, we exclude raw materials that may also be producer inputs

[11]Linder's hypothesis is supported empirically by Thursby and Thursby (1987) and Bergstrand (1988)

[12]Although many goods can be readily classified as intermediate goods (e.g., rolled steel), others are not so easily classified. For example, we have classified wood pulp as an intermediate input, but not sawn lumber. The latter was treated as a raw material because it has not been substantially transformed from its raw form and because most of the sectors output is sold to the construction industry. Construction is usually treated separately from goods producing industries. There are numerous instances where judgements like this had to be made and in general we erred on the side of caution in order not to over estimate the extent of intermediate goods trade. For those interested readers, the classification of all 5420 Harmonized System 6-digit commodities is available from the authors.

(e.g., potatoes) and capital goods that are used to produce products (e.g., metal stamping equipment).

In spite of this narrow definition, 43% of total Canada-US trade in 1992 was in intermediate goods. Ontario's combined trade with the Great Lakes and Mid Atlantic accounted for almost half of total intermediate goods trade (48%). By comparison, these three regions were responsible for only 29% of Canada-U.S. trade in all other types of goods. The relative importance of intermediate goods trade varies considerably across regions. For example, intermediate goods account for high proportions of the Great Lakes, New England, Québec and Ontario's exports. In contrast to these large industrial regions, intermediate goods account for much lower proportions of exports from the Plains, West, Prairies and Alberta-BC (see Tables 7 and 8). Furthermore, the percentage of intermediate goods also varies depending on the trading partner. For example, 59% of Ontario's *total* trade with the Great Lakes states is in intermediate goods, versus only 23% of Ontario's trade with the West. Finally, the volume of intermediate goods trade tended to be strongest between regions that are in close proximity. The Atlantic provinces and Québec's most important trading partners are New England and the Mid Atlantic states. Similarly, Ontario's is the Great Lakes states, the Prairies the Plains states and Alberta-BC the West. We will return to this point, but first we want to define in more detail the relationship between industrial structure and intermediate goods trade noted above.

Table 7: Intermediate goods as a percentage of exports from Canadian regions - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	Total
New England	47.4	68.0	28.1	67.3	68.1	51.2
Mid Atlantic	52.2	56.7	44.4	34.8	14.5	44.5
Great Lakes	24.0	65.8	55.4	31.7	14.6	48.2
South Central	25.5	55.5	31.6	54.8	12.3	32.0
South Atlantic	37.2	56.9	24.7	57.1	18.4	30.0
Plains	14.3	58.8	36.6	40.3	14.6	37.2
South West	60.4	38.4	27.2	34.5	18.6	28.5
Rocky Mountains	5.1	49.3	20.1	37.8	16.2	20.7
West	18.7	34.7	22.1	50.2	24.7	24.8
Total	43.5	59.2	40.0	39.4	18.7	39.3

Source: Statistics Canada (1996)

Table 8: Intermediate goods as a percentage of exports from American regions - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*	Total
New England	25.9	68.0	45.9	31.7	45.8	53.6
Mid Atlantic	37.9	45.4	48.3	37.6	33.4	46.5
Great Lakes	25.4	34.1	62.0	37.7	30.3	58.0
South Central	53.7	58.6	49.0	37.8	42.4	48.9
South Atlantic	40.9	44.5	43.0	32.3	31.4	41.7
Plains	26.1	24.7	30.0	23.2	21.4	27.1
South West	65.7	68.7	55.4	55.1	57.5	57.6
Rocky Mountains	22.2	20.5	31.3	35.6	28.1	29.0
West	17.8	36.7	24.5	29.6	28.4	27.2
Total	34.1	48.7	51.8	33.7	32.7	48.2

Source: Statistics Canada (1996)

Intermediate goods trade and differences in industrial structure

As we noted above, we might expect intermediate goods trade to be greatest between regions whose industrial structures complement each other. That is, they specialize in different industries that have strong input-output relationships. If we believe specialization is the result of differences in factor endowments, there is an obvious link between this definition of complementarity and the H-O theorem. Therefore, the most trade would be between regions with dissimilar industrial structures. Referring to Table 8, the strong Alberta-BC–Great Lakes and Atlantic–New England trade supports this contention. However, we also see very strong intermediate goods trade between Ontario and the Great Lakes and to a lesser extent the Mid Atlantic – regions with similar factor endowments.

Paradoxically, if trade is driven by increasing returns to scale, the greater the similarity of economic structure the greater the potential for trade in intermediate inputs. The net effect is cross-trade in the same types of goods. Therefore, if the similarity of industrial structure drives trade we should see a high level of intra-industry trade. We use Grubel and Lloyd's (1975) unadjusted index of intra-industry trade (here after referred to as the G-L index) to measure the degree of inter-regional intra-industry trade. The G-L index is given by the following equation,

$$G\text{-}L\ index = \left(1 - \frac{\left(\sum_i |X_i - M_i| \right)}{\left[\sum_i (X_i + M_i) \right]} \right) \cdot 100, \tag{3}$$

where X_i is exports and M_i is imports of good i. The value of the index may be interpreted as the proportion of exports that are not offset by imports in the same industry – i.e. a measure of the proportion of intra-industry trade. In order to reduce the influence of aggregation on the index, we have calculated it using the 6-digit Harmonized System (HS) commodity classification. Arguably, at this level of disaggregation we are underestimating intra-industry trade because very similar goods that are produced using the same inputs are being classified as different commodities.

In total, 44% of all Canada-US trade is of the intra-industry type[13]. Intra-industry trade in intermediate goods is somewhat higher at 51%. Theoretically, this implies trade is taking place to take advantage of increasing returns to scale at the plant level (see Grubel and Lloyd, 1975) or because of Hicks' neutral technological differences between the firms in the two countries (Davis, 1995). Not surprisingly, we see considerable variation in the degree of intra-industry trade between regions (see Table 9). Intra-industry trade is strongest between Ontario and the Great Lakes states and between Québec and New England. The former case is dominated by products related to the auto industry found in both regions and the latter is dominated by trade in integrated circuits. In contrast, intra-industry trade between the Atlantic region and New England is very low. The same is true of the Prairies and Alberta-BC and all U.S. regions. If we were to generalize, it would appear that intra-industry trade is strongest between regions that have large industrial economies, but is the weakest between regions that specialize in producing resources and industrial regions or between resource-producing regions.

[13]This number is somewhat lower than other estimates. However, they were conducted at a lower level of disaggregation, which tends to reduce the degree of intra-industry trade.

Table 9: Regional pattern of intra-industry trade in intermediate goods (%) - 1992

	Atlantic	*Québec*	*Ontario*	*Prairies*	*Alberta-BC*
New England	2.4	48.4	34.6	12.1	5.4
Mid Atlantic	7.2	35.5	35.9	14.5	7.2
Great Lakes	5.2	13.4	53.8	8.5	5.6
South Central	6.7	6.9	39.4	7.8	10.6
South Atlantic	14.6	16.0	39.4	9.6	12.5
Plains	7.5	17.1	31.9	11.9	5.7
Rocky Mountains	3.1	13.9	30.4	8.0	11.0
South West	16.1	14.4	22.7	9.5	16.4
West	18.5	38.7	35.6	10.4	26.7

Source: Statistics Canada (1996)

Intra-industry trade, scale economies and the friction of distance

The logical relationship between intra-industry trade and scale economies can be taken a step further. To repeat the argument made above, there is an obvious trade-off between increasing returns and the friction of distance. Downstream firms will not benefit from increasing returns in the production of intermediate goods if those savings are offset by the cost of transporting intermediate goods. If distance related costs are too high, specialization will not occur. Therefore, we would expect to see the most intra-industry trade in intermediate goods between regions that are in close proximity.

As an informal test of this hypothesis, we compare the regional pattern of trade for goods with a high G-L index values to those with lower values[14]. To be more specific, we have divided the flows of goods (defined by their 6-digit HS

[14] The G-L index for a single good i is simply $\left\{1-\frac{|X_i - M_i|}{(X_i + M_i)}\right\} \bullet 100$

classification) into five categories based on the G-L index for each good (see for example Table 10). By finding the total value of exports for each category, we can calculate an index of integration (equation 3). However, because the demand for intermediate goods is strictly industrial, the index is calculated based on the size of each region's manufacturing output, rather than total output. (Calculating the index on the basis of total output could substantially underestimate the index value for those regions with a large GDP but a relatively small manufacturing sector.)

Tables 10 through 13 show the index of integration for two Canadian (Ontario and Alberta-BC) and two American regions (Great Lakes and West) for categories of goods defined by their G-L indexes. Although we could have presented more examples, these regions roughly reflect what we observe for the rest. Table 10 presents the index values for Ontario. The variation in the pattern of integration depending on the range of the G-L index values is striking. Reading down the columns, we see that in the case of complete inter-industry trade (G-L = 0.00) the pattern of integration is geographically dispersed, with no one region dominating Ontario's exports. However, as we move from left to right (and continuing to read down each column) the pattern becomes focused on those American regions that are close to Ontario. Therefore, at the highest levels of intra-industry trade (G-L = 0.75-1.00), the pattern of trade is geographically focused on the Great Lakes region.

As with Ontario, Alberta-BC has a geographically dispersed pattern of integration when there is complete inter-industry trade and as intra-industry trade becomes stronger the pattern of trade is focused on regions that are in close proximity (i.e., the West and Rocky Mountains regions) (see Table 11). However, unlike Ontario, Alberta-BC's trade is dominated by inter-industry rather than intra-industry trade. That is, although intra-industry trade is stronger between Alberta-BC and those U.S. regions in close proximity, it does not have a significant influence on the overall volume of trade. There are two possible explanations for this. First, the economic structure of Alberta-BC compared to its American counterparts is very different. This is certainly true in some cases (e.g., the Great Lakes region). However, at least anecdotally, Alberta-BC's resource oriented economy has much in common with that of parts of the West and Rocky Mountains regions. This leads us to the second explanation. It is probably the case that the requirements for intermediate inputs is relatively low in resource oriented industries. Since their primary inputs are raw materials that are produced locally, intra-industry trade in intermediate goods is relatively small. This is in sharp contrast to, for example, the auto industry – centered in Ontario and the Great Lakes region – that requires a very large variety and volume of intermediate inputs.

Table 10: Multilateral index of integration, Ontario - 1992

G-L index	0	>0-24	25-49	50-74	75-100	Total
New England	0.8	6.6	1.2	3.6	1.6	13.8
Mid Atlantic	0.1	11.3	8.7	7.7	3.1	31.0
Great Lakes	1.1	8.4	2.9	9.8	16.1	38.3
South Central	0.5	2.4	1.0	1.8	3.2	8.8
South Atlantic	1.2	2.7	1.7	2.4	2.2	10.2
Plains	3.5	2.5	4.2	2.2	1.5	13.9
South West	0.4	6.7	0.7	0.8	0.9	9.5
Rocky Mountains	2.6	1.8	0.6	0.5	2.4	7.9
West	0.4	4.4	0.6	1.1	0.8	7.2
Total	1.0	6.0	2.8	4.5	5.3	19.5

Source: Statistics Canada (1996 and 1992b) and Bureau of the Census (1996)

Table 11: Multilateral index of integration, Alberta-BC - 1992

G-L index	0	>0-24	25-49	50-74	75-100	Total
New England	9.7	3.7	0.1	0.3	0.1	13.9
Mid Atlantic	1.3	4.2	0.3	0.1	0.1	6.0
Great Lakes	6.1	2.3	0.1	0.1	0.1	8.7
South Central	2.0	1.5	0.3	0.1	0.2	4.1
South Atlantic	0.5	1.9	0.1	0.1	0.2	2.9
Plains	8.1	2.0	0.2	0.1	0.1	10.6
South West	1.4	1.0	0.8	0.7	0.5	4.5
Rocky Mountains	7.3	15.6	1.1	1.0	0.6	25.6
West	1.3	17.1	1.5	3.9	2.5	26.3
Total	3.5	4.7	0.5	0.7	0.5	9.8

Source: Statistics Canada (1996 and 1992b) and Bureau of the Census (1996)

There is a similar, although not as clear-cut, pattern of integration for American regions. In the case of the Great Lakes regions (Table 12), there is a strong inter-industry trade with the Prairies and very little with Ontario. However, as the G-L index rises Ontario tends to dominate, particularly at higher levels. We should note that results for the Atlantic and Québec regions are biased downward and as such should be discounted.

Table 12: Multilateral index of integration, Great Lakes - 1992

G-L index	0	>0-24	25-49	50-74	75-100	Total
Atlantic	1.8	0.7	0.0	0.1	0.0	2.6
Québec	0.7	1.1	0.3	0.5	0.8	3.3
Ontario	0.9	25.9	5.4	12	17	61.1
Prairies	10.7	15.7	1.7	0.9	0.5	29.4
Alberta-BC	2.1	3.0	0.5	0.1	0.1	5.8
Total	1.4	14.9	3.0	6.5	9.2	34.9

Source: Statistics Canada (1996 and 1992b) and Bureau of the Census (1996)

In the case of the West, we see a consistently high index of integration with Alberta-BC, while those for Ontario and Québec remain within the same low range, regardless of the level of intra-industry trade (see Table 13). In this case, inter-industry trade is more focused on local regions, but intra-industry trade has a more dispersed pattern among the Canadian regions, although at a generally low level. This may reflect the fact that the West's economy is geographically isolated from the Canadian industrial heartland in Ontario and Québec.

Table 13: Multilateral index of integration, West - 1992

G-L index	0	>0-24	25-49	50-74	75-100	Total
Atlantic	0.9	0.2	0.2	0.0	0.3	1.6
Québec	0.6	1.3	0.4	0.4	1.1	3.8
Ontario	0.4	2.2	0.9	1.9	0.7	6.1
Prairies	3.3	2.9	0.3	0.2	0.2	6.9
Alberta-BC	2.2	8.0	4.3	2.8	2.7	20.1
Total	0.9	2.8	1.2	1.5	1.1	7.5

Source: Statistics Canada (1996 and 1992b) and Bureau of the Census (1996)

Controlling for industrial structure

One problem with the analysis presented in the last four tables is that it does not take direct account of the industrial structure of the trading regions. We do not know whether higher intra-industry trade between proximate regions is a reflection of underlying economic forces noted above or simply variations in the industrial structure of the trading regions. For example, if the auto industry were centered in the West, would we see the same volume of intra-industry trade that is experienced between Ontario and the Great Lakes? Therefore, it is necessary to control for the industrial structure of the regions.

Tables 14 and 15 show the proportion of output in the West and Great Lakes regions sold to Ontario and Alberta-BC (respectively) for selected 3-digit SIC sectors. Ideally, we would like to present more industries, but because of disclosure problems many sectors at the 3-digit level are not reported.

Both tables illustrate that the Ontario and Alberta-BC markets are much more important for the region that is the shortest distance away[15] and this is a result that is consistent across all industries. For example, a higher proportion of the Great Lakes output of *motor vehicle and equipment* (SIC 371) is exported to Ontario than is the case for the West (see Table 14). On the other hand, a higher proportion of the West output of the same sector is sold to Alberta-BC than the Great Lakes (see Table 15). This implies the geographic pattern of intra-industry trade that we discussed above is

[15]Note that because we are comparing *both* American regions' exports to the same Canadian market, the proportion of output is directly comparable between them. There is no need to calculate an index of integration.

not purely the consequence of variations in regional industrial composition. In other words, if the same percentage of *motor vehicle and equipment* output were exported to Ontario from the West and the Great Lakes, then the high volume of intra-industry trade between the two regions would simply be the result of the large presence of the auto industry in the Great Lakes. Since this is not the case, we can argue that it is not only the industrial composition of the trading regions, but also the *geographic configuration* of production that dictates the volume and composition of their trade. These results support the significance that geographers (see Storper and Scott, 1995), regional scientists (see Howes and Markusen, 1993) and trade economists (see Krugman, 1991a[16]) have placed on the influence of space on trade.

Table 14: Intermediate goods exports to Ontario as a percentage of U.S. regional production - 1992

	Great Lakes		West	
SIC and description	Exports ($ millions)	% Output	Exports ($ millions)	% Output
204 Grain mill products	38.0	0.23	0.1	0.00
286 Ind organic chems	164.9	1.88	5.5	0.58
331 Blst furn & steel pr	580.1	1.70	4.6	0.14
349 Misc fabr metal prds	406.1	3.83	47.0	1.46
361 Electric distr equip	105.8	3.48	8.9	1.65
371 Motor vehicles & eq	11,203.8	6.98	73.2	0.80
381 Measuring & contr dev	71.1	0.87	62.6	0.58

Source: Statistics Canada (1996) and Bureau of the Census (1996)

[16]For a critical review of Krugman's work and its contribution to economic geography see Martin and Sunley (1996).

Table 15: Intermediate goods exports to Alberta-BC as a percentage of U.S. regional production - 1992

	Great Lakes		West	
SIC and description	Exports ($millions)	% Output	Exports ($millions)	% Output
204 Grain mill products	6.5	0.04	3.0	0.06
286 Ind organic chems	14.7	0.17	13.1	1.37
331 Blst furn & steel pr	22.7	0.07	55.0	1.67
349 Misc fabr metal prds	34.6	0.33	45.8	1.42
361 Electric distr equip	3.3	0.11	5.0	0.93
371 Motor vehicles & eq	56.6	0.04	51.1	0.56
381 Measuring & contr dev	7.7	0.09	23.0	0.21

Source: Statistics Canada (1996) and Bureau of the Census (1996)

Conclusions

Our analysis has uncovered significant variations in the magnitude and structure of trade relations between pairs of Canadian and American regions. The overall Canada - U.S. trade picture is dominated by a few very strong bilateral regional relationships, especially those between Ontario and the Great Lakes, Mid Atlantic, and South Atlantic States. A multilateral index of economic integration that controls for the size of regional economies reveals a number of other strong relationships, including those between; New England and Quebec; the Canadian Prairies and the U.S. Plains; and Alberta-BC and the U.S. Rocky Mountain States. Not surprisingly, the intensity of bilateral cross-border trade relations appears to be affected by the friction of distance.

Trade in intermediate goods accounts for a large proportion of many bilateral trade volumes. We are able to decompose intermediate goods trade flows into two components: inter-industry trade, which is most readily explained by differences in regional factor endowments, and intra-industry trade, which occurs between regions with similar industrial structures and may be attributed to specialization within industrial categories to achieve scale economies. A major finding is that intra-industry trade is most prevalent between pairs of regions located close to each other, while the spatial patterns of inter-industry trade are more dispersed. This lends support to the argument that intra-industry trade is more sensitive to the friction of distance.

Theoretically, what these results imply is that there is a spatial corollary to the hypothesis that the share of intra-industry trade increases as the factor endowments of the trading countries become increasingly similar (Helpman and Krugman, 1985). That is, at least in terms of intermediate goods, the share of intra-industry trade will rise the more geographically proximate are the trading partners. In the context of the simple conceptual model presented above (Figure 1), if the final goods produced in *Country B* only originated in its Southwest corner, inter-industry trade in intermediates would dominate. What these results also suggest is that any empirical model intended to explain the volume and composition of trade that is applied to the North American economy in particular, and any large economic space in general, may be misspecified if it does not take into account the geography of production. In this light, Wonnacott and Wonnacott's (1967) work was ahead of its time.

From an analytical modeling perspective these results are promising. In recent years, there has been a growing literature that has applied modeling techniques developed out of trade theory to economic geography (e.g., Krugman, 1991b, Krugman and Venebles, 1995 and Venebles, 1996). By and large, these models are characterized by a two nation/region trading system where there is one factor of production, monopolistically competitive markets, increasing returns in production, and trade costs over space. The models show that production will be dispersed or concentrated in one of the countries/regions depending on the strength of increasing returns and trade costs, *inter alia*. The results presented above and evidence from other studies (Hanson, 1996, 1997 and Quah, 1996) lend support to the significance these models place on the interaction between trade costs and increasing returns. The development of analytical models that incorporate more than one factor of production, two trading sectors, and more than two regions with differential trade costs within a general equilibrium framework presents a substantial challenge. To that end, we have developed a fairly simple model that incorporates aspects of these factors within a two nation, two region system (Brown and Anderson, 1998). What this model indicates is that depending on the tradeability of intermediate goods and the relative size of the trading nations, there may be a divergence between national and regional welfare.

These empirical and analytical results also imply that there may be room for regional as well as national trade policy. That is, as national governments relinquish control over their borders through trade agreements such as NAFTA, regions will play an increasingly important role. Ontario and the Great Lakes states have a shared interest in the health of the North American auto industry that has developed out of the integration of the two regions spurred by the 1965 Auto Pact. Any trade policy that affects the health of this industry has a far stronger impact on this cross-border region than any other. The same is true of northern Mexico and the Southern U.S.. Hanson (1996, 1997) has found an increasing concentration of production along the Mexico-U.S. border that has resulted from trade liberalization between the two countries. Finally, in Europe Quah (1996) has found economic spillovers between geographically proximate regions in different countries is better able to explain variations in regional income than national factors. The question then becomes, what is the basis for greater regional economic integration and what policy instruments, if any, are useful or available to regions to affect this process?

