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Redesigning Canadian Trade Policies for New Global Realities

Edited by Stephen Tapp, Ari Van Assche and Robert Wolfe

About this chapter

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Redesigning Canadian Trade Policies for New Global Realities, edited by Stephen Tapp, Ari Van Assche and Robert Wolfe, will be the sixth volume of The Art of the State. Thirty leading academics, government researchers, practitioners and stakeholders, from Canada and abroad, analyze how changes in global commerce, technology, and economic and geopolitical power are affecting Canada and its policy.

Chapter summary

Businesses vary in terms of their productivity and how they react to changes in the trading environment. These differences have long been recognized by researchers and policy-makers, but they have only recently been subjected to rigorous analysis. Since this analysis uses complex economic models, it is not generally well understood by nonspecialists. In this chapter Beverly Lapham (professor of economics at Queen's University) provides an accessible overview of recent developments in these theoretical trade models and explores some of their policy implications.

Lapham describes an important model developed by Marc Melitz that emphasizes firm-level decisions and firm heterogeneity. The model's prediction that increased trade raises productivity is not new. What is new is its demonstration of how this occurs—through differing responses to trade policy that shift the economy's resources from firms with lower productivity to those with higher productivity. This prediction and several others from the model have strong empirical support, including that exporters are larger and more productive than nonexporters.

The author also examines some recent extensions of the Melitz model that focus on, for example, how complementarities between importing and exporting increase a firm's productivity; the impact of trade on the labour market and the potential for increased wage inequality; the reinforcing link between trade and innovation; and the potential for trade to reduce the mark-ups of selling prices relative to production costs.

These recent advances in trade theory offer governments the chance to improve economic performance, but this requires a new policy approach. This new approach, says Lapham, should include considering more broadly the impact of trade policies on potential (not only existing) traders and trade flows, and the distributional impacts of trade on firms and workers. Policy would also do well to lower the fixed costs of participating in international markets and to facilitate importing and exporting. As well, this new direction calls for greater coordination of traditional trade policies, such as tariffs and trade negotiations, and nontraditional policies, such as productivity, innovation, investment and industrial policy. It is also important to communicate the productivity benefits of trade to the general public. Finally, these new policy orientations demand new policy tools. The most essential is the increased use of firm-level data to quantify differences across firms and to support policy decisions using firm-based trade models that capture the unique and important features of the Canadian economy.

Résumé de chapitre

La productivité des entreprises et leur réaction aux changements de l'environnement commercial sont fort variées. Bien connues des chercheurs et des décideurs, ces différences font depuis peu l'objet d'une analyse plus rigoureuse. Cette analyse reposant toutefois sur des modèles économiques complexes, elle est généralement peu comprise dans les milieux non spécialisés. Beverly Lapham (professeure d'économie à l'Université Queen's) propose dans ce chapitre une description plus accessible de l'évolution récente de ces modèles théoriques et en examine certaines répercussions politiques.

Elle décrit notamment l'important modèle de Marc Melitz, qui met l'accent sur l'hétérogénéité et les décisions des entreprises. Ce modèle, selon lequel l'accroissement des échanges stimule la productivité, n'a rien de nouveau. Mais il en démontre de façon inédite le mécanisme : les réactions différentes aux politiques commerciales entraînent le transfert des ressources économiques vers des entreprises à forte productivité. Cette prédiction du modèle ainsi que plusieurs autres s'appuient sur de solides données empiriques, qui indiquent notamment que les entreprises exportatrices sont plus grandes et plus productives que les non-exportateurs.

Beverly Lapham examine aussi quelques prolongements récents du modèle de Melitz, centrés sur les points suivants : productivité accrue des entreprises qui combinent importations et exportations ; incidence du commerce sur le marché du travail et accentuation potentielle de l'inégalité salariales ; renforcement des liens entre commerce et innovation ; rôle éventuel du commerce dans la réduction des marges sur les prix de vente par rapport aux coûts de production.

Bien que ces avancées théoriques offrent aux gouvernements l'occasion d'améliorer la performance économique, seule une nouvelle approche leur permettra d'en tirer profit. Cette approche devrait notamment considérer de manière plus globale l'effet des politiques commerciales sur les négociants et les flux d'échanges potentiels (et non seulement existants), de même que l'incidence distributive du commerce sur les entreprises et les salariés. Il serait aussi utile de faire réduire les coûts fixes liés à la participation aux marchés internationaux et de faciliter les importations comme les exportations. Cette réorientation nécessiterait toutefois de mieux coordonner les politiques traditionnelles (ayant trait, par exemple, aux négociations tarifaires et commerciales) et les nouvelles initiatives, entre autres en matière de productivité, d'innovation, d'investissement et de politique industrielle. Il faudrait également faire valoir auprès du public les gains de productivité découlant du commerce. Enfin, puisque toute réorientation nécessite de nouveaux outils, il serait essentiel d'utiliser plus largement les données des entreprises pour mesurer ce qui les différencie, et d'appuyer toute décision en matière de politique sur des modèles commerciaux d'entreprise qui traduisent les caractéristiques clés de l'économie canadienne.

