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The Paul Storer Memorial Lecture—Cross-Border Trade Integration and Monetary Policy



by Stephen S. Poloz

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Abstract

In this paper we explore the nexus between cross-border trade integration and monetary policy. We first review the evidence that trade liberalization has increased the degree of integration in North America and conclude that, while robust structural inferences remain elusive, there is sufficient supporting evidence for central banks to treat the issue seriously. The paper then discusses several channels by which increased integration might affect macroeconomic models. We introduce modifications to the Bank of Canada's main policy model, ToTEM, to capture some of the impacts of integration suggested in the literature and generate stochastic simulations to compare versions of the model with low and high integration. The main conclusion is that increased integration may make it more challenging for central banks to control inflation, in the sense that doing so will require more variability in interest rates, exchange rates and the output gap.

JEL classification: E37, E5, F1, F41, F6

Bank classification: Economic Models; Monetary Policy; Trade Integration

Résumé

Dans le présent document, nous étudions le lien entre l'intégration du commerce transfrontalier et la politique monétaire. Nous examinons d'abord les indications d'un accroissement du degré d'intégration en Amérique du Nord induit par la libéralisation des échanges et concluons que, si des inférences structurelles robustes restent difficiles à cerner, la preuve recueillie est suffisante pour inciter les banques centrales à prendre la question au sérieux. Puis, nous décrivons plusieurs canaux par lesquels l'intégration accrue peut se répercuter sur les modèles macroéconomiques. Nous donnons un aperçu des modifications apportées à TOTEM, le principal modèle macroéconomique de la Banque du Canada, pour tenir compte de certains des effets de l'intégration mentionnés dans la littérature, puis générons des stimulations stochastiques pour comparer des versions du modèle comportant un degré d'intégration faible ou élevé. La conclusion principale est que l'intégration accrue pourrait compliquer la tâche des banques centrales lorsqu'il s'agit de maîtriser l'inflation, car une plus grande variabilité des taux d'intérêt, des taux de change et de l'écart de production serait alors nécessaire.

Codes JEL : E37, E5, F1, F41, F6

Classification de la Banque : Modèles économiques, Politique monétaire, Intégration des échanges

Introduction

Paul Storer was a special fellow. We met back in 1984 when he was fresh out of the Master's program at the University of Toronto, and I was fortunate that he chose to accept an appointment in my group at the Bank of Canada. I know I helped influence his decision to go back to school three years later for his PhD, and his choice of the University of Western Ontario, now known somewhat ironically as Western University. While he was there, I was able to visit him from time to time, and it was a pleasure watching him grow.

Sincere, dedicated, thoughtful, skeptical—these are some of the words I would readily use to describe Paul. But most importantly, he was a very nice person, highly likeable and a joy to work with. It never seems fair when we lose someone like Paul, but, to me, this loss seems especially so, for we barely managed to stay in touch after he and his wife Tina moved to Bellingham. Email from time to time, and a beer or dinner when he and Tina were in Ottawa, it was always great to catch up, and now I treasure those memories even more.

I'm very touched to have been invited to give today's lecture in Paul's memory, and I wanted badly to do something that Paul would have appreciated. Fortunately, Paul had wide-ranging research interests, so I had a lot to choose from. But he had clearly settled onto Canada–US relations, particularly trade issues, as a core interest. And, his first full-time job was in monetary policy. So, today I have chosen to explore an issue he cared about deeply—cross-border trade integration—and to do so through the lens of a monetary policy practitioner.

Let me offer a quick sketch of my narrative. Paul had a strong interest in whether the trade liberalization of the Canada-US Free Trade Agreement (CUSFTA), and the later move to NAFTA, had actually led to increased integration of our two economies. His work, often with Steven Globerman (see, for example, Globerman and Storer 2004), finds little definitive evidence of increased integration of the Canada-US economies in the wake of either CUSFTA or NAFTA. This seems to be the case whether you investigate trade flows, investment flows, labour mobility, or the convergence in prices or factor input prices.

At the same time, some of their findings suggest that the issue may be too complex and the demands on the data too great to support rigorous empirical inference. In particular, there are some large shifts in trade patterns at the sectoral level, suggestive of increased specialization and more trade in components—in short, “supply chaining.” Moreover, as Globerman and Storer themselves observed, periodic significant fluctuations in the Canada–US exchange rate, combined with a degree of domestic price stickiness, are likely to pose challenges for empirical work around integration.

In what follows I will build on some of those observations and argue that there is more (albeit soft) evidence of increased trade integration when the definition of trade is broadened to embrace all the dimensions of international business. This includes widespread supply chaining and the establishment of foreign affiliates selling directly to host markets or third markets; in other words, globalization in its various forms. Indeed, it is important not to restrict attention to the three NAFTA partner countries, since additional countries (for example, China) may be important facilitators of integration within North America. Statistical agencies are still catching up to these business trends, so, by necessity, much of the evidence we will bring to the matter will be indirect. We make no rigorous empirical claims, especially related to the effects of specific trade agreements, but suggest that the evidence of increased integration is sufficient for monetary policy to take it seriously.

This issue intersects with monetary policy along at least two dimensions. First, monetary policy formulation depends heavily on empirical economic models, and the evolution of international business is certain to have consequences for model structure and for key model parameters. For example, domestic inflation may come to be driven more by global demand and supply, and less by domestic forces. As well, the effects of fluctuations in domestic interest rates and exchange rates on the domestic economy may diminish as economies become more integrated.

The second dimension relates to monetary policy strategy, including both the appropriate choice of target for the central bank to aim at and the time horizon over which it should attempt to exert control. In attempting to smooth real economic fluctuations—with the goal of achieving an inflation target—the central bank creates interest rate and exchange rate fluctuations. These fluctuations may need to be greater in a world where increased cross-border integration has weakened some of the key macroeconomic linkages relied upon by central banks. These shifting trade-offs need to be well understood in order to frame appropriate policy choices. We will explore these policy issues using a state-of-the-art macro model of the Canadian economy.

Trade Evolution and Economic Integration

We begin by describing the various ways in which trade has evolved in North America during the past 30 years. The concept of “trade penetration” is one useful proxy for the importance of international trade for the domestic economy since it goes beyond the traditional concept of exports. We use a country’s nominal exports plus its imports as a share of nominal GDP to measure the importance or “penetration” of trade into domestic value creation, focusing on trade in goods for convenience. In a globalized world, where production processes are often geographically fragmented, the competitiveness of a country’s exports depends increasingly on inputs imported from other countries, since that facilitates the division of labour between lower-wage and higher-wage workers. Clearly, this fragmentation boosts international trade for a given level of GDP. In effect, we trade parts, and then we trade the final products, which

implicitly means trading the parts again (Hummels, Ishi and Kei-Mu 2001; Yi 2003; Chen, Kondratowicz and Kei-Mu 2005).