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CHAPTER 3

National and Regional Effects of Final and Intermediate Goods Trade[17]

Introduction

The origins of the model that we present in this paper are both empirical and theoretical. Empirically, it stems from our analysis of trade among Canadian and American regions (Brown and Anderson, 1999). Among other things, the study indicated that a large proportion, and in some cases most, of inter-regional trade was in intermediate goods. It was also found that, for both intermediate and final goods, a large proportion of trade was of the intra-industry variety. Trade was found to be strongest between regions in close geographic proximity and this was especially true of intra-industry trade in intermediate goods.

These results imply a relationship that is driven by external returns that are spatially circumscribed. That is, the presence of intra-industry trade in intermediates suggests that this trade may be driven by increasing returns to scale (Grubel and Lloyd, 1975). If there are transportation and/or transaction costs associated with the movement of intermediate goods over space, downstream firms benefit from external

[17]This paper has been submitted to *Urban Economics and Regional Science*

returns only if they locate close to their suppliers. Consequently, if there are two regions located adjacent to each other along the border, there will be an incentive for upstream firms to sell to downstream firms on the other side – external returns spill over the border. However, if the regions are located far from each other, firms may be unable to trade intermediates (e.g., due to just-in-time production). Furthermore, if the market available to intermediate goods producers in one region is smaller, the prices of their goods passed on to downstream industry will be higher. Therefore, that region's final goods producers may be disadvantaged if they are competing for the same markets as downstream producers in the larger region. Since the cost of transporting finished goods is often low relative to their price, this may be the case. Therefore, depending on the geographic configuration of production and the size of the national economies, trade may benefit the regional economies or it may act as a drag.

This last point raises another issue. Small countries push for more liberalized trade, at least in part, to take advantage of increasing returns afforded by larger markets and to raise the utility of consumers who have greater access to more varieties of low-cost goods. However, because regions often specialize in different industries, the benefits and costs of trade may not be shared equally. There may be a divergence between national and regional welfare. In federations such as Canada this is of particular concern because policy debates are often driven by conflicts among regional interests.

Therefore, the model presented below has two objectives: first, to determine the impact of trade on regions depending on their relative location and the size of their economies, and second, to place this within the context of the benefits that might accrue at a national scale.

The model builds on Krugman's earlier work on trade theory (Krugman 1979, 1980) and has much in common with his and others' application of trade theory to economic geography (Krugman 1991a,b; Krugman and Venebles, 1995; and Venebles, 1996). It is similar to these models in that we base it, in part, on monopolistic competition and the interaction between pecuniary external returns and factors markets to determine the implications of economic integration on the location of production (see Krugman and Venebles, 1995 and Venebles, 1996).

Our model differs, however, in several important respects. First, trade costs are not explicit. We assume intermediate goods are either tradeable or non-tradeable. In this sense, our approach is similar to that of Krugman and Helpman's (1985) treatment of intermediate goods.

Second, unlike Krugman (1991b), we assume labour is fixed in space. This may on the surface appear to be contradictory in the context of the sensitivity of labour migration to wage differentials in both Canada and the United States (see Anderson and Papageorgiou, 1994 and Eichengreen, 1993). However, we are more comfortable with adjustment taking place through the substitution of capital for labour rather than through migration; firms are more responsive to market signals than labour. Only in the very long run, and probably imperfectly, does the regional distribution of labour adjust to interregional wage differences.

Third, we make a clear distinction between intermediate inputs and variable capital. This is not made in other papers and can lead to confusion. Unlike variable capital, substitution between intermediates and labour is unlikely unless the mix of intermediates effects the amount of labour used in production. Changing the mix of intermediates because of variation in prices is doubtful, however, because this would change the nature of the product (McCann, 1995). The only other reason for the ratio of intermediates to labour to change is if there were increasing returns in production. However, if this were the case, marginal costs would no longer be constant, a key assumption of these models. Therefore, it is reasonable to take the perspective that there is not substitution among intermediates or between intermediates and labour and capital. We account for this by using a Leontief–Cobb-Douglas total cost function.

Finally, the model, albeit it in a rudimentary way, is able to show the effects of trade at a regional and national scale. This allows us to identify circumstances where regional and national interests are potentially in conflict.

The paper is divided into four sections. Following the introduction, the second section describes the model. The third section analyses the effects of opening trade at the regional and national scales. Initially, we assume that both nations are exactly the same and that there is free trade in final goods, but trade in intermediate goods is prohibited. These results are compared with circumstances where intermediates are tradeable and both nations differ in size, and where intermediates are non-tradeable and asymmetry persists. The fourth and final section includes a brief conclusion.

Trade model

We assume in the model that both the final and intermediate goods sectors experience falling average costs that are due to the presence of fixed costs. The final goods firms operate in monopolistically competitive markets, while intermediate goods producers are monopolies, but operate under contestable market conditions.

Initially, we will describe the characteristics of demand. This is followed by a description of supply and the equilibrium conditions of the model.

Demand

Consider a situation where consumers have a utility function, $U(D_1, D_2)$, where preferences for sector 1 goods (D_1) are independent of sector 2 (D_2). We assume individuals have Cobb-Douglas preferences between sectors:

$$U(D_1,D_2) = D_1^{\psi} D_2^{1-\psi};\ 0<\psi<1. \tag{1}$$

As specified, this function ensures the share of income spent on each sector is independent of income and prices (Wong, 1995). Following Krugman (1979 and 1980), we assume that a representative consumer's utility for sector one goods, U_1, is an additive function of her consumption of n goods,

$$U_1 = \sum_{j=1}^{n} d_j^{\theta};\ 0<\theta<1, \tag{2}$$

where d_j is the consumption of good j. The closer θ is to zero the more value consumers place on variety.

There are three assumptions that underlie this 'love of variety' approach. First, all goods enter the function symmetrically. Second, all consumers have identical preferences, and third, all varieties are treated symmetrically on the production side (Wong, 1995). Together these assumptions ensure consumers purchase the same quantity of each variety.

Consumers maximize their utility subject to the budget constraint

$$np_j d_j = \psi I, \tag{3}$$

where p_j is the price, n is the number of varieties and I is income. The demand function generated by the first order condition of the maximization is given by

$$d_j = \left(\frac{\theta}{\lambda p_j}\right)^{\frac{1}{1-\theta}}. \tag{4}$$

The Lagrangian multiplier, λ, can be interpreted as the marginal utility of income.[18] The price elasticity of demand, ε, is equal to $1/(\theta-1)$ and is constant. If the number of goods is large, we can assume the cross price elasticities of demand are close to zero. Therefore, firms will set their prices independent of their competitors.

Individual expenditures on D_2 goods are given by $(1 - \psi)I$. We choose units

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[18]The larger the number of goods available to consumers the greater will be the value of λ. That is, the more utility an individual would gain from an extra unit of income.

such that $D_2 = 1$ and treat it as the numeraire. The reason for including sector 2 will become clear in a moment.

Supply

The total cost function (C_j) for a representative firm selling to final demand markets is defined as

$$C_j = \left(\sum_{i=1}^{m} a_i w_i + w_l^{\alpha} w_k^{1-\alpha} \right) y_j + K_j; \quad 0 < \alpha < 1, \tag{5}$$

where, as we will demonstrate later, a_i is the amount of input i used per unit of output (Leontief's technical coefficient), w_i is the price each intermediate good, w_l is the price of labour and w_k is the rental price of variable capital. Output is denoted by y_j and K_j is a fixed cost. Including a fixed cost ensures that average costs are falling. As specified, this function allows substitution between variable capital and labour but no substitution between factor inputs and intermediates or between intermediate inputs. In order to simplify the presentation, we make the assumption that the amount of each input i used per unit of output is the same[19], which implies (5) can be rewritten as

$$C_j = \left(m a_i w_i + w_l^{\alpha} w_k^{1-\alpha} \right) y_j + K_j. \tag{6}$$

Marginal costs (c_j) are constant and are given by

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[19]It is unnecessary to make this assumption in order for the model to be tractable.

$$c_j = \frac{\partial C_j}{\partial y_j} = ma_i w_i + w_l^{\alpha} w_k^{1-\alpha}. \tag{7}$$

Firms that produce intermediate goods have a similar cost function,

$$C_i = w_l^{\alpha} w_k^{1-\alpha} y_i + K_i, \tag{8}$$

where y_i is output and K_i is a fixed cost. We assume intermediate goods producers use only labour, variable capital and some fixed input in production. Furthermore, we make the simplifying assumption that the proportion of capital and labour used in final and intermediate goods production is the same. Without this assumption the model is intractable.

The total labour force is given by L and is the sum of the labour force used in both sectors, $L_1 + L_2$, where subscripts 1 and 2 denote the sectors.

Finally, we should note that because of the symmetry assumptions it is not necessary to maintain the subscripts i and j. However, we do so in order to distinguish between intermediate and final goods sectors.

Equilibrium conditions

There are three equilibrium conditions that must be satisfied, which relate to the final and intermediate goods markets, and the labour market. Starting with the final goods market, if we can identify workers with consumers, output will depend on the size of the total labour force in each country and consumption:

$$y_j = Ld_j. \tag{9}$$

Substituting (4) into (9) will provide a link between the quantity of good j demanded and the price:

$$y_j = L\left(\frac{\theta}{\lambda p_j}\right)^{\frac{1}{1-\theta}}. \tag{10}$$

Assuming all firms are profit maximisers, they would want to set prices such that marginal revenue equals marginal costs. Marginal revenue (r_j) is determined by the price and the elasticity of demand:

$$r_j = p_j\left(1 - \frac{1}{|\varepsilon|}\right) = p_j\theta. \tag{11}$$

Equating marginal revenue with marginal cost and solving for p_j,

$$p_j = \frac{c_j}{\theta}, \tag{12}$$

will give the profit-maximizing price. The price is independent of output because marginal costs and the price elasticity of demand are constant.

Once the firm sets its price, we know the level of consumption, and based on

(10) the firm's output (see Figure 1). Assuming free entry, if profits are greater than zero, there is an incentive for new firms to enter the industry. No two firms would produce the same product because any slight scale advantage would lead to lower costs for one of the firms. Inevitably, a falling market share and associated higher costs would force one competitor out of business (Wong, 1995). Consumers, preferring variety, spread their income across a broad range of goods, which raises their marginal utility of income, and therefore, pushes y_j downward (see (10)). Prices will remain constant[20] because firms, being profit maximisers, continue to set their prices such that marginal revenue equals marginal cost. Since income and prices are constant, each consumer's purchasing power is unchanged. Therefore, the output of sector 1 is fixed and consequently the output of intermediate goods firms. This result substantially simplifies the process leading to an equilibrium because the wage and the prices of intermediate inputs will remain constant. The equilibrium is reached by each firm moving back up its average cost (AC) curve until excess profits are eliminated (see Figure 1). Setting profits (π_j) equal to zero,

$$\pi_j = p_j y_j - C_j = 0, \tag{13}$$

and solving for y_j,

[20] Krugman (1980) assumes prices fall because with more goods the marginal utility of income increases. We assume prices are fixed and consumers maximize their utility given the number of goods. The marginal utility of income will still increase, but it will be determined given prices, income, and the number of goods.

$$y_j = \frac{\theta}{1-\theta}\frac{K_j}{c_j}, \tag{14}$$

will give the equilibrium output of each variety (see Figure 1).

The demand for intermediate inputs is a function of the size of the final goods sector. Sector 1's output is determined by total national expenditures on its goods and their price:

$$Y_1 = \frac{\psi IL}{p} = \frac{\theta\psi IL}{c_j}. \tag{15}$$

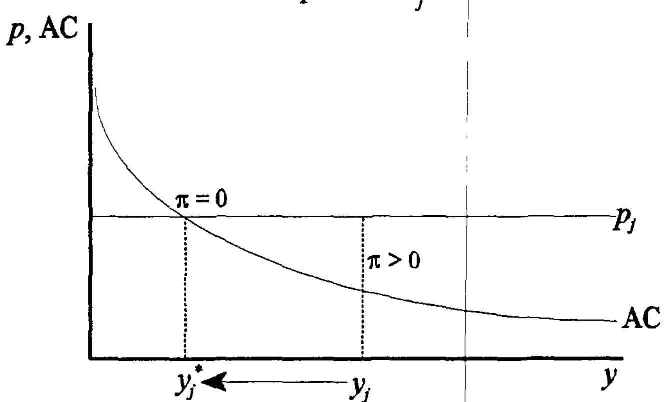

Figure 1: Final goods sector equilibrium

Once we know the output of sector 1, Sheppard's lemma tells us (trivially) the total requirements for each input i,

$$y_i = \frac{\partial C_j}{\partial w_i} Y_1 = a_i Y_1. \tag{16}$$

Therefore, the demand for intermediate inputs is a direct function of final goods output, and is unaffected by the price of intermediate inputs.

Unlike final goods, we assume intermediate inputs are undifferentiated. Because firms experience falling average costs, each intermediate good is produced by a monopolist. If potential competitors can enter and exit rapidly, and established firms do not have a cost advantage, the market may be considered contestable (Helpman and Krugman, 1985), eliminating the possibility of monopoly rents.

There are three equilibrium conditions that must be satisfied if the market is contestable. First, the market must clear. Second, the equilibrium is feasible – no firm makes a loss, and third, the equilibrium is sustainable (Helpman and Krugman, 1985). As Figure 2 illustrates, the model satisfies all three conditions. In equilibrium, demand, which by assumption is completely inelastic, is satisfied and the firm breaks even. The equilibrium is stable because any competitor that sets its price below w_i* operates at a loss. The monopolist has no incentive to set prices above w_i* because excess profits induces competitors to enter the market, eliminating its market share. Therefore, each monopolist sets its price equal to average costs:

$$w_i = w_l^{\alpha} w_k^{1-\alpha} + \frac{K_i}{y_i}. \tag{17}$$

In addition to the goods markets, we also have to ensure the labour market is in equilibrium. Using Sheppard's lemma, the amount of labour used by each final goods firm *j*,

$$l_j = \frac{\partial C_j}{\partial w_l} = \alpha w_l^{\alpha-1} w_k^{1-\alpha} y_j. \tag{18}$$

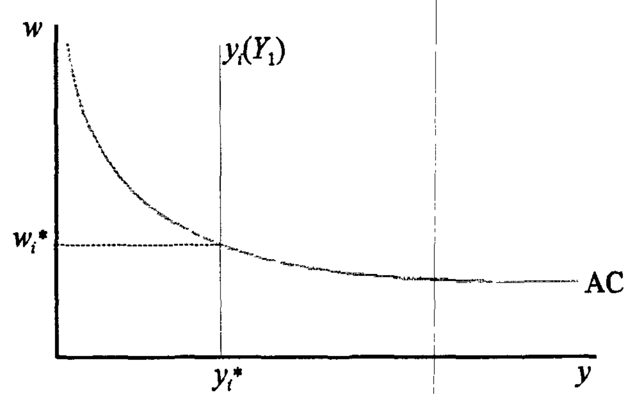

Figure 2: Intermediate sector equilibrium

Similarly, the amount of labour used by each intermediate goods firm is

$$l_i = \frac{\partial C_i}{\partial w_l} = \alpha w_l^{\alpha-1} w_k^{1-\alpha} y_i. \tag{19}$$

Assuming full employment, wages will be set to ensure

$$L_1 = n l_j + m l_i. \tag{20}$$

Equations (13), (17) and (20) form the three equilibrium conditions that must be satisfied. We assume the regional demand for variable capital is small compared to its total demand, and therefore, its price is fixed.

Finally, the number of varieties of final goods can be determined by dividing the total final goods output by the production by each firm j:

$$n = \frac{Y_1}{y_j} = (1-\theta)\frac{\psi IL}{K_j}. \tag{21}$$

This clearly demonstrates a close relationship between the number of varieties produced and the taste for variety, the size of the market, and fixed costs.

Two nation, two region economy

Assume that there are two countries, A and B, that have a common border. Contained within each country are regions a and b that are small compared to their respective national economies (see Figure 3). Due to their small size, wages in a and b have a negligible effect on the demand for final goods.

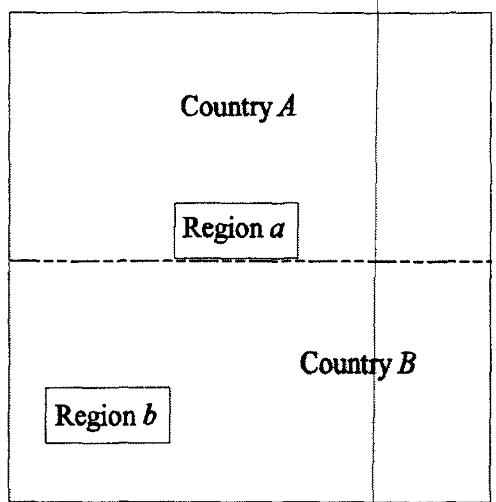

Figure 3: Configuration of regions *a* and *b* within their respective countries

Sector 1 is found only in *a* and *b*, and sector 2 is exclusively located outside of these two regions. There are no transportation costs experienced within each region. However, intermediate goods shipments in and out of *a* and *b* incur transportation costs. Therefore, intermediate goods firms have an incentive to locate only within their region's borders. There are no transportation costs associated with the movement of variable capital inputs and final goods. Labour is immobile, except within each region. The total labour available to final and intermediate goods producers is simply the labour force in each region.

Assuming that regions *a* and *b* are small and sector 1 is found exclusively within them may appear to be contradictory. However, we can think of each consumer's utility function as containing many sectors. Therefore, in this case we are focussing on only one (sector 1) and treating the rest as simply all other goods (sector 2). For example, sector 1 can be thought of as consumer durables or food products (or even subsets of these sectors) and sector 2 as the rest of the basket of goods that consumers purchase. This also implies that the sectors defined in the utility function are what we would commonly think of as industries.

Trade with complete symmetry and non-tradeable intermediate goods

Assume that both countries and their respective regions are equal in size and have the same technology and tastes. Also assume that the geographic pattern of specialization is such that intermediate goods are non-tradeable (see Figure 4). Under these restrictive assumptions, the effect of freeing trade is to double the market available to each firm ($L_A + L_B$). Since we assume symmetry, wages and prices for inputs and final goods are the same. Consumers, preferring variety, spread their incomes equally across all goods. By doubling demand while at the same time doubling the number of goods ensures that each firm's output remains constant. The only effect of freeing trade is to increase the number of goods available to consumers, raising their utility. Krugman (1980) generates the same result.

Obviously, non-tradeable intermediate goods and complete symmetry are very strong assumptions and it is necessary to relax them in order to generate more meaningful results. We will assume initially that intermediate inputs are tradeable and allow variation in the size of the regional and national economies.

Trade with asymmetry and tradeable intermediate goods

Instead of the geographic pattern of production given in Figure 4, assume now the two regions are found adjacent to each other along the border and both nations are unequal in size. Consequently the movement of intermediate goods is now costless. Therefore, free trade leads to the integration of both consumer and intermediate input markets. The integration of the latter will prove to have a significant effect on wages and prices, which would not be seen in its absence.

With free trade, intermediate goods producers on both sides of the border rationalize. That is, no two firms would produce the same product because any slight scale advantage would lead to the demise of the other. The effects of opening up trade do not end here. For exposition purposes, we describe the process after trade is freed as a sequence of events. However, in the model these events occur simultaneously. Because the output of every remaining intermediate goods firm increases, each firm moves down its average cost curve, lowering its price (see Figure 4). Therefore, final goods firms' average cost curves and their profit-maximizing price lines shift downward. At this point we reach a new temporary (denoted by the superscript T) position (see Figure 4). This point is only temporary because the lower final goods' prices increases the purchasing power of consumers. Therefore, the total demand for sector 1's goods rises:

$$Y_1^T = \frac{\theta\psi IL}{c_j^T} > \frac{\theta\psi IL}{c_j}. \tag{22}$$

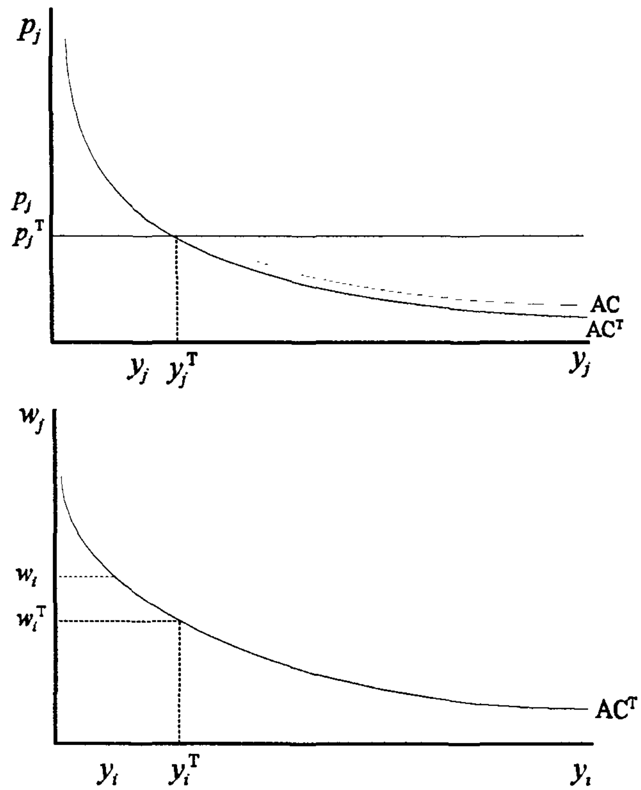

Figure 4: Effect of falling intermediate goods prices on final goods prices and output

If total demand rises, so too will the total demand for labour in each region, forcing wages upward. Therefore, any savings generated by larger intermediate goods firms must be weighed against higher wages in both the intermediate and final goods sectors. The question then is what will be the equilibrium price and wage?