International Trade with Firm Heterogeneity: Theoretical Developments and Policy Implications

Beverly Lapham

OVER THE PAST DECADE, CUTTING-EDGE RESEARCH ON INTERNATIONAL TRADE HAS increasingly adopted a firm-level approach. This new perspective has opened up a wide range of issues in empirical trade, trade theory and trade policy. This chapter focuses on developments in theoretical trade models. It describes the seminal approach by Melitz (2003) and reviews some of the vast subsequent research that emphasizes firm-level decisions and differences (or heterogeneity) across firms.

Researchers and policy-makers have long recognized that firms respond differently to changes in the trading environment, and that these differences matter. However, formal analysis of those varied responses and their impacts has only been conducted in the last decade or so, using intricate economic models. As a result of the modelling complexities, new ideas about how trade affects firms, workers and the broader economy are generally not well understood by non-specialists. This is unfortunate, not only because this research is important and interesting, but also because understanding how these models operate provides a valuable perspective for those considering the impact of trade policies and comparing alternative trade policy options.

Early research on firm-level trade in the mid-1990s revealed vast differences between firms in both exporting behaviour and productivity — and as a result of subsequent work, we now better appreciate the intimate links between these two observations. Important differences among firms have also been documented in wage rates, the use of imported inputs and the extent of involvement in global value chains, among other factors. These differences can have significant impacts on firms' success in global and domestic markets, and on how changes in trade policy impact firm-level production

decisions. This new research suggests that the effects of trade policies may ultimately be harder to pin down and predict in a world where firms vary in their responses across the wide set of business decisions they face. But at the same time, the rapid rise in global trade and the increased integration of the global economy has put a premium on improving our understanding of what affects firm behaviour and performance through theoretical and empirical analysis. By making progress on these fronts, the recent firm-level emphasis on international trade research will offer a lasting contribution.

The theories described in this chapter suggest a strong re-enforcing relationship between international trade and productivity that is now well supported by the empirical evidence. For example, Baldwin and Yan ("Trade and Productivity," in this volume) summarize findings from firm-level data for Canada and demonstrate that access to foreign markets has been associated with substantial productivity gains in Canadian manufacturing. Their results are highly consistent with recent developments in trade theory and establish that this association generally applies to the Canadian economy. This chapter contends that applying these theories can inform and ultimately improve the design of Canadian trade and productivity policies.

My objectives are to describe how modern trade models work for non-specialist readers, present some key results and recent extensions, and discuss some new policy implications that arise from these models. To preview the latter, this work suggests that policy-makers give more consideration to the impacts of trade-related policies on potential trade; reduce fixed trade costs; communicate the productivity enhancements from trade; facilitate imports as well as exports; and better analyze the distributional impacts of trade. To effectively address these important issues, trade analysts need access to firm-level data to better understand and quantify firm-level differences in the Canadian economy, all with a view to informing Canadian trade policy deliberations and decisions.

The chapter is organized as follows: to provide a broader context for evaluating recent developments in the literature, in the next section I briefly describe the evolution of trade theory. I then outline the seminal model by Melitz (2003) that incorporates heterogeneous firms into a trading environment. I discuss other theoretical studies and more recent developments in this literature, as well as some general policy implications.

The Evolution of Trade Theory

Theoretical approaches to trade theory can be classified into three broad groups, from oldest to newest: country-based, industry-based and firm-based. I summarize some of the main elements of each group in table 1.

Theories in the country-based group are often called traditional models of trade, built upon the research of Ricardo (1817), Heckscher (1919), Ohlin (1933), Samuelson (1939) and Vanek (1968). These models emphasize differences between

Table 1
Trade theory approaches since the 1800s (baseline models)

	Country-based (1800s-1970s)	Industry-based (1980s-2000s)	Firm-based (2000s-present)
General			
Industries	Two homogeneous goods sectors	One differentiated goods sector	One differentiated goods sector
Producers			
Technologies[1]	Constant returns to scale	Increasing returns to scale	Increasing returns to scale
Technology differences	Across industries; across countries	No differences	Across firms
Market structure[2]	Perfect competition	Monopolistic competition	Monopolistic competition
Consumers			
Income source	Capital and labour	Labour	Labour
Preferences		Desire for variety	Desire for variety
Key results			
Type of trade	Across industries	Within industries	Within industries
Sources of gains from trade	Across-industry reallocations of resources	Higher scale of production; more product variety; lower markups	Higher scale of production; more product variety; within-industry re-allocation of resources
Aggregate productivity effects of trade	Not applicable	Positive effects from higher scale	Positive effects from higher scale and reallocation across firms

Source: Author.
[1] "Constant-returns-to-scale technologies" implies that doubling production inputs doubles production outputs. "Increasing-returns-to-scale technologies" implies that doubling production inputs more than doubles outputs.
[2] "Perfect competition" implies that firms sell identical goods and are price takers in output markets, whereas in monopolistically competitive markets, firms sell differentiated goods and have some degree of market power to set their own prices.

countries as the primary driving force behind international trade. In them, trade liberalization increases societal welfare by reallocating resources toward a country's industries of comparative advantage and away from its industries of comparative disadvantage. In this approach, the winners and losers of increased international trade are primarily determined by factor ownership patterns. For example, if there were no income transfers across factor owners, this theory predicts that in a relatively capital-abundant and labour-scarce country, such as Canada, capital owners would benefit from increased trade while labour would lose.