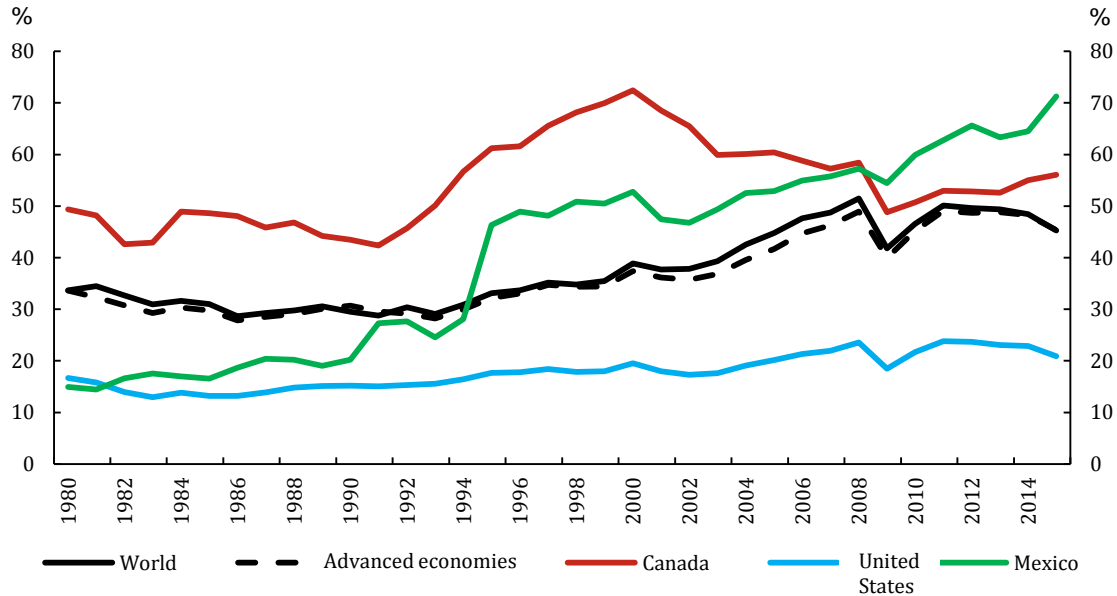
Chart 1 offers some data on trade penetration of goods for the world and for the three NAFTA economies. At the global level, trade penetration rose steadily from the early 1990s through to the collapse in trade after the global financial crisis in 2007–08. There was a recovery in trade penetration after the ensuing global recession, but since 2010 total trade has been flat or even declining slightly in importance to global GDP.

The weakness of global trade growth in the past few years has attracted considerable attention (Francis and Morel 2015; Poloz 2016). A key reason seems to be that globalization has happened in waves that cannot be expected to be repeated. Early development of global value chains (GVCs) was mainly the product of technological improvements and falling tariffs and other costs, such as transportation and logistical support costs. GVC development received a major boost when China joined the World Trade Organization (WTO), which, again, can only happen once (Ferrantino and Taglioni 2014; Constantinescu, Matoo and Ruta 2015). A second reason is that the world has entered a phase of subdued business investment because of the weight of post-crisis uncertainty, and investment spending is a very trade-intensive activity. Accordingly, soft investment has a disproportionate effect on global trade flows (Morel 2015). A third reason, offered by Stratford (2015), is that emerging markets generally have lower import elasticities than advanced economies; consequently, as the relative contribution of emerging economies to global GDP growth rises, the global income elasticity of trade has been declining. It is therefore reasonable to expect global trade to pick up as the world economy gathers momentum; but it seems less likely to exceed global GDP growth to the same extent as in the past.

This global pattern in trade penetration has been mimicked by the US economy. Canada and Mexico have had different experiences, however. Mexico has seen a steady rise in trade penetration for more than 30 years, with a big acceleration coming on the heels of NAFTA in 1994. There was a minor decline in trade in the wake of the global financial crisis, but the uptrend resumed right afterward. In contrast, Canada saw no rise in trade penetration in the immediate aftermath of CUSFTA in 1988 (indeed, trade penetration was in a downtrend) but then saw a rapid rise in trade penetration from 1991–2000. NAFTA may have contributed to this rise after 1994, but the fact that much of the 1990s increase in trade penetration was unwound during the following decade suggests that other forces may have been at work. One contributing factor was the global telecom boom and subsequent bust, in which certain Canadian companies were active participants. Another was the steady appreciation of the Canadian dollar from 2002 to 2008, and its persistent strength in the aftermath of the global financial crisis. This resilience was mainly the product of high oil prices, which led to considerable restructuring in many export sectors, including automobiles and forestry products, and the outright exit of large numbers of exporting companies. The US business cycle was

also a contributor. Since 2010, a modest uptrend in trade penetration has resumed in Canada.

Chart 1: Evolution of the trade penetration of North American countries
Nominal merchandise imports and exports as a share of GDP, annual, 1980–2015



Sources: International Monetary Fund, Haver Analytics and Bank of Canada calculations