The first step is to solve for marginal costs. Based on equation (7), we know that marginal costs depend on the price of intermediate goods and the wage. In turn, the price of intermediate goods depends on the wage and the size of each intermediate goods firm (see (15)). Substituting (18) and (19) into (20), Y_1 for ny_j and (16) for y_j and solving for w_l gives:

$$w_l = w_k\left[\frac{\alpha Y_1(1+ma_i)}{L_1}\right]^{\frac{1}{1-\alpha}}. \tag{23}$$

Substituting (16) and (23) into (17) provides the relationship between Sector 1 output and intermediate input prices:

$$w_i = w_k\left(\frac{\alpha Y_1(1+ma_i)}{L_1}\right)^{\frac{\alpha}{1-\alpha}} + \frac{K_i}{a_i Y_1}, \tag{24}$$

If we substitute (15) into (23) and (24), and in turn (23) and (24) into (7), it is possible to solve for c_j:

$$c_j = (1+ma_i)\theta\psi IL\left(\frac{\alpha}{L_1}\right)^{\alpha}\left(\frac{w_k}{\theta\psi IL - mK_i}\right)^{1-\alpha}. \tag{25}$$

If the size of the market for final and intermediate goods increases because of economic integration, we would expect the marginal cost of final goods to fall. In order to prove this contention we make the assumption that the size of the regional labour force is a function of the size of the total labour force available in countries A

and B: $L_1 = \mu L$, where μ is some positive value less than 1. Therefore, from the perspective of each country, trade can be looked upon as an increase in L. There is no need to treat the two regions separately. The marginal cost equation (25) can be rewritten as

$$c_j = (1 + ma_i)\theta\psi I\left(\frac{\alpha}{\mu}\right)^{\alpha}\left(\frac{Lw_k}{\theta\psi IL - mK_i}\right)^{1-\alpha}. \tag{26}$$

The rate of change of marginal costs with respect to the size of the market is then

$$\frac{\partial c_j}{\partial L} = (\alpha - 1)\frac{(1 + ma_i)\theta\psi I\alpha^{\alpha}w_k mK_i}{(\mu L)^{\alpha}(\theta\psi IL - mK_i)^{2-\alpha}} < 0. \tag{27}$$

Therefore, marginal costs are always falling as the size of the market increases. We should note that we obtain the same result even if we allow L_1 to increase non-linearly with L.

Since wages are a direct function of marginal costs,

$$w_l = w_k\left(\frac{\alpha\theta\psi I(1 + ma_i)}{\mu c_j}\right)^{\frac{1}{1-\alpha}}, \tag{28}$$

we can also conclude that as the size of the market increases regional wage rates always increase. The region whose external market increases the most experiences the highest relative wage gains; the smaller nation's region benefits the most.

Rising regional wages also means the capital-labour ratio (κ) increases,

$$\kappa = \frac{v_j}{l_j} = \frac{v_i}{l_i} = \left(\frac{1-\alpha}{\alpha}\right)\frac{w_l}{w_k}, \tag{29}$$

where v_j and v_i are the amount of variable capital utilized by final and intermediate goods firms. v_j and v_i are obtained by applying Sheppard's lemma to equations (6) and (8), respectively. Therefore, trade leads to more capital intensive production. This is interesting in the sense that by simply expanding markets the capital labour ratio changes.

Finally, the utility of consumers in both countries increases. Utility can be defined by the following function:

$$U_1 = nd_j^{\theta} = \theta\psi l\left[\frac{(1-\theta)L}{\theta K_j}\right]^{1-\theta} c_j^{-\theta}. \tag{30}$$

The total differential of (30) is

$$dU_1 = (1-\theta)\theta\psi l\left[\frac{(1-\theta)}{\theta K_j}\right]^{1-\theta} c_j^{-\theta}L^{-\theta}dL - \theta\psi l\left[\frac{(1-\theta)}{\theta K_j}\right]^{1-\theta} c_j^{-\theta-1}L^{-\theta}dc_j > 0. \tag{31}$$

It is clear from (30) that utility increases with the size of the labour force, and that since marginal costs are falling with L, consumer utility always rises when the two regional economies integrate.

The welfare effects of free trade when intermediate goods are included are much broader. The real wage increases for all workers because prices have fallen. In addition, the nominal wages of workers in a and b have risen.[21] Therefore, the bordering regions are better off than their respective countries as a whole. We generate this result even though the substitution effect between sector 1 and sector 2 goods is excluded from the model.

Asymmetry and non-tradeable intermediate goods

Unlike in the last section, we make the assumption here that intermediate inputs are non-tradeable. Analytically, this is more difficult to work with because the marginal cost of producing final goods will vary across regions in autarky and in equilibrium. In order to simplify the analysis to follow, we maintain the assumption that the size of the labour force available to final and intermediate goods producers in each region is a fixed proportion (μ) of their respective national labour forces. This implies firms located in the larger nation's region always charge lower prices (see (27)).

First of all, let us choose units such that the labour force in country B is equal to 1 ($L_B = 1$), and we assume the labour force in A is some fraction γ of L_B ($L_A = \gamma$). The final goods sector in each region will only take a share of income spent on sector 1 goods:

[21]Note that because both regions are small compared to their national markets rising wages in the final goods and input sectors will have a negligible effect on final demand.

$$Y_{1_a} = \frac{\delta_a \theta \psi I(\gamma+1)}{c_{j_a}}. \tag{32}$$

δ_a is the share of expenditures on goods produced in region a and is given by:

$$\delta_a = \frac{n_a d_{j_a}(\gamma+1)}{n_a d_{j_a}(\gamma+1) + \sigma n_b d_{j_a}(\gamma+1)} = \frac{n_a}{n_a + \sigma n_b}, \tag{33}$$

where,

$$\sigma = \left(\frac{p_{j_a}}{p_{j_b}}\right)^{\frac{1}{1-\theta}} = \left(\frac{c_{j_a}}{c_{j_b}}\right)^{\frac{1}{1-\theta}}. \tag{34}$$

Sigma (σ) can be interpreted as the units of a good produced in b purchased per unit of a good produced in a (Krugman, 1980).

For illustrative purposes, it is helpful to make the assumption that product markets integrate prior to any adjustments in terms of prices and the number of final goods producers. This allows us to substitute (21) into (33), which reduces to

$$\delta_a = \frac{\gamma}{\gamma + \sigma}. \tag{35}$$

Since we have assumed country B is larger than country A, based on (27) we would expect the marginal cost of producing units in b to be lower. Therefore, σ is greater than 1 (see (34)) and a's share of total demand is less than what we would expect based simply on the size of its country's labour force. By substituting (34) into (35) and (35) into (32), the relationship between output in a and the size of the combined market for final goods can be explicitly defined:

$$Y_{1_a} = \frac{\gamma}{\gamma + \left(\dfrac{c_{j_a}}{c_{j_b}}\right)^{\frac{1}{1-\theta}}} \frac{\theta\psi I(\gamma+1)}{c_{j_a}} \tag{36}$$

Note that the higher the elasticity of demand the larger the initial decline in a's output.

Although (36) demonstrates the small region's output falls, the magnitude of that decline is unknown. As we will illustrate below, the extent of the decline depends crucially on the value of the model's exogenous variables.

By modifying (25) to include the share term and the labour force in both countries we can define marginal costs in a as follows:

$$c_{j_a} = (1 + ma_i)\delta_a \theta\psi I(1+\gamma)\left(\frac{\alpha}{L_1}\right)^{\alpha}\left(\frac{w_k}{\delta_a \theta\psi I(1+\gamma) - mK_i}\right)^{1-\alpha}. \tag{37}$$

We use (25) to define marginal costs because any increase or decrease in demand does not result in a rise or decline in the labour force available to final and intermediate goods producers.

The rate of change in the marginal cost of final goods with respect to the size of the market is given by the following:

$$\frac{\partial c_{j_a}}{\partial \delta_a} = \mathrm{E}(1 + ma_i)\theta\psi I(1+\gamma)\alpha^{\alpha} L_1^{-\alpha} w_k^{1-\alpha}\left[\delta_a \theta\psi I(1+\gamma) - mK_i\right]^{\alpha-1}, \tag{38}$$

where

$$\mathrm{E} = \left[\frac{\alpha - 1}{1 - \dfrac{mK_i}{\delta_a \theta \psi I (1+\gamma)}} + 1 \right]. \tag{39}$$

Although (38) and (39) appear on the surface to be difficult to interpret, it is only E that determines whether marginal costs will be increasing or decreasing with respect to δ_a. If the market is relatively small, marginal costs fall as it increases in size. However, if the market is large enough, any further growth would lead to higher prices. This is an intuitively appealing result. When demand is small relative to the size of the region's resources, the influence of fixed costs on intermediate input prices is relatively strong, outpacing any wage gains. However, as output increases, savings on fixed costs diminish and at some point wages gains begin to dominate. The point at which prices begin to rise is given by:

$$1 + \gamma = \frac{mK_i}{\alpha \delta_a \theta \psi I}. \tag{40}$$

We know that if the sizes of both national markets are the same ($\gamma = 1$) $\delta^a = 0.5$, which implies $mK_i/\alpha\ \theta\psi I = 1$. Using this as a benchmark, there is one exogenously given level of internal national demand that final goods prices will begin to rise. Where each nation is relative to that point, will determine the relative magnitude of *a*'s decline (or *b*'s rise). There are three possible combinations:

$$(a)\ \frac{\partial c_{j_a}}{\partial \delta_a}<0,\ \frac{\partial c_{j_b}}{\partial \delta_b}<0;\qquad (b)\ \frac{\partial c_{j_a}}{\partial \delta_a}<0,\ \frac{\partial c_{j_b}}{\partial \delta_b}>0;\qquad (c)\ \frac{\partial c_{j_a}}{\partial \delta_a}>0,\ \frac{\partial c_{j_b}}{\partial \delta_b}>0.$$

For option (a) both nations are on the downward-sloping portions of their price curves. This is the most perilous condition for region *a*. In successive rounds of adjustment *a*'s prices rise as *b*'s falls. However, since there is always be demand for *a*'s goods, production will continue take place in *a.* In the second case ((b)), the smaller nation is on the downward sloping and the larger nation is on the upward-sloping part of the price curve. Under these circumstances, both regions' costs will rise and consequently, *a*'s decline will not be as precipitous. Finally, in the third case (c) both regions are on the upward-sloping section of their price curves. Declining output causes prices to fall in *a* and the opposite would be true of *b*. There is, in effect, an immediate floor on the decline of *a*'s output and a ceiling on *b*'s. Nevertheless, output still declines in *a* and rises in *b*, and the magnitude depends on the price differential in autarky and the elasticity of demand.

Therefore, in all three cases the smaller nation's region is worse off. The region loses a large share of its home market and is unable to sufficiently penetrate the other nation's market to account for this loss. As a consequence, wages fall in *a* and increase in *b*, as it benefits from a larger two-nation market. In contrast to its region, the real wages of consumers in country *A* rise because from their perspective the overall price of products has declined. The real wage in *B* may decline if the price of *b*'s goods increase. Of course, the citizens in country *B* also benefit from a greater number of varieties, and therefore, the welfare loss may be more apparent than real. Nevertheless, the prime beneficiaries of free trade are workers in b and consumers in A. Finally, it is also worthy of note that as a result of free trade producers in the smaller region are more labour intensive than they were originally. To a lesser degree the opposite would be true of the larger region. Therefore, even if both nations have the same relative stocks of labour and capital, the factor intensity of exports of the same types of goods will diverge as the two economies integrate.

Conclusions

The model that we present here illustrates a clear relationship between the geographic configuration of production and the impact of trade on regions. If the pattern of production is such that intermediate goods are tradeable, trade benefits both small and large nations and their respective regions. In fact, the small country and its regions benefit the most. On the other hand, if trade in intermediate goods is prohibited, the smaller nation benefits, but its region incurs a loss of welfare. The magnitude of the loss depends on relative influence of increasing returns in the intermediate goods sector and wages on costs. Nevertheless, production still takes place in the smaller country's region when trade is freed. Therefore, the model avoids the prediction of most models of this kind that production will be evenly spread over space or concentrated in one of the regions.

At a broader level, the model illustrates that in a world where production is clustered in space, our understanding of the impacts of trade is heavily influenced by the geographic scale that we study its effects and the relative location of producing regions. For example, on the surface it would appear the adjustment costs associated with growing trade between Canada and the United States are fairly low because a significant proportion of the trade is of the intra-industry type. However, the results of the model indicates that in the presence of non-tradable intermediates, the impact of trade may be severe at the regional scale.

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CHAPTER 4

The Potential for Economic Integration among Canadian and American Regions[22]

Introduction

The strong economic relationship between Canada and the United States has led many to view the two economies as a closely integrated whole. In more concrete terms, the perception is that Canadians are as likely to trade with Americans as themselves (Helliwell, 1996). However, recent work by McCallum (1995) and Helliwell (1996) proves this perception to be incorrect. Their analysis demonstrates that by controlling for the economic weights of the trading partners and the distance between them, internal trade within Canada far exceeds trade among Canadian and American regions. The border remains a significant barrier to trade.

Although McCallum and Helliwell's analyses shed some light on the trading relationship among Canadian and American regions, there are from our perspective two questions that are left unanswered. First, what is the potential for further economic integration? McCallum and Helliwell's analyses suggest that without the

[22]This paper has been submitted to *Papers in Regional Science*.

presence of the border Canadian trade with the United States would be twenty times higher. Our analysis of Canada-US regional trade indicates the potential for trade is heavily influenced by the industrial structure of the trading partners in addition to their relative size and geographic location (Brown and Anderson, 1999). This result implies that a more accurate measure of the potential for further economic integration would take into account variations in the demand and supply of intermediate goods, which account for approximately 40% of Canada-US trade (Brown and Anderson, 1999).

Second, what underlying factors influence these trade flows? The gravity model, which has proven to be one of the most statistically successful models of international trade flows and is used by McCallum and Helliwell, provides us with little insight into why these geographic patterns of trade come about. Therefore, the second goal of this paper is to develop a trade flow model that has a clear theoretical and empirical interpretation. Although our model takes on the gravity model's form, we hope its theoretical derivation may provide a better interpretation of its results.

There are two reasons why the answers to these questions are of interest. First, the potential for trade is also an indication of the potential for welfare gains. That is, the greater the degree of integration the greater the degree of specialization, and therefore, efficiency growth. Second, knowledge of the industrial and geographic pattern of potential integration may be a useful tool for developing trade policy, and in particular, regional trade policy. That is, if we are able to understand whether a sector's markets are regional or continental in nature and what underlying forces are driving its trade, then we also have a better understanding of what policies, if any, may be useful for improving interregional trade.

The organization of the paper is as follows. We begin with the literature review, where we initially and very briefly review two of the most prominent theories of international trade and connect them to Canada-U.S. trade and our understanding of its underlying causes. These theoretical findings are then related to trade flow models and specifically the gravity model. Following this, we develop a trade flow model that takes into account factors influencing both the supply and demand for traded goods. The statistical specification of the model and its data requirements are then reviewed and the model's results discussed. The final section outlines some brief conclusions and avenues for future research.

Literature review

Among the most prominent explanations of international trade are the Heckscher-Ohlin (H-O) theorem and increasing returns to scale. The H-O theorem (Ohlin, 1933) states that countries will export those goods whose production is intensive in the factors of production they have in relative abundance. The increasing returns explanation of trade, on the other hand, is based on the premise that as production of a particular firm increases unit production costs will fall (Helpman and Krugman, 1985). In the context of Canada-U.S. trade, increasing returns have received the most attention for two reasons. First, because both countries have relatively similar endowments of labour and capital, we would expect factor prices to be similar. Second, the small size of the Canadian market has resulted in Canadian firms that are often smaller than their American counterparts. This latter factor was identified by Eastman and Stykolt (1967) as a potential cause of higher prices charged by Canadian manufacturers compared to their American counterparts.

The core of the Eastman-Stykolt (E-S) hypothesis can be described as follows. Since the protected Canadian market is small, firms operate using equipment that is less efficient than the best-practice found in the United States. Canadian firms are discouraged from using the most efficient equipment for two reasons. First, the most advanced equipment is often designed for large scale production, which in the Canadian context may account for a substantial share of the market, and therefore, makes investment in it risky. Second, the smaller local market forces firms to produce a large number of varieties using short production runs in the same plant, leaving the plant idle for long periods of time. When production is organized in this fashion, the higher carrying (fixed) costs of best-practice equipment is harder to sustain. This problem is further exacerbated by longer periods of downtime for retooling associated with more automated, best-practice equipment.

The E-S hypothesis is a strong argument for liberalized trade between Canada and the United States if Canadian firms are able to compete effectively in the American market. Wonnacott and Wonnacott (1967) used it as a basis for their study of the competitiveness of Canadian firms under free trade conditions. Wonnacott and Wonnacott's broad conclusion was that Canadian firms located in the geographic nexus of Canadian manufacturing production, Southern Ontario, were well situated in terms of their costs and geographic location relative to the American market if free trade were to come about. The same was not true, however, of peripheral Canadian regions located far from the Canadian and American economic cores. Harris and Cox (1983) and Cox (1994) also used the E-S hypothesis as a basis for their general equilibrium model of Canada-U.S. trade, which showed free trade would result in substantial welfare gains for Canada, which were not seen in other computable general equilibrium models that did not take into account industrial organization (Helpman and Krugman, 1989).

If Canadian industries are to take advantage of the economies described by Eastman and Stykolt, they must be able to effectively penetrate the American market. Therefore, one of the most important questions for the analysis of the regional implications of Canadian-American trade is as follows. Given the geographic and industrial structure of the trading regions what is the potential for trade if all barriers to trade were eliminated – the border no longer acts as a significant barrier to trade? This is the question that Wonnacott and Wonnacott (1967) tried to answer. Their analysis was, however, hampered by a lack of trade flow data at the time, which did not allow them to directly measure the influence of industrial and spatial structure on trade. The data are now available to do so.

Any attempt to explain the volume of trade inevitably leads to a discussion of the gravity model. The model's application to international trade has a long history dating back to the pioneering work by Timbergen (1962) and Pöyhönen (1966). Its numerous applications to international trade have proven that the model is able to consistently explain a high proportion of international trade (Anderson, 1979, Bergstrand, 1985, and Thursby and Thursby, 1987). Despite its statistical success, the gravity model's contribution to our understanding of trade is limited. Its functional form can be derived from the H-O theorem (Deardorff, 1995) and models of increasing returns (Krugman, 1979). Therefore, it is not an effective test of either theory. This does not mean, however, that there is no point to its theoretical derivation. What is necessary is that the theoretical basis for its derivation and its interpretation is applicable to the problem at hand. As we have demonstrated, increasing returns to scale would appear to be one of the key factors driving Canada-U.S. trade, particularly from the Canadian perspective. The model that we develop uses this as its fundamental basis. Nevertheless, it should be kept in mind that the H-O theorem may apply to the Canada-U.S. trade as well, and therefore, ours is only a partial explanation of their trading relationship.

Trade model

In order to develop the trade flow model, we initially define the conditions for the supply and demand for intermediate inputs. We chose to focus the discussion on intermediate goods for two reasons. First, as we noted in the introduction, they form an important component of Canada-U.S. trade. Second, and following from this, we want to develop a clear framework to understand the supply and demand for intermediates. Furthermore, as we will show, it is a fairly easy to move from this analysis to final goods, and therefore, by focussing on intermediates there is no loss of generality.

Supply of intermediate inputs

In order to define the cost conditions facing each firm, we apply a narrow definition of what Chandler (1990) argues is the primary competitive strategy of a large proportion of industry, *scale* and *scope*. We define the relationship between the two terms as follows. By operating at a sufficiently large *scale* firms are able to reduce their unit production costs and this is often achieved by producing several varieties in the same plant, *scope*. However, by increasing their scope firms may also incur extra costs[23] (e.g., equipment is idle while it is retooled for the next production run). Therefore, in order to minimize their costs, manufacturers must make a choice between their overall scale of production and the number of varieties that they produce. There is, of course, a close relationship between Chandler's concept of scale and scope and the E-S hypothesis.