The industry-based group includes models initially referred to as new trade theory.[1] Increasing returns to scale in production (whereby doubling inputs more than doubles outputs) at the firm level and differentiated products are typical in these models, and in fact are the main reasons for international trade. In these models, trade liberalization raises aggregate welfare by increasing the firm-level scale of production, which lowers industry average cost; increasing the variety of products available to consumers; and possibly lowering markups of price over marginal cost. Because these models generally assume that consumers are identical, they effectively exclude changes in the trading environment from affecting the income distribution.

The most recent developments in international trade theory are in the firm-based group — a subset of which is the focus of this chapter. These models emphasize the importance of gaining a better understanding of productivity differences across firms and thus a deeper comprehension of the effects of changes in the trading environment. Much of the research in this group follows on the work of Melitz (2003) and includes increasing returns to scale and product differentiation (the same forces behind trade as in the earlier industry-based group). However, because different firms have different technologies in these models, trade liberalization further lowers industry average cost, as increased trade causes the most productive firms to expand and the least productive firms to exit. These models are well suited to analyzing the distributional effects of trade across firms within the same industry, as well as potential distributional impacts across consumers in their role as shareholders.[2]

A Baseline Model of International Trade with Heterogeneous Firms

THE SEMINAL MODEL OF FIRM HETEROGENEITY AND INTERNATIONAL TRADE WAS formalized by Melitz (2003).[3] Before discussing this model in detail, it will help to take a step back and explain the basic intuition for the new mechanisms that it

proposes. When a closed economy opens to trade, there are opposing effects on producers. Businesses can sell abroad to a larger market (which can raise profits), but they also face stiffer competition and higher real wages at home (which can reduce profits). The same pressures arise in the older, industry-based trade models, but because those models consider firms to be homogenous, they all react in the same way to these changes. Melitz's approach is novel because he allows firms to differ in their productivity. Because of this change, firms can respond differently to policy shocks. For the most productive firms, the positive effect tends to dominate: they produce more and become more profitable. Conversely, for the least productive firms, the negative effect dominates: their profits get squeezed, causing some firms to produce less and some firms to exit the industry altogether. These opposing reactions within the industry shift the economy's resources from relatively low- to high-productivity firms. This increases overall productivity and welfare. Thus, the different firm-level responses within particular industries have significant implications for the effects of trade on prices, outputs, productivity and welfare, and firm heterogeneity therefore provides predictions that are different from those of earlier, country-based or industry-based trade models.

Consider a simplified version of the Melitz model with two countries. Each country has the same industry — think of it as the automobile industry — producing different car varieties that are internationally tradable.

The many individuals living in each country play multiple roles in the model economy. They are workers who own labour (the only factor of production), and they earn labour income by working in their country's auto industry. They are also shareholders in car-producing firms in their country, so they receive a share of the firms' profits as income. Finally, they are consumers who spend their incomes to buy cars. In the basic model, all individuals are the same. As a result, they all work the same amount, own equal shares of all firms, and buy the same number of cars.

Consumers' welfare increases when they buy more of a particular type of car and when they buy different cars (consumers desire variety). The model assumes that consumers have demand functions for each type of car characterized by a (constant) price elasticity of demand (which is the same across all car varieties and is independent of the level of consumption).

In each country, there are many firms in the auto industry, and no two firms produce exactly the same car. An entrepreneur who wants to enter the auto

industry must hire some labour to obtain a production technology. The exact technology the entrepreneur will receive is uncertain, but the properties of the distribution of possible technologies are known. After receiving a technology, the entrepreneur decides whether to produce (at which point the entrepreneur technically becomes a firm) or not (if producing with this technology is unprofitable). The labour costs to obtain a technology are known as the fixed cost of entry and are the same for all entrepreneurs.

Firms must hire a constant amount of labour to establish themselves — this fixed cost of production is the same for all firms. To produce cars, each firm uses some labour, the amount of which varies across firms. This constant marginal cost of production differs across firms, and is the uncertain component for the entrepreneur before entry. A firm's average cost falls as it produces more (due to the fixed cost of production), and the average cost varies across firms due to differences in their production *level* and differences in their *marginal cost* of producing. Firms that require a relatively high amount of labour to produce each car are called low-productivity (or high-cost) firms; producers that need low labour inputs are called high-productivity (or low-cost) firms. Thus, the auto industry in each country has firms that differ in the types of car they produce, their average and marginal production costs, and how many cars they produce.

Cars can be sold in the domestic market and the firm's export market. There is no cost to selling in the domestic market, but there are trade costs for exporting, which also involve a fixed and a variable component. The fixed export costs can be thought of as the need to research foreign market conditions or conform to different product standards. Shipping costs and tariffs are examples of variable export costs. Variable export costs are modelled as a fraction of output that is "lost" when transporting the good to the export market (for example, two cars must be shipped to the other country for one car to arrive for sale). All firms face the same exporting costs in each export market.

Firms selling in the domestic market offer a unique variety of car (say a Ford Focus), but face competition with closely substitutable cars — from other domestic cars (Chevrolet Cruze) and from imported cars (Volkswagen Golf). The two markets are segmented, and the firm competes separately in each market. Also, because each firm has a monopoly with its particular car but faces competition from other car varieties, the market structure is monopolistically competitive — firms are not price-takers, but instead choose their price in each market to maximize profit.