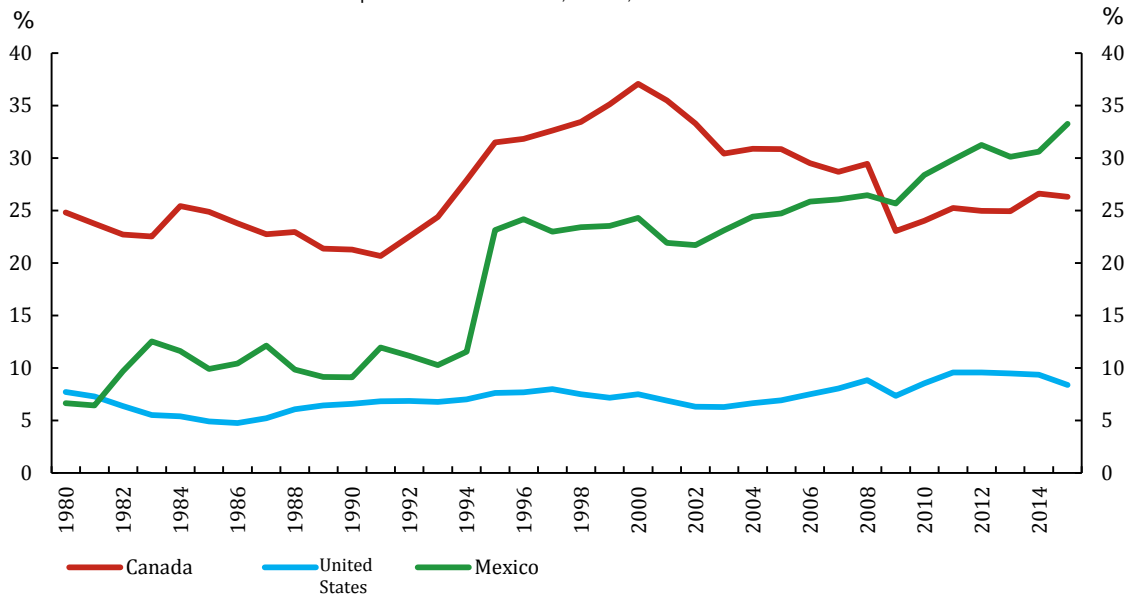
Last observation: 2015

By this simple measure then, one would conclude that the three NAFTA countries have become more integrated with the global economy during the past 30 years, especially Mexico. The latter observation fits one’s priors that smaller countries tend to have the most to gain from trade liberalization. It is also consistent with empirical evidence in Romalis (2007), showing that export volumes between these countries increased significantly because of NAFTA. See also Caliendo and Parro (2015), who develop a calibrated model suggesting that NAFTA augmented intra–North American trade by 118 per cent for Mexico, 41 per cent for the United States, and 11 per cent for Canada.

The implications of these trends for goods exports in the three NAFTA economies are illustrated in Chart 2. Exports as a share of GDP have almost doubled in the United States in the past 30 years but have been showing weakness recently. Mexico has seen a steady rise in exporting, particularly in the wake of NAFTA, and today has an export-to-GDP ratio approaching 35 per cent. In contrast, the export sector trauma of the 2000s has taken Canada’s export-to-GDP ratio from a high of 37 per cent to about 26 per cent—albeit resuming a modest uptrend—today.

Chart 2: North American exports as share of GDP

Nominal total merchandise exports as a share of GDP, annual, 1980–2015



Sources: International Monetary Fund, Haver Analytics and Bank of Canada calculations

Last observation: 2015

The concept of total trade penetration embodies the idea that countries trade not just in final goods but in the components that go into them. Indeed, this is the essence of the benefits of globalization. A given product can be fragmented into various components, some of which require highly skilled, highly paid workers and some which can be mass produced at low cost in lower-wage locations. Trade connects these fragments together into GVCs and permits better matching between skills and products and therefore lower overall costs and higher productivity. GVCs clearly boost conventional trade statistics for a given unit of GDP and make interpretation of those statistics more difficult.

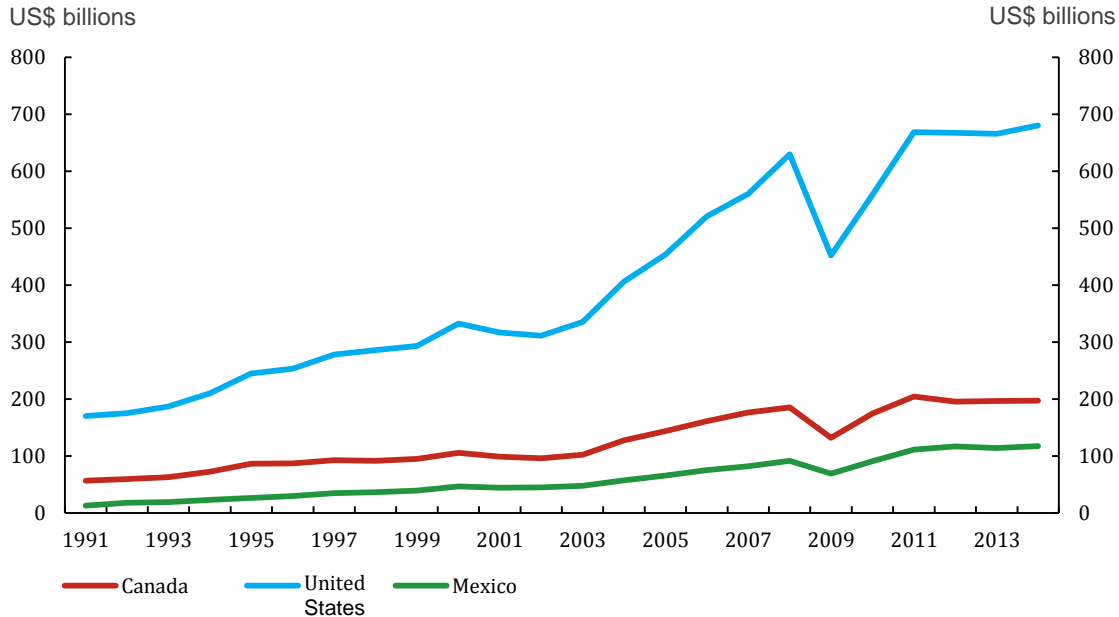
One way to tackle this issue and gain insight into the degree of cross-border integration is to examine the flow of intermediate goods between countries. After all, consumers are not interested in intermediate goods, only the finished product. Trade in intermediate goods is, therefore, business to business and productivity-enhancing. Chart 3 shows the trends in global trade in intermediate goods for the NAFTA countries.

These data show that there has been a strong tendency for trade in intermediate goods to grow in all three countries. While all three have seen an uptrend since NAFTA, the large acceleration after 2000 suggests that the bigger influence may have been China's accession to the WTO. The level of intermediate goods trade for the United States dwarfs that for Canada and Mexico by factors of four and seven, respectively. The importance of intermediate goods trade to the US economy is consistent with its role as a global hub for multinational enterprises (MNEs) that develop GVCs spanning multiple countries, including its NAFTA partners. Although it would be difficult to disentangle

these data, they are at least consistent with a rising degree of North American integration over the past 20 years.

