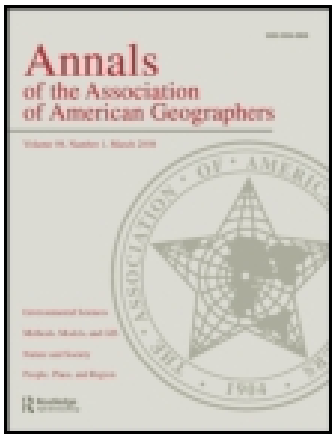

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Trade Specialization and Reciprocal Trading Relationships in Canada and the United States, 1989 and 2001

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Interregional trade flows of Canada (provinces) and the United States (states), the world's largest bilateral trading partnership, are investigated using a measure of trade specialization similar to the location quotient and using provinces and states as the spatial units of analysis. Past research investigating the clusters in the geography of international trade flows have focused on national units of analysis, despite the fact that subnational units display geographical patterns of trade distinct from their respective nations. Regional trading relationships have evolved since the establishment of free trade between Canada and the United States as the result of decreased costs in accessing foreign markets. These new trading relationships now incorporate more U.S. states and fewer Canadian provinces in most cases. *Key Words: Canada–U.S. trade, interregional trade, location quotient, region.*

加拿大（省）和美国（州）之间的区域间贸易流动，是世界最大的双边贸易伙伴关系。本文将加拿大的省与美国的州作为空间单位，利用一种和区位商类似的贸易专业衡量方法对上述关系进行了分析研究。过去的针对国际贸易流动中地理群体的研究调查的重点是以国家为基本单位的，尽管事实上国家以下的区域展示出的贸易地域格局是有别于其各自所属的国家的。加拿大和美国之间的区域贸易关系自美加自由贸易建立以来一直不断演化着，以降低进入外国市场的成本。在多数情况下，更多的美国州和更少的加拿大省加入到这种新的贸易关系中。*关键词：加拿大-美国贸易，区域间贸易，区位商，区域。*

En este artículo se investigan los flujos comerciales interregionales de Canadá (provincias) y Estados Unidos (estados), la más grande asociación de comercio bilateral del mundo, mediante el uso de una medida de especialización comercial parecida al cociente locacional, y utilizando las provincias y estados como las unidades espaciales de análisis. La investigación dedicada anteriormente al estudio de *clusters* (apiñamientos) en la geografía de los flujos de comercio internacional basaba sus análisis en unidades nacionales, a pesar del hecho de que las unidades de categoría subnacional pueden desplegar patrones geográficos de comercio distintos de los de sus respectivas naciones. Desde el establecimiento del libre comercio entre Canadá y E.U. han surgido otras relaciones regionales de comercio, como resultado de la disminución de costos al acceder a los mercados extranjeros. En la mayoría de los casos, estas nuevas relaciones comerciales incorporan ahora más estados de E.U. y menos provincias canadienses. *Palabras clave: comercio Canadá-E.U., comercio interregional, cociente locacional, región.*

In the past twenty years, international exports of merchandise trade have more than doubled, whereas global output has increased by approximately 50 percent (International Monetary Fund 2005a, 2005b). Additionally, trade in services, although a relatively small portion of international trade, is growing at a faster rate (Dicken 2003). Perhaps most important, economic growth is positively associated with international trade[1] (see Noguer and Siscart 2005), making a nation's involvement in the international economy important for its well-being. Understanding the nature of international trade, including its geography, is therefore important for all nations.

A body of research has emerged in recent years investigating the geography of international trade and the formation of supranational trading regions (see K. Anderson and Norheim 1993; O'Loughlin and Anselin 1996; J. P. Poon 1997; and J. P. H. Poon, Thompson, and Kelly 2000); however, despite the importance of understanding the geography of international trade at the national level, Hoare (1993, 701) notes that

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> a little-explored facet of the global economy is the way regions within nations and different parts of the international community interact through trade flows. . . . Given the well-established tendency for any one country to trade more with some overseas nations than with others we should expect at least as much and probably more trading-partner specialization on the part of that country's constituent localities.

Therefore, most of the information on trading relationships found at the national level is simply based on averages of the trading relationships that exist at the subnational level.

In North America, a number of studies have investigated regional trade changes, but these studies each focus on one small region, or even one city (see Melvin 1988; Warf and Cox 1990; Calzonetti 1991; McConnell and MacPherson 1991). Studies that investigate the exports from U.S. states or their regional groupings tend to examine the trade of U.S. states or regions with the "rest of the world," Canada as a whole, or regional groupings of Canadian provinces (see Erickson and Hayward 1991; Warf and Cox 1993; Hayward and Erickson 1995; Gazel and Schwer 1998; Coughlin and Wall 2003; Sawchuk and Sydor 2003). There is, however, some research that deals with all of Canada's regions and their respective trading patterns with the United States.

Brown (1998), dividing Canada and the United States into three regions, finds that the composition of Canada–U.S. trade varies geographically: Atlantic Canada is dominantly involved in natural resource–based trade flows; Ontario has a broadly based composition of trade flows dominated by manufacturing, particularly the automotive industry; and Cascadia's trade flows consist of manufactured goods and natural resources. Norcliffe (1996), measuring the destinations and origins of Canadian regions' exports and imports at the national level, finds that Ontario and the Prairie provinces (Alberta, Saskatchewan, and Manitoba) have the highest proportions of imports from the United States (72.2 and 84.5 percent of imports in 1993, respectively), whereas Ontario has the highest proportion of exports to the United States (89.5 percent), largely due to the automotive industry. Quebec and the Prairies are also high at 78.9 and 75.3 percent, respectively. Dividing Canada into five regions and the United States into nine regions, Brown and Anderson (1999) find regional ties similar to those of Brown (1998) and Norcliffe (1996). They also find that geographically close regions are the most integrated and that intra-industry trade is highest in central Canada, followed by western Canada, the Atlantic provinces, and the Prairie provinces.

Despite these interesting patterns, none of these studies incorporate a temporal component to investigate any changes in the spatial distribution of Canada–U.S. trade potentially arising from the Canada–United States Free Trade Agreement (CUFTA) or the North American Free Trade Agreement (NAFTA). Polèse (2000) is the first to fill this gap, finding that Quebec is more integrated with the rest of Canada than with Ontario, and Ontario is the least integrated with the rest of Canada but the most integrated with the United States. Acharya, Sharma, and Rao (2003), using four U.S. and five Canadian regions, find the following: Canadian exports to New England and the Midwest have fallen, exports to the Northwest have remained constant, imports for all three regions have remained relatively constant, and—the most striking result—there have been large increases for imports and exports with the U.S. South. This phenomenon is common across all five Canadian regions. Similar to past studies, British Columbia, the Prairies, and Atlantic provinces specialized in natural resources; Quebec specialized in labor-intensive products and Ontario specialized in manufactured goods (Acharya, Sharma, and Rao 2003).

This relatively small literature on Canada–U.S. interregional trade is instructive, but limited in two ways. There are very few studies that measure regional change in trade over time, and regional groupings are determined before the analysis of trade patterns. This article contributes to the literature on the geography of international trade through an analysis of changing trading patterns using Canadian provinces and U.S. states as the primary units of analysis and through the application (and extension) of the methods that measure trade specialization and trading regions to a subnational level, using Canadian provinces and U.S. states as the initial units of aggregation. The analysis uses the years 1989 and 2001, the earliest and latest years available for high-quality data on interregional trade at the time of analysis (the data for the intervening years are available but for reasons of brevity are not analyzed here). In what follows I examine the most recent theoretical approaches to international trade and economic integration and then examine regional trade specialization.

(New) Economic Geography, North American Integration, and Regions

The classical and new models of international trade predict similar geographical effects resulting from increased economic integration. Some of these models, containing an economically large and small country

or multiple regions within each country, apply well to Canada and the United States.

(New) Economic Geography and Economic Integration

Geographical theories of international trade are based on new trade (Krugman 1979, 1980, 1981; Lancaster 1980) and classical trade theories (Ricardo 1911; Ohlin 1967; Samuelson 1953). The new economic geography, based on the firm-level economies of scale, imperfect competition, and product differentiation of new trade theory (see Krugman 1991), predicts that a decrease in trade costs increases the agglomeration of production in the larger of two economies; firms migrate to the larger economy to minimize transportation costs. Subsequently, the larger economy exports to the smaller economy, so that the nature of agglomeration, not comparative advantage, dictates trading patterns (Fujita, Krugman, and Venables 1999). In this context, trade costs take two forms: transportation costs and (non-)tariff barriers. Behrens (2006) shows that decreases in both or either of these trade costs (they are normally treated as a single impediment to international trade) lead to the agglomeration of production in the larger economy.