Sorting firms by their productivity and export status

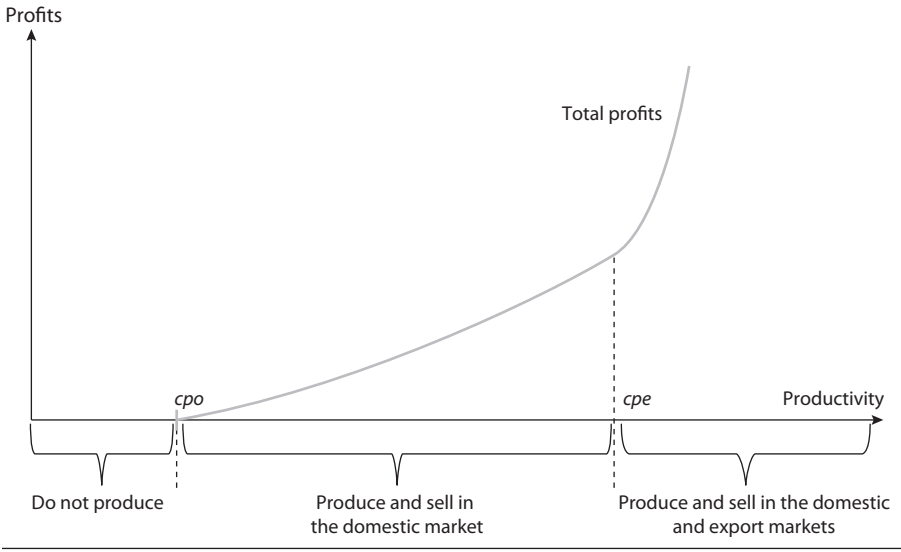
In the model's equilibrium, world demand equals supply for each car variety, demand equals supply for labour within each country, and aggregate variables (for example, output, wage income, profits) are unchanged over time.[4] As is typical in these models, individuals make optimal labour and consumption decisions to maximize their welfare. The model focuses largely on *firms*' decisions relating to production, pricing and exporting. These are also made optimally to maximize profits.

First, consider a nonexporter, who sells only in the domestic market. This firm will maximize profits by choosing a price that equates its marginal revenue and marginal cost. The result is a price above marginal cost, and the markup (of price over marginal cost) depends on the price elasticity of demand in the domestic market. Since consumers have a constant elasticity of demand, which is the same for all varieties, all firms have the same markup. This means that firms with higher marginal costs of production set higher prices, and they will have lower domestic-market sales and profits than will firms with lower marginal costs of production.

Exporters sell in both the domestic and export markets. In the domestic market, the exporting firm uses the pricing strategy described above. The firm chooses the same markup in both markets (because demand conditions are identical), but the marginal cost of selling to the export market is higher because of the additional variable trade costs of exporting. An exporting firm therefore charges a higher price in the export market, and the ratio of the firm's prices across the export and domestic markets depends only on the variable trade cost. In export markets, as in the domestic market, higher-cost firms charge higher prices and have lower sales and profits than lower-cost firms.

Returning to the production decision, after receiving a technology, the entrepreneur will only produce if it is efficient enough to generate (nonnegative) profits in equilibrium.[5] As implied by the discussion above, firms' profits decrease with their marginal costs. A key equilibrium property of the model is the existence of a cut-off level of marginal cost for operation, below which an entrepreneur earns profits. Entrepreneurs with relatively poor technologies (with a marginal cost above the cut-off) do not start firms, while entrepreneurs with relatively good technologies do (as they have a marginal cost below the cut-off). Thus, the economy as a whole has an equilibrium *cut-off productivity level for operation* (denoted *cpo* in figure 1), such that all firms that choose to produce are at least as productive as the *cpo*.

Figure 1
The relationship between a firm's productivity and profits in the Melitz model



Source: Author.
cpo = cut-off productivity level for operating *cpe* = cut-off productivity level for exporting

Firms export only if they can earn profits in the foreign market, taking into account the exporting costs. By the same logic as for the domestic market, there is an equilibrium *cut-off productivity level for exporting* (denoted *cpe* in figure 1), such that all exporting firms are this productive or more so. Also, note that the profit function becomes steeper at *cpe*, reflecting the increased total profits when exporters start accessing the larger market.

If the fixed and variable costs of exporting are significant, the cut-off productivity for exporters is higher than the cut-off productivity for domestic operations (*cpe* > *cpo)*. One way to think of this is that only the more productive firms have sufficient profits to cover the fixed costs of exporting. Therefore, in the model's economy, the less productive firms (those between *cpo* and *cpe*) only sell domestically. The most productive firms sell both domestically and internationally (*cpe* and beyond). A crucial part of the analysis is thus the question of what happens to these two equilibrium cut-off productivity levels after a trade liberalization.