We can relate scale and scope formally through the following total cost function for some representative firm z producing varieties of goods belonging to sector i[24]:

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[23]This is a narrow definition of scope. For example, by producing a wider variety of products the firm may be able to take fuller advantage of product or process technologies that it has developed in-house or distributions systems that it has developed.

[24]We should note that the functional form of this cost function owes much to Ethier's (1979 and 1982) treatment of the influence of the variety of inputs on production.

$$C_{z(i)} = f(\boldsymbol{x})n^{\omega}y_v + K_z; \qquad \omega > 1. \tag{1}$$

Where $\boldsymbol{x}$ is a vector of factor and material input prices, n is the number of varieties produced, y_v is the output of each variety, which we assume to be equal across varieties, and K_z is a fixed cost. Note that since the parameter ω is assumed to be greater than one, total costs are a non-linear function of the number of varieties produced.

The output of each firm is simply ny_v, and therefore we can rewrite (1) as

$$C_{z(i)} = f(\boldsymbol{x})ny_v n^{\omega-1} + K_z. \tag{2}$$

Average costs would then be given by

$$AC_{z(i)} = f(\boldsymbol{x})n^{\omega-1} + \frac{K_z}{ny_v}. \tag{3}$$

If we assume that the market for each variety is contestable, firms would follow average cost pricing (Helpman and Krugman, 1985). Under these circumstances, firms choose to produce the number of varieties that minimize average costs given the level of demand for each variety. If this were not the case, competitors would have an incentive to enter the market. Therefore, firms would choose the number of varieties that would minimize average costs:

$$\frac{\partial AC_{z(i)}}{\partial n} = (\omega-1)f(\boldsymbol{x})n^{\omega-2} - \frac{K_z}{n^2 y_v} = 0. \tag{4}$$

Solving for n,

$$n = \left[\frac{K_z}{y_v(\omega - 1) f(x)} \right]^{\frac{1}{\omega}}, \tag{5}$$

it is evident that as demand for each variety increases the number of varieties produced in each plant declines. Increasing market size leads to more plants producing fewer varieties. Finally, expanding markets will also lead to lower prices since

$$p_v = AC_{z(i)} = R f(x)^{\frac{1}{\omega}} \left[\frac{K_z}{y_v} \right]^{\frac{\omega - 1}{\omega}}, \tag{6}$$

where $\mathrm{R} = \left[(\omega - 1)^{(1-\omega)/\omega} + (\omega - 1)^{1/\omega} \right]$ and is a positive constant. This is the core of the E-S hypothesis.

Demand for intermediate inputs

Turning now to the demand for intermediate inputs, assume that some downstream sector j has the following weakly separable production function:

$$y_j = f(M, Z), \tag{7}$$

where M is a function of material inputs i and Z is a function of factor inputs. If we define production as a two stage process, where the choice of each aggregate input i is separate from the choice among the varieties that it is composed of, we can define the following sub-production function:

$$X_i = \sum_{v=1}^{m} x_v^{\theta}; \quad 0>\theta<1. \tag{8}$$

We assume, for simplicity, that m is large enough to ensure that the optimal number of varieties, n, produced by each supplier is a small number relative to m. This provision ensures that there are no significant barriers to entry. Using this specification, we make the further assumption that the amount of input X_i necessary to produce y_j is some additive function of the number of varieties that it is composed of – we can think of X_i as a composite input that can be made using some combination of varieties v. The lower the value of θ the more differentiated are the inputs required in production. What this means is that in order to produce the aggregate X_i, firms are better off purchasing a large variety of inputs, rather than a single variety. Given that firms would want to minimize the cost of purchasing the aggregate input i,

$$\min C_i = \sum_{v=1}^{m} p_v x_v, \tag{9}$$

they would choose to purchase

$$x_v = \left(\frac{\theta}{\lambda p_v} \right)^{\frac{1}{1-\theta}}, \tag{10}$$

where λ is a Lagrangian multiplier. The elasticity of demand, ε, is then 1/(θ-1).

The important point to note here is that the level of downstream demand has a potentially strong influence on the structure and costs of upstream firms and that this demand is influenced by the price of each variety. Increasing downstream demand will result in a fall in the number of varieties produced by each firm and a fall in the price of each variety. Therefore, even in this very simple model, trade will have a significant effect on the organization of production and potentially prices.

What is left out of the analysis to this point is any perspective on what these results might imply for regional trade. We have established a rationale for a demand for variety and that in the presence of fixed costs, why several varieties will be produced in the same plant. If production is concentrated in a few plants then it must also be concentrated in space. Furthermore, since a demand for variety exists, downstream firms will source their inputs from several suppliers. Therefore, based in this very simple logic, trade must take place.

This argument can be taken a step further. When trade costs are present, upstream and downstream firms may agglomerate to take advantage of external economies. Downstream firms would want to be close to their suppliers in order to have access to cheaper inputs. Furthermore, upstream firms would want to be close to their customers in order to take advantage of large scale production. Agglomeration, however, may also bid up factor prices, which act as a centrifugal force (Krugman and Venebles, 1995, and Venebles, 1996). At some point, the benefits of agglomeration will be overcome by higher factors prices. That is, $f(x)$ in (6) increases. Whether production is dispersed or concentrated depends on the interaction between these factors. The most important point for our purposes, however, is that there is a clear rationale for why production is differentiated over space. Therefore, we are not relying on the Armington assumption, which is a criticism that Deardorff (1995) has made of some theoretical derivations of the gravity model (see, for example, Anderson, 1979).

In order to understand this more clearly, consider a situation where rising factor prices have led to the dispersal of both final and intermediate goods production over space and transportation costs are low. In this case, downstream firms would continue to demand roughly the same amount of each variety regardless of where it is produced. At the other extreme, high trade costs may force downstream firms to primarily source their inputs from local suppliers. Local suppliers in turn would produce a larger number of varieties in order to minimize their average costs. The net result is strongly curtailed, and in the extreme no inter-regional trade. Therefore, the interaction between location and these economies may determine the volume of trade between upstream producers located in different regions. The purpose of the formal trade model that we develop next is to capture these influences.

Formal trade model

The potential level of exports between two regions (A and B) can be determined based on the input-output relationship among the regions' sectors. Given that we know the amount of input i used per unit of output of sector j, a_{ij}, the output of sector i that is destined to be used by sector j in some region B is given by:

$$X_{ij_B} = a_{ij} X_{j_B}. \tag{11}$$

If we assume that there is no friction of distance, demand for variety and firms specialize to take advantage of increasing returns, exports of aggregate input i from A to B is simply A's share of industry i's total output in all regions. Therefore, we can define the volume of exports from A to B as follows:

$$T_{ij_{AB}} = a_{ij} X_{j_B} \left(\frac{X_{i_A}}{\sum_{A=1}^{r} X_{i_A}} \right), \tag{12}$$

where r is the number of regions in the continental economy. As it stands, equation (12) represents the simplest form of the trade model. However, as we just noted above, a more meaningful model would take into account the effect of production and distance related costs on the choice of where to source intermediate goods.

Logically, since there would be some transportation cost incurred between A and B, domestic firms would purchase a larger quantity of inputs from those suppliers that are close by. The amount of a representative variety produced in A purchased per unit input available to firms located in B is:

$$\sigma_{AB} = \left(\frac{\rho}{p_{v_A} \tau_{AB}} \right)^{\varepsilon}, \tag{13}$$

where τ is some trade cost and ρ is a weighted average of the c.i.f prices of all inputs utilized by firms in B and is given by

$$\rho = \frac{\sum_{A=1}^{r} p_{v_A} \tau_{AB} T_{ij_{AB}}}{a_{ij} X_{j_B}}. \tag{14}$$

If we assume, as above, that the market for intermediates is contestable, the ratio of prices is merely the ratio of average costs for each variety. This substantially increases the economic content of the model – given that average costs (AC_v) are some function of factor and material input prices in addition to how production is organized within the firm. Therefore, the model takes into account both cost conditions and the relative location of upstream and downstream industry.

Now, let us rewrite (12) as follows

$$T_{ij_{AB}} = \sigma_{AB} a_{ij} X_{j_B} X_{i_A} k_B. \tag{15}$$

where k_B is a sharing-out function or what is referred to in the spatial interaction literature as a balancing term, which we will define explicitly in a moment. Since we know that the total production of i utilized by industry j must add up to (11), the following is true:

$$\sum_{A=1}^{r} T_{ij_{AB}} = a_{ij} X_{j_B} = a_{ij} X_{j_B} k_B \sum_{A=1}^{r} \sigma_{AB} X_{i_A}. \tag{16}$$

Solving for k_B and substituting back into (15) gives

$$T_{ij_{AB}} = a_{ij} X_{j_B} \frac{\sigma_{AB} X_{i_A}}{\sum_{A=1}^{r} \sigma_{AB} X_{i_A}}. \tag{17}$$

Substituting (14) into (13) and (13) into (17) and simplifying results in the following

$$T_{ij_{AB}} = a_{ij} X_{j_B} \frac{\left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}}{\sum_{A=1}^{r} \left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}}. \tag{18}$$

This is the typical functional form of the attraction constrained gravity model. The volume of trade is positively associated with the size of the two input-output linked sectors and negatively associated with trade costs. The denominator in the expression represents the attractiveness of other potential sources of inputs for firms located in *B*. Therefore, if *A* is poorly situated to serve *B*'s market, the denominator will tend to shift *A*'s exports from *B*.

The extent of this trade depends crucially on the interaction between distance related and other localized costs and the demand for variety. If the demand for variety is high, θ is close to zero, and the delivered price of a good will have a relatively small effect on demand. On the other hand, if the demand for variety is low, the delivered price of a good will have a much stronger influence on demand. In fact, as θ approaches one, the elasticity of demand approaches infinity. Therefore, substitutability in production can also be seen a substitutability over space. What this means is that if we use distance, for example, as a measure of transportation and other distance related costs and the demand for variety is substantial enough its parameter value may be low even though transportation costs may account for a substantial portion of the delivered price.

To this point, the discussion has centred on the demand for intermediate goods. However, since the data that we will be using in the analysis cannot be disaggregated into intermediate and final goods, the model must be equally applicable to both. If we assume utility is an additive function of the number of varieties consumed (see Krugman, 1979 and 1980), $U_i = \sum_{v=1}^{m} c_v^{\theta}$, where c_v is the consumption of variety v, then consumer demand for each variety would be given by

$$x_v = \left(\frac{\theta}{\lambda p_v} \right)^{\frac{1}{1-\theta}}. \tag{19}$$

Equation (19) is exactly the same as (10). Therefore, we can treat consumer or any other type of final demand as simply another sector j. Note, however, that this simplification is based on the assumption that the elasticity of demand across sectors j is exactly the same. We will maintain this assumption throughout the paper.

Specification and estimation

In order to apply empirically the model described in equation (18) it is necessary to make some modifications. First, since we only know the flows between regions, rather than between sectors, we can only estimate trade flows of goods i between regions A and B, which implies (18) should be summed over all sectors j:

$$T_{i\cdot_{AB}} = \sum_{j=1}^{m} T_{ij_{AB}} = \sum_{j=1}^{m} a_{ij} X_{j_B} \frac{\left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}}{\sum_{A=1}^{r} \left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}} . \tag{20}$$

This is a relatively minor modification since (20) still allows us to take into account variations in industrial and final demand over space. Second, given that prices cannot be determined directly, (20) has to be estimated using several proxy variables that we will define explicitly below. Therefore, the final form of the model is

$$T_{i\cdot_{AB}} = \sum_{j=1}^{m} a_{ij} X_{j_B} \frac{\prod_{k=1}^{l} z_{k_A}^{\eta_k} d_{AB}^{\beta} X_{i_A}^{\phi}}{\sum_{A=1}^{r} \prod_{k=1}^{l} z_{k_A}^{\eta_k} d_{AB}^{\beta} X_{i_A}^{\phi}} , \tag{21}$$

where the z_ks are variables that influence the price of goods produced in A as well as some dummy variables, and d_{AB} is the distance between A and B, which is intended to approximate the influence of distance related costs on trade. Note that in its estimateable form the trade model does not explicitly measure the price elasticity of demand. However, this does not reduce our ability to interpret the results of the model. That is, we should be still able to interpret the substitution of goods in production and consumption over space.

Although it would appear improbable, equation (21) can be estimated using ordinary least squares by linearizing it as follows[25]

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[25]The proof of this transformation can be found in Fotheringham and O'Kelly (1989).

$$lnT_{i_{AB}} - \frac{1}{r}\sum_{A=1}^{r} lnT_{i_{AB}} = \sum_{k=1}^{l} \eta_k \left(lnz_{k_{AB}} - \frac{1}{r}\sum_{A=1}^{r} lnz_{k_{AB}} \right) + \beta \left(lnd_{AB} - \frac{1}{r}\sum_{A=1}^{r} lnd_{AB} \right) + \phi \left(lnX_{i_A} - \frac{1}{r}\sum_{A=1}^{r} lnX_{i_A} \right). \quad (22)$$

Equation (22) provides us with an estimate of all the relevant variable parameters.

Data

In order to estimate the model, flow, industrial, distance and several types of nominal data are required. Their sources and qualities are outlined in this order below.

Trade flow data

In order to determine the potential volume of trade between Canadian and American regions we need a relevant benchmark of economic integration. In McCallum and Helliwell's analysis, internal trade within Canada was compared with province to state trade. Since we are most concerned about the potential for integration into the American economy, it would be more useful to use American trade flows as a benchmark. That is, we are assuming that after controlling for all the relevant factors, internal U.S. trade represents the maximum level of integration that we could reasonably expect. Internal Canadian flows may not be the best benchmark for two reasons. First, they may be biassed upwards because the protection of the domestic market in the past has promoted long east-west trade routes from the industrial heartland of Ontario and Quebec to the outlying eastern and western provinces. The economic geography of the United States is not as concentrated.

Secondly, since most of Canada's output is produced within a few hundred kilometres of the American border, the majority of the journeys will take place in the United States. Therefore, it is the American transportation system that is the most relevant.

Combined with the specification of the model described by equation (18), the use of internal U.S. trade flow data implies the model can only be applied to exports from Canadian provinces to U.S. states and among U.S. states. American exports to Canada should be excluded from the model. In order to understand why this is the case it is worthwhile to take a closer look at the specification. The estimate of flows between some origin A and destination B is based on the sum of the values of each of the independent variables for origin A minus the average value of the independent variable for all other origins. If we use a dummy variable to take account of the flows that have a Canadian region as an origin or destination, the average for that variable when Canada is a destination is one. Consequently, the value of the dummy variable in the estimation for those pairs is zero, which biases the estimation of the model. Even if we used two dummy variables, one for Canada as an origin and one for Canada as a destination, the model would not take into account the influence of the border for Canadian destinations, because the probability (equation 17) would be unaffected by the value of the dummy variable. Only if we included internal Canadian trade in the model would this problem be resolved. Therefore, as specified, the model can only explain Canadian exports to the United States and internal American trade.

Internal U.S. trade flows are measured using the Bureau of Transportation Statistics' Commodity Flow Survey (CFS) (Bureau of the Census, 1997), which was implemented in 1993. These data are reported at the two-digit Standard Transportation Classification (STC) level. The STC is equivalent to the 1956 Standard Industrial Classification (SIC) and since there is very little change in the two-digit SICs between the 1956 and the current 1987 classification, the STC data are roughly comparable to the 1987 SIC.

The CFS estimates all merchandise trade in the United States, with the exception of commodities transported by pipeline as well as goods covered by SIC 27, *printing and publishing*. We used, however, only flows of manufactured goods (SICs 20, 22-26, and 28-39). SIC 21, *tobacco products*, was also excluded because of disclosure problems. Although it would have been possible to expand the analysis to include other sectors, there were concerns regarding the comparability of Canadian and American data for these sectors. Furthermore, the sectors that we did include accounted for a large majority of internal U.S. trade covered by the CFS (87%) and Canada-U.S. trade (83%).

Trade flows between Canadian provinces and U.S. states in 1993 are derived from Statistics Canada's TIERS (1996) data base. These data are reported using the Harmonized System Classification (HSC) and were converted to the U.S. 1987 SIC using a concordance provided by the Census Bureau. The flow data were then converted to U.S. dollars using the 1993 average exchange rate. Although all flows of merchandise trade are reported by this data base, because of the limitations of the CFS, we only estimated the model for Canadian flows of goods covered by SICs 20, 22-26 and 28-39.

Industrial data

Manufacturing output (OUT) data are provided by Statistics Canada (1995) and the Census Bureau's (1996) 1993 survey of manufacturers. Although the Canadian data are reported using Canada's 1980 SIC, the data are roughly comparable at the two-digit level with the US 1987 SIC. A concordance published by Statistics Canada was used to adjust the Canadian data where necessary. We should note, however, that although the concordance provides a means to compare data reported by the classification, it does not necessarily resolve all of the incongruities between the two systems. Nevertheless, we are confident that there is no systematic bias remaining that would have a significant influence on the results of the model.

The Annual Surveys were also used to measure the influence of regional variations in the characteristics of industrial sectors on the delivered price of their goods. These variables are productivity (PROD), wages (WAGE), and localization economies (LQ) (Bureau of the Census, 1996 and Statistics Canada, 1995). Productivity was measured as value added per employee. Typically, productivity is measured as value added per hour of work. However, since hours are reported only for production workers, this measurement of productivity may be biassed downward for Canadian plants because a significant proportion of them are branch operations that undertake little head office or research functions. Wages are measured, for similar reasons, as pay per employee. Finally localization economies, which may be interpreted as the benefits (or costs) of similar firms locating in the same state or province, were measured using location quotients. The location quotient for each industry was estimated using:

$$LQ = \frac{VA_{i_A} \sum_{i=1}^{n} VA_{i_{NA}}}{VA_{i_{NA}} \sum_{i=1}^{n} VA_{i_A}}, \tag{23}$$

where VA_{i_A} and $VA_{i_{NA}}$ represent value added in region A and North America, respectively.

Distance

Distance is measured as road distance between the largest metropolitan area in each state or province. Internal state distances are determined by calculating the radius of a circle that is the area of the state.

Nominal data

Dummy variables were used to take into account characteristics of origin-destination pairs that might have a systematic effect on trade flows. As noted above, the most important for our purposes is the influence of Canada as an origin. Consequently, the difference between province to state flows and state to state flows is accounted for by a dummy variable (CAN). In addition, since there is the possibility that Canadian flows may be consolidated in border states, flows between provinces and states with a common border are also accounted for by a dummy variable (BORD). The CFS takes into account both internal and state to state flows. Since internal flows may include goods that might not typically be exported over long distances (e.g., bakery products), a dummy variable was included for internal flows (INTR). The same might also be true of trade between bordering states, so we also included a dummy variable for contiguous states (CNTG).

Model results

In this section of the paper we outline and interpret the results of the estimation. Initially, we review the results with regards to output, price related variables and the nominal variables. Following this we discuss the influence of the border as it is measured by the model. However, before discussing the model's results in detail we would like to outline some of the basic characteristics of Canadian exports to the United States as well as internal American trade.

In 1993 Canada exported $108 billion ($U.S.) worth of goods to the U.S., $90 billion of which is covered by the analysis (see Table 1). Therefore, on aggregate the model accounts for the vast majority of Canadian exports. However, this does not mean the model is equally applicable to all regions. In the cases of Alberta and Saskatchewan the model only accounts for a small proportion (22% and 44%, respectively) of their exports. Therefore, the model's ability to explain their trade is weak.

Table 1: Exports from Canadian regions and U.S. internal trade ($US millions)

	British Columbia	Alberta	Saskat-chewan	Manitoba	Ontario	Quebec	Atlantic Canada	Canada	United States
Food products	172	438	63	120	1,669	617	253	3,332	852,009
Textiles	3	0	1	7	244	225	10	491	100,807
Apparel	66	9	0	32	193	308	7	616	290,917
Lumber & wood prod	3,585	196	56	96	1,286	1,125	236	6,581	124,343
Furniture and fixtures	28	47	0	46	1,159	214	12	1,507	69,105
Paper products	854	658	88	66	2,369	3,163	811	8,008	194,512
Chemicals	144	870	774	61	2,712	721	68	5,350	527,936
Petroleum & coal prod	35	188	51	46	438	184	930	1,872	340,894
Rubber and misc plstics	42	26	3	35	1,443	338	446	2,333	168,146
Leather products	2	0	0	14	25	18	1	60	44,984
Stone, clay and glass	62	23	1	4	638	178	15	920	90,862
Primary metals	291	33	104	84	4,658	2,809	19	7,998	228,428
Fabricated metals	70	32	1	10	1,208	298	23	1,642	237.001
Machinery and equip	375	107	61	243	5,058	792	33	6,669	440.271
Electronic equipment	141	183	15	59	1,909	2,488	8	4,802	411,067
Transport equipment	154	26	15	311	32,733	3,808	23	37,070	626,657
Instruments	46	33	1	6	915	117	9	1,127	199,266
Misc manuf prod	11	3	0	5	202	263	6	490	142,212
Total	6,080	2,875	1,233	1,243	58,859	17.665	2,910	90,866	5,089,417
Total - All Good	7,160	12,809	2,555	1,914	61,223	19,284	3,986	108,931	5,826,019

Source: Statistics Canada (1996) and Bureau of the Census (1997)

It should also be clear from Table 1 that in terms of total trade, and the trade covered by the model, Canadian exports are dominated by Ontario and Quebec. It is also worth noting that for each Canadian region exports tended to be concentrated in a few sectors. For example, fifty per cent of British Columbia's exports are *wood products* and 53% of Ontario's is *transportation equipment*. Based on these trade patterns, we would expect the impacts of trade to vary considerably depending on the region in question. We will not detail these impacts in detail in this paper. For those interested readers, these results are reviewed in at separate paper (Brown, 1998).