Chart 3: Global trade in intermediate goods by NAFTA countries

Total trade (imports and exports) of intermediate goods, annual, 1991–2014



Sources: World Integrated Trade Solution and Bank of Canada calculations

Last observation: 2014

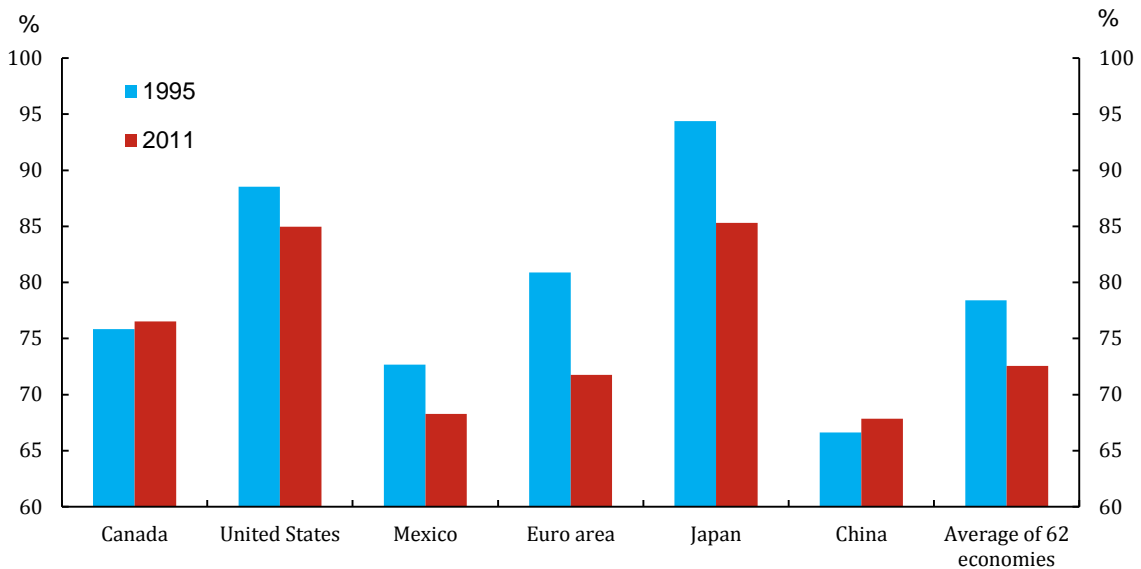
Trade in intermediate goods goes far beyond refined raw materials or minor parts to include full subsystems. Trade in automobiles provides an illustration: a very large portion of the total value added in an automobile comes from the parts and subsystems made by manufacturers in the supply chain, whether they are building engines, transmissions, electronic systems or even glass. Final assembly of vehicles is in fact a relatively low value-added activity today—amounting to well under 10 per cent of the final value of the automobile—with much more value added embedded in the parts and subsystems made by suppliers. Aircraft manufacturing is broadly similar in this respect.

Supply-chain trade often happens within the same firm, the trade-facilitated version of vertical integration. Thus, the MNE creates (or purchases) entities that supply it, thereby increasing reliability, maximizing efficiency and perhaps internalizing the value added (and profitability) that lies in the supply chain. Such arrangements are very clear in the manufacturing sector of the NAFTA countries. For the United States, some 40 per cent of manufactured exports to Canada are intra-firm, and about 50 per cent of imports from Canada are also intra-firm. Similarly, around 40 per cent of US manufactured exports to Mexico are intra-firm, but a much higher proportion of US imports from Mexico—70 per cent—are intra-firm. These data point to a very high level of cross-border integration, at least in certain manufacturing sectors, including automobiles, aerospace and telecommunications equipment.

As noted earlier, trade through a value chain creates some double-counting, or perhaps more appropriately multi-counting, of trade flows, because the same items cross borders more than once. Consider a mobile phone, designed and engineered in one country, assembled in another country from components produced in several other supplier countries and then sold to the entire world. Even in this relatively simple example, parts of the phone cross borders more than once, and each time that value is recorded as someone’s export. What this means is that any change in the structure of global value chains can either inflate or depress normal “gross” trade flows.

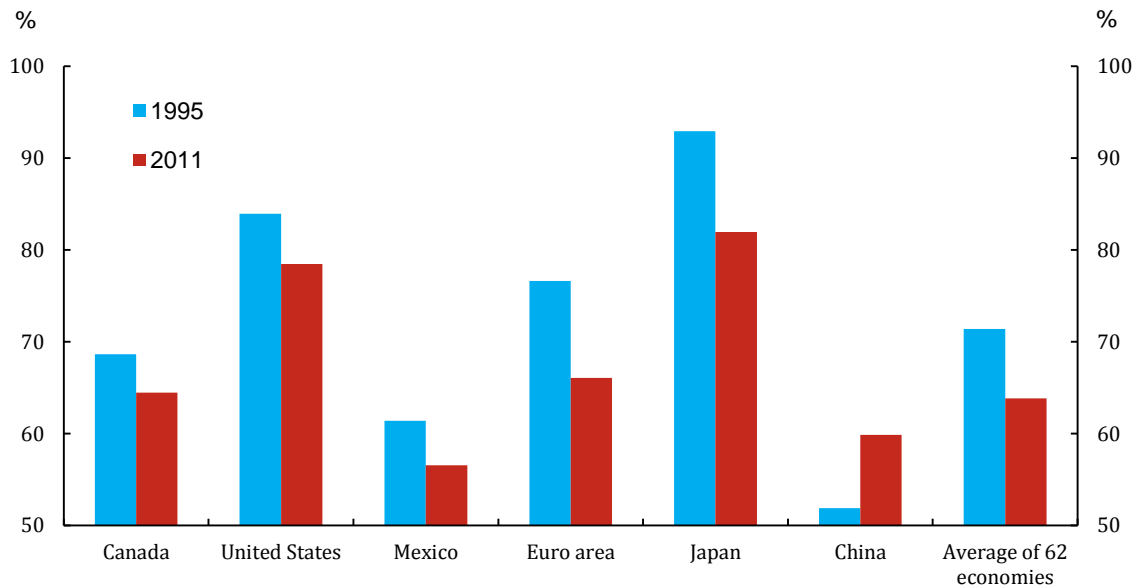
In an effort to understand these phenomena better, the Organisation for Economic Co-operation and Development (OECD) has developed indicators of “trade in value-added terms,” which attempt to capture the value added in each country’s participation in a value chain. Viewed from the domestic lens, building a global value chain means outsourcing content of the final product, thereby reducing its domestic content. The OECD data show that 45 of 61 economies have seen a decline in the domestic content of their exports over the past 20 years (Chart 4). This includes Mexico, where the maquiladoras (suppliers clustered near the Mexico–US border) have captured considerable offshoring activity from US and Canadian firms. Indeed, the maquiladoras today account for over 25 per cent of manufacturing employment in Mexico (Bergin, Feenstra and Hanson 2009), while at the same time incorporating imported inputs from Asia and elsewhere in Latin America.

Chart 4: Domestic value added share of gross exports



Note: “62 economies” equals 61 countries plus OECD’s “Rest Of World”
 Source: Trade in Value Added (TIVA), Organisation for Economic Co-operation and Development

Chart 5: Domestic value added share of gross exports in the manufacturing sector



Note: "62 economies" equals 61 countries plus OECD's "Rest Of World"
Source: Trade in Value Added (TIVA), Organisation for Economic Co-operation and Development

While these observations fit our hypothesis of increased integration across a large number of economies, two exceptions are worth noting. One is Canada, where there has been a modest increase in domestic value added to total exports. The reason for this is that Canada's growth engine during much of the 2002–12 period was in the commodity sector—primarily oil—and this is of course largely domestic value added. Data from Canada's manufacturing sector clearly show a declining portion of domestic value added, reflecting a globalization trend (Chart 5). The other interesting exception is China, which has been by far the most important recipient of GVC business, often in very labour-intensive forms. This means that the explosion of global trade in the wake of China's accession to the WTO has contained a large share of Chinese domestic value added. Over time, however, China has been creeping up the value-added chain, particularly in manufacturing, as Chart 5 illustrates.