Hanink and Cromley (2005) develop a classical model of international trade with regionally based factor endowments and comparative advantage. Using simulation methods, they find support for Melvin's (1985) analytical result that high tariffs generate increased interregional trade within a country. If a country does not have the option of international trade because of (non-)tariff barriers, it trades with other "internal" regions. This pattern is well documented with Canada. Because of historically high (non-)tariff barriers between Canada and the United States, interprovincial trade is much greater than predicted based on the economic sizes and distances between trading partners (McCallum 1995; Courchene 2003). Consequently, interregional trade may be substituted for international trade. Also, regions closer to the international border are impacted more by free trade than distant regions; Krugman and Elizondo (1996) and Alonso-Villar (1999) find a similar result for U.S.–Mexico international trade. This has implications for Canada–U.S. international trade because more U.S. states are distant from the border than contiguous to the border.

Consequently, it is expected that decreased tariffs (the movement toward free trade or its complete establishment) will have a greater impact on regions geographically close to the border, and agglomeration of production will occur in the larger (U.S.) economy; however, as Sjöberg and Sjöholm (2004) are correct to point out, changes in spatial patterns from trade liberalization are more complicated than most geographical models of international trade predict. Issues such as accessibility and infrastructure (ports, roads, and general physical geography) impact theoretical predictions because economic activity does not occur on an isotropic plane.

Furthermore, high wages or land costs in one country, restraints on labor or capital mobility, and locally generated economies of scale may interfere with theoretical predictions. For example, the governmental provision of health care in Canada gives Canadian labor a 15 to 20 percent cost savings over the United States (Holmes 1993).[2] This is significant, possibly outweighing any savings in transportation costs from being closer to the larger market of the United States. Additionally, Canada and the United States are a free trade area, not a common market: a free trade area, by definition, deals with tariff and nontariff barriers, whereas a common market also removes barriers to labor and capital mobility. There are currently provisions for the movement of labor, capital, and investment between Canada and the United States, but labor is not free to move—capital investment is significantly liberalized. Finally, firms may be located in one of Markusen's (1996) "sticky" places such that savings in transportation costs are greatly offset by losses of locally generated (external) economies of scale—no longer having access to Storper's (1997) untraded interdependencies.

There is another way for firms and regions to minimize transportation costs without changing their production location. Most new economic geography models have two regions, one home and one foreign, so that firms must move to minimize transportation costs; however, when each country has multiple regions (ten provinces and fifty states, for example), removing (non-)tariff barriers allows exports and imports to be sent and sourced from a multitude of regions. For example, before free trade it may have been cheaper for firms in British Columbia to ship goods to and from Ontario rather than to and from the state of Washington; transportation costs were less than (non-)tariff costs. After the establishment of free trade, however, transportation costs are more than (non-)tariff costs, so goods are shipped to and from Washington. There may not be perfect substitution, but some substitution would likely occur. Therefore, even without the perfect mobility of factors, or considering constraints outlined by

Sjöberg and Sjöholm (2004), spatial patterns of interregional and international trade are expected to shift. The question is then from and to where?

North American Integration

The formal institutionalization of trade between Canada and the United States predates Canada's confederation with the Elgin-Marcy Reciprocity Treaty of 1854 that covered natural resources and agricultural products—over two-thirds of Canadian merchandise trade at that time (Crookwell 1990). With a number of subsequent failed attempts to reestablish free trade with the United States (see Fry 1987), Canadian politicians focused international trade policy on the General Agreement on Tariffs and Trade (GATT), established in 1947, to reduce global trade barriers. When crisis hit Canada's automotive industry, however, free trade with the United States became the topic of discussion.

Often called a managed trade agreement, the Canada–United States Automotive Products Trade Agreement of 1965 (Auto Pact) permitted duty-free movement of automotive vehicles and parts between Canada and the United States (Holmes 2000).[3] The Auto Pact increased efficiency, competitiveness, and trade, with a geographical division of labor favoring labor-intensive production in Canada (Holmes 1993, 1996). Subsequently, international trade between Canada and the United States expanded: by the early 1980s more than 70 percent of Canada's international trade (20 percent of Canada's economy) was tied to the United States[4] (International Monetary Fund 2005a, 2005b).

Despite the fact that 85 percent of trade (because of the Auto Pact and the GATT) crossed the border duty free, Canada was vulnerable to unilateral action from the United States through foreign trade policy changes—a concern in the early 1980s because of economic conditions and talk of protectionism (Coffey et al. 1999). Consequently, in 1985, the Canadian government requested a comprehensive free trade agreement with the United States. Given the high degree of international trade between Canada and the United States one could argue that the CUFTA made an existing condition and trend official; however, as shown by Schwanen (1997), Clausing (2001), and Trefler (2004), Canada–U.S. trade increased far more than expected without the CUFTA: approximately half of the international trade increases are attributable to the CUFTA.

Only two years after the CUFTA entered into force, Canada began negotiations with the United States and the United Mexican States (Mexico) to establish the NAFTA (Cameron and Tomlin 2000).[5] The primary concern was Canadian access to the United States. Because of relatively cheap labor costs in Mexico, Canada would lose its status of relatively cheap labor. Despite these concerns, early studies of the effects of the NAFTA found no significant impact on Canada–U.S. trade (see Gould 1998; Krueger 1999, 2000), and later studies (see Coughlin and Wall 2003; Wall 2003; Romalis 2005) found that Canada experienced mild positive effects. Most recently, Andresen (forthcoming) found that the NAFTA has significantly increased international and interprovincial trade, with the economically smaller provinces experiencing the greatest magnitude impacts.

Since 1989, the expansion of trade has increased significantly (Table 1), with Canadian exports increasing by a larger factor (2.63) than U.S. exports (1.97). Currently, more than $2 billion in goods cross the Canada–U.S. border every day, and 14 million trucks and 220 million people cross every year (Andreas 2003; Sydor 2003). This bilateral volume of trade is the largest in the world, comprising 25 percent of all American exports (2.5 percent of U.S. gross domestic product [GDP]) and 87 percent of all Canadian exports (25 percent of Canadian GDP). Despite uneven economic dependence through trade, Canada and the United States are each other's most significant trading partner. The dominant industrial sectors involved are metals, machinery, and transportation, but raw materials (particularly petroleum) are becoming important for Canadian exports. The general spatial pattern in Canadian trade shifted from an east–west to a north–south configuration, but the specific nature of the new north–south trading relationship is not known. Do the traditional divisions of western, central, and eastern Canada simply trade with more U.S. states? Such appears to be the expectation because most research on Canadian trading patterns uses these regions as the spatial units of analysis. Alternatively, are these traditional groupings of provinces breaking apart and forming new regions with U.S. states? Understanding the nature of these trading regions is particularly important in any further integration between these two economies such as a currency union or the Security and Prosperity Partnership—the NAFTA and Security and Prosperity Partnership have been the subject of recent political debate. The nature of these trading regions is of particular importance because any further integration will no doubt have geographical effects (Coughlin and Wall 2003; Wall 2003).

Table 1. Total and industrial sector trade, billions of constant 1997 Canadian dollars

	Canadian exports		U.S. exports	
	1989	2001	1989	2001
Total trade	117.0	307.2	99.7	196.9
Animal agriculture	2.8	7.8	1.0	2.0
Vegetable agriculture	0.9	3.1	2.4	4.0
Food	0.9	5.5	1.2	4.2
Beverages and tobacco	0.9	2.0	0.6	1.5
Mining, quarrying, petroleum	13.3	53.7	2.9	4.4
Chemicals	4.7	12.1	5.4	14.7
Plastics and rubber products	3.3	13.8	4.8	13.0
Wood products	5.3	15.3	1.3	2.3
Paper products	11.7	18.0	1.9	5.6
Printing and publishing	0.5	1.7	1.7	2.6
Leather	0.3	0.5	0.3	0.3
Textiles	0.5	2.6	1.6	3.4
Clothing	0.3	3.0	0.4	1.2
Nonmetallic mineral products	2.4	5.1	2.4	3.7
Primary and fabricated metals	11.0	19.8	7.0	14.4
Nonelectrical machinery	11.1	27.2	21.0	39.1
Electrical machinery	5.0	17.7	10.0	20.4
Motor vehicles and parts	36.0	75.0	26.1	42.6
Other transport	2.7	10.7	2.5	5.4
Professional goods	1.2	3.6	3.4	7.5
Other	2.2	9.1	1.9	4.7

Source: Statistics Canada (2004).

Regions

There is a difficulty using the term *region* when discussing international trade. Most often, a region, in the context of the (geographical) international trade literature, is discussed as a supranational entity, but it also describes a subnational entity. In essence, a region is "an emergent, socially constituted phenomenon" (Jessop 1995, 682). A region is emergent because it is dynamic; it is always becoming. A region may be in stasis or equilibrium for some period of time, but changes in geopolitical situations, such as free trade, alter the conditions from which the region emerged such that it emerges again (Cohen 1991). A region is socially constituted in the sense that regions have different boundaries for different contexts. Because they are socially constructed, regions are historically contingent with inertia to maintain boundaries within a particular context (J. Anderson and O'Dowd 1999). As noted by Scott (1999), regions are a part of the process of political regulation that operates at different geographic scales, especially in the context of problem solving that involves multiple levels of government (Swyngedouw 1997). To be regulated, though, the region must be defined. Once governed, the historical contingencies used to define the region have changed. As such, a region is simultaneously dynamic and resistant to change.