To summarize, the model's key prediction is that within a given industry, higher-productivity firms will export. Because these exporting firms have lower

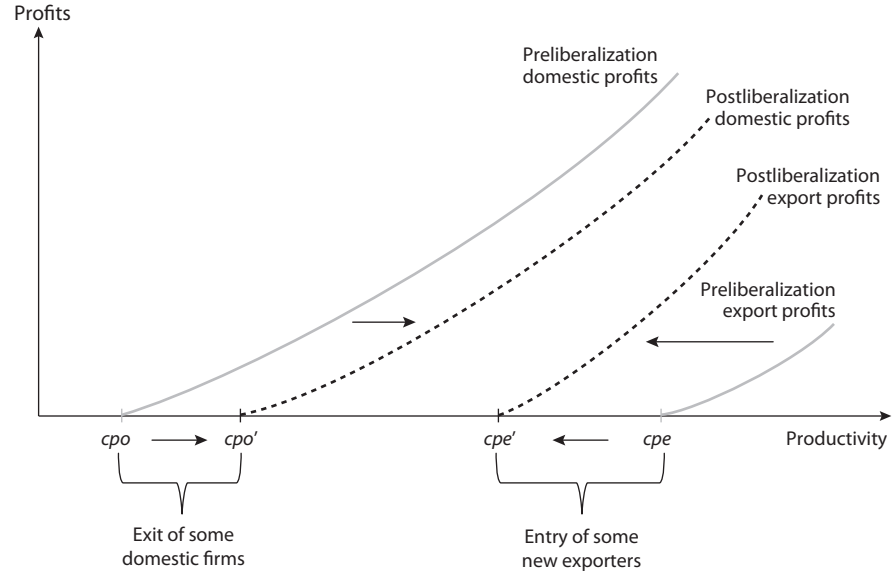
marginal costs than nonexporters, they set lower prices and have higher sales in their domestic market. Moreover, exporters have higher output and employment than nonexporters. This model, therefore, makes a one-way causal prediction running from a firm's productivity to its export status: only the most productive firms export. In this literature, this is sometimes called a *self-selection* model of exporting. Note that in this baseline model, exporting by itself does not increase a firm's productivity.[6]

The effects of trade liberalization

The effects of more liberal trade policies can be studied by decreasing the variable and/or fixed costs of exporting.

First, consider a fall in the *variable* trade cost — this could represent lower international transportation costs for shipping cars or decreasing tariffs on importing cars (where, for simplicity, I assume the same policy is adopted in both markets).[7] This change lowers the marginal cost for firms to sell in the export market. Since

Figure 2
The effect of trade liberalization on domestic and export profits



Source: Author.
cpo = cut-off productivity level for operating *cpe* = cut-off productivity level for exporting

Box 1
Intensive versus extensive margin adjustments

For quantity changes in response to new government policies or macroeconomic conditions, this research often discusses two margins of adjustment:

(1) An *intensive margin* response at the firm level — such as a change in a firm's output, employment or profits

(2) An *extensive margin* response — a change in the number of firms engaged in an activity, such as the number of active firms or the number of exporters

markups are unchanged, this lowers export prices and increases firms' sales and profits from the export market.[8] This is shown in figure 2 as a leftward shift in the curve that depicts profits from the export market as a function of firm productivity. In the figure, this lowers the cut-off productivity for exporting from *cpe* to *cpe'* and prompts the entry of new exporters. The firm-level output and profit changes are *intensive margin* adjustments to trade liberalization, while the entry of new exporters is an *extensive margin* response (see box 1). Also note that to increase production, exporters demand more labour, which puts upward pressure on the real wage.

The fall in variable trade costs also symmetrically decreases the relative price of imports. This has two effects. First, it lowers consumer prices in each country. Second, it increases the relative demand for imports in each country, which decreases market share and production for nonexporters. As a result, all firms suffer lower sales in their domestic market. Combining this with the higher real wage described above, profits from domestic sales fall for all firms. This is shown in figure 2 as a rightward shift in the curve that depicts profits from the domestic market as a function of firm productivity. Hence, the firms with the lowest productivities exit and the productivity cut-off level of the least productive firm in the industry increases from *cpo* to *cpo'*. Thus, trade liberalization generates an additional intensive margin response as output by nonexporters falls, and another extensive margin response as some firms exit.

The relationships between firm productivity and profits before and after trade liberalization are summarized in figure 3. The solid curve shows profits before the reduction in variable trade costs; the dashed curve depicts profits afterward. Businesses can be placed into five groups according to the effect of

the trade liberalization on their profits and export status. From lowest to highest productivity, these are:

Group 1: Nonexporters who exit and lose profits

Group 2: Nonexporters who remain nonexporters and lose profits

Group 3: Nonexporters who become exporters and lose profits

Group 4: Nonexporters who become exporters and gain profits

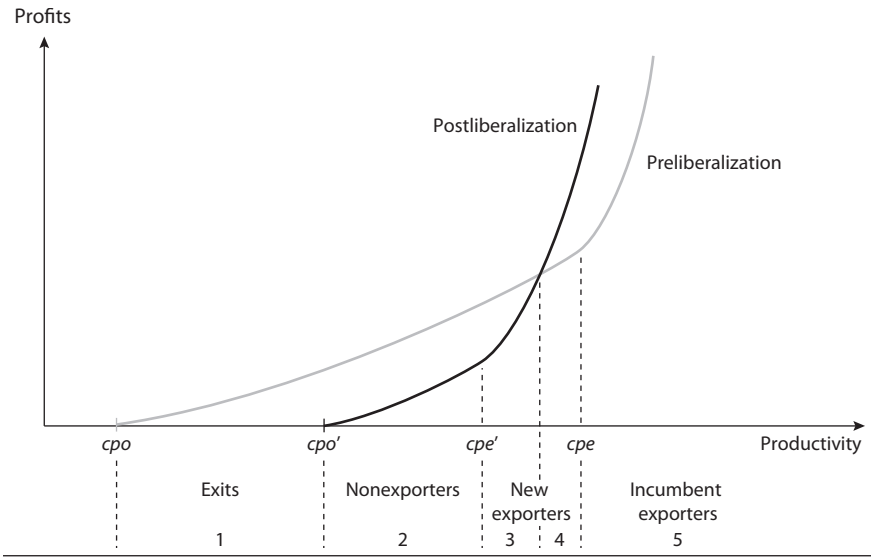
Group 5: Exporters who remain exporters and gain profits[9]

This result highlights the distributional effects of trade liberalization that occur across firms within an industry, and which were generally absent in earlier trade models with homogeneous firms. Importantly, the contraction and exit of firms with relatively low productivity and the expansion of firms with relatively high productivity increases the overall productivity in the industry. This is sometimes called the *selection effect* of trade liberalization.

Trade liberalization increases welfare in this model. Individuals benefit from lower prices, higher real wages and increased purchasing power.[10] Because of free entry, aggregate profits before and after the trade liberalization are zero.

Figure 3

The relationship between a firm's productivity and profits before and after trade liberalization



Source: Author.

cpo = cut-off productivity level for operating *cpe* = cut-off productivity level for exporting

Therefore, when individuals are identical, with equal shareholdings across individuals, a decrease in variable trade costs has no effect on their income as shareholders (dividends), so there are no welfare effects through this channel. This changes when holdings of firm shares differ among individuals: those who only held shares in low-productivity firms that exited after the trade liberalization would see their dividend income fall. In general, because of the differential effects on firms' profits, a fall in variable trade cost redistributes dividend income from individuals who hold shares in relatively low-productivity firms to those who hold shares in relatively high-productivity firms. Thus, in this model, trade liberalization can have distributional effects across individuals according to their prior shareholdings. (These distributional effects across shareholders *within* the same industry contrast with older models of trade where distributional effects tend to occur *across* industries.)

At the national level, trade liberalization brings aggregate welfare gains. If individuals are identical this follows from the fact they all have higher real incomes after liberalization. The analysis is more complicated when individuals' shareholdings differ. In that case, the total gains to individuals who are better off after the liberalization exceed the total losses to individuals who suffer reduced dividend income. Within this model, the government could in principle design taxes and transfers to ensure that no individual is worse off after trade liberalization. In reality, this is considerably harder. Finally, since this simple model has identical countries, trade liberalization raises global welfare.

Trade liberalization that results from lowering the *fixed* costs of exporting has similar impacts to a fall in variable trade costs, but the mechanisms are slightly different. For instance, lower fixed trade costs do not generate a rise in the output of incumbent exporters.[11] However, the other basic mechanisms remain unchanged and the individual, national and global welfare impacts are qualitatively similar.

Empirical validation

The predictions of the Melitz model are broadly consistent with evidence from firm-level data from various countries. For example, numerous studies document that only a fraction of firms export in a typical industry (though the frequency varies widely by country). Furthermore, among firms that engage in trade, exporters often export only a portion of their output. Baldwin and Yan ("Trade and Productivity," in this

volume) document these facts for Canadian manufacturing firms. They estimate that, on average, over the period 1974 to 2010, 35 percent of Canadian manufacturing firms exported, and approximately 40 percent of those firms' sales were exports.[12]

Empirical studies also consistently find that firms that export tend to be larger, more productive, more intensive of capital and skilled labour, and to pay higher wages than firms that do not participate in international markets.[13] Baldwin and Yan also find that Canadian manufacturing exporting plants (which comprised only 35 percent of all manufacturing firms) accounted for more than 70 percent of manufacturing employment and were 13 percent more productive than nonexporters over 1974-2010. The baseline Melitz model is consistent with these positive correlations between a firm's size and productivity and its export status.[14]

Finally, empirical studies of past trade liberalizations provide compelling evidence of firm-level, industry-level and aggregate productivity growth following policy reforms, primarily as a result of within-industry reallocations of resources and firm-level innovations rather than across-industry reallocations. Using Canadian plant-level manufacturing data, Baldwin and Gu (2004) and Baldwin and Yan (2012) document these effects in Canada for bilateral tariff reductions, while Trefler (2004) estimates the effects on these plants of the Canada-US Free Trade Agreement (FTA).[15] For example, Baldwin and Gu (2004) show that within the Canadian manufacturing sector, reallocations across plants were responsible for more than half of the productivity growth in a majority of industries following the trade agreement. These findings are consistent with newer, firm-based trade models, but contrast with country-based models.