Yet another indicator of rising cross-border integration is the growing importance of foreign affiliates in facilitating trade. A domestic company has a choice of producing at home and shipping abroad, or locating abroad and shipping directly to that host country and to third countries. Either arrangement may be supported by a global value chain. Importantly, both CUSFTA and NAFTA liberalized and offered legal protection of cross-border investment, so to understand the effects of these agreements we need to look beyond the cross-border flows of goods and services.

Data on the operations of foreign affiliates with domestic majority ownership are less widely available and reported with a substantial lag. That being said, by 2013, sales by Canadian-owned foreign affiliates almost matched the amount of total exports sold from Canada, at Can\$510 billion versus Can\$573 billion, respectively. In effect, there is

almost as large a Canadian economy operating in foreign countries as there is in the domestic export sector, creating jobs and GDP both domestically and abroad. Canadian-owned affiliates operating in the United States account for about half of this total activity and employ some 600,000 people in the United States; Canadian operations in Mexico generate sales of about Can\$15 billion and employ nearly 70,000 people in that country. The number of associated jobs in Canada is much more difficult to estimate.

Importantly, the corresponding US figures are an order of magnitude greater. US affiliates operating abroad generate annual sales of some US\$6 trillion, with over US\$600 billion of that taking place in Canada, and over US\$200 billion in Mexico. These are very large numbers; at a minimum, they imply that standard export and import data provide a very incomplete picture of the complexity of international business relationships.

While these observations are not definitive, they collectively support the view that cross-border integration has increased in North America over the past 20 years. As mentioned above, deeper structural evidence of increased integration is harder to come by, especially related to specific trade agreements. This is probably because the effects of trade agreements are highly sector-specific, often even firm-specific, and there are always numerous other forces that affect macro statistics. For example, some sectors may have been more protected than others before a trade agreement, so outsized adjustments may be masked in the aggregate data. Shifts in industry composition or in factor intensity can easily distort micro phenomena when aggregated into macro statistics. And, there may be subsequent shocks that hit particular industries.

Nevertheless, the literature has built a number of insights on the effects of specific trade agreements over time. For example, in the wake of CUSFTA, Canada's manufacturing sector saw a 5 per cent drop in employment and a 6 per cent increase in productivity. Looking at a finer level of detail, those industries with the deepest tariff cuts saw a drop in employment by some 12 per cent and a rise in productivity of around 15 per cent. Importantly, these employment effects were erased over the longer term, as job gains were made in other manufacturing companies (Trefler 2004; Lileeva 2008). In related work, Lileeva and Trefler (2008) show that improved access to foreign markets induces productivity-enhancing investment. McCalman and Spearot (2013, 2015) provide evidence that US firms in the auto sector re-configured their GVCs in response to NAFTA. Mexico was an important beneficiary. Many of these changes are most dramatic at the firm level, which underscores the role of intra-industry reallocation in facilitating structural adjustment to trade liberalization (Melitz 2003).

As for convergence in factor pricing, Caliendo and Parro (2015) find that NAFTA lowered the terms of trade for Canada by 0.1 per cent and for Mexico by 0.4 per cent, while raising the US terms of trade very slightly. Although real wages increased for all three economies, Mexico showed the largest gains—weakly suggestive of some degree of factor price convergence. The generally positive income effect of trade liberalization

highlighted in the basic model of trade (Krugman 1980) receives surprisingly little attention. The main channel for this effect is falling import prices, and the positive effect of lower import prices on domestic purchasing power can be easily lost in the debate about how domestic producers will compete and how many domestic jobs may be lost. Job losses may not be well captured by import price indexes when a central result of trade liberalization is an increase in the number and variety of products that become available to domestic consumers (Feenstra 1994; Kehoe and Ruhl 2013). Another complicating factor in this research is the possibility that profit margins may not be constant, which may weaken the pass through of decreases in costs that come from trade liberalization to domestic consumers (De Loecker et al. 2012).

Summing up, a broad-brush review of data on international business and the empirical literature demonstrates substantial evidence that that cross-border trade integration has increased in the past 20 years. At the same time, it remains possible to be skeptical of the depth of the integration hypothesis, especially attempts to credit either CUSFTA or NAFTA specifically with the observed trends in the trade data, since definitive structural empirical evidence to support it is limited. Certainly, the impact of the two agreements on trade seems to have fallen short of predictions made by proponents during pre-agreement debate.

Furthermore, some would point to recent evidence of integration reversals, as certain industries have “reshored” back to the United States. However, it is important to keep such anecdotes in perspective; globalization was never likely to take us to an idyllic end-state of pure integration, since the realities of international commerce continue to intrude. These realities include the limited availability of trade finance in many smaller countries, the costs of building and maintaining global logistics networks, geopolitical risks, the preference to have suppliers closer to buyers, and long-distance after-sales service and maintenance, just to name a few.

Most importantly, perhaps, the trend to factor equalization—although not proven, it is easy to see rising wages in China or Mexico, for example—creates a new optimization problem for MNEs with GVCs whenever a company undertakes periodic strategic reviews of its cross-border structure. Such reviews can lead (and have led) to decisions to re-shore parts of the supply chain back to the home country—in short, the optimal supply-chain arrangement can vary considerably over time as underlying conditions evolve. This means that the degree of integration may also vary significantly over time, in both directions, making it risky to treat it as a permanent state of the world.

My overall reading is that the evidence of increased international integration is sufficiently compelling for policy-makers to take it seriously, since it may affect their policy models and decision-making frameworks. These issues are explored in the next section.

Integration and the Monetary Policy Transmission Mechanism

It is easiest to think about the implications of these trends in international trade in the context of a textbook open-economy model with inflation driven by a Phillips curve and the central bank targeting inflation. In this framework, a macroeconomic shock moves projected inflation off target and the central bank adjusts interest rates in a manner that brings inflation back to target over the next six-to-eight quarters. For ease of exposition, assume a negative shock to foreign demand, prompting the central bank to cut interest rates to keep inflation on target.

The interest rate response of the central bank works mainly through intertemporal substitution by both consumers and firms, who borrow more and spend more on goods, housing and investments. Meanwhile, the cut in interest rates is associated with some depreciation in the domestic currency, which boosts exports and dampens imports, broadening the policy effect on aggregate demand. The weaker currency may also have partially offsetting effects on consumer spending and investment spending because of the higher cost of imports. The depreciation of the exchange rate boosts domestic inflation temporarily. However, the increase in domestic aggregate demand combined with these other effects offsets the drop in foreign demand and brings inflation sustainably back to target.