This form of governance is important for regional economic development. Porter (2003) states that the economic performance of regions varies significantly across space and industrial classification. Consequently, understanding the subnational region is important for the development and implementation of public policy. Of particular importance are cross-border regions because their political regulation involves the international scale. In regard to Canada and the United States, cross-border regions have long been recognized, existing in central Canada (Courchene 2001) and western Canada (Edgington 1995; Paelinck and Polèse 1999). More recently, the Policy Research Initiative (2005) identified five cross-border regions for Canada and the United States: West (Cascadia), Prairies–Great Plains, Great Lakes–Heartland, Quebec–Northeast, and Atlantic. The question, however, is whether these regions are properly identified, particularly because they are expected to be dynamic.

Trade Specialization of the Canadian Provinces, 1989 and 2001

Data

Canada–U.S. international trade data are from Statistics Canada (2004), based on the Harmonized Tariff Schedule (HTS) classifications. Canadian provinces and U.S. states are the smallest geographic units, with all HTS classifications aggregated based on their origin, destination, and industrial sectors as defined by Statistics Canada.[6] Interprovincial trade data come from three sources: *Interprovincial Trade in Canada, 1984–1996* (Statistics Canada 1998), *Interprovincial and International Trade in Canada, 1992–1998* (Statistics Canada 2000), and Statistics Canada's (2005) *Canadian Socio-Economic Information Management System*.

The primary limitation of these data is that only commodities are included; trade data for services are not available for province–province and province–state trade. Although Harrington (1989) shows that services are impacted by free trade between Canada and the United States, services are a small portion of trade between industrialized countries (Dicken 2003), and commodities will be more affected by free trade than will services (Warf and Randall 1994). Consequently, the analysis is undertaken without much concern for bias. Another limitation is that these data are gathered using customs declarations that may be susceptible to the underreporting of commodities to avoid tariff costs as well as human error in reporting and aggregation; however, little can be done regarding such limitations, which are present in most data.

Following the analysis of reciprocal trading regions, the calculation of provincial tariff rates is undertaken to explain changes in trading regions. Tariff rates are negotiated at the national level for all industries, but not all industries are represented equally in each province and state. The Statistics Canada (2004) data contain the value of tariff duty collected for each HTS category that is aggregated to the provincial level, generating a provincial tariff rate. These calculations only involve commodity classifications that cross the border, so if a tariff rate prohibits trade of a particular commodity the corresponding tariff data are not included in the calculation. Unfortunately, nothing can be done to offset this limitation. Therefore, this variable is considered an underestimate of the true provincial tariff rate. Also, the provincial tariff rate is based only on Canadian tariffs, so it does not necessarily capture the degree of protection for the U.S. markets. The correlation between the Canadian and U.S. tariff rates measured at the national-industry level is nonetheless rather high, $r = 0.812$ (p value < 0.001).

Finally, the size of each Canadian province and U.S. state may impact the analysis, because it is economic size (i.e., GDP) that matters for trade.[7] Small provinces and states are susceptible to large changes in index values from small changes in trade volumes. As such, caution must be used when making inferences regarding economically small provinces or states. Additionally, if an economically large province or state and an economically small province or state are aggregated into a region, the new region takes on the characteristics of the larger province or state. Little can be done regarding these limitations of the data.

The Trade Location Quotient for Provincial Imports and Exports

Past research uses a trade intensity index to measure trade specialization. If two countries have an intense trading relationship, there is a geographical bias in international trade: region A sends a larger portion of its trade to region B than would be expected given the share of world exports destined for region B. The basic trade intensity index—used by O'Loughlin and Anselin (1996), J. P. Poon (1997), and J. P. H. Poon, Thompson, and Kelly (2000)—is computed as:

$$I_{ij} = {}^{x_{ij}}/_{m_j}, \tag{1}$$

where x_{ij} is the share of country i's export shipments to region j and m_j is the share of world imports destined for region j. If I_{ij} is equal to one, country i exports proportionately to region j; if I_{ij} is greater than one, country i exports a disproportionately larger share of its exports to region j; and if I_{ij} is less than one, country i exports a disproportionately smaller share of its exports to region j.[8] Therefore, this index has the same interpretation as the location quotient.

Any geographical bias in international trade found in a country's exports is relative to the geographical bias in all other countries' trade. For example, if all countries export 50 percent of their international trade to one country, a phenomenon that clearly indicates a geographical bias, and country i also exports 50 percent of its trade to this country, then based on the calculated I_{ij} there is no trade intensity or specialization. Also, I_{ij} only uses export flows to measure trade intensity, despite the fact that the many countries produce disproportionate shares of global output: in 2001 the United States accounted for 27 percent of the world's GDP but only

5 percent of the world's population. It is therefore expected that international trade is dominated by a small number of economically large countries.

Attempting to account for GDP, K. Anderson and Norheim (1993) and O'Loughlin and Anselin (1996) compute the following trade intensity index:

$$P_{ij} = t_i I_{ij}, \tag{2}$$

where t_i is the ratio of country i's global exports to country i's GDP_i, and I_{ij} is the same as Equation 1. There is a problem with this index as well. Using x_{ij} to represent the volume of exports from country i to region j, Equation 3 shows that P_{ij} does not have an intuitive interpretation:

$$P_{ij} = t_i I_{ij} = \left(\frac{x_i}{GDP_i}\right)\left(\frac{x_{ij}/x_i}{m_j}\right) = \frac{x_{ij}}{GDP_i}\frac{x_{ij}}{x_i}\frac{1}{m_j} = \frac{x_{ij}}{GDP_i}\frac{\text{Total World Exports}}{\text{World Exports}_j} \tag{3}$$

The first term in Equation 3 does have the interpretation of country i's dependence on region j through trade, but the second term in the equation is the inverse of m_j. This shrouds the interpretation of P_{ij}: P_{ij} changes when country i alters its economic dependence on region j and when the ratio of global exports to region j and total global exports changes. Therefore, using P_{ij} does not indicate *why* trade intensity is changing.

The current analysis uses a different measurement, referred to as the trade location quotient, TLQ_{ij}:

$$TLQ_{ij} = (x_{ij}/x_{iw})/(GDP_j/GDP_w), \tag{4}$$

where x_{ij} is the value of exports from province or state i to province or state (or region) j, x_{iw} is province or state i's total exports to Canada and the United States, GDP_j is the GDP of province or state j, and GDP_w is the GDP of Canada and the United States. The TLQ_{ij} index measures the percentage of province or state i's exports sent to province or state j relative to province or state j's share of Canada–U.S. GDP. If the TLQ_{ij} index is equal to unity, province or state i exports to province or state j proportionally; if the TLQ_{ij} index is less than unity, province or state i exports disproportionately less to province or state j; and if the TLQ_{ij} index is greater than unity, province or state i exports disproportionately more to province or state j Following Miller, Gibson, and Wright (1991), if the TLQ_{ij} index is less than 0.70, a region is very underrepresented; 0.70 to 0.90 indicates that a region is moderately underrepresented; 0.91 to 1.10 means that a region has average representation; 1.11 to 1.30 shows that a region is moderately overrepresented; and greater than 1.30 indicates that a region is highly overrepresented.

Provincial Trade Specialization with Other Provinces and U.S. States

Notable for exports and imports across all provinces is the high degree of trade specialization with other Canadian provinces.[9] This high degree of trade specialization is decreasing with respect to exports, except for those provinces that are geographically close. Consequently, the shifting from an east–west to a north–south trading pattern is only present for distant provinces. The Atlantic provinces and the Territories are largely decreasing their trade specialization in exports with other Canadian provinces, particularly with western and central Canada. With regard to imports, there is far greater provincial variation. Some provinces exhibit notable increases in trade specialization from the other Canadian provinces usually related to geographical proximity; however, in 2001 a high degree of trade specialization in exports and imports still exists between most provinces.

The geographically close U.S. states increased their trade specialization with many Canadian provinces. The trade intensity of those U.S. states close to the Canada–U.S. border has increased for exports and imports. This increased intensity and significant change in the trade specialization of exports and imports are a definite indication of a changed spatial configuration of Canada–U.S. interregional trade.

Reciprocal Trading Regions in Canada and the United States

Determining the Reciprocal Trading Regions

In past research, regional assignment has been undertaken using spatial statistical methods (O'Loughlin and Anselin 1996) and the Intramax method (J. P. Poon 1997; J. P. H. Poon, Thompson, and Kelly 2000). O'Loughlin and Anselin (1996) use two spatial statistical measures to assess the existence of the global triad, one global and one local. Global spatial statistical measures identify clustering (or lack thereof) of international trade for the world as a whole, whereas local spatial statistics identify clusters of international trade in multiple places on the same map. The global measure is Moran's I, a measure of spatial autocorrelation, and

the local measure is the G_i^* statistic of Getis and Ord (1992), one of the local indicators of spatial association (Anselin 1995). The use of spatial statistics is generally appropriate in the analysis of spatial phenomena but is limited because spatial contiguity and cartographic distance are used for the identification of regions. In the context of subnational regions, Allen, Massey, and Cochrane (1998) note that regions are not necessarily spatially contiguous arrangements of economic space. Rather, regions may have holes such that they are not continuous. Consequently, any search for regions in cartographic space places an unnecessary restriction on the identification of trading regions.