The estimation results are summarized in Table 2. With the exception of *stone, clay and glass*, the estimations were based on fewer pairs than the potential 2744. This was due to zero flows between some pairs, which were excluded, and the suppression of some U.S. interregional trade and industrial data. The model was significant in all cases (at a *p-value* = 0.0000) and its fits were also fairly high, ranging from an adjusted R^2 of 0.47 to 0.84 (see Table 2).

Table 2: Model estimation results

SECTOR	n	OUT	DIST	PROD	WAGE	LQ	CAN	INTR	CNTG	BORD	CLIM[a]	AdjR^2
Food Products	1739	**0.8242** 0.0000	**-1.3703** 0.0000	**-0.2014** 0.2462	**0.7823** 0.0092	**0.3579** 0.0000	**-2.7824** 0.0000	**2.0196** 0.0000	**0.9416** 0.0000	**0.7451** 0.0013	**0.5160** 0.0000	**0.8453**
Textiles	646	**1.0593** 0.0000	**-0.4520** 0.0000	**-0.4520** 0.1084	**0.3284** 0.2737	**-0.1836** 0.0000	**-1.7214** 0.0000	**1.9729** 0.0000	**0.6120** 0.0000	**0.4953** 0.1345		**0.7650**
Apparel	1234	**1.0291** 0.0000	**-0.7220** 0.0000	**1.3455** 0.0000	**-2.4641** 0.0000	**-0.5306** 0.0000	**-2.3473** 0.0000	**1.7662** 0.0000	**0.8564** 0.0000	**1.3570** 0.0002		**0.6887**
Lumber & Wood Products	1377	**0.6995** 0.0000	**-0.9065** 0.0000	**-0.1628** 0.4628	**1.5396** 0.0000	**0.1852** 0.0000	**-0.3033** 0.0000	**2.8614** 0.0000	**1.3390** 0.0000	**0.7410** 0.0007		**0.7343**
Furniture and Fixtures	1047	**0.9256** 0.0000	**-0.8249** 0.0000	**-0.4670** 0.0199	**0.2221** 0.4122	**0.0754** 0.0410	**-0.7194** 0.0000	**1.9286** 0.0000	**0.6339** 0.0000	**0.4584** 0.0596		**0.7697**
Paper Products	1314	**0.7964** 0.0000	**-1.1462** 0.0000	**0.2939** 0.0589	**1.2944** 0.0000	**-0.0950** 0.0338	**-0.4188** 0.0000	**1.3781** 0.0000	**0.6065** 0.0000	**0.2328** 0.3116		**0.7164**
Chemicals	1498	**0.8219** 0.0000	**-1.1009** 0.0000	**-0.0835** 0.4140	**1.4355** 0.0000	**-0.3045** 0.0000	**-0.7896** 0.0000	**1.8546** 0.0000	**0.8768** 0.0000	**0.8053** 0.0012		**0.7571**
Petroleum and Coal Products	291	**0.9204** 0.0000	**-1.2949** 0.0000	**-0.1369** 0.6505	**-1.8036** 0.1745	**0.2306** 0.1068	**-0.7148** 0.0070	**3.7704** 0.0000	**1.7792** 0.0000	**0.8332** 0.0662		**0.7585**
Rubber and Misc. Plastics	1425	**0.9059** 0.0000	**-1.0329** 0.0000	**0.4553** 0.0248	**-0.9755** 0.0000	**-0.3122** 0.0000	**-0.8811** 0.0000	**1.4074** 0.0000	**0.5628** 0.0000	**0.1915** 0.4220		**0.7423**
Leather Products	274	**0.4763** 0.0298	**-0.1568** 0.3245	**-1.3369** 0.0018	**2.4248** 0.0000	**0.0131** 0.8756	**-3.1421** 0.0000	**1.9374** 0.0000	**0.8016** 0.0000	**0.8036** 0.1580		**0.4668**

SECTOR	n	OUT	DIST	PROD	WAGE	LQ	CAN	INTR	CNTG	BORD	CLIM[a]	AdjR^2
Stone, Clay and Glass	2744	**1.0303** 0.0000	**-1.0979** 0.0000	**-0.7105** 0.0044	**-0.1008** 0.7608	**-0.0179** 0.7844	**-1.2281** 0.0000	**2.3622** 0.0000	**0.7760** 0.0000	**0.9003** 0.0003		**0.7520**
Primary Metals	1247	**0.9400** 0.0000	**-1.1651** 0.0000	**-0.2029** 0.1685	**0.1439** 0.5947	**-0.2635** 0.0000	**-0.8406** 0.0000	**1.3054** 0.0000	**0.5829** 0.0000	**0.2820** 0.3046		**0.7440**
Fabricated Metals	1652	**0.9550** 0.0000	**-1.1323** 0.0000	**-0.3102** 0.0210	**-0.5146** 0.0050	**-0.2636** 0.0000	**-1.9277** 0.0000	**1.4915** 0.0000	**0.5984** 0.0000	**0.3810** 0.0663		**0.8182**
Machinery and Equipment	1703	**1.0315** 0.0000	**-0.7989** 0.0000	**-0.5483** 0.0000	**0.4458** 0.0077	**-0.3072** 0.0000	**-0.9689** 0.0000	**2.1662** 0.0000	**0.7724** 0.0000	**1.2041** 0.0000		**0.8084**
Electronic Equipment	1579	**0.9670** 0.0000	**-0.6430** 0.0000	**-0.7575** 0.0000	**1.1356** 0.0000	**-0.2565** 0.0000	**-1.7718** 0.0000	**2.0738** 0.0000	**0.7050** 0.0000	**1.0699** 0.0000		**0.7774**
Transport Equipment	1134	**1.0964** 0.0000	**-1.0171** 0.0000	**0.0540** 0.7177	**-0.2267** 0.3400	**-0.4561** 0.0000	**-0.3569** 0.0004	**1.4561** 0.0000	**0.5597** 0.0000	**0.1061** 0.7019		**0.7439**
Instruments	1163	**1.1809** 0.0000	**-0.5523** 0.0000	**-0.8629** 0.0000	**-0.9995** 0.0000	**-0.2467** 0.0001	**-1.3045** 0.0000	**2.3883** 0.0000	**0.7535** 0.0000	**0.9312** 0.0021		**0.7519**
Miscellaneous manufactured products	1136	**1.1799** 0.0000	**-0.7605** 0.0000	**0.3834** 0.0005	**-1.7472** 0.0000	**-0.3259** 0.0000	**-2.1095** 0.0000	**1.6643** 0.0000	**0.6901** 0.0000	**0.4524** 0.0990		**0.7649**

Note: Bolded figures are elasticities and the plain text below are p-values.
[a]CLIM is a dummy variable for states with large winter and citrus crop production (Florida, Texas, New Mexico, Arizona and California).

There are two types of variables included in the model. Those that control for systematic effects that we want excluded from the model (INTR, CNTG and BORD) and the rest which are intended to account for variations in output and prices and the border effect. In all cases the INTR and CNTG variables were significant and had the expected signs. The INTR variable was positive, which is an indication that the characteristics of goods traded internally were different than those moving between states. This effect may also be partly responsible for the positive and significant CNTG parameters. The BORD variable was at all times positive and in many cases significant. Therefore, there would appear to be some consolidation of shipments taking place in border states. However, since the CNTG variable is significant and positive, the BORD variable may simply be picking up localized trade that would not otherwise occur unless the trading regions shared a common border.

These results appear to imply there are two types of goods. Non-tradeables that move only short distances within each state or just across their borders and tradeables that can be shipped over much longer distances. The term non-tradeable in this context should not be confused with its more common definition where it refers to services that are inherently non-tradeable. These dummy variables are necessary because without them non-tradeables may overwhelm the influence of tradeables on the parameter estimates. Since we are primarily concerned with goods that travel at least moderate distances this is important. However, it should also be kept in mind that at a sufficiently small scale all non-tradeables, in this context, are tradeable. This is in the end an arbitrary distinction, but a necessary one.

In order to interpret the rest of the model's results, it may be helpful to begin with the simple trade model described by equation (12). This model would be valid if all goods were produced at the same unit price and transported costlessly over space. Output alone would explain the volume of trade. In other words, regardless of the elasticity of demand (ε), firms and consumers would source their goods from all locations, without prejudice. However, if there are variations in prices resulting from differences in factor costs, productivity and distance related costs, output will not be the sole determinant of interregional trade. Under these circumstances, firms and consumers will trade-off the benefits of variety against variations in the delivered price.

The first question we have to answer, therefore, is how important is output as an explanatory variable? Table 3 outlines the partial *R-squareds* for output as well as several other price related variables that we will discuss in a moment. The contribution of OUT is always significant and positive. However, what is clear from Table 3 is that its contribution varies significantly across the sectors. For example, for *food production*, OUT accounts for just over a quarter of the model's explanatory power. On the other hand, for *textiles* OUT accounts for just over two-thirds. Therefore, in those sectors where OUT tends to dominate, variations in the delivered price of the good has little influence over demand. This may be because transportation costs account for only a small proportion of the goods overall cost or because the elasticity of demand is low; the preference for variety is high.

The influence of variations in the delivered price is accounted for in the model by PROD, WAGE, LQ and DIST. PROD is expected to have negative influence on the price, and therefore, a positive influence on trade. Higher wages, on the other hand, tend to push up prices, and therefore, should have a negative influence on trade. The true empirical interpretations of the WAGE and PROD variables are more complicated, but for now these will suffice. Since the LQ variable may account for positive or negative externalities associated with the agglomeration of production, its sign may be positive or negative. Given that the model accounts for variations in wages, productivity and externalities, the distance variable should account for variations in distance related costs alone, which are associated with each region's geographic situation relative to its competitors. PROD, WAGE and LQ, on the other hand, should be viewed as variables specific to each location.

Of the variables that we associate with variations in price, distance contributes the most to the models' explanation. Excluding *leather products*, DIST's partial R^2 values ranged from 0.05 to 0.37, with most values over 0.15 (see Table 3). Relative to output, the distance variable is most important for sectors that sell bulky and heavy materials (e.g., *food products, lumber and wood products, paper products, petroleum and coal products*) and that produce products that are relatively undifferentiated (e.g., *fabricated metal products*). In those sectors where production is relatively differentiated (e.g., *apparel* and *instruments*) the contribution of distance to the explanation is small.

In contrast to the DIST variable, the influence of the other price related variables is not as clear. In the case of PROD, although we would expect its sign to be positive, in many cases it is negative and significant (see Table 2). There are several possible reasons for this. First, if variations in productivity across locations is relatively small, it may be picking up variations in the rental rate of capital and land, and possibly tax rates. Secondly, since we are dealing with fairly aggregate sectors, variation in value added per employee may result from the regional concentration of sub-sectors. This explanation, however, presupposes a negative relationship between value added per employee and trade. In terms of raw correlations, PROD is positively associated with trade. Its influence typically becomes negative when output is included in the model, which implies the first explanation is the most likely.

We found the WAGE variable, like PROD, to have a positive or negative effect on trade depending on the sector in question. Nevertheless, its interpretation is more straightforward. A negative sign is obviously associated with wages pushing up costs, and therefore prices. WAGE's influence in this regard is most prevalent in the *apparel* sector (see Table 2), which is expected given the labour intensive nature of this sector. It is also worthy of note that since *apparel* is a differentiated product and increasing returns are not strong, firms may still survive even though their wage rates are high. In most instances, however, the WAGE variable has a positive influence on trade. This may simply reflect higher marginal revenue products and in that sense may be a result of variations in productivity. This does not explain, however, why the WAGE has a positive influence on trade for *machinery and equipment* and *electronic equipment* and PROD has a negative influence on these same sectors (see Table 2).

Table 3: Partial R^2 for output and price related variables

SECTOR		Price Related Variables				
	OUT	DIST	PROD	WAGE	LQ	R^2
Food products	**0.2406 (+)**	**0.3156 (-)**	0.0008 (-)	**0.0039 (+)**	**0.0204 (+)**	**0.8462**
Textiles	**0.5353 (+)**	**0.0525 (-)**	0.0040 (-)	0.0019 (+)	**0.0316 (-)**	**0.7603**
Apparel	**0.4092 (+)**	**0.1027 (-)**	**0.0285 (+)**	**0.0470 (-)**	**0.0658 (-)**	**0.6760**
Lumber & wood products	**0.3151 (+)**	**0.2189 (-)**	0.0004 (-)	**0.0273 (+)**	**0.0221 (+)**	**0.6858**
Furniture & fixtures	**0.4858 (+)**	**0.2088 (-)**	**0.0052 (-)**	0.0006 (+)	**0.0040 (+)**	**0.7596**
Paper products	**0.3451 (+)**	**0.2862 (-)**	0.0027 (+)	**0.0149 (+)**	**0.0034 (-)**	**0.7074**
Chemicals	**0.3593 (+)**	**0.2464 (-)**	0.0004 (-)	**0.0328 (+)**	**0.0249 (-)**	**0.7434**
Petroleum and coal products	**0.1098 (+)**	**0.1913 (-)**	0.0007 (-)	0.0066 (-)	0.0092 (+)	**0.7166**
Rubber & misc plastic products	**0.4806 (+)**	**0.2421 (-)**	**0.0035 (+)**	**0.0101 (-)**	**0.0265 (-)**	**0.7361**
Leather products	**0.0206 (+)**	0.0402 (-)	**0.0364 (-)**	**0.0655 (+)**	0.0001 (+)	**0.4668**
Stone, clay & glass	**0.4485 (+)**	**0.2813 (-)**	**0.0074 (-)**	0.0001 (-)	0.0001 (-)	**0.7345**
Primary metals	**0.4206 (+)**	**0.2856(-)**	0.0015 (-)	0.0002 (+)	**0.0337 (-)**	**0.7369**
Fabricated metals	**0.5762 (+)**	**0.3733 (-)**	**0.0032 (-)**	**0.0048 (-)**	**0.0303 (-)**	**0.8102**
Machinery & equipment	**0.4980 (+)**	**0.1898 (-)**	**0.0151 (-)**	**0.0042 (+)**	**0.0372 (-)**	**0.7980**
Electronic equipment	**0.5072 (+)**	**0.1257(-)**	**0.0446 (-)**	**0.0258 (+)**	**0.0172 (-)**	**0.7686**
Transport equipment	**0.3789 (+)**	**0.1808 (-)**	0.0001 (+)	0.0008 (-)	**0.0441 (-)**	**0.7401**
Instruments	**0.5325 (+)**	**0.0968 (-)**	**0.0305 (-)**	**0.0162 (-)**	**0.0132 (-)**	**0.7415**
Miscellaneous manufactured products	**0.5796 (+)**	**0.1804 (-)**	**0.0090 (+)**	**0.0394 (-)**	**0.0613 (-)**	**0.7450**

Note: Significant variables at a critical value of 0.05 are bolded and the direction of their relationship to the dependent variable are in brackets.

Finally, although LQ is positively correlated with trade, it tends to be negatively associated when the level of regional output (OUT) is taken into account. Although this result is expected for some sectors, in the case of *machinery and equipment* and *electronic equipment*, which we would expect to benefits from agglomeration economies of the pecuniary kind that we emphasize above and from technological spillovers, these results are surprising. Given the emphasis in the literature ofbenefits ofagglomeration (see, for example, Porter, 1990 or Scott, 1988), these results are all the more surprising. If they are to be believed, they suggest that at the margin there are negative externalities associated with agglomeration, which may be because of congestion effects or the bidding up of factor prices. Therefore, both the PROD and LQ variables may be picking up variations in prices not explicitly accounted for in the model.[26]

Broadly speaking, the location specific price variables' influence is small in comparison to that of distance (see Table 3). These results should not be interpreted as an indication that the level of wages, productivity and agglomeration are unimportant for the overall competitiveness of individual firms. They may very well be, but their influence may be limited to the firm's regional markets. For example, if wages in the fabricated metals sector are higher in California than in Georgia makes little difference because the market for this sector is regional. However, within the

[26]We also tested the possibility that the linearization of the model and its estimation led in some way to biassed estimates by estimating an unconstrained version of the gravity equation. The results, however, were very similar, and therefore, we rejected this as a possibility.

regional market variations in wages or productivity may have a substantial influence on trade. At the same time, because there is effective competition in these markets, production would not take place in locations that do not provide competitive conditions. Production is in spatial equilibrium. Therefore, the influence of these variables, as measured by the model, may very well be small.

As we noted in the introduction, one of the objectives of the analysis is to determine the influence of the border on Canada-U.S. trade. Given that the model accounts for output as well as distance, wages, productivity and localization economies, the CAN dummy variable should take into account the border effect. What we find is that model's results give qualified support to McCallum (1995) and Helliwell's (1996) conclusion that the border represents a significant barrier to trade. The results also indicate the border effect does not apply equally across all sectors (see Table 2). Its parameter value ranges from a low of -0.37 for *lumber and wood products* to a high of -3.25 for *leather products*. This implies that if the border had no influence on trade, exports would be between 1.3 and 23.1 times higher depending on the sector in question[27]. Significantly, the sector with which Canada has had the most open trade with the United States, *transportation equipment*, has the second highest parameter value (-0.35). Since *transportation equipment* dominates Canadian trade with the U.S., this result implies the border's influence may not be as high as

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[27] If the border had no influence on trade, the parameter for CAN would be zero. However, if it is less than zero the border has a negative influence on trade. For example, in the case of *Food Products* the parameter was estimated to be -3.25. Therefore, the border reduced trade by $\exp^{-3.25}$ or by 23.1 times. Therefore, without the border trade would increase by that amount.

McCallum and Helliwell's results suggest. This is the case. If we treat the model's output as that generated by an unconstrained version of the gravity model, which is what McCallum and Helliwell use, without the presence of the border Canadian trade with the United States would increase by 2.75 fold. This is much smaller than McCallum and Helliwell's predicted twenty fold increase in trade. Although our results are based on more recent data than McCallum and Helliwell, it is unlikely trade growth can account for this difference. Therefore, the results appear to confirm our initial hypothesis that internal Canadian trade may be more spatially extensive than American trade, and therefore, inflated McCallum and Helliwell's estimates.

Although our results are not as dramatic as those of McCallum and Helliwell's, the border still has a significant effect on trade. Furthermore, given that the border's influence is not universal, its effect may be considered as much an estimate of the potential for further economic integration as a barrier to trade. That is, since the border seems to have only a strong influence on some sectors and not others it cannot be concluded that the border itself or some other systematic effect is a deterrent to trade.

Conclusions

The trade model that we present in this paper successfully explains a large proportion of the trade among Canadian and American regions. The model's results indicate output contributes the most to its explanation in almost all sectors. Distance remains a significant barrier to trade and in most cases markets appear to be regional rather than national or continental. We found productivity, wages and localization economies/diseconomies influenced trade as well. However, their influence is small compared to that of output and distance and at times contradictory.

The model also confirms the empirical findings of McCallum (1995) and Helliwell (1996) that the border remains a significant barrier to trade. However, it also shows that its effect is not as strong as measured when internal Canadian trade is used as a benchmark. The results also indicate the border's influence variers considerably across sectors, which implies the border effect measured by the model may also be seen as a measure of trade potential if the model effectively controls for the choice of where final and intermediate goods will be sourced.

Given the model's broad success, and in particular, its implication that the border effect may be viewed as a measure of trade potential, there are several avenues for future research. First, how does the potential for trade vary across Canadian regions and American states? Since distance remains an important determinant of trade and the composition of trade varies significantly among regions, we would expect its effects to vary significantly over space.

The second avenue of research relates to policy. If we know where the potential for trade exists and in what sectors, we have a tool to increase the effectiveness of the large sums of money that state, provincial and federal governments spend on promoting their industries within the North American continent.