The monetary policy transmission mechanism relies in the first instance on two key reduced-form parameters: the interest elasticity of aggregate demand and the exchange rate elasticity of aggregate demand. The issue to consider is how the evolution of international trade may have influenced these parameters over time, either directly, or through more subtle changes in the underlying structure of the economy. The ultimate effects on inflation will depend on the interaction between the domestic output gap and domestic inflation (the Phillips curve). Each of these relationships may be altered by an increase in cross-border integration.

To illustrate, let's compare a world in which entire products are produced in individual countries and exported to others, with one that is "integrated" or "globalized," dominated by MNEs with suppliers scattered around the world. In both states, global demand for a given product is the ultimate demand shock variable. However, the investment decisions of an MNE will be driven more by global variables than individual domestic variables. This could include interest rate fluctuations—assuming the MNE has access to global capital markets, its decision making may be less influenced by domestic interest rates and more by global interest rates. To date, however, there is very little empirical evidence for or against this conjecture, so we have set it aside.

Similarly, a fluctuation in an individual exchange rate may have a more muted impact on MNEs in a globalized world, because for any given MNE built on GVCs, the depreciation of one currency means an appreciation of another, both of which could be in the firm's portfolio of demand and supply. In concrete terms, as a country becomes more

integrated into GVCs, a depreciation of the exchange rate improves its competitiveness by only a fraction of the value of final goods exports, rather than the whole bundle (Ahmed, Appendino and Ruta 2015). Furthermore, notice that the process of building a GVC involves increasing the degree of specialization at each point in the supply chain. This specialization presumably reduces the substitutability of producers across countries, thereby providing a second structural reason why the exchange rate elasticity of exports may decline with increased trade integration.

In related literature, Caselli et al. (2015) show that sectors that are more open to trade are less exposed to domestic supply and demand shocks and tend to be less correlated with the rest of the economy. Further, sectors that are more open to trade tend to be more specialized and more volatile (di Giovanni and Levchenko 2009). And, countries that trade more tend to exhibit higher business-cycle synchronization (di Giovanni and Levchenko 2010; Liao and Santacreu 2015). Given these inferences, it is not surprising to find that globalization has made domestic inflation more sensitive to global demand developments and less sensitive to domestic disturbances (BIS 2016, 68). In other words, the global output gap may become a more important determinant of domestic inflation, at the expense of the domestic output gap.

Another important structural channel to consider is the linkage between cross-border integration and income distribution. It is generally understood that increased trade penetration and specialization leads to the offshoring of labour-intensive, lower-productivity fragments of the supply process. This leads to higher average productivity levels and higher incomes domestically. Logically, it may also lead to an increase in domestic income dispersion, a widely observed stylized fact of the past 20 years and much discussed in the United States.

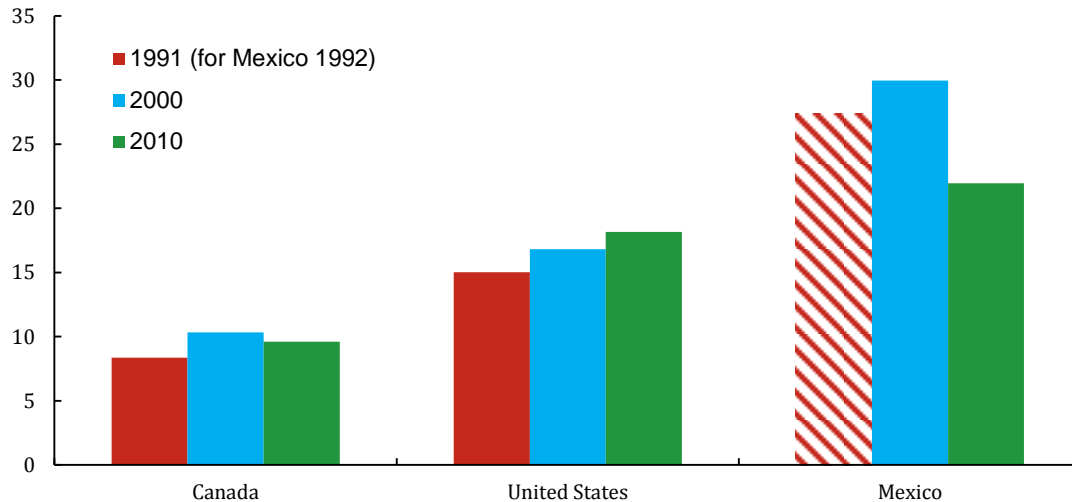
Based on a model developed by Krugman (2008), Bivens (2007) concludes that trade restructuring may account for about 15 to 20 per cent of the observed increase in income dispersion. Others have found evidence that this linkage may be even more pronounced for developing countries; for example, Mexico experienced a significant increase in income inequality soon after trade liberalization (Goldberg and Pavcnik 2007). It is evident that the situation varies tremendously from one country to another, in part because the implications of trade liberalization for a given country depend on what other policies are implemented concurrently or subsequently. Further, income distribution outcomes that are sometimes attributed to globalization are often driven by other factors, particularly technological change (Autor, Dorn and Hanson 2015; Harrigan, Reshef and Toubal 2016).

Chart 6 shows one summary income distribution statistic, the ratio of the income share of the top 10 per cent to that of the bottom 10 per cent, for the NAFTA countries. All three showed an increase in income dispersion during the 1990s. This trend has continued into the 2000s for the United States, but has partly reversed in Canada and has more than fully reversed in Mexico. Of course, since other elements of the policy

architecture that affect income distribution have not remained constant through this period, we make no claim that these patterns are driven by trade.

Chart 6: Trend in income distribution across North American countries

Income share held by highest 10% over income share held by lowest 10%, annual, 1991 (1992 for Mexico), 2000, 2010



Sources: World Bank, Haver Analytics and Bank of Canada calculations

Last observation: 2010

Shifts in income distribution could have implications for the standard open-economy models that policy-makers rely on. Since they may have less access to credit, low-income groups are more likely to be credit constrained and therefore less likely to be influenced by intertemporal substitution than high-income groups. Meanwhile, high-income groups tend to make their spending plans independently of the level of interest rates. An increase in income dispersion, then, could increase the share of the population that is less influenced by interest rate fluctuations, perhaps pointing to a lower interest elasticity of consumption in aggregate.

There is limited empirical evidence of this conjecture to date. However, it is important to acknowledge that the level of empirical confidence in estimates of the interest elasticity of aggregate demand is not high to start with. There is evidence that low-income households have a higher marginal propensity to consume out of their disposable incomes than high-income households (Blundell, Browning and Meghir 1994; Guvenen 2006; Parker et al. 2013). While weakly supportive of the conjecture of a lower sensitivity to interest rate movements in partial equilibrium, this evidence also suggests that once the income effects from interest rate movements are factored in, low-income households won't necessarily adjust their spending by less than their high-income counterparts. Indeed, Kaplan and Violante (2014) offer a model in which increased income dispersion may actually increase interest sensitivity of consumption indirectly through a higher average income elasticity.