The Intramax method (J. P. Poon 1997; J. P. H. Poon, Thompson, and Kelly 2000) does not rely on the strict cartographic relations of contiguity and distance. Rather, it is a clustering algorithm that uses I_{ij} to form trading regions. Intramax is advantageous because it allows data to determine the nature of regional formation: regions are determined endogenously, rather than relying on an a priori designation of regions. Intramax identifies two countries with the greatest intensity of trade, collapses the two countries to form a region, and repeats this process iteratively until all countries are assigned to a region (J. P. H. Poon, Thompson, and Kelly 2000). Masser and Brown (1975) and Fischer et al. (1993) provide more detailed accounts of this algorithm.

The necessity for all countries to be assigned to a region is not explicitly in conflict with the endogenous nature of Intramax, but it is possible that not all countries (or subnational units within one country) are involved in a trading region. This does not mean that these countries (or subnational units) do not trade, only that they are not all necessarily part of a trading region. Also, trade intensity is an important dimension of regional assignment, but intensity on its own may be misleading. J. P. H. Poon, Thompson, and Kelly (2000) identify the first trading region as Ivory Coast and Burkina Faso. The trading relationship between these two countries is indeed intense, but their trade volume is inconsequential in the context of world trade. J. P. H. Poon, Thompson, and Kelly (2000, 431) do note that the absolute volume of trade may "obscure regional patterns because they do not normalize for country size," but this issue is with the measurement of trade intensity; trade volume should not be ignored in regional assignment. Without considering the absolute volume of international trade in regional assignment, J. P. H. Poon, Thompson, and Kelly (2000) assign France and Germany to different trading regions in 1985, despite the fact that these countries had the world's second largest bilateral trading volume that year. France and Germany do have different countries that are highly dependent on trading with them, but any economically meaningful trading region must join France and Germany together because of the magnitude of their trade.

The algorithm used here addresses these limitations while maintaining the strength of the Intramax method: the algorithm is data driven, it is endogenous, and it does not impose a contiguity constraint. To address the issue of all provinces and states being assigned to a trading region, the concept of a reciprocal bilateral trading relationship is invoked. A reciprocal bilateral trading relationship is present if and only if TLQ_{ij} and TLQ_{ji} for the two provinces or states are greater than some predetermined threshold value. This criterion requires that trading partners export disproportionately more to each other. The predetermined threshold value 1.30 is used in the following analysis. This captures highly overrepresented reciprocal bilateral trading relationships, based on the Miller, Gibson, and Wright (1991) classifications for the location quotient. This is followed by a sensitivity analysis that uses 1.20 and 1.10, capturing moderate overrepresentation. Although this sensitivity analysis is not equivalent to the application of a Monte Carlo procedure, it is undertaken to ensure that the results are not sensitive to changes in the critical threshold value.

The condition of reciprocity in interregional trade is important for the determination of a trading region. Suppose Ontario exports to Ohio without reciprocity, Ohio exports to Nevada without reciprocity, and Nevada exports to Ontario without reciprocity. Now suppose that all of these exports are considered "intense." Would it make sense to consider these areas a region? Each province or state may be dependent on another province or state through interregional trade, but to classify this dependence as a trading region is questionable.

After a reciprocal bilateral trading relationship is established, the TLQ_{ij} index is no longer used in the analysis. At this stage, the volume of interregional trade between the two subnational units is incorporated. The reciprocal bilateral trading relationship with the largest volume of interregional trade is designated as a region.

The steps for the iterative regional assignment algorithm are as follows:

1. Calculate the TLQ_{ij} index for each of the sixty-one provinces and states and all of their bilateral trading partners producing a 61×61 matrix of TLQ_{ij} indexes.

2. Using the TLQ_{ij} indexes, identify all reciprocal bilateral trading relationships.
3. Aggregate the trade flows within each reciprocal bilateral trading relationship and rank them by the magnitude of their aggregate trade flows.
4. Classify the largest magnitude aggregate trade flow as a region.
5. Recalculate the TLQ_{ij} indexes treating the region as one spatial unit.
6. Repeat until there are no reciprocal bilateral trading relationships.

This methodology uses relative intensity to establish all of the reciprocal trading regions, incorporating trading volumes into regional assignment. The methodology used here therefore uses relative and absolute measures of interregional trade to establish trading regions. These trading regions are referred to in what follows as reciprocal trading regions. The temporal component of this analysis (1989 and 2001) serves to show any changes in Canada–U.S. trading regions over time.[10]

The clustering method adopted has advantages over simple spatial economic methods such as analyzing trade flow matrices at the subnational level or regression: rather than dealing with fixed spatial boundaries (trade flow matrices) and average tendencies (regression), it considers the bilateral interactions between the subnational units and aggregates them into larger trading regions. In the context of regional formation, working with fixed spatial boundaries prevents any aggregation of spatial units into multilateral trading regions—bilateral trading regions can be identified—unless the trade flow matrices are all recalculated and reanalyzed, a cumbersome exercise. With regard to regression, whether or not Canadian provinces are significantly trading more with U.S. states in 2001 can be statistically tested; however, because regression analysis deals with averages, it cannot be used to form trading regions.

This current method of regional assignment does bias toward forming regions involving economically larger provinces and states because trade volume is one of the criteria for region formation. This bias is in opposition to the bias of the Intramax method toward forming regions with economically smaller (although extremely open) economies. It is possible that the regional assignment algorithm used here excludes some small provinces and states from regions because they do not have sufficiently large trade volumes, although this potential bias is considered less of a concern than the bias found within the Intramax method.

Table 2. Provincial reciprocal trading regions, 2001

		$TLQ_{ij} > 1.30$		
Ontario	British	New Brunswick	Manitoba	Territories
Michigan	Columbia	Maine	Minnesota	Alaska
Quebec	Alberta	Nova Scotia	Wisconsin	
Vermont	Washington	Massachusetts	Iowa	
	Saskatchewan	Newfoundland	Nebraska	
	Montana	Prince Edward	South	
	Wyoming	Island	Dakota	
	North Dakota			
		$TLQ_{ij} > 1.20$		
Ontario	British	New Brunswick	Territories	
Michigan	Columbia	Maine	Alaska	
Quebec	Alberta	Nova Scotia		
Vermont	Washington	Massachusetts		
	Saskatchewan	Newfoundland		
	Manitoba	Prince Edward		
	Montana	Island		
	North Dakota			
	Wyoming			
		$TLQ_{ij} > 1.10$		
Ontario	British	New Brunswick	Territories	
Michigan	Columbia	Maine	Alaska	
Quebec	Alberta	Nova Scotia		
Vermont	Washington	Massachusetts		
	Saskatchewan	Newfoundland		
	Manitoba	Prince Edward		
	Montana	Island		
	North Dakota	New Hampshire		
	Wyoming			

Reciprocal Trading Regions, 1989 and 2001

The reciprocal trading regions involving Canadian provinces have undergone significant changes between 1989 and 2001. The industrial sectors contributing at least 5 percent of the trade within the reciprocal trading regions are reported, but these data are restricted to cross-border trade because of data availability.[11] All reciprocal trading regions are referred to using the first state and province to form the region.

In 1989 there were three reciprocal trading regions, each conforming to the dominant views of the divisions in Canada: western Canada, central Canada, and eastern Canada—see Tables 2 and 3 and Figures 1 through 3 for a list and maps of all the reciprocal trading regions in 1989 and 2001. The Ontario–Michigan reciprocal trading region includes Ontario, Quebec, Michigan, and Vermont. Given the high degree of trade specialization between Ontario and Quebec, Ontario and Michigan, and Quebec and Vermont, the establishment of this reciprocal trading region is no surprise. Trade specialization in this reciprocal trading region is dominated by automotive trade between Michigan and Ontario (64

Table 3. Provincial reciprocal trading regions, 1989

		$TLQ_{ij} > 1.30$	
Ontario	British Columbia	New Brunswick	
Michigan	Alberta	Nova Scotia	
Quebec	Washington	Massachusetts	
Vermont	Saskatchewan	Newfoundland	
	Manitoba	Maine	
	Montana	South Carolina	
	Territories	Prince Edward Island	
		$TLQ_{ij} > 1.20$	
Ontario	British Columbia	New Brunswick	
Michigan	Alberta	Nova Scotia	
Quebec	Washington	Massachusetts	
Manitoba	Saskatchewan	Newfoundland	
Vermont	Montana	Maine	
	Territories	South Carolina	
		Prince Edward Island	
		$TLQ_{ij} > 1.10$	
Ontario	British Columbia	New Brunswick	Saskatchewan
Michigan	Washington	Nova Scotia	Illinois
Quebec	Oregon	Massachusetts	Minnesota
Alberta	Wisconsin	Newfoundland	North Dakota
Manitoba	Territories	Maine	Indiana
Vermont	Montana	South Carolina	Oklahoma
		Prince Edward Island	

percent of all trade in this region), as well as Michigan's trade in the machinery industry (21 percent).