The Literature on Trade with Firm Heterogeneity

THERE IS A VAST LITERATURE THAT INCORPORATES FIRM HETEROGENEITY INTO TRADE models. It often builds on the Melitz framework.[16]

International participation and other firm-level choices

In the baseline Melitz model, the only international activity available to firms is exporting. Subsequent research has explored the implications of firm heterogeneity for other forms of international market participation that have become parts of today's global commerce. For example, by incorporating imported intermediate inputs into the production of final goods, researchers can examine the role of

firms as importers (of inputs) as well as exporters (of output).[17] Many researchers have found that imported inputs raise firm productivity — typically because they are of higher quality than domestic inputs, or because of increasing returns to variety in production. This suggests a natural complementarity between importing and exporting behaviour at the firm level: firms that use imported inputs tend to be more productive, which in turn makes them more likely to be able to meet the fixed costs of exporting. Thus, a new prediction from these model extensions is that importing firms are more likely to be exporters, and that both importing and exporting tend to raise productivity.

Another set of international decisions that firms may face involves the location and organization of their production processes. For example, foreign direct investment by firms is explored in Helpman, Melitz and Yeaple (2004). Firms' decisions to internationally outsource some part of their production process and the implications for global value chains have been a subject of considerable research.[18]

Product-level decision-making has also received attention (particularly as the availability of product-level data improves). Firms' decisions regarding product quality, how many products to produce, and in which international markets to sell which products are examples of some issues explored.[19]

Labour markets and international trade

The movement of labour from contracting firms to expanding firms is an important response to trade liberalization in models of firm heterogeneity. In many models, that reallocation occurs in a frictionless labour market where all workers are paid the same wage. However, a growing literature is incorporating labour market frictions to examine the impact of trade liberalization on unemployment and wage inequality in the presence of firm heterogeneity. This research sheds new light on the impacts of changes in trade policy on individual workers, inequality, and aggregate employment and unemployment in microfounded models of labour and goods markets. This is especially important in light of trends observed in a large number of countries of rising wage and income inequality coinciding with increased trade.[20]

Some models incorporate labour market frictions using "efficiency wage" frameworks,[21] while others use search and matching frictions.[22] I will briefly discuss the class of models reviewed by Helpman, Itskhoki and Redding (2013) to

illustrate the latter approach. In that framework, labour market search frictions generate unemployment and the productivity of workers is specific to a worker-firm match. Firms cannot directly observe individual workers' productivities, but they can undertake costly evaluation of workers to obtain information about their productivity. The model predicts that more productive firms (exporters in the Melitz model) that have higher profits will undertake more evaluation, eliminate less productive workers and as a result have an even more productive workforce. It follows that workers in exporting firms will have higher average wages. Thus, the model generates wage inequality across workers within sectors as well as aggregate unemployment — making this a rich environment for exploring the impact of trade liberalization on labour market outcomes.

Here are three results of interest for our purposes. First, when a closed country opens for trade, revenues shift from low- to high-productivity and high-wage firms. This increases the dispersion of wages, and the model therefore predicts a positive correlation between income inequality and trade. Note that the country-based Heckscher-Ohlin model also predicts this for countries with an abundance of skilled labour, because resources reallocate across industries in response to increased trade. That model emphasizes changes in the relative wages of high- and low-skilled workers and hence a positive association between trade and wage inequality across worker groups (according to education, occupation and so on.) This offers an interesting contrast, since increased wage inequality in models with firm heterogeneity and search frictions arises from within-industry reallocations and implies a positive association between trade and inequality among people working in the *same* job or industry. The empirical evidence suggests that wage inequality in many countries arises both within and between different occupations and industries.[23] Furthermore, some papers use theoretical models of trade that assume firm heterogeneity to provide empirical evidence based on firm-level data that increased trade significantly raises wage inequality within sectors and occupations.[24]

Second, the effect on unemployment of opening a closed economy to trade is ambiguous. On the one hand, trade shifts workers toward more productive firms, and this reduces the hiring rate in the labour market because these firms are more selective. This effect tends to increase the unemployment rate. On the other hand, depending on what happens to expected wage income, trade either increases or has no effect on the matching rate (i.e., how often firms and workers

meet to conduct job interviews). This second effect either decreases or has no effect on the unemployment rate. Because of these potentially opposing effects, the net impact of trade on the unemployment rate is uncertain.

Finally, if a country with prohibitive trade barriers lowers those barriers slightly, its wage inequality will initially rise. However, as the country continues to lower trade barriers, wage inequality eventually falls. That is, a fall in trade costs reduces inequality when trade costs are low but raises inequality when trade costs are high. The difference arises because the increase in wages for the most productive firms resulting from lower trade costs only occurs when a subset of firms are exporters. The richness of these results clearly indicates the potential of this line of research to increase our understanding of the effects of increased trade on unemployment and wage inequality in developed economies.

Trade and innovation

Another relatively new area of research explores the links between firms' participation in international markets and their innovation activities. Whereas in the Melitz model, a firm's productivity is taken as given and affects its decision to export, this research also examines the opposite causal relationship: the increased profits accruing to firms that are active in international markets allow them to undertake costly innovation activities, in turn increasing their productivity. This new channel provides additional productivity and welfare gains from trade liberalization. For example, Atkeson and Burstein (2010) and Lileeva and Trefler (2010) analyze models with exporting and innovating firms. They demonstrate that — in addition to the increased output of exporting firms after trade liberalization — those firms also increase their innovation expenditures, which further enhances the positive productivity impact of increased trade. Some researchers are now studying environments in which firms anticipate increased profits from entering as exporters and undertake costly innovations that then allow them to export.