In principle, the interest elasticity of aggregate demand represents an amalgam of a spectrum of actors, not a representative agent. The importance of this issue depends on how significant the underlying heterogeneity might be. A more promising line of inquiry might be to model income distribution explicitly, and to simulate the effects of an increase in income dispersion due to globalization in the model. A rough attempt to do so is explored in the next section.

Monetary Policy Implications of Rising Integration

In this section we use the Bank of Canada's macroeconomic policy model, ToTEM (for Terms-of-Trade Economic Model) to investigate how increased cross-border integration may affect monetary policy transmission.

ToTEM is a large-scale multi-sector dynamic stochastic general-equilibrium (DSGE) model that reflects the consensus view of the key macroeconomic linkages in the Canadian economy (Murchison and Rennison 2006; Dorich et al. 2013). It contains sufficient detail to allow us to illustrate the range of possible interactions between cross-border integration and monetary policy. This includes separate modelling of the commodity and non-commodity export sectors and the production of domestic consumer goods and services. ToTEM also models consumption behaviour with two groups of consumers, one of them credit constrained. Members of the latter group consume all disposable income each period and therefore do not react directly to changes in interest rates, but instead react only to secondary movements in income that are induced by interest rate fluctuations. Although the trade literature does not suggest that increasing the share of credit-constrained consumers is an implication of increased trade integration, it can serve as a crude proxy for increased income dispersion and yield a preliminary insight into the matter.

To study the effects of rising cross-border integration then, we compare a base version of the model with a version featuring five changes to the model structure. These changes reflect the conjectures of the preceding section and are as follows:

1. A lower exchange rate elasticity of non-commodity export demand
2. A higher share of imported inputs into the production of non-commodity exports, reflecting the development of GVCs
3. A higher share of imported inputs into the production of domestic consumer goods, reflecting the development of GVCs
4. A lower elasticity of substitution between domestic inputs and imported inputs into the production of non-commodity exports, reflecting increased specialization
5. A higher share of credit-constrained consumers, to proxy for an increased dispersion of income

We subject the two versions of the model to the same series of exogenous shocks and compare the model responses. Throughout, monetary policy is guided by the maintenance of the inflation target. Our conjecture is that increased integration will make the economy less responsive to both interest rate and exchange rate fluctuations, thereby making inflation targeting more challenging. In both versions of the model, the central bank is equally successful in offsetting fluctuations in inflation relative to its inflation target, so we compare the variability in interest rates, exchange rates and the output gap that are necessary to ensure this outcome.

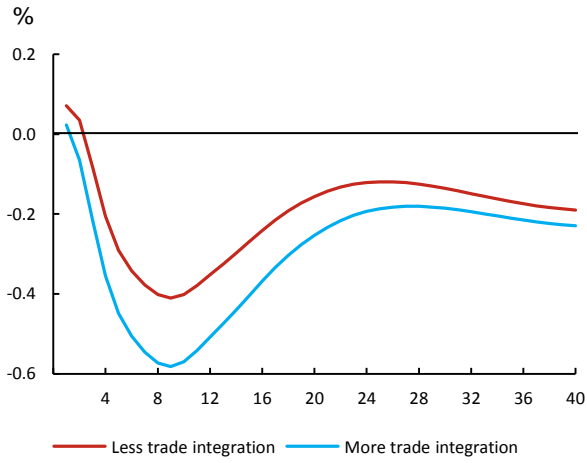
Our conjectures are shown in Chart 7 based on the response of the two versions of the model to an exogenous decrease in global demand. The specific form of the shock is a decline in foreign demand that builds to -1.2 per cent after six quarters and then gradually returns to control over the next five years. The deviations of inflation from target in the two versions of the model are very similar and modest, since the central bank policy objective is the same in both models. As expected, the central bank cuts interest rates in response to the shock somewhat more aggressively in the version of the model with higher cross-border integration. In contrast, the reaction of the real exchange rate to the shock is much greater in the high-integration version of the model, and the domestic real economic downturn much deeper and more prolonged.

These observations are generally in line with our conjectures and are aligned with the results of Woodford (2007), that a more highly integrated global economy will make it more challenging for central banks to stabilize economic growth while pursuing inflation targets. In effect, rising integration loosens the connection between the domestic output gap and domestic inflation. Both versions of the model see a significant decline in exports when foreign demand falls, albeit more so in the high-integration version. This decline produces a deterioration in the current account balance, and the resulting wealth effects cause the path of consumption and therefore GDP to remain below control for an extended period of time. In short, it takes the economy several years to adjust fully to the shock, regardless of the level of cross-border integration.

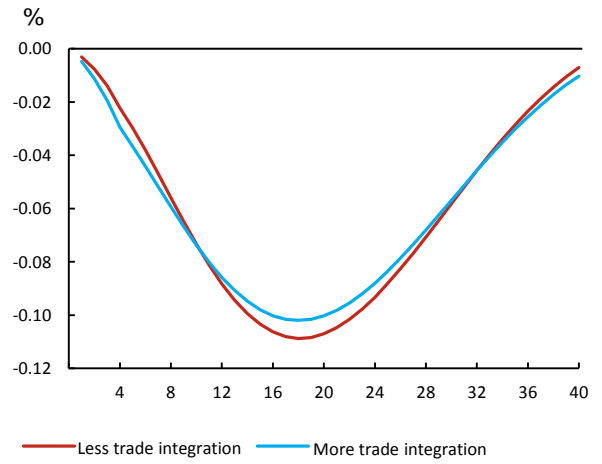
These insights may be generalized by calculating unconditional variances for the model's key variables for a given array of historical exogenous shocks. In effect, we generate macroeconomic data by running the same historical shocks through both versions of the model and compare the resulting variances of key variables between versions. Table 1 summarizes the results of this exercise.