The New Brunswick–Massachusetts reciprocal trading region encompasses all of the Atlantic provinces with Massachusetts, Maine, and South Carolina. The high degree of trade specialization existing in 1989 between the Atlantic provinces, Maine, and Massachusetts is expected, but the inclusion of South Carolina is a curiosity. This curiosity stems from the high degree of paper products traded within the region (16 percent), which is a notable industry in South Carolina. Other well-represented industries include animal agriculture (26 percent); mining, quarrying, and petroleum (29 percent); and plastics and rubber products (13 percent). These goods dominantly flow to and from Massachusetts and Maine.

Finally, the British Columbia–Washington reciprocal trading region includes all of the western provinces, the Territories, Washington, and Montana. All of the western provinces had high degrees of trade specialization in exports to Montana, and British Columbia and Alberta had high degrees of trade specialization in exports to Washington. This reciprocal trading region was the most diverse in terms of industries represented in 1989: animal agriculture (6 percent); mining, quarrying, and petroleum (46 percent); wood products (11 percent); paper products (5 percent); machinery (5 percent); and other transport (8 percent). Although trade in this region is dominated by natural resources, trade outside of these primary industries is notable, particularly for Washington with regard to machinery and other transport (dominated by aircraft and related products). Given the propensity of many researchers to group all of western Canada together, this reciprocal trading region is no surprise. Overall, the findings for the 1989 reciprocal trading regions are far from novel, including all Canadian provinces and only a select few U.S. states. The same cannot be said for the reciprocal trading regions in 2001.

The Ontario–Michigan reciprocal trading region remains intact. Although Ontario and Quebec have decreased their trade specializations in exports and imports since 1989, there is still a high degree of trade specialization between them. The same can be said with regard to Ontario–Michigan and Quebec–Vermont for the trade specialization in imports, but these two province–state combinations increased their trade specialization in exports. Curiously, no new U.S. states have been added to this reciprocal trading region since the establishment of free trade and very little change has occurred in its industrial composition. This lack of new U.S. states in the Ontario–Michigan reciprocal trading region is particularly curious. Most significantly, Ohio is not present, despite its large automotive sector. Also, more southern U.S. states such as Kentucky and Tennessee have intense automotive trade with Ontario, and Alabama, Mississippi, and South Carolina have all recently built automotive assembly capacity. Regardless, this reciprocal trading region maintains its position as the cross-border region with a strong manufacturing base.

The New Brunswick–Massachusetts reciprocal trading region maintains all of its 1989 members, less South Carolina; there is a corresponding drop in paper products trade. Most of these provinces and states increased their trade specializations in exports and imports in 2001. Nova Scotia maintains its high degree of trade specialization in exports to South Carolina, but that specialization is not strong enough to keep South Carolina in the reciprocal trading region in 2001. The industrial composition of trade has changed since 1989: plastics and rubber products have all but disappeared (13 to 1 percent), wood products have risen (3 to 9 percent), and mining, quarrying, and petroleum have increased dramatically (29 to 49 percent). As with the Ontario–Michigan reciprocal trading region, there has not been the addition of U.S. states. This reciprocal

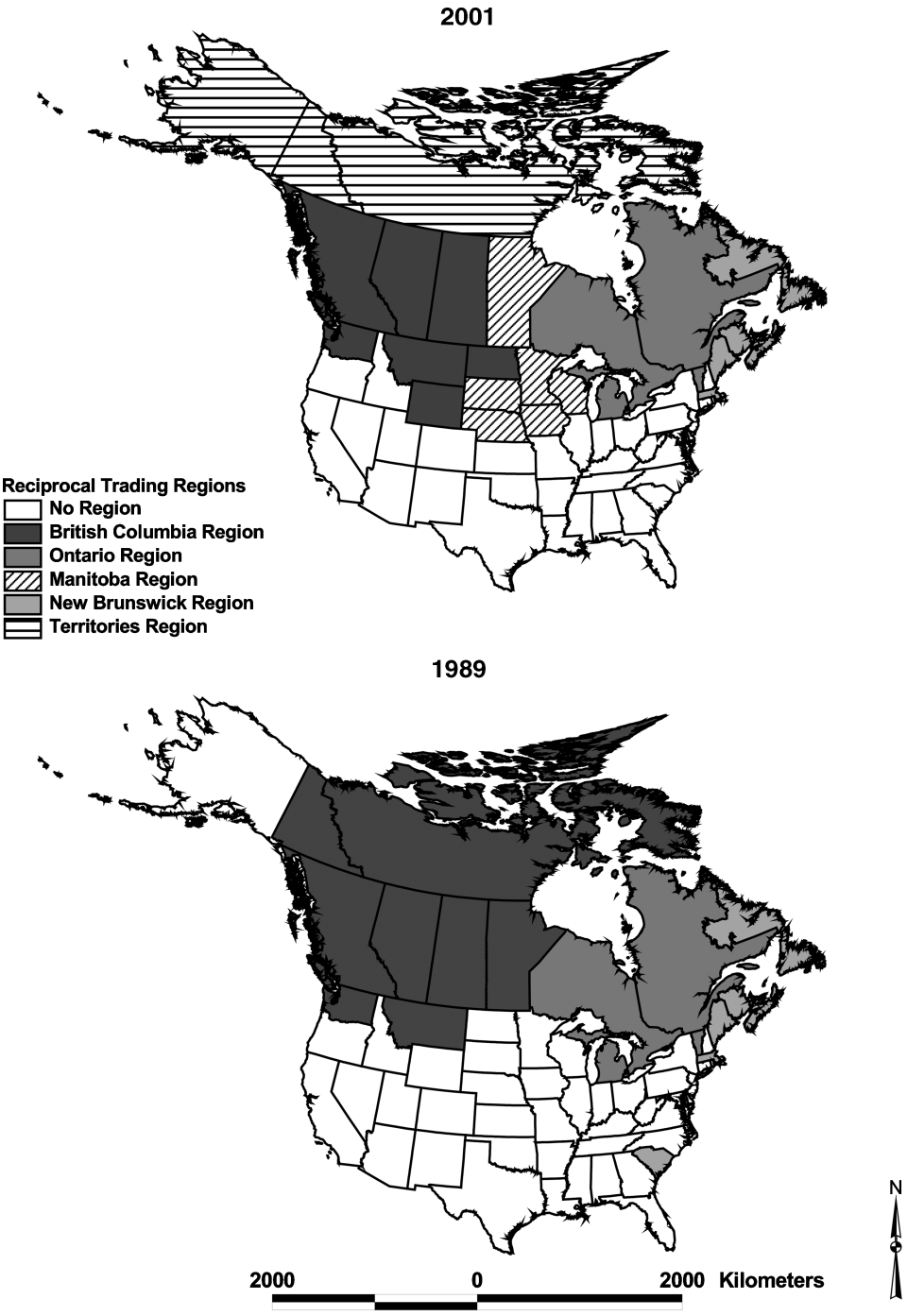

Figure 1. Reciprocal trading regions in Canada and the United States, 2001 and 1989: 1.30 threshold. *Source:* Statistics Canada (1998, 2000, 2004, 2005), calculations by the author.

trading region maintains its position as a resource-based cross-border region.

Western Canada has undergone significant spatial change. The once unified British Columbia–Washington reciprocal trading region, with only two U.S. states, was broken into three reciprocal trading regions by 2001. The Territories separated from the rest of Canada, forming a reciprocal trading region with Alaska that trades in animal agriculture (46 percent) and mining, quarrying, and petroleum (32 percent). British Columbia, Alberta, and Saskatchewan formed a reciprocal trading region with Washington, Montana, Wyoming, and North Dakota. This once diverse reciprocal trading region now trades in mining, quarrying, and petroleum (59 percent) and wood products (7 percent). These changes are notable because Brown (1998) shows trade for western Canada has been a mix of manufacturing and resource industries. Clearly,