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CHAPTER 5

Regional Trade Policy and the Integration of the American and Canadian Economies[28]

Introduction

For centuries trade policy has been the almost exclusive domain of national governments. However, as national governments relinquish control over their borders, nations as spatial economic entities begin to lose their significance. In their place, many have turned to regions as a basis to understand the causes and effects of trade (see Krugman, 1991 and Howes and Markusen, 1993) and as a *natural* territory for the application of trade policy (see Markusen, 1996, Courchene 1998 and Storper and Scott, 1995). The purpose of this paper is to set the parameters within which we can understand the potential for economic integration across the Canada-U.S. frontier and what this implies for the role of government at the scale of states and provinces. The paper focuses on border regions because these are the places where the benefits (or costs) of greater economic integration may be felt the most, and therefore, where regional policy may be the most important.

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The analysis shows that the greatest potential for economic integration is among regions that are in close geographic proximity. Furthermore, this potential varies depending on the industrial structures of the trading regions. In particular, interregional trade appears to be highest among regions with similar industrial structures where trade is driven by specialization at the firm level. These results imply that policies developed to encourage greater integration will be most effective in border regions. Furthermore, what forms these policies might take and what sectors may be targeted depend, at least in part, on the underlying causes of regional economic development. Trade policy at the scale of regions becomes indistinguishable from regional development policy.

The paper is organized as follows. After a brief review of some of the relevant literature and how it relates to the Canada-U.S. trading relationship, the specification and basic results of a trade flow model of Canada-U.S. regional trade is presented. Following this, the predictions of the model with regards to the degree of integration among Canadian and American regions is outlined as well as a detailed description of the trading relationships within three potential transnational regions. The policy implications of the analysis are then discussed and some brief conclusions outlined.

Trade policy and the Canadian economy

As was noted above, regional trade policy comes to the fore as national governments open their borders to trade. The objectives of this section are to first briefly outline the historical development of trade policy in Canada and its economic implications, and second, to outline how trade can be understood, at least theoretically, at a regional scale.

Through much of its history, the Canadian economy developed under tariff protection that forced an east-west pattern of trade on the country. After the Second World War, however, Canada began to open its borders to trade through reciprocal reductions in the tariff and non tariff barriers. This was accomplished by way of successive rounds (Kennedy, Tokyo and Uruguay) of multilateral negotiations under the General Agreement on Tariffs and Trade (GATT) and through bilateral agreements with the United States. Of these agreements, the most prominent are the 1965 Auto Pact, which led to an integrated North American market for automobiles and parts, the 1989 Canada-U.S. Free Trade Agreement (CUSFTA) and the 1993 North American Free Trade Agreement (NAFTA), which includes Mexico.

One of the primary rationales for Canada's shift towards free trade is the detrimental effect of tariff protection on efficiency of Canadian industry, and therefore, the wealth of the nation. Eastman and Stykolt (1967) argue that tariff protection has led Canadian manufacturing firms to produce their products at a smaller scale than their American counterparts and to produce more varieties in the same plants using less sophisticated technology. These factors, combined with a market structure that tends towards oligopolistic conditions, it is argued, explains the generally higher prices charged by Canadian firms compared to their American counterparts. In this context, the benefits of trade do not only accrue from comparative advantage, but also from the reorganization of production within plants to take advantage of the larger American market. That is, firms specialize by producing fewer varieties with longer production runs. Harris and Cox (1983) and Cox (1994) have found these economies to be the primary benefit of free trade with the United States.

As trade barriers forced an east-west pattern of trade on Canada, the removal of these barriers is likely to result in a more north-south pattern of trade. As Wonnacott and Wonnacott (1967) realized, in the context of Canada-U.S. trade the impact of free trade also depends on the location of Canadian industry relative to American markets and competitors. It is still surprising the degree to which distance continues to control the flows of goods on the North American continent. Using simple gravity models, McCallum (1995) and Helliwell (1996) found the distance variable had an elasticity over one for internal Canadian trade and trade among Canadian and U.S. regions. This is substantially higher than other applications of the gravity model to world trade (McCallum, 1995). In a similar analysis undertaken by William Anderson and myself, we found that although the influence of distance varied considerably depending on the sector, in many cases its elasticity was over one. We also found distance to be consistently one of the most important contributors to the model's explanation (Brown and Anderson, 1998a). Based on these results alone, it is clear that geographic proximity can have a strong influence on trade flows.

There is a close association between these empirical findings and the growing theoretical literature that seeks to connect many of the recent advances in trade theory to economic geography (see Ottaviano and Puga, 1997 for a recent review of the literature). In general, the argument is made that when increasing returns exist and there are moderate levels of transportation costs, industry tends to agglomerate. That is, in the presence of transportation costs firms have an incentive to locate close to large markets in order to take advantage of scale economies. If transportation costs are too high, firms spread out because the costs of accessing distant markets outweigh the benefits of larger scale production. On the other hand, if transportation costs are too low, location relative to markets becomes irrelevant (Krugman and Venebles, 1996). Venebles (1996) argues that downstream demand for intermediate goods is another way to explain these centripetal forces. The larger the size of downstream demand the lower the costs of upstream producers. If these savings are passed on to downstream firms and there are transportation costs associated with the movement of intermediate goods, there is a basis for industrial agglomeration. Venebles also makes the argument that factor markets act as a centrifugal force. The benefits of agglomeration have to be balanced against the bidding up of factor costs (e.g., wages) in those locations. It is the interaction among factor costs, transportation costs and scale economies that determines whether production is dispersed or concentrated.

In the context of Canada-U.S. trade, these external returns may spill over the border, inducing specialization and trade in intermediate inputs. Therefore, if the trading regions have similar industrial structures and are in close geographic proximity, intermediate goods producers may reorganize their production to serve the larger cross-border market. On the other hand, if the regions are located far from each other, intra-industry trade is less likely because distance related costs overcome the benefits of specialization. We have found that the regional patterns and composition of Canada-U.S. trade are consistent with this perspective (Brown and Anderson, 1999).

In summary, Canadian industry developed under the protection of tariff barriers, which resulted in a manufacturing sector oriented towards serving its small national market. As a consequence, Canadian industries were and are less efficient that their American counterparts (see Statistics Canada, 1996 for a recent comparison of Canadian and American productivity). In the later half of this century, Canada has become increasingly integrated into the world economy and in particular the economy of the United States. The success of this venture depends on the ability of Canadian firms to penetrate the American market by reorganizing their production in order to reduce their production costs. The North American market is, however, more regional than continental in nature. The ability of Canadian firms to take advantage of larger markets depends on the economic structure of American regions that are in close geographic proximity. What this also implies is that the potential for economic integration and the influence that policy might have on that process at a regional scale are important subjects of study.

Trade model

In order to determine the potential for economic integration, I am going to apply a simple trade flow model whose economic derivation can be found in a separate paper (Brown and Anderson, 1998a). The purpose of the model is to statistically explain trade flows among North American regions at the scale of states and provinces. By using American internal state to state trade as a benchmark of regional economic integration, the potential for further economic integration among Canadian and American regions can be measured. In other words, the model helps to answer the following question. If the border no longer had an influence on trade, what degree of economic integration would be expected among Canadian and American regions?

The model is specified as follows:

$$T_{ij_{AB}} = a_{ij} X_{j_B} \frac{\left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}}{\sum_{A=1}^{r} \left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}}, \tag{1}$$

where $T_{ij_{AB}}$ is the trade in commodity i produced in region A sold to sector j located in region B, a_{ij} is a technical coefficient, X_{j_B} is the output of sector j in region B, p_{v_A} is the price of a representative variety of commodity i, τ_{AB} is the trade cost between A

and B, X_{i_A} is the output of commodity i in A and ε[29] is the elasticity of demand. Equation (1), which is the functional form of an attraction constrained gravity model, implies exports from region A in commodity i to sector j in region B is function of the demand for commodity i in B multiplied by the probability of sourcing i in A. This probability depends on the output of sector i in A and its c.i.f. price relative to all other potential sources of commodity i.

In order to apply the model empirically two modifications are necessary. First, since we do not know the trade flows among sectors but only among regions, the demand for sector i in each region is summed over all sectors j:

$$T_{i.AB} = \sum_{j=1}^{m} T_{ij_{AB}} = \sum_{j=1}^{m} a_{ij} X_{j_B} \frac{\left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}}{\sum_{A=1}^{r} \left(p_{v_A} \tau_{AB}\right)^{\varepsilon} X_{i_A}}. \tag{2}$$

Secondly, prices and trade costs are unknown, and therefore it was necessary to measure their influence using a set of proxy variables. Furthermore, there are systematic influences on trade that result from such factors as the border that must also be taken into account. Therefore, the final functional form of the model is as follows,

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[29]In Brown and Anderson (1998a) we show that the elasticity of demand depends on the demand for variety on the part of firms (for inputs) and consumers. If consumers or firms have a high preference for variety prices would have only a marginal influence on the demand for goods, and therefore, the pattern of trade. However, if they saw little difference between goods then prices would have a much stronger influence on demand.

$$T_{i_{AB}} = \sum_{j=1}^{m} a_{ij} X_{j_B} \frac{\prod_{k=1}^{l} z_{k_A}{}^{\eta_k} d_{AB}^{\beta} X_{i_A}{}^{\phi}}{\sum_{A=1}^{r} \prod_{k=1}^{l} z_{k_A}{}^{\eta_k} d_{AB}^{\beta} X_{i_A}{}^{\phi}}, \tag{3}$$

where the z_ks represent variables that influence the mill price as well as dummy variables that account for systematic effects, which I will define explicitly in a moment, and d_{AB} is the distance between A and B and is a proxy variable for trade costs or what might be more generally termed the friction of distance. The data sources for these variables and the estimation procedure are outlined in the Appendix.

The model uses several variables other than distance (DIST)[30] to estimate the influence of variations in the characteristics of origins on the delivered price of their goods. These include productivity (PROD), wages (WAGE), and localization economies (LQ) (Bureau of the Census, 1996 and Statistics Canada, 1995). Productivity was measured as value added per worker and wages are measured as pay per employee. Finally localization economies, which may be interpreted as the benefits (or costs) of similar firms locating in the same state or province, were measured using location quotients[31].

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[30]We measured the distance between the largest city in each state and province to determine the distance between each region pair.

[31]The location quotient for each industry was estimated using:

$$LQ = \frac{VA_{i_A} \sum_{i=1}^{n} VA_{i_{NA}}}{VA_{i_{NA}} \sum_{i=1}^{n} VA_{i_A}},$$

where VA_{i_A} and $VA_{i_{NA}}$ represent value added in region A and North America, respectively.

Dummy variables were used to take into account characteristics of origin-destination pairs that might have a systematic effect on trade flows. The most important for our purposes is the influence of Canada as an origin. Consequently, the difference between province to state flows and state to state flows is accounted for by a dummy variable, which is referred to here as the 'border effect' variable. The term 'border effect' does not only refer to the border as barrier in and of itself, but also those factors, such as tariff and non-tariff barriers, that impede regional economic integration. In Brown and Anderson (1998a) we used one dummy variable for all of Canada. Here a different variable is used for each Canadian origin (BC - British Columbia, AB - Alberta, SK - Saskatchewan, MB - Manitoba, ON - Ontario, QC - Quebec and AC - Atlantic Canada). There are several reasons for this. First, since at the two digit level there is considerable room for regional differentiation of production, some regions may have an industrial mix that allows them to trade more readily than others. For example, within the *stone, clay and glass products* sector Ontario may be relatively more specialized in automotive glass products, which are far more tradeable than other products included in the sector (e.g., clay products). Consequently, Ontario may be more integrated into the American market compared to other Canadian regions.

Due to the characteristics of the trade flow data bases themselves, there are also other systematic effects that might influence the model's parameter estimates. First, the possibility exists that Canadian flows may be consolidated in border states.

Therefore, flows between provinces and states with a common border are also accounted for by a dummy variable (BORD). Second, the American flow data that were used took into account internal as well as state to state flows. Since internal flows may include goods that might not typically be exported over long distances (e.g., bakery products), a dummy variable was included for internal flows (INTR). The same could be true of trade between bordering states, and so we also included a dummy variable for contiguous states (CNTG) (see the Appendix for further discussion of the trade data bases).

Model results

In order to facilitate the discussion, the results of the estimation are presented below (see Tables 1 and 2). However, because these results are very similar to those presented in Brown and Anderson (1998a), the bulk of the discussion focuses on the model's predictions of economic integration at a regional scale.

The results presented in Table 1 are the parameter values for all variables except the border effect variables, which are presented in Table 2. There are several generalizations that can be taken from the results presented in Table 1. First, OUT, which accounts for aggregated levels of supply, is always positive and significant. DIST is always negative, and with the exception of *leather products,* significant. The signs of the other price related variables (PROD, WAGE and LQ) are often inconsistent, but in many cases significant. The expectation is that PROD would be positively associated with trade, WAGE negatively associated and LQ, which can represent positive or negative localization economies, may take on either sign. The positive association between the WAGE and trade is not particularly surprising given that the WAGE variable may be picking up variations in the marginal revenue product over space. The negative and significant values for the PROD variable is more surprising. However, because productivity is measured as value added per employee, it may be picking up variations in the rental rate of capital and land as well as variations in tax rates over space. Finally, the results for the LQ variable are of interest because in those sectors where we would most expect positive localization economies to exist (e.g., *machinery and equipment* and *electronic equipment*) the elasticities are negative. This implies that the regional concentration of production may lead to congestion effects or the concentration of production in one sector may mean necessary supporting and related sectors are not present.

Taken as a whole, the price related variables are a function of degree to which inputs are substitutable. That is, if the goods within each commodity classification are easily substituted for each other, then variations in price due to trade costs, productivity, wage and localization economies may have a substantial influence on demand. However, if inputs are not easily substituted and production is differentiated over space their elasticities will be much smaller. Therefore, the distance variable's elasticity, for example, may be as much a reflection of the substitutability of varieties in production and consumption as variations in the cost of moving these goods over distance.

The other three variables (INTR, CNTG and BORD) control for the influence of internal trade, contiguous states and trade that is consolidated in border states. As expected, the INTR variable is positive and highly significant, which is an indication that state internal trade is different than external trade. The positive and significant value of CNTG is also an indication that some goods are only traded locally and may be a reflection of the same factors influencing INTR. Finally, the BORD variable was in all cases positive and in many instances significant. Therefore, in some cases trade may be consolidated in border states before it is exported to other regions of the United States. However, the BORD variable may also be picking up some of the trade that the INTR and CNTG variables are taking into account.

Table 1: Model estimation results

SECTOR	n	OUT	DIST	PROD	WAGE	LQ	INTR	CNTG	BORD	CLIM[a]	AdjR²
Food Products	1739	**0.8533** 0.0000	**-1.3660** 0.0000	**-0.3071** 0.0808	**1.0141** 0.0016	**0.3111** 0.0000	**2.0322** 0.0000	**0.9503** 0.0000	**0.8446** 0.0002	**0.4727** 0.0000	**0.8483**
Textiles	646	**1.1602** 0.0000	**-0.5362** 0.0000	**0.0130** 0.1084	**0.7350** 0.0121	**-0.2204** 0.0000	**1.8214** 0.0000	**0.5547** 0.0000	**0.6419** 0.0535		**0.7853**
Apparel	1234	**1.0671** 0.0000	**-0.7474** 0.0000	**1.3207** 0.0000	**-2.3860** 0.0000	**-0.5353** 0.0000	**1.7191** 0.0000	**0.8368** 0.0000	**1.3182** 0.0003		**0.6980**
Lumber & Wood Products	1377	**0.6832** 0.0000	**-0.9388** 0.0000	**0.5347** 0.0473	**1.1426** 0.0001	**0.1445** 0.0000	**2.8057** 0.0000	**1.3213** 0.0000	**0.6882** 0.0015		**0.7413**
Furniture and Fixtures	1047	**0.9901** 0.0000	**-0.8743** 0.0000	**-0.4997** 0.0119	**0.2023** 0.4561	**0.0566** 0.1304	**1.8488** 0.0000	**0.5980** 0.0000	**0.3794** 0.0596		**0.7795**
Paper Products	1314	**0.8367** 0.0000	**-1.1655** 0.0000	**-0.1812** 0.2698	**1.5523** 0.0000	**-0.0180** 0.6943	**1.3670** 0.0000	**0.6064** 0.0000	**0.2970** 0.1847		**0.7164**
Chemicals	1498	**0.9455** 0.0000	**-1.1754** 0.0000	**-0.0218** 0.8330	**1.0382** 0.0000	**-0.3432** 0.0000	**1.7194** 0.0000	**0.8244** 0.0000	**0.8985** 0.0001		**0.7830**
Petroleum and Coal Products	291	**1.0744** 0.0000	**-1.3376** 0.0000	**0.5724** 0.1044	**-2.4849** 0.0579	**0.0200** 0.8982	**3.6612** 0.0000	**1.7280** 0.0000	**0.7815** 0.0844		**0.7736**
Rubber and Misc. Plastics	1425	**0.9581** 0.0000	**-1.0470** 0.0000	**0.3392** 0.0753	**-1.0983** 0.0000	**-0.1555** 0.0012	**1.4049** 0.0000	**0.5671** 0.0000	**0.4430** 0.0481		**0.7790**
Leather Products	274	**0.5910** 0.0181	**-0.1318** 0.4204	**-1.2506** 0.0060	**2.2733** 0.0002	**0.0054** 0.9489	**1.9854** 0.0000	**0.8315** 0.0024	**0.6008** 0.3152		**0.4633**

SECTOR	n	OUT	DIST	PROD	WAGE	LQ	INTR	CNTG	BORD	CLIM[a]	AdjR²
Stone, Clay and Glass	2744	**1.0592** 0.0000	**-1.1148** 0.0000	**-0.8894** 0.0005	**-0.1036** 0.7594	**-0.0130** 0.8459	**2.3381** 0.0000	**0.7688** 0.0000	**0.7665** 0.0033		**0.7536**
Primary Metals	1247	**0.9747** 0.0000	**-1.1934** 0.0000	**-0.3091** 0.0393	**-0.1595** 0.5947	**-0.2505** 0.0000	**1.2544** 0.0000	**0.5682** 0.0000	**0.1257** 0.6444		**0.7518**
Fabricated Metals	1652	**0.9599** 0.0000	**-1.1315** 0.0000	**-0.2748** 0.0413	**-0.5065** 0.0063	**-0.2542** 0.0000	**1.4963** 0.0000	**0.6007** 0.0000	**0.2811** 0.1801		**0.8201**
Machinery and Equipment	1703	**1.0354** 0.0000	**-0.7763** 0.0000	**-0.6154** 0.0000	**0.4032** 0.0681	**-0.3044** 0.0000	**2.2191** 0.0000	**0.7973** 0.0000	**1.2445** 0.0000		**0.8111**
Electronic Equipment	1579	**1.0382** 0.0000	**-0.6673** 0.0000	**-0.8303** 0.0000	**0.9866** 0.0000	**-0.2297** 0.0000	**2.0400** 0.0000	**0.6900** 0.0000	**1.0755** 0.0000		**0.7837**
Transport Equipment	1134	**0.9540** 0.0000	**-0.9638** 0.0000	**0.1962** 0.1762	**0.1131** 0.6388	**-0.4561** 0.0000	**1.5238** 0.0000	**0.5935** 0.0000	**0.1488** 0.5780		**0.7631**
Instruments	1163	**1.2302** 0.0000	**-0.5946** 0.0000	**-0.8579** 0.0000	**-1.2165** 0.0000	**-0.1989** 0.0019	**2.3135** 0.0000	**0.7189** 0.0000	**1.0263** 0.0008		**0.7597**
Miscellaneous manufactured products	1136	**1.1945** 0.0000	**-0.7724** 0.0000	**0.4451** 0.0001	**-1.8056** 0.0000	**-0.3395** 0.0000	**1.6386** 0.0000	**0.6802** 0.0000	**0.4539** 0.1053		**0.7686**

Note: Bolded figures are elasticities and the plain text below are p-values.
[a]CLIM is a dummy variable for states with large winter and citrus crop production (Florida, Texas, New Mexico, Arizona and California).

For the purposes of this paper, the primary point to be drawn from the analysis is that the model is able to control for those factors that influence the supply and demand of traded goods. Therefore, any measurable effect of the border as a barrier to trade should be a measure of trade potential if all artificial barriers to trade are removed. The influence of the border on province to state flows as compared to state to state flows are outlined in Table 2. It should also be noted at this time that only the border's influence on Canadian exports to American regions is measured by the model. The influence of the border on American exports to Canada was excluded because of essentially technical issues associated with the linear transformation of (3) (see Appendix).