Chart 7: Illustrating the effect of trade integration using ToTEM
 Negative foreign demand shock

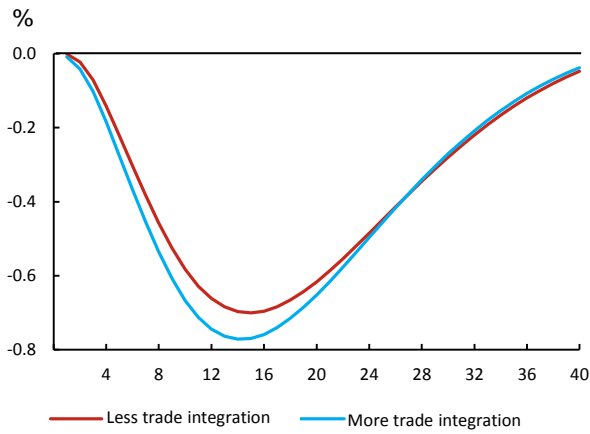
a. GDP



b. Core inflation (year-over-year)



c. Annualized short-term interest rate



d. Real exchange rate (G6/C\$)

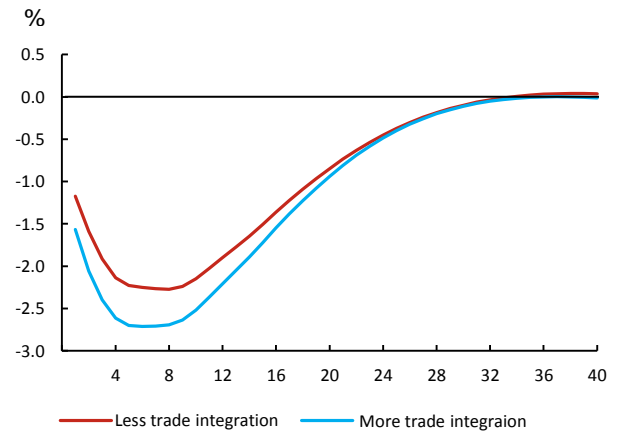


Table 1: Comparison of unconditional variances generated by two versions of ToTEM

	Effect of increased integration (per cent)
Output gap	+29
Nominal interest rate	+10
Real exchange rate	+34

The results from ToTEM suggest that higher trade integration may be associated with higher variability of interest rates, real exchange rates and the output gap, although the effect on interest rate variability is quite modest. The relatively large increase in real exchange rate variability is related to the complexity of stock-flow interactions in the model. In ToTEM, any shock that leads to a deterioration of the current account will put downward pressure on the real exchange rate until the country's net foreign asset position stabilizes, and this process requires a bigger exchange rate movement when the economy is more integrated.

ToTEM also suggests that the output gap will be more variable when trade integration is high. Since the variability of inflation is the same in both versions of the model, this means that greater trade integration also changes the nature of the trade-off between output and inflation stabilization, in effect making it more challenging to stabilize the economy while pursuing an inflation target. Increasing globalization, then, may be an argument for allowing more flexibility in inflation targets in order to produce less variability in the real economy.

We also performed this exercise with versions of the model looking at the five model changes separately and then decomposed the changes in variance associated with globalization into the five components. These results are provided in Table 2.

Table 2: Variance decomposition of the five model changes

Percentage of the change in variance

	Change 1	Change 2	Change 3	Change 4	Change 5	Total
Output gap	28	0	17	10	45	100
Nominal interest rate	54	0	-15	15	46	100
Real exchange rate	51	3	6	31	9	100

Description of model changes:

Change 1: A lower exchange rate elasticity of non-commodity export demand

Change 2: A higher share of imported inputs in the production of non-commodity exports

Change 3: A higher share of imported inputs in the production of domestic consumer goods

Change 4: A lower elasticity of substitution between domestic inputs and imported inputs in the production of non-commodity exports

Change 5: A higher share of credit-constrained consumers

As expected, the reduction in the exchange rate elasticity of export demand plays an important role in generating higher variances in interest rates, exchange rates and the output gap. Comparatively speaking, increases in the share of imported inputs in domestic production of either non-commodity exports or domestic consumption goods has only modest effects on the variances. Increased specialization in domestic production, modelled as a lower elasticity of substitution between domestic and import inputs, generated significantly higher exchange rate variability but has limited effects on the variance of interest rates or the real economy. Finally, higher income dispersion—modelled here crudely as an increase in the share of credit-constrained consumers—has its primary effect by reducing the economy’s interest elasticity, as expected. This generates higher variability in both interest rates and the output gap but leads to very little change in exchange rate outcomes.

The relative variances generated by ToTEM offer trade-offs that could be considered strategically when designing macroeconomic policies. In particular, the relative variances could be influenced through the complementary use of policy instruments other than monetary policy, such as automatic fiscal stabilizers or macroprudential policies. Alternatively, policy-makers could consider allowing additional flexibility in the central bank’s inflation objective—a widening of inflation-target bands, for example, or allowing a longer period to pass before a complete return to target after a shock. Such a change would allow the variance of inflation to increase and the variances of the other key variables to decrease. Such trade-offs would be very difficult to formalize *ex ante*, however, and may best be considered within the risk-management problem faced by all central banks. This is especially true given that such risk management must occur in a forward-looking fashion in the presence of considerable uncertainty regarding model structure and the nature of shocks.

Conclusion

It is an article of faith among most economists that trade liberalization will lead firms and households to reoptimize their behaviour and will manifest itself in increased integration of economies. The aggregate economic gains from such a shift are widely acknowledged, as are the potential effects on income distribution.

Nevertheless, the real world is sufficiently complex, and so many things are not being held constant, that proving such conjectures empirically can be very difficult. My good friend Paul Storer held that faith but wore his skepticism like a comfortable suit, for a number of good reasons. I’ve argued here that seeking rigorous empirical proof may be too much of a burden for the data to bear. By taking a broader lens to international business activity, what we see is highly suggestive that trade liberalization has increased integration within the NAFTA economies—and this constitutes sufficient evidence for policy-makers to take the issue seriously.

We conjecture that rising integration will appear in parameter bias or even structural misspecification in workhorse forecasting and policy models, posing a real issue for central bankers. Ultimately, policy models can be revised to capture these evolutions in behaviour, subject to the caveat that the degree of integration need not be constant through time. The Bank of Canada's model, ToTEM, is capable of capturing such shifts, in theory, but model respecifications need to be based on reliable empirical work, which is not extensive. For the present, it may have to suffice for policy-makers to acknowledge the risks posed by shifts in integration and consider how to insulate policy decisions from those risks.

Our model simulations suggest that models that do not recognize rising integration are likely to predict that monetary policy actions will be more effective at stabilizing the economy and controlling inflation than they will prove to be in practice. In other words, a central bank that relies on a model that does not take rising trade integration into account when it should do so will tend to react too gradually and perhaps insufficiently to external shocks. This would run the risk of inflation deviating from target for longer than desired.

On the other side of this risk is a modicum of comfort—by all counts, it would appear that trade integration is not headed for infinity. Rather, the optimal level of cross-border integration is a complex decision by individual companies that depends on logistics, transportation costs, geopolitical risk and evolving cost structures in foreign economies. As such, we have every reason to believe that the bias that globalization may be introducing into our models evolves gradually, probably in both directions, and has natural limits. Nevertheless, policy-makers need to acknowledge that international developments will have an influence on their economies and on the volatility of their financial markets.

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