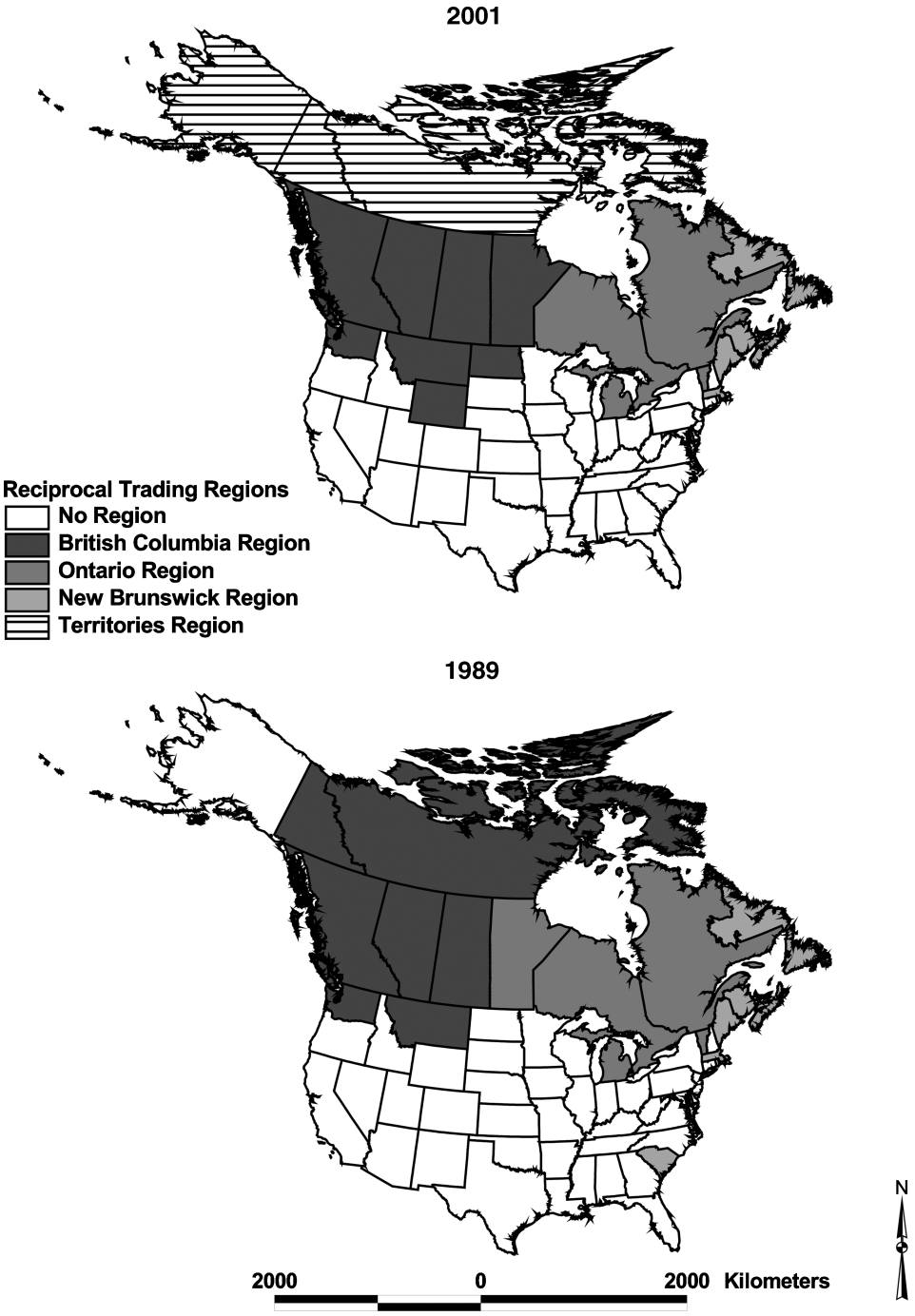

Figure 2. Reciprocal trading regions in Canada and the United States, 2001 and 1989: 1.20 threshold. *Source:* Statistics Canada (1998, 2000, 2004, 2005), calculations by the author.

this portion of western Canada now focuses on the latter.

Manitoba separated itself from Canada, forming a reciprocal trading region with Minnesota, Wisconsin, Iowa, Nebraska, and South Dakota. With six industrial sectors well represented (animal agriculture, 13 percent; mining, quarrying, and petroleum, 14 percent; plastics and rubber products, 5 percent; primary and fabricated metals, 5 percent; nonelectrical machinery, 12 percent; and motor vehicles and parts, 20 percent), the Manitoba–Minnesota reciprocal trading region is the most diversified in 2001. Consequently, the previously stated manufacturing component of western Canada's international trade now resides in Manitoba. Clearly, Manitoba has substituted its intense trading relationships with Canadian provinces with geographically

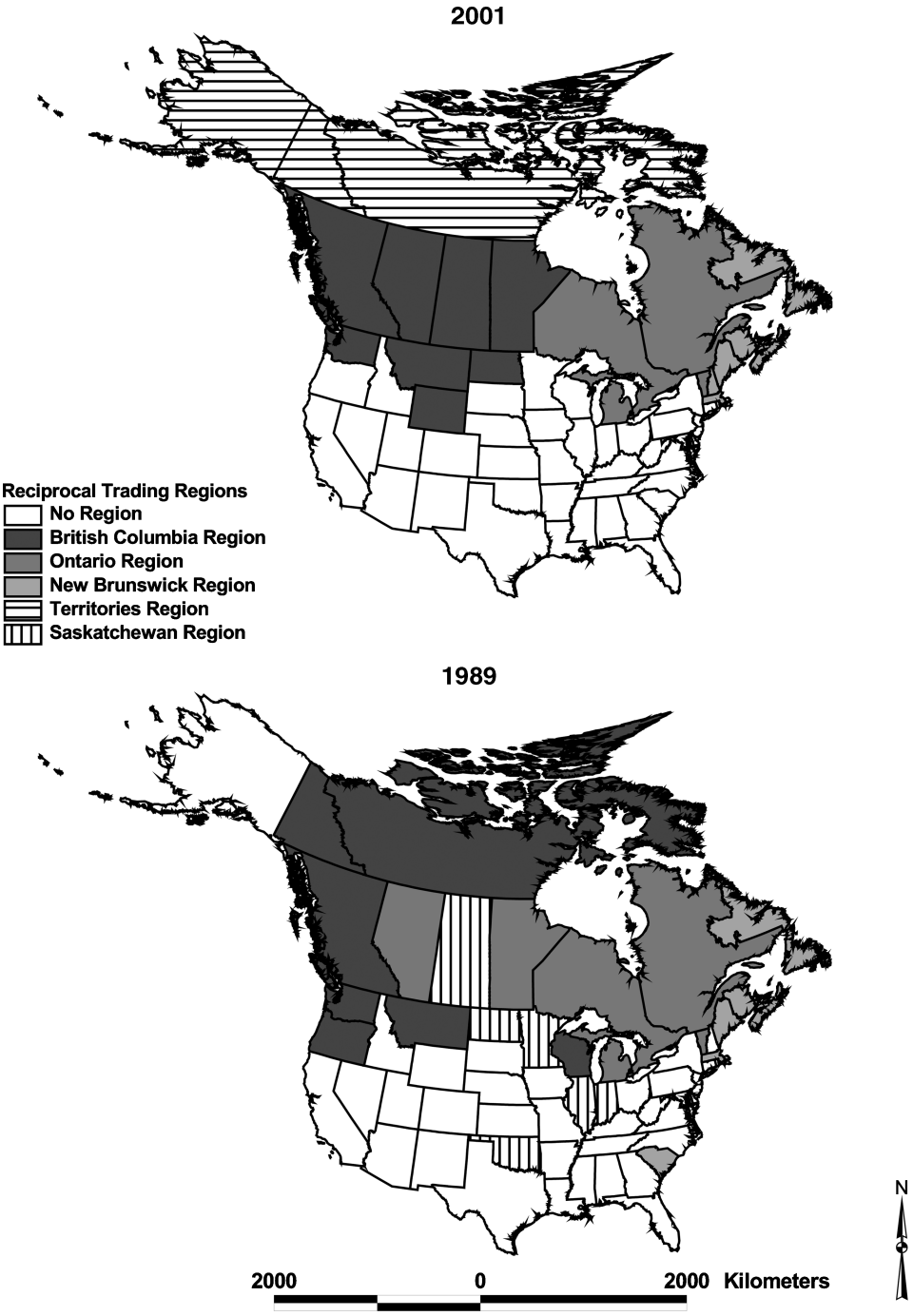

Figure 3. Reciprocal trading regions in Canada and the United States, 2001 and 1989: 1.10 threshold. *Source:* Statistics Canada (1998, 2000, 2004, 2005), calculations by the author.

close U.S. states. The more industrially diverse U.S. states of Wisconsin, Minnesota, and Iowa are geographically closer to Manitoba than their Canadian equivalents, so it is no surprise that such a spatial shift occurred with the recent decreases in (non-)tariff barriers to the United States, as predicted by the revised theoretical prediction.

Sensitivity Analysis

It is possible that the reciprocal trading regions are artifacts of the critical threshold value 1.30. This value is not considered too low—a 30 percent overrepresentation in bilateral trade relations definitely constitutes an intense trading relationship—but it might be too high.

According to the classification of Miller, Gibson, and Wright (1991), a TLQ_{ij} index value greater than 1.10 is considered moderately overrepresented. As such, the lower critical threshold values 1.20 and 1.10 are used to investigate the sensitivity of the regional assignments. All of these thresholds are admittedly arbitrary, but no value less than 1.10 should be considered an intense trading relationship.

Relaxing the critical threshold value to 1.20 alters the reciprocal trading regions in 1989 and 2001, but the interpretation of change is essentially the same. With a critical threshold value of 1.30, Manitoba belongs to the British Columbia–Washington reciprocal trading region in 1989, but to the Ontario–Michigan reciprocal trading region when the critical threshold value is 1.20. Geographically speaking, this change is of little consequence because Manitoba is indeed geographically close to Ontario, the largest provincial economy in Canada. Manitoba's TLQ_{ij} index values for exports and imports are high with Alberta and Saskatchewan, but the volume of trade between Manitoba and Ontario dominates.