The first point to be drawn from Table 2 is that the border's influence varies considerably across sectors. For example, without the border exports of *food products* might rise by between 10 and 32 fold[32] depending on the origin. While for *lumber and wood products* the influence of the border variable is much smaller and, with the exceptions of Quebec and Alberta, its parameter estimates are insignificantly different from zero. What is also striking about Table 2 is the degree to which the border's influence varies depending on the region in question. For example, in the case of *chemicals* the estimated border effect parameter is positive and significant for Saskatchewan, but negative for all other provinces. It is unlikely that these results can

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[32]As was noted above, the influence of the border is accounted for by a dummy variable. As estimated for *food products* in British Columbia, for example, the border reduced trade by $\exp^{3\ 4680}$ or 32 fold. Therefore, if the border had no influence, trade might increase by the same amount.

be attributed to missing variables that might account for variations in provincial competitiveness. Rather, the results are more likely a reflection of the very aggregate sectors used in the analysis. Staying with the *chemicals* example, Saskatchewan is a major potash producer, but doesn't produce or export many other types of chemical products. If the model were estimated for *potash* alone, the positive border effect may very well disappear. Therefore, variation in the industrial composition of regions within the sectors used in the analysis may explain variations in the border effect.

This conclusion might imply that the border effect measured by the model is due to aggregation problems rather than the influence of Canada as an origin. However, when the model is estimated with a dummy variable for Canada as a whole, in all sectors the influence of the border is significant and negative (Brown and Anderson, 1998a). Therefore, if Canadian exports to the U.S. on aggregate are similar to U.S. internal trade, the border's influence is valid. Furthermore, Ontario and Quebec, which arguably have the most diversified manufacturing sectors, consistently have significant and negative parameter estimates. The only exception is *transportation equipment* which is positive and significant for Ontario. However, in Ontario this sector is heavily influence by the Auto Pact which has been in place for over thirty years. We would expect, therefore, the influence of the border to be at least neutral in this case. Nonetheless, the model's predictions should be treated with caution in those sectors where the border effect varies significantly across regions.

Table 2: The influence of the border on Canadian exports to the United States

SECTOR	BC	AB	SK	MB	ON	QC	AC
Food Products	**-3.4680** 0.0000	**-2.3538** 0.0000	**-2.8625** 0.0000	**-2.5457** 0.0000	**-2.8659** 0.0000	**-3.0119** 0.0000	**-2.6925** 0.0000
Textiles	**-1.5637** 0.0811		**1.7985** 0.0279	**1.7077** 0.0043	**-1.9120** 0.0000	**-1.9040** 0.0000	**0.3303** 0.4583
Apparel	**-1.2964** 0.0000	**-1.8514** 0.0013		**-1.0235** 0.0047	**-2.7582** 0.0000	**-2.8377** 0.0000	**-1.6489** 0.0014
Lumber & Wood Products	**-0.1266** 0.4116	**-1.1413** 0.0000	**-0.2408** 0.1926	**0.1020** 0.5844	**-0.1291** 0.3814	**-0.3656** 0.0046	**0.2317** 0.1540
Furniture and Fixtures	**-0.5747** 0.0150	**-0.1646** 0.3141		**-0.3684** 0.0506	**-0.8370** 0.0000	**-1.1588** 0.0000	**0.9651** 0.0092
Paper Products	**-1.4789** 0.0000	**0.2435** 0.1679	**-2.7397** 0.0791	**-0.5052** 0.0111	**-0.8346** 0.0000	**-0.4653** 0.0010	**0.0070** 0.9690
Chemicals	**-1.4202** 0.0000	**-0.3809** 0.0075	**0.9326** 0.0000	**-0.5339** 0.0214	**-1.3542** 0.0000	**-1.5297** 0.0000	**-0.3657** 0.1221
Petroleum and Coal Products	**-1.6292** 0.0096	**1.0953** 0.0274	**0.4345** 0.8522	**2.0103** 0.4681	**-0.8125** 0.0061	**-0.3687** 0.3287	**1.4808** 0.3355
Rubber and Misc. Plastics	**-1.3810** 0.0000	**-1.1931** 0.0000		**-0.7236** 0.0101	**-1.3754** 0.0000	**-1.2539** 0.0000	**1.3483** 0.0000
Leather Products	**-1.5085** 0.3775			**-2.3724** 0.1072	**-3.1383** 0.0000	**-2.9632** 0.0000	
Stone, Clay and Glass	**-1.1942** 0.0000	**-0.8312** 0.0010		**-0.7270** 0.2479	**-1.4799** 0.0000	**-1.2238** 0.0000	**-0.4213** 0.2188
Primary Metals	**-0.1595** 0.3990	**-1.5450** 0.0000	**-3.0201** 0.0296	**-0.9239** 0.0000	**-1.1741** 0.0000	**-0.4739** 0.0007	**-2.0312** 0.2645
Fabricated Metals	**-2.0476** 0.0000	**-1.8599** 0.0000		**-1.6840** 0.0000	**-1.9536** 0.0000	**-1.9748** 0.0000	**-0.3725** 0.2894
Machinery and Equipment	**-1.1701** 0.0000	**-1.4356** 0.0000	**-1.1096** 0.0000	**-0.5174** 0.0002	**-0.8400** 0.0000	**-0.9720** 0.0000	**-0.9823** 0.0000
Electronic Equipment	**-1.3514** 0.0000	**-1.2228** 0.0000	**-1.3221** 0.0001	**-0.9978** 0.0000	**-2.1346** 0.0000	**-2.2209** 0.0000	**-1.4250** 0.0001
Transportation Equipment	**-0.8382** 0.0000	**-1.0943** 0.0002	**-0.4061** 0.2110	**-0.6962** 0.0022	**0.4103** 0.0203	**0.1219** 0.4132	**-2.4132** 0.0000
Instruments	**-0.3779** 0.0945	**-0.3839** 0.1245		**-0.9001** 0.1438	**-1.6648** 0.0000	**-1.3840** 0.0000	**-3.8272** 0.1491
Miscellaneous Manufactured Products	**-2.1325** 0.0000	**-1.5352** 0.0053		**-0.1225** 0.7802	**-2.4014** 0.0000	**-2.0377** 0.0000	**-2.6761** 0.3116

The influence of the border on the model's predictions can be tested by setting the value of the border effect dummy variables to zero and comparing the results to the model's original predictions. The effect of setting the dummy variable to zero is to increase the attractiveness of each Canadian region as an origin. Therefore, from the perspective of each American region the probability of sourcing goods from Canada rises. Since the total value of each region's imports must remain the same, this implies internal American trade falls. This does not mean, however, that American GDP will decline because the elimination of the border's influence works in both directions.

Before moving on to the discussion of the predictions, there is one further point regarding the estimation of the border effect. For all sectors the border effect parameters were only set to zero if they were negative. Therefore, we are assuming the border's influence can only be negative. This also means that for those regions where the border effect is positive the model may predict a fall in trade for the same reason that internal American trade falls. Therefore, in those cases the predictions are ignored; trade is assumed to remain at the same level. This is an admittedly *ad hoc* solution and points to some of the difficulties of working with aggregate sectors.

As one might expect based on the results presented in Table 2, when the influence of the border is removed the predicted level of exports from Canadian regions to American regions[33] increased significantly and vary across regions (see

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[33]American Regions: New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont); Mid Atlantic (Delaware, Maryland, New Jersey, New York, Pennsylvania); South Atlantic (District of Columbia, Florida, Georgia, North Carolina, South

Table 3). According to the model, Saskatchewan has the least potential (72%) and Quebec the highest (193%). Ontario has the second lowest predicted increase of just over 100%. However, as measured as exports as a percentage of manufacturing shipments, in 1993 Ontario was the most dependant of all the provinces at 38% on the American market. Doubling exports implies, at current levels of output, 78% of Ontario's manufactured shipments would go to the United States.

What is also evident in Table 3 is that for each region the potential for trade also varies across its trading partners. What this implies is that the demand for manufactured goods varies considerably across regions and because the border effect differs across sectors so does the potential for increased trade. Although the potential for increased trade may seem significant, some inter-regional flows are very small, and therefore, they have little influence on the aggregate levels of trade. Table 4, which breaks down export growth by region, gives a far better perspective on which regions account for most of the export growth.

Broadly speaking, Table 4 demonstrates that the largest potential for increased trade is between regions that are in close geographic proximity. This is, of course, a reflection of the strong influence that the distance parameter has on trade flows (see Table 1). Therefore, the most important source of export growth for British Columbia and Alberta is the West, while for Ontario it is the Great Lakes states and Quebec the

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Carolina, Virginia, West Virginia); Great Lakes (Illinois, Indiana, Michigan, Ohio, Wisconsin); South Central (Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Tennessee); Plains (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota); Rocky Mountains (Colorado, Idaho, Montana, Utah, Wyoming); South West (Arizona, Oklahoma, New Mexico, Texas); and West (California, Nevada, Oregon, Washington)

Mid Atlantic states. The exception is Atlantic Canada. Here the Mid Atlantic and South Atlantic states combined account for 40% of the region's export growth. Although the continued importance of New England should not be discounted, what the model appears to imply is that given the economic weight of these regions, and potentially their industrial structures, their influence is stronger.

What is also presented in Table 4 is the current regional distribution of exports. By comparing the current pattern of trade with the pattern of growth, it is possible to see whether the regional distribution of flows will shift as the two countries integrate further. In general, the results presented in the table indicate the distribution of trade flows will tend to concentrate in regions that are in close proximity. For example, 65% of British Columbia's export growth is in the West, which accounts for only 38% of British Columbia's current trade.[34] Although British Columbia is the most prominent example, this pattern is repeated across the country. Again, the one exception is Atlantic Canada. Here the model indicates the distribution of exports will shift away from New England and towards the South Atlantic and South West regions.

[34]Eliminating the border effect acts roughly proportionately on each of the sectors. The increase in trade in regions that are close by reflects the composition of demand and the degree to which each sector is influenced by the friction of distance. Therefore, the predicted regional shift in trade is driven by changing the relative composition of trade among the two-digit sectors used in the analysis.

Table 3: Percentage change in the predicted level of exports resulting from the removal of the border effect

	British Columbia	*Alberta*	*Saskatchewan*	*Manitoba*	*Ontario*	*Quebec*	*Atlantic Canada*	*Canada*
New England	102.8	82.2	126.5	180.5	100.5	237.1	125.1	144.3
Mid Atlantic	87.8	135.1	90.5	150.2	119.1	209.3	99.7	143.6
South Atlantic	96.1	172.8	76.6	140.2	91.5	190.6	135.7	111.5
Great Lakes	108.1	133.2	67.7	145.4	109.2	174.7	86.3	114.8
South Central	98.5	189.4	23.9	129.4	94.6	178.6	112.4	110.0
Plains	100.2	145.8	54.9	157.3	118.0	163.4	110.5	124.6
Rocky Mountains	122.5	137.3	109.5	211.6	92.2	166.7	360.9	114.8
South West	110.5	174.4	102.2	148.0	81.6	173.8	143.3	103.1
West	191.6	131.7	69.5	135.0	78.0	160.8	107.7	133.7
United States	150.0	143.9	71.9	149.9	103.9	193.3	112.5	123.1
Cascadia	196.3	144.9	84.1	184.7	62.6	152.1	231.2	144.5

Table 4: Percentage breakdown of current export shares and growth shares by region

	British Columbia		*Alberta*		*Saskatchewan*		*Manitoba*		*Ontario*		*Quebec*		*Atlantic Canada*		*Canada*	
	Current	Growth	Current	Growth	Current	Growth	Current	Growth	Current	Growth	Current	Growth	Current	Growth	Current	Growth
New England	3.6	4.8	2.8	0.8	0.8	1.4	3.4	1.8	4.9	4.4	20.0	13.7	34.3	18.1	8.3	6.8
Mid Atlantic	7.0	2.5	8.5	6.0	3.8	8.1	7.4	8.0	19.6	20.7	28.1	35.2	23.3	23.9	19.8	22.3
South Atlantic	10.3	2.7	3.7	8.2	3.2	9.1	5.5	8.8	11.8	10.6	9.9	12.4	10.6	16.1	10.8	10.3
Great Lakes	14.7	7.7	24.1	12.7	39.0	14.4	18.6	19.1	33.5	37.1	18.5	13.4	15.5	14.1	28.5	27.2
South Central	4.0	1.8	5.9	6.0	5.7	1.9	5.3	5.4	6.6	6.5	6.6	6.1	4.8	5.8	6.3	5.9
Plains	7.4	3.3	11.3	11.1	37.8	20.7	40.1	31.5	6.4	8.4	4.1	5.5	1.8	4.6	6.8	7.6
Rocky Mountains	8.8	7.0	10.2	15.8	2.8	16.7	2.5	5.3	1.6	2.2	1.1	2.2	0.6	2.4	2.3	3.0
South West	5.7	4.5	6.3	13.1	1.3	10.8	4.2	9.8	6.6	5.6	6.2	6.3	3.0	8.7	6.3	6.0
West	38.5	65.7	27.2	26.4	5.7	16.8	12.9	10.2	9.0	4.5	5.5	5.2	6.1	6.4	10.9	10.9
United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cascadia	30.4	60.5	16.7	22.5	4.7	16.8	10.0	5.8	2.6	1.8	2.4	2.1	2.4	3.4	5.0	7.8

One note of caution with regards to the conclusions drawn from Table 4 is warranted here. We see a shift in the distribution of flows to regions in close proximity because distance has a strong influence on the flows of goods for most sectors. This does not mean, however, that large flows do not take place between regions that are far apart. These flows are just rarer. Therefore, it would be natural for the model to predict an increasing concentration of trade among regions in close geographic proximity.

Transnational regions

This paper began with a discussion of trade policy. Since then, it has focussed on explaining the model and the influence of the border. Now I would like to begin the transition back to policy. In order to do so, it is helpful to look in detail at the trading patterns of the three transnational regions: Atlantic Canada–New England, Ontario–Great Lakes and Cascadia. The regions will be discussed in this order below.

New England has long been perceived by Atlantic Canadians as a potential market for their goods that was cut off through the implementation of high tariffs under the National Policy in 1879. One of the more interesting questions that we can answer using this analysis is whether this perception is reflected in reality.

First, however, some comment should be made regarding the quality of the predictions for Atlantic Canada–New England trade. Of the sectors where data were available (those that are not shaded in Table 5), the model only predicted 23% of the actual level of trade. There are several possible reasons for this. First, since New

England is accessible by sea as well as land and because sea transportation is typically cheaper than land transportation, the distance parameter may be overestimated. The sectors that are underestimated the most (*Food Products*, *Lumber and Wood Products* and *Paper Products*) tend to be significantly influenced by the distance variable (see Table 1). Second, and probably more likely, given the large size of the New England market relative to Atlantic Canada's output, one or two strong inter or intra firm relationships can lead to very large trade flows. Finally, in the case of *food products* Atlantic Canada exports are dominated by fish products. Many of these products are shipped to New England and are then distributed to other parts of the United States.

Returning to the issue of trade potential, the elimination of the border effect has the most significant influence on *food products* and *transportation equipment*. Combined, both sectors account for 90% of the predicted increase in trade between the two regions. On the other hand, for *lumber and wood products* and *paper products* the border variable was insignificant, and therefore, we would expect little change in these sectors. Furthermore, since the model underestimates these flows significantly, there would appear to be little unexploited demand. Therefore, for the third and fourth most important manufacturing sectors covered in the analysis the potential for increased trade is minimal.

Table 5: Atlantic Canada–New England Trade (1993)

	Atlantic Canada					New England	
	Exports to New England ($US 000's)				**Output** ($US 000's)	**Demand** ($US 000's)	**G-L Index** (%)
	Actual	Predicted	Border Effect	Change			
Food Products	149,177	13,516	157,706	144,190	3,852,503	25,402,080	14.0
Textiles	0	0	-	-	84,251	3,703,657	-
Apparel	731	1,227	4,678	3,451	55,495	8,646,612	3.1
Lumber & Wood Products	110,938	24,587	24,587	-	630,600	3,611,337	12.0
Furniture and Fixtures	1,504	3,722	3,722	-	49,295	3,339,919	18.2
Paper Products	334,587	48,759	48,759	-	757,402	7,630,561	5.1
Chemicals	20,547	10,252	12,622	2,370	181,445	14,239,732	6.3
Petroleum. and Coal Products	451,015					10,306,059	4.6
Rubber & Miscellaneous Plastics	6,458	21,983	21,983	-	110,448	5,887,826	16.8
Leather Products	430					1,729,224	24.4
Stone, Clay and Glass	7,462	4,344	5,604	1,260	188,653	2,956,554	1.3
Primary Metals	1,099					8,426,655	17.3
Fabricated Metals	9,326	8,910	11,551	2,642	235,855	8,180,907	2.1
Machinery and Equipment	6,402	4,319	10,759	6,440	94,636	13,918,708	17.0
Electronic Equipment	1,373	741	2,335	1,593	132,848	14,789,905	8.0
Transportation Equipment	8,169	2,290	25,455	23,165	916,990	26,388,380	18.9
Instruments	605					7,676,474	7.8
Miscellaneous Manufacturing	3,718					3,786,664	4.8
Total (disclosed sectors)	657,701	144,650	329,761	185,111	7,290,420	138,696,178	9.2

Sources: Statistics Canada (1995), Bureau of Economic Analysis (1994, 1997), Bureau of the Census (1994a, 1994b, 1994c, 1995a, 1995b, 1995c,1996a and 1996b)

What is also evident in Table 5 is that the industrial structures of the two regions are very different. Outside of *food products* and *transportation equipment*, the highest levels of demand[35] in New England are in sectors where output in Atlantic Canada is fairly small (e.g., *electronic equipment*, *chemicals* and *machinery and equipment*). Atlantic Canada has found comparative advantage in other sectors. Over time, the proximity of the New England market may draw investment to these sectors in Atlantic Canada. However, because the results presented here depend on the current industrial structure of Atlantic Canada and New England, no predictions can be made in this regard.

Compared to Atlantic Canada–New England, the Ontario–Great Lakes region's trade is spread across a far broader range of sectors. Furthermore, the model is also considerably more successful at predicting the aggregate level of trade (see Table 6). There are several other characteristics of the Ontario–Great Lakes relationship that are of note. First, the border effect has a strong influence on a broader selection of sectors (see Table 6) and when its influence is removed the predicted level of trade is almost always higher than its actual level. The two exceptions are *lumber and wood products*, for which the border effect is small, and *furniture and fixtures*, whose level of actual trade far outweighs the predicted level. At least in part, this is due to trade in seats which are used as car parts, and therefore, are covered under the Auto Pact.

[35]Demand is measuring using gross output data for each state aggregated over the region multiplied by input-output coefficient derived from the 1987 Benchmark Input-Output Tables (Bureau of Economic Analysis, 1994).

Second, despite the fact that the border's influence on *transportation equipment* has been excluded, the predicted level of trade after the border effect has been removed is doubled. Therefore, at current levels of output, Ontario's fully integrated level of trade with the Great Lakes states would account for 28% of its total manufactured output. Furthermore the significance of *transportation equipment*, by necessity, would decline from 69% of the original predicted level of trade to 33% of the fully integrated level. The potential for economic integration is much broader than the auto sector.

Table 6: Ontario–Great Lakes Trade (1993)

	Ontario					Great Lakes	
	Exports to Great Lakes ($US 000's)				**Output** ($US 000's)	**Demand** ($US 000's)	**G-L Index** (%)
	Actual	Predicted	Border Effect	Change			
Food Products	539,305	411,775	6,520,991	6,109,216	18,975,585	80,366,440	25.9
Textiles	61,398	46,591	288,005	241,414	1,868,160	8,518,396	17.0
Apparel	55,571	102,174	1,478,067	1,375,893	1,435,049	25,595,060	22.3
Lumber & Wood Products	564,756	278,848	313,604	34,756	2,216,478	13,016,786	11.5
Furniture and Fixtures	597,618	157,146	354,137	196,991	1,745,466	10,061,180	60.2
Paper Products	853,962	669,630	1,479,632	810,002	5,422,415	24,789,937	15.4
Chemicals	986,541	851,436	3,123,666	2,272,230	11,855,836	54,292,407	20.1
Petroleum. and Coal Products	149,804	292,349	643,767	351,418	5,316,695	31,287,572	43.5
Rubber & Miscellaneous Plastics	557,635	421,616	1,590,067	168,451	5,700,744	24,008,517	46.4
Leather Products	5,644	12,870	263,777	250,907	403,503	4,485,292	13.5
Stone, Clay and Glass	297,092	135,285	564,772	429,488	2,596,187	12,506,418	41.2
Primary Metals	1,440,562	923,648	2,866,453	1,942,805	8,373,198	49,131,619	26.1
Fabricated Metals	599,261	342,483	2,302,279	1,959,796	7,529,298	37,646,946	42.4
Machinery and Equipment	1,835,438	1,066,225	2,379,100	1,312,875	7,372,810	51,881,765	26.0
Electronic Equipment	620,944	397,049	3,038,868	2,641,819	7,947,760	45,722,909	21.3
Transportation Equipment	10,261,502	13,897,556	13,897,556	-	60,817,315	100,313,455	56.7
Instruments	246,441	124,183	630,085	505,902	1,634,630	22,196,586	21.5
Miscellaneous manufacturing	33,914	46,969	496,768	449,799	948,070	10,291,867	16.6
Total	19,707,387	20,177,834	42,231,594	22,053,760	152,159,199	606,113,152	43.2

Sources: Statistics Canada (1995), Bureau of Economic Analysis (1994, 1997), Bureau of the Census (1994a, 1994b, 1994c, 1995a, 1995b, 1995c,1996a and 1996b)

Finally, also included in Table 6 (and Table 5) is the Grubel and Lloyd index (G-L Index)[36], which is a measure of intra-industry trade. A value of zero indicates that there is no cross-trade in the same types of goods and a value of 100 indicates all trade is in the same kinds of commodities. As indicated in Table 6, a fairly high proportion of the current Ontario–Great Lakes trade is of the intra-industry type. Therefore, it would appear that this trade is being driven by specialization at the firm level, rather than in the case of Atlantic Canada where specialization appears to have taken place at the industry level. In a similar vein, it is also evident in Table 6 that in most sectors where the Great Lakes states have a high level of demand output already exists in Ontario. Therefore, increased trade is more likely to involve reorganized production within the firm (the Eastman–Stykolt hypothesis) rather than a shift in resources across sectors.