With a critical threshold value of 1.20, Manitoba forms a region with the other western provinces in 2001. This change, although representing some sensitivity in the critical threshold values, is instructive in understanding the dynamics of interregional trading patterns within Canada and the United States. Only with the lower critical threshold value does Manitoba join other Canadian provinces in a reciprocal trading region. When the critical threshold value is increased, Manitoba separates itself from all other provinces and forms its own reciprocal trading region with geographically close U.S. states. Therefore, the volume of trade between Manitoba and other Canadian provinces is larger than its volume of trade with the U.S. states, but the intensity of Manitoba's trade is greater with geographically close U.S. states. With time, as Manitoba presumably increases its trading volumes with the U.S. states, the lower critical threshold value will not alter the formation of reciprocal trading regions involving Manitoba.

Further relaxing the critical threshold value to 1.10 alters the reciprocal trading regions in 1989, with no significant changes in 2001. In 1989, the British Columbia–Washington reciprocal trading region gains the U.S. states of Oregon and Wisconsin but loses Alberta to the Ontario–Michigan reciprocal trading region. Although Alberta trades far more intensely with British Columbia than with Ontario, the sheer volume of trade with Ontario dominates once the reciprocal trading relationships are established. Saskatchewan now forms a reciprocal trading region of its own with five U.S. states. Saskatchewan does have a high degree of trade intensity with North Dakota, in particular, and Minnesota, but the other U.S. states in Saskatchewan's reciprocal trading region have low or average trade intensity with Saskatchewan; Illinois does have large trade volumes. This is a clear case of a critical threshold value that is too low.

This outcome clearly indicates the need to consider relative (trade intensity) and absolute (trade volumes) measures when undertaking regional assignment. If the relative measure has too low a threshold, the absolute measure will dominate, generating curious results. If the relative measure has too high a threshold, no regional assignment takes place. Overall, there is more consistency across the sets of reciprocal trading regions than not. The general pattern is an increase in the number of reciprocal trading regions with those regions including more U.S. states that are geographically close. Rather than Canada consisting of three reciprocal trading regions in 1989, the country is now made up of four reciprocal trading regions with the fifth (involving Manitoba) becoming well defined by 2001.

Discussion

The new economic geography predicts that Canadian exports will fall and imports will rise because Canadian firms will locate in the larger U.S. economy to take advantage of decreased transportation costs, whereas regionally based comparative advantage predicts that exports and imports will rise, particularly for geographically close regions. As noted earlier, because of complications, these theoretical predictions may not be revealed in the analysis. Rather, a revised expectation was generated that is consistent with both theories: to minimize transportation costs in the presence of complications, decreased tariffs lead to a spatial reconfiguration of trading partners that favors geographically close regions (provinces and states).

Understanding the Nature of the Reciprocal Trading Regions

The revised expectation's utility is immediately present in this analysis. As shown in Table 1, Canadian exports increased more than U.S. imports at the national and (most) industrial levels of aggregation—Canadian exports increased in all cases. As such, agglomeration in the larger economy (the United States)

and the corresponding exports back to the smaller economy (Canada) to replace production simply did not occur. The regionally based comparative advantage prediction of geographically close regions being affected more than geographically distant regions did emerge, but the shift did not occur uniformly; it only occurred in the west. Therefore, the changed spatial configuration of trading patterns presented earlier conforms well to the revised theoretical prediction.

One unexpected result is that central and eastern Canada essentially have no change in their reciprocal trading regions since the establishment of free trade with the United States. The shifting of the spatial pattern of trade from an east–west to a north–south configuration has occurred but not in the trading regions east of Manitoba. Also, western Canada has now fragmented into three separate reciprocal trading regions. Although it might not be a surprise that western Canada has a greater focus on trade with the United States, it is the only portion of Canada that has undertaken such a change. Consequently, it should no longer be considered a cohesive economic region of Canada as it has been in the past.

The question that remains is this: why do particular regions of Canada exhibit much more change than others? In the past, the higher tariffs that provinces faced when trading with the United States fostered interprovincial trade because smaller, although significant, interprovincial trade barriers presented a lower cost (Loizides and Grant 1992; Doern and MacDonald 1999). Once tariff barriers were reduced to levels lower than those impeding interprovincial trade, however, it was expected that Canadian provinces would trade differently. The reason this change in the spatial pattern of trade has not occurred is evident when considering the provincial tariff rates.

As shown in Table 4, the magnitude of the provincial tariff rate exhibits a decreasing west-to-east pattern in 1989 with little variation in 2001 (New Brunswick is the only exception). These provincial tariff rates represent the barriers to the U.S. market for each province at the establishment of free trade, so it is expected that the further east a province is, the less it will adjust its trading patterns in response to tariff rate decreases. This is precisely what occurred. As such, the curiosities stated earlier can be understood when one considers and calculates provincial barriers to the U.S. market. The fragmentation of western Canada can also be understood with reference to theoretical predictions. Given that geographic proximity is important to regional assignment once barriers to the U.S. market are low, provinces should substitute distant provinces for close states. The principal cities in Manitoba and the Territories are, on average, close to 2,500 km from Vancouver, British Columbia, whereas Vancouver, British Columbia, is less than 250 km from Seattle, Washington. Washington is in a reciprocal trading region with British Columbia in both years, but this example illustrates the predictions well.

With central and eastern Canada having such low provincial tariff rates at the inception of free trade it is no wonder that subsequent lowering of those tariffs had little impact on trading patterns. Western Canadian provinces faced much higher barriers to the U.S. market at the inception of free trade and adjusted their trading patterns accordingly: the Territories are now in a reciprocal trading region with Alaska; British Columbia, Alberta, and Saskatchewan are in a reciprocal trading region with their geographically close U.S. states; and Manitoba has separated itself from other provinces to form a reciprocal trading region with its geographically close U.S. states. This adjustment is even more apparent when considering the industrial composition of Canadian provincial exports to the United States.

Table 5 shows the top three industrial sectors, based on the volume of exports to the United States, for each province in 1989 and 2001. Although most of the changes in the industrial composition of trade are not drastic, the provinces most active in altering the industrial nature of their trade with the United States are the western Canadian provinces, particularly the Territories. New Brunswick also has some notable changes in its industrial composition. At the other end of the

Table 4. Provincial barriers to U.S. market, effective tariff rates

	1989	2001
British Columbia	3.36	0.12
Alberta	3.58	0.26
Saskatchewan	2.49	0.09
Manitoba	2.85	0.14
Territories	2.92	0.04
Ontario	2.42	0.09
Quebec	2.72	0.14
New Brunswick	3.18	0.08
Nova Scotia	2.04	0.40
Prince Edward Island	1.07	1.27
Newfoundland	1.93	0.50

Source: Statistics Canada (2004), calculations by the author.

Table 5. Top-ranked provincial export shares to the United States

	Rank, 1989			Rank, 2001		
Province	1	2	3	1	2	3
British Columbia	Wood products (38)	Paper products (24)	Primary and fabricated metals (9)	Wood products (30)	Mining, quarrying, and petroleum (23)	Paper products (11)
Alberta	Mining, quarrying, and petroleum (70)	Chemicals (6)	Animal agriculture (4)	Mining, quarrying, and petroleum (73)	Electrical machinery (5)	Animal agriculture (5)
Saskatchewan	Mining, quarrying, and petroleum (38)	Chemicals (31)	Paper products (9)	Mining, quarrying, and petroleum (41)	Chemicals (22)	Vegetable agriculture (9)
Manitoba	Primary and fabricated metals (20)	Nonelectrical machinery (17)	Motor vehicles and parts (12)	Mining, quarrying, and petroleum (18)	Animal agriculture (11)	Motor vehicles and parts (9)
Ontario	Motor vehicles and parts (49)	Nonelectrical machinery (13)	Primary and fabricated metals (9)	Motor vehicles and parts (44)	Nonelectrical machinery (13)	Primary and fabricated metals (6)
Quebec	Paper products (20)	Primary and fabricated metals (19)	Motor vehicles and parts (14)	Primary and fabricated metals (14)	Other transport (13)	Paper products (12)
New Brunswick	Paper products (36)	Mining, quarrying, and petroleum (34)	Wood products (7)	Mining, quarrying, and petroleum (49)	Paper products (16)	Wood products (12)
Nova Scotia	Animal agriculture (29)	Plastics and rubber products (27)	Paper products (23)	Mining, quarrying, and petroleum (30)	Plastics and rubber products (19)	Animal agriculture (16)
Prince Edward Island	Food (34)	Vegetable agriculture (27)	Animal agriculture (26)	Food (51)	Animal agriculture (25)	Nonelectrical machinery (9)
Newfoundland	Mining, quarrying, and petroleum (61)	Animal agriculture (28)	Paper products (9)	Mining, quarrying, and petroleum (60)	Animal agriculture (18)	Paper products (16)
Territories	Nonelectrical machinery (65)	Other (11)	Primary and fabricated metals (10)	Nonmetallic mineral products (42)	Wood products (16)	Other (10)

Note: Values in parentheses are trade shares.
Source: Statistics Canada (2004), calculations by the author.

scale is Ontario. Although Ontario does not have the lowest provincial tariff rate, the industrial composition of its trade with the United States is virtually unchanged.

A cautionary note is necessary regarding the nature of the reciprocal trading regions. Throughout this analysis it is assumed that decreased tariff barriers from the CUFTA and NAFTA are responsible for the changing spatial trading relationships. This assumption has been invoked because decreased tariffs are the primary outcome of free trade and are an important component in the theoretical frameworks discussed here. Other factors that may impact spatial trading patterns, however, are not controlled for when making these statements: the NAFTA altered domestic content requirements in the automotive trade that may have prevented the Ontario–Michigan reciprocal trading region from expanding further south, and the automotive industry experienced significant structural adjustment that predates either of the free trade agreements. To seek out labor markets outside of the traditional manufacturing sites of Michigan and Ontario, new production facilities located in the "transplant corridor" that extends south to Tennessee (Holmes 1996; Dicken 2003, 392), and more recently to Alabama, Mississippi, and South Carolina. Although this did not have an impact on the reciprocal trading region involving Michigan and Ontario, such changes may be occurring in other areas of the United States and Canada.

Additionally, the economic base of provincial economies may affect regional trade patterns and the degree to which change occurs in those patterns over time. As shown by Clapp (1998), the resource cycle can significantly alter the economic base of an economy; see Barnes, Hayter, and Hay (2001) for another discussion of how an economy based on resources can be altered. In the case of the resource cycle, once a resource is depleted and an economy alters its economic base to survive, it is no surprise that trading patterns change. Although resource-based eastern Canada exhibited little change, the manufacturing base in central Canada is less susceptible to changes in its economic base than is western Canada, potentially explaining why western Canada exhibited the most change. The analysis of provincial tariff rates gives credence to the assumption that the CUFTA and NAFTA are primary factors in the changed spatial trading patterns, but further research is necessary to evaluate these alternative explanations.

Finally, these explanations relate back to the inertia and historical contingencies of (cross-border) regions. Western Canada is far from being a new geopolitical phenomenon, but eastern and central Canada have longer (trading) relationships with the United States. Networks have been shown to be important for international trade (Rauch 1999), so this longer history in central and eastern Canada may be well entrenched in their corresponding cultures such that the establishment of free trade only enhanced preexisting networks. Western Canada may have had the highest tariffs but also a lesser degree of trading networks—less inertia to maintain pre-free-trade regions. Reduction in trade barriers has the direct effect of lowering economic barriers as well as the indirect effect of lowering social, cultural, and political trade barriers, allowing for the establishment of new trading networks. In short, change in trade barriers and locational factors are likely not the only dimensions at work with these changing reciprocal trading regions.

Policy Implications

These reciprocal trading regions are likely to continue adjusting to the new economic space set out in the CUFTA and the NAFTA, but these agreements are written so there is little that policy can do to change their current and future effects. Although this statement may be true, Canada and the United States are most likely moving toward further economic integration in the future.

Gilbert (2005) denies the inevitability of further economic integration between Canada and the United States, but a deeper economic relationship has been discussed for some time and has become a concern because of recent political events. Courchene and Harris (1999) and Grubel (1999) argue for the creation of a monetary union between Canada and the United States to decrease the costs of trade, eliminating exchange rate variability. With the large increases in international trade since the CUFTA (Trefler 2004), such a proposal seems to be a "natural" next step. Despite further integration not being a political issue currently (R. G. Harris, personal communication, 19 February 2007), the recent terrorist attacks on the United States have prompted Canadian business representatives to call for further economic integration (Gilbert 2005).

The reasoning for this call for further economic integration is a familiar concern for Canada: access to the U.S. market. Increased border security leads to increased costs of trade through increased delays, paperwork, and so on. Consequently, Canada is in a similar

position as it was in the early 1980s and the early 1990s. Moving production from one industry to another (a possible consequence of further economic integration) necessarily involves economic restructuring that has implications for jobs, wages, and economic welfare. Additionally, if the theoretical predications of the new economic geography are correct (agglomeration of production in the larger economy), further integration that allows freer movement of labor and capital may involve significantly greater economic restructuring depending on the relative strengths of the remaining complications for those theoretical predictions, such as physical geography and transportation networks. Although Trefler (2004) shows that the long-term benefits of the CUFTA outweigh the short-term adjustment costs, this might not be the case if the regional dynamics of trade are not considered in further economic integration. The geographical effects of such agreements, and the resulting reciprocal trading regions, must be considered in any further integration to minimize the adjustment costs to state and provincial economies.

Conclusion

Previous research on trade specialization and the formation of trading regions has focused on national units of analysis. This article, in contrast, focuses on these phenomena at the subnational scale for Canada and the United States. The measurement of trade specialization meaningfully incorporates economic size and the regional assignment algorithm addresses previous limitations while maintaining strengths.

The analysis of trade specialization for exports and imports shows the utility of using provincial and state boundaries as the initial units of analysis. Although geographically close provinces exhibit similarities with their trade specializations in exports and imports, there are marked differences that would go unnoticed if individual provinces and states were aggregated to larger regions. Canadian provinces almost always maintain high degrees of trade specialization in exports and imports with each other, and that degree of trade specialization decreases as the distance between the provinces increases. The trade specialization of Canadian provinces with U.S. states for exports and imports is strongly related to geographic proximity: once (non-)tariff barriers to the United States were lower than internal barriers, Canadian provinces minimized transportation costs through trade with geographically close U.S. states. Trade intensity clustering with the U.S. states close to the border increased from 1989 to 2001.

These changing trade specializations in exports and imports altered the spatial configuration of reciprocal trading relationships. Decreased tariffs between Canadian provinces and U.S. states increased market access for Canadian provinces. Whereas once there were lower barriers to trade at an interprovincial level, now those barriers are lower at the international level. Consequently, the reciprocal trading regions involving Canadian provinces reoriented themselves toward the United States. In western Canada, this has led to more reciprocal trading regions, each with fewer Canadian provinces and more U.S. states.

Acknowledgment

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Notes

1. This positive relationship between economic growth and international trade is not new; however, this more recent reference deals with methodological criticisms of previous research. It should also be noted that although increased international trade may have positive impacts on the well-being of a nation, those benefits may very well be unevenly distributed such that some lose from free trade while others gain. The economic argument here is that the "winners" can compensate the "losers." Whether they do so is another issue altogether.
2. There was also the cost savings that emerged from the relatively low value of the Canadian dollar. This advantage, however, has recently disappeared.
3. See Anastakis (2005) for a discussion of how the Auto Pact represented an alternative to the two extremes of free trade and protectionism that were debated at that time.
4. The issue of Canada's trade dependency on the United States is hotly debated in the political economy literature. This dependency is generally not considered a positive aspect of Canada's international activity. In response to this trade dependency, the Canadian government has attempted to diversify Canada's trade portfolio since the 1980s with little success.
5. Mexico initiated negotiations for what was to become the NAFTA but only with the United States. Canada

initiated its own involvement after it learned about the Mexico–U.S. negotiations.
6. Appendix, listing these industrial sectors and their corresponding HTS codes, is provided.
7. Provincial GDP is obtained from Statistics Canada (2005) and U.S. state GDP is obtained from the U.S. Bureau of Economic Analysis.
8. Region *j* may be a country.
9. The detailed tables of the TLQ indexes are not included for brevity but are available from the author.
10. As mentioned earlier, 1989 and 2001 are analyzed because they have the earliest and latest high-quality data available. It is important to note that these years are at similar points in the Canadian business cycle, either at or near the bottom of the trough. Consequently, the changes in regions reported here are not expected to be the result of vastly different economic conditions in the years under analysis.
11. Detailed tables are available from the author.

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Appendix. Definitions of industrial sectors, by two-digit Harmonized Tariff Schedule code

Industrial sector	Two-digit Harmonized Tariff Schedule code
Animal agriculture	01, 02, 03, 04, 05
Vegetable agriculture	06, 07, 08, 09, 10, 11, 12, 13, 14
Food	15, 16, 17, 18, 19, 20, 21
Beverages and tobacco	22, 23, 24
Mining, quarrying, and petroleum	25, 26, 27
Chemicals	28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38
Plastics and rubber products	39, 40
Wood products	44, 45, 46
Paper products	47, 48
Printing and publishing	49
Leather	41, 42, 43
Textiles	50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60
Clothing	61, 62, 63, 64, 65, 66, 67
Nonmetallic mineral products	68, 69, 70, 71
Basic metals and fabricated metals products	72, 73, 74, 75, 76, 78, 79, 80, 81, 82, 83
Nonelectrical machinery	84
Electrical machinery	85
Motor vehicles and parts	87
Other transport equipment	86, 88, 89
Professional goods	90, 91, 92
Other industries	93, 94, 95, 96, 97

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