Turning finally to Cascadia, which is defined as Alberta, British Columbia, Washington State, Oregon, Idaho and Wyoming, we see a different relationship again. Cascadia appears to occupy the middle ground between the resource related manufactured outputs of Atlantic Canada and the broad based exports of Ontario. The model indicates that trade will increase significantly overall (see Table 7) and in most

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[36]The index is given by the following simple equation,

$$G\text{-}L\ index = \left(1 - \frac{\left(\sum_i |X_i - M_i| \right)}{\left[\sum_i (X_i + M_i) \right]} \right) \cdot 100,$$

where X_i is exports of commodity i and M_i is imports of commodity i. Commodities are defined here using the Harmonized System commodity classification at the six-digit level. At this level of aggregation there are 5420 commodities, which implies the level of intra-industry trade measured by the index is not due to aggregation.

sectors. In particular, it predicts a larger absolute increase in trade in *food products*, *chemicals* and *fabricated metal products*.

Although there is a considerable basis for the integration of these two regions' economies, for several of the key sectors located in American Cascadia there is little output on the Canadian side. These sectors include *electronic equipment* and *transportation equipment*. Therefore, like Atlantic Canada, Canadian Cascadia appears to have specialized in sectors where some comparative advantage, typically resource based, exists.

What is again unclear is whether there will be a shift of resources away from these sectors to take advantage of other types of demand. That is, if the high level of demand on American side of the border is large enough for Canadian firms to organize their production to take advantage of increasing returns, the marginal revenue products of labour and capital may be high enough to attract resources to these sectors.

That being said, Canadian Cascadia does not have the advantage of a highly developed industrial economy as that found in Ontario. There large investments had already been made in plants and equipment and the broader public and private infrastructure is in place to support these industries. Therefore, Ontario would find it much easier to reorganize production to serve the large regional and continental market across the border. Furthermore, of the three regions the model predicts Ontario is the best positioned to take advantage of economic integration.

Table 7: Cascadia Trade (1993)

	Canadian Cascadia					American Cascadia	
	Exports to American Cascadia ($US 000's)				**Output** ($US 000's)	**Demand** ($US 000's)	**G-L Index** (%)
	Actual	Predicted	Border Effect	Change			
Food Products	200,773	113,027	2,584,881	2,471,854	8,077,042	17,113,442	11.3
Textiles	1,186	1,573	6,983	5,410	127,655	1,408,342	12.0
Apparel	30,251	54,585	192,556	137,970	315,610	5,328,231	13.8
Lumber and Wood Products	916,788	1,276,222	1,465,429	189,206	8,706,687	7,873,177	23.9
Furniture and Fixtures	9,202	44,764	69,041	24,278	369,168	2,132,008	33.8
Paper Products	340,944	329,615	1,076,639	747,024	4,296,543	4,761,687	9.4
Chemicals	155,061	275,681	754,392	478,710	3,462,254	7,661,920	5.9
Petroleum. and Coal Products	45,456	104,927	258,191	153,264	3,721,981	6,686,892	25.1
Rubber & Miscellaneous Plastics	30,588	57,739	209,919	152,179	622,152	3,628,038	40.1
Leather Products	909	2,298	7,496	5,198	26,973	885,289	34.9
Stone, Clay and Glass	53,427	94,970	241,202	146,232	1,253,217	2,399,846	30.0
Primary Metals	53,817	211,766	270,928	59,162	1,308,712	4,613,202	12.7
Fabricated Metals	38,287	85,146	586,608	501,462	1,977,135	6,488,403	28.8
Machinery and Equipment	100,293	167,525	524,340	356,812	1,675,942	8,964,097	34.2
Electronic Equipment	59,947	73,842	262,433	188,591	918,462	8,311,378	21.6
Transportation Equipment	43,198	196,607	452,111	255,504	778,561	18,456,250	24.9
Instruments	10,493	27,671	39,699	12,028	204,542	4,503,504	18.7
Miscellaneous manufacturing	5,401	7,487	58,170	50,683	289,878	2,188,477	18.0
Total	2,096,021	3,125,445	9,061,018	5,935,567	38,132,693	113,404,183	20.5

Sources: Statistics Canada (1995), Bureau of Economic Analysis (1994, 1997), Bureau of the Census (1994a, 1994b, 1994c, 1995a, 1995b, 1995c, 1996a and 1996b)

Regional trade policy

In this final section of the paper I want to outline the role of regional governments in the implementation of trade policy. At least on the surface, regional governments have little control over trade since they do not regulate the flow of goods across their borders[37] and they have little influence over the monetary policies of central banks or the fiscal policies of national governments, which can both influence trade (Krugman and Obstfeld, 1994). However, as I have demonstrated above, it is at a regional scale where integration is taking place, and therefore, where the underlying causes and effects of trade are to be found. Consequently, the avenues left for government to influence trade are regional. Whether states and provinces are the best vehicle for trade policy is a matter of debate (see Markusen 1996 and Porter 1996). Nevertheless, as Courchene (1998) has pointed out, in Canada and in Europe sub-national regions are increasingly taking greater control of their economic destinies, which are often tied to markets outside of their own countries. Therefore, trade is integral to their economic policies.

The question is, therefore, what form might these policies take? The discussion to this point in the paper suggests that trade depends on each region's relative factor endowment (comparative advantage) and its geographic proximity to large markets (increasing returns). Theoretically, if trade is driven by factor endowments there is

[37]Canadian provinces do have some control over interprovincial trade. However, in the context of rapidly integrating continental and world markets these powers are unlikely to be used and what trade barriers that remain are liable to be eroded through time.

little room for government policy. Specialization that is driven by comparative advantage will ensure an optimal allocation of resources (Wong, 1995). If increasing returns are driving trade, there is a theoretical basis for intervention. In the presence of increasing returns there is the potential for a process of cumulative causation to develop (Myrdal, 1957). That is, if a region has an initial advantage in a particular industry its market will grow, which will in turn lead to lower production costs and a rising market share. Some have argued that this is a basis for the application of what might be loosely termed strategic trade policy (see Howes and Markusen, 1993). That is, regions may be able to identify high growth, highly productive industries and encourage their development through the application of subsidies as well as other policy instruments. This approach, however, has been strongly criticized by Krugman (1996). He argues that, although theoretically strategic trade policy may work, in practice the ability of governments to identify winning industries is limited and the benefits are, in a general equilibrium sense, small. Porter (1996) takes a similar perspective and argues that in Japan, where strategic trade policy may have been applied the most, the government record is at best mixed.

There is an additional argument against strategic trade policy. The underlying causes of competitiveness are so broad that it would be difficult for government to identify and create all the necessary conditions for development. Porter (1996, 87) argues that growth occurs ". . .because of several factors: concentration of highly specialized knowledge, inputs and institutions; the motivational benefits of local competition; and the presence of sophisticated local demand for a product or service."

It is difficult to envisage how government could create these advantages where they did not to some degree already exist.

What is apparently left to regional government is the control that they exercise over the environment in which economic activity occurs (Courchene, 1998; Porter 1990 and1996; and Storper and Scott, 1995). The point here is that although comparative advantage and increasing returns may be necessary conditions for trade they may not be sufficient conditions. In this context, the role of regional policy becomes a question of how governments can enhance the economic advantages that regions already possess. There is an important difference between this approach and that of strategic trade policy. Strategic trade policy is based on the identification of sectors where extraordinary rents can be accumulated. Through the application of export subsidies a nation's or region's firms may be able to achieve enough market power that their rents outweigh the costs of subsidizing the industry. Here I am arguing that government policy may be effective where a region's advantage has already been revealed. This is similar to the argument made by Porter (1990 and 1996) and Bröcker (1997), among others.

At this juncture, it is helpful return to a discussion of the data presented above. As I have already noted, in the case of Atlantic Canada–New England trade, Atlantic Canada appears to have specialized in resource related manufacturing sectors where it benefits from comparative advantage. However, at present, Atlantic Canada has only a fairly small presence in those sectors where there is a considerable amount of demand in New England (e.g., *machinery and equipment* and *electronic equipment*).

Given New England's proximity and the size of its market, this would appear to be an important area for public investment of resources. However, why should resources be directed towards these sectors? Even if, for example, *electronic equipment* pays a wage premium over that of *food products*, it is unlikely the benefits would outweigh the costs of government intervention. This does not mean that development in these sectors should be discouraged. However, the model's prediction that trade in *food products* may increase substantially from their predicted level implies this may be a more productive area of public investment. The same argument might be made regarding *food products* and *paper products* in Canadian Cascadia.

To gain an additional perspective, it is useful to look at the relationship between Ontario and the Great Lakes region. Here Ontario's manufacturing sector that developed to serve the national market has and continues to reorient itself to serve the Great Lakes market, especially in intermediate inputs (Courchene, 1998 and Brown and Anderson, 1999). Given the large amount of intra-industry trade between Ontario and the Great Lakes states, it would appear that trade is being driven by specialization at the firm level. That is, the data are consistent with the Eastman-Stykolt hypothesis. What then is the role of regional policy in this case?

In the instance of Atlantic Canada–New England trade, the argument is that Atlantic Canada could specialize to serve the New England market. However, this specialization would tend to enhance their economic differences since it would take place at the sectoral level. This also implies the room for policy coordination among the Atlantic provinces and New England states is fairly narrow. Atlantic Canada acts as a supplier to New England but there is little economic integration beyond that.

As I have noted, in the case of Ontario–Great Lakes trade, specialization appears to be taking place at the firm level: that is, the economic similarities of these regions are driving trade. To a lesser degree this is the case in Cascadia as well. To the extent that economic integration increases the economic efficiency of producers on both sides of the border, both regions will benefit; external returns spill over the border (see Brown and Anderson, 1998a and 1999). For Ontario–Great Lakes and Cascadia there is considerably more latitude for regional trade policy in the form of intergovernmental cooperation.

For example, given that intra-industry trade in intermediate goods appears to more sensitive to the friction of distance (Brown and Anderson, 1999), it is in the interest of all parties that the flows of goods across their borders be as frictionless as possible. Therefore, efforts to reduce any delays at the border or to harmonize their regulations that might impede trade are very practical measures that can be taken. This would also have the added benefit of increasing the competitive pressures on local firms, which Porter (1990 and 1996) argues is one of the main drivers of competitive success.

Conclusions

Over the last half century, Canada has moved from an economy that was focussed on supplying its national market to one that is oriented towards serving a continental market. This move in the direction of more open trade has been driven by the benefits that accrue from comparative advantage but also the benefits of specialization at the level of the firm. What the analysis indicates is that the trading relationship between the United States and Canada is very much a regional one. Regions that are in close geographic proximity are the most integrated. Furthermore, it is these regions where the potential for increased trade is the greatest, and therefore, where efforts on the part of governments to increase trade may be the most effective.

What the analysis also shows is that the potential for trade among these transnational regions varies significantly and the bases for economic integration also differs across regions. Therefore, regional trade policy will also vary. In Atlantic Canada–New England the role of government may be limited to enhancing the region's resource related manufacturing sectors, which in turn would tend to enhance the differences between the two regions. Therefore, their latitude for economic cooperation is limited. On the other hand, economic integration of Ontario and the Great Lakes states is based on intra-industry specialization. Here the fortunes of regions on both sides of the border are tied much more closely together, and therefore, the basis for regional cooperation is broader.

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Appendix

Estimation procedure

In order to estimate (3), it can be linearized as follows:

$$lnT_{i.AB} - \frac{1}{r}\sum_{A=1}^{r} lnT_{i.AB} = \sum_{k=1}^{l} \eta_k \left(lnz_{k_{AB}} - \frac{1}{r}\sum_{A=1}^{r} lnz_{k_{AB}} \right) + \beta \left(lnd_{AB} - \frac{1}{r}\sum_{A=1}^{r} lnd_{AB} \right) + \phi \left(lnX_{i_A} - \frac{1}{r}\sum_{A=1}^{r} lnX_{i_A} \right). \quad \text{(A1)}$$

The proof of (A1) can be found in Fotheringham and O'Kelly (1989). One important characteristic of (A1) is that if we wish to account for the influence of the border on trade using a dummy variable for province-state flows, it is only applicable to Canadian exports to American regions. This is due to the fact that the model is estimated based on the value of each variable minus the average for each destination. Consequently, if a dummy variable is used for Canadian destinations, the value of the variable would be zero. Therefore, in the analysis it is only possible to measure the influence of the border on Canadian exports to the United States.

The predicted level of interregional trade flows are determined by the probability that commodity *i* will be sourced from region *A*:

$$P_{i.AB} = \frac{\prod_{k=1}^{l} z_{k_A}^{\eta_k} d_{AB}^{\beta} X_{i_A}^{\omega}}{\sum_{A=1}^{r} \prod_{k=1}^{l} z_{k_A}^{\eta_k} d_{AB}^{\beta} X_{i_A}^{\omega}}, \qquad \text{(A2)}$$

multiplied by the total imports into region *B*:

$$\hat{T}_{i.AB} = \sum_{A=1}^{r} T_{i.AB} P_{i.AB}. \qquad \text{(A3)}$$

Data Requirements

The data required to estimate (A1) includes trade flows, manufacturing output, cost data, and nominal data (dummy variables). A detailed overview of the sources of these data can be found in Brown and Anderson (1998b and 1999). Consequently, I will review the sources of the data very briefly below.

In the analysis we use internal American trade as a benchmark of economic integration. These trade flows are compared with province to state trade to determine the potential volume of trade between Canadian and American regions. Internal U.S. trade flows are measured using the Bureau of Transportation Statistics' Commodity Flow Survey (CFS)[38] (Bureau of the Census,1997) and province to state flows are derived from Statistics Canada's TIERS (1996) data base.

Manufacturing output data are provided by Statistics Canada (1995) and the Census Bureau's (1996) 1993 survey of manufacturers. Data regarding industrial output and demand outside of the manufacturing industries, which are only required for American regions, were covered by the economic census in 1992 (Bureau of the Census, 1994a, 1994b, 1994c, 1995a, 1995b, 1996a, and 1996b). When data at the

[38]Although the CFS estimates all merchandise trade in the United States (excluding commodities transported by pipeline as well as goods covered by the SIC 27, *printing and publishing*), only flows of manufactured goods (SIC 20, 22-26, and 28-39) were included in the analysis. *Tobacco products* (SIC 21) were also excluded because trade flow and output data were too often classified for confidentiality reasons.

state level were not available, the sector's output was allocated by state using the County Business Patterns (1995c) employment statistics. In the few instances where employment data were reported only by intervals, we took the average of the interval as the level of employment. Finally, in most instances state level data was only available for 1992. These data were inflated to 1993 level using gross output at the national level for those sectors (Bureau of Economic Analysis, 1997).

CONCLUSIONS

As was noted in the introduction, the purpose of this dissertation is to determine the degree to which industrial and spatial structure influence the volume and composition of trade among Canadian and American regions. Based on these results, the dissertation was also intended to shed some light on the potential regional impacts of trade, the potential for increased trade and the policy implications of regional economic integration. In this concluding chapter I would like to outline the degree to which these aims have been realised.

There is strong empirical evidence that industrial and spatial structure are important determinants of the volume and composition of trade. This was apparent in the empirical analysis undertaken in the Chapter 2 and the econometric work under taken in Chapters 4 and 5. On the surface, this is not at all surprising. It has long been recognized that distance influences the flows of goods over space (see, for example, Ullman, 1980). However, it is when industrial and spatial structure are combined that we are able to gain additional insight.

In Chapter 2, it was demonstrated that trade among regions with similar industrial structures was greatest if the regions were in close geographic proximity. However, as distance increased, trade tended to be more prevalent among regions that specialized in different industrial structures. We identified the former as being consistent with specialization at the level of the firm (increasing returns) and the latter as consistent with sectoral specialization (H-O theorem). It would appear that since increasing returns are more easily replicated than factor advantages, trade would be more spatially circumscribed. Therefore, given that the degree of similarity between the regions' factor endowments would influence the proportion of intra-industry trade (Helpman and Krugman, 1985), so too would their geographic location relative to each other. That is, if we had two pairs of regions, with each pair having the same relative differences in their factor endowments, the pair that was the closest together would have the largest share of intra-industry trade. From a theoretical perspective, this is one of the more interesting insights that arose out of this research.

One of the conclusions that can be drawn from Chapter 2 is that if the regions are located close enough to each other, the benefits of specialization on the part of producers outweighs the costs of moving intermediate goods over space. This idea was dealt with in two ways in the rest of the thesis. In the theoretical paper (Chapter 3) it was argued that proximity may lead to consolidation within the intermediate goods sector, whose benefits are passed on as external returns to downstream producers. However, intermediates were defined as homogenous goods and trade was either frictionless or was prohibited because of the distance between the two specialized regions. In Chapters 4 (and Chapter 5), this concept was incorporated into the analysis in a different, possibly more realistic, way. Here specialization on the part of intermediate producers was limited by the extent of the market. The extent of the market depends on the delivered price of intermediates (and final) goods and the degree to which prices influence the demand for variety. Therefore, by substituting goods in production (consumption), downstream firms (consumers) also substitute goods over space. Trade is closely linked to the trade-off between the demand for variety and the cost of moving goods over space.

Because industrial and spatial structure can influence the volume and composition of trade, they may also determine its impacts on regions. In Chapter 3 this hypothesis was addressed using an analytical model. It indicated that the effect of trade on regions depends on the tradeability of intermediate inputs, the interaction among increasing returns and factor markets and the relative size of the trading nations. The model demonstrated that if intermediates are tradeable all regions and nations will benefit from trade. However, if intermediates are non-tradeable, the smaller nation's region will experience a decline in welfare even though its nation as a whole may benefit from trade. Therefore, there may be a divergence between the national interest and the regional interest.

Given that the national interest may not reflect regional interests, trade policy is also a regional concern. Therefore, the potential for further economic integration with the United States and the sectoral and regional pattern of that integration may be of considerable interest to regional governments.

In Chapter 4 the potential for further economic integration among Canadian and American regions was measured by comparing province to state trade to state to state trade: that is, internal American integration was used as a benchmark. After controlling for other factors that might influence inter-regional trade flows, the model indicated that without the border Canadian exports of manufactured products covered in the analysis would increase by approximately 2.75 fold. Although a significant predicted increase, it is smaller than McCallum (1995) and Helliwell's (1996) estimates of a twenty fold increase in trade using internal Canadian trade as a benchmark of economic integration.

The model's results also indicated that the border effect varied across sectors. Given that regional specialization persists, this implies the potential for increased trade varied across regions and region pairs. This intuition was confirmed in the empirical analysis undertaken in Chapter 5. Therefore, if regional governments are interested in increasing trade, and in particular trade with bordering regions, their efforts would be most effectively focussed on those sectors where a large potential exists.

What form these policy efforts might take depends on the characteristics of the region pairs and the forces driving economic integration. If trade is generated by specialization at the sectoral level, regional policy may be limited to enhancing the province or state's competitiveness in those sectors where they have a comparative advantage. However, if trade is driven by specialization at the firm level, and in particular in the production of intermediate inputs, the latitude for cooperation among regional governments on both sides of the border is much broader. Therefore, efforts to coordinate the regulation of industries or to reduce delays at the border are practical policies that may help to enhance the productivity of industries of the transnational region as a whole.

In summary, the analyses contained in the four main chapters of this dissertation indicate that trade between Canada and the U.S. is heavily influenced by the industrial and spatial structure of their regional economies. Trade is strongest between regions with similar economies that are in close geographic proximity. Large trade flows may also occur between regions that are located far apart, but this trade tends to be generated by specialization at the sectoral level. Given this evidence, it would also be reasonable to state that the impacts of trade and the potential for further economic integration vary across regions. Therefore, as regional economies integrate into the wider continental market, trade and trade policy will become an increasing concern of regional governments. The form that these policies might take depends on the region in question and the characteristics of its main trading partners.

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