Procompetitive effects of trade

In Melitz (2003), all consumers' demand functions have a constant elasticity of demand that is the same across all product varieties. This means that all varieties of the good sell at the same markup of price above marginal cost in all markets. Furthermore, because changes in the trading environment don't change this demand elasticity, markups are unaffected by trade liberalization. This differs

from some models in the earlier industry-based category, in which increased trade reduces markups — often called the *procompetitive effects* of trade. This is important for two reasons. If trade reduces firms' market power and lowers markups, then this provides yet another channel for consumers to gain from trade. Second, empirical studies such as Tybout (2003) provide evidence of these procompetitive effects after trade liberalization episodes.

The model developed by Melitz and Ottaviano (2008) is an important contribution to this literature. It incorporates variable markups and analyzes how differences in market size modify the impact of trade liberalization. The basic framework of this model has been used extensively, so I shall just describe the main innovations of the model and its results.

This model has an industry in each country, as in Melitz (2003).[25] Now, however, as an individual consumes more, he becomes less price-sensitive, so his elasticity of demand falls with his level of consumption. As in Melitz, firms with lower cost levels set lower prices and have higher demand — but unlike Melitz, because lower-cost firms face less elastic demand, they choose higher markups. This implies that economies that have more consumers and more demand (such as the US) will be more competitive and will have lower average prices, higher average productivity and more firms than smaller markets like Canada. Multilateral trade liberalization will have similar positive productivity effects to these, but in addition, average markups will fall as exporting firms reach larger markets, and this will benefit consumers.

Melitz and Ottaviano (2008) extend this basic picture of firms choosing various markups to include multiple countries that differ in size and trade costs (modelled as barriers to imports). They examine the impact of various forms of trade liberalization in the short run with no firm entry and in the long run with equilibrium levels of firm entry, demonstrating that if a country undertakes *unilateral* trade liberalization by decreasing the costs of selling in its market, its consumers gain from higher productivity, lower markups and more varieties for consumption in the short run, while the trading partner is unaffected. However, in the long run (after extensive margin effects such as firm entry are included), the liberalizing country actually has fewer firms and lower average productivity than before the liberalization, while its trading partners experience the opposite. Thus, in the long run, a unilaterally liberalizing country experiences aggregate welfare losses while its trading partners make welfare gains. This is an interesting

result that suggests short-run gains from unilateral trade liberalization can be undone by longer-run patterns of firm entry. Several papers extend Melitz and Ottaviano (2008) or develop other models with nonconstant markups to analyze a wide range of issues caused by increased trade competition, the elimination of less productive firms and lower markups.[26]

Comparative advantage considerations

Some papers incorporate firm heterogeneity into traditional models of trade, which are based on cross-country differences and comparative advantage. These build upon the influential paper by Eaton and Kortum (2002), which develops and estimates a Ricardian model of trade (with constant returns in production and perfect competition) that considers geographical barriers.[27] Their framework is particularly useful for deriving sophisticated, gravity-style equations that relate bilateral trade volumes between countries to countries' characteristics (such as the size of countries' economies and the distance between countries). These equations can be estimated using industry- and country-level data to better understand the determinants of trade flows and quantify trade impacts. For example, guided by their theory, Eaton and Kortum (2002) estimate that Canada would experience aggregate welfare gains between 0.5 and 1.1 percent if the US were to unilaterally remove tariffs, and a welfare gain of nearly 2 percent if the volume of world trade were to double. Several authors extend the Eaton and Kortum (2002) environment and have provided important quantitative analysis of the impact of changes in the trading environment for a broad set of countries.[28] A novel insight of this research is that gravity equations of trade flows should include measures of firm or industry heterogeneity.

Another area of research examines comparative advantage considerations in models with firm heterogeneity and imperfect competition. These models highlight the effects of trade liberalization on resource reallocation *within* industries (as highlighted in firm-based models) alongside reallocations *across* industries (as highlighted in country-based models of traditional comparative advantage). The papers by Bernard, Eaton, Jensen and Kortum (2003) and Bernard, Redding and Schott (2007) are important examples.

In Bernard, Eaton, Jensen and Kortum (2003), there are many sectors characterized by imperfect competition and each has firms with different productivity levels. There are also cross-country differences in technologies in each sector, capturing Ricardian-style comparative advantage motivations for trade. Importantly,

there are variable trade costs that allow for market segmentation and limit firms' abilities to export. As in the Melitz model, trade liberalization has selection effects as low-productivity firms exit and high-productivity exporters expand, leading to aggregate productivity gains. However, unlike Melitz, this model also generates reallocations across industries and highlights intensive and extensive margin responses to changes in the trading environment. An important contribution of the paper is to use US plant-level data to quantify these effects.

While that paper incorporates firm heterogeneity into a classical model of trade, Bernard, Redding and Schott (2007) do so in a neoclassical factor-proportions model of trade. Their model has skilled and unskilled labour, two industries that differ in their labour intensities and two countries that differ in their supplies of two types of labour. Each industry produces differentiated varieties of a final good (such as shoes and automobiles) with increasing returns to scale, imperfect competition and firms with different levels of productivity. Consumers earn income from supplying the two types of labour and desire variety. There are fixed and variable costs of exporting.

In this model, trade liberalization that decreases trade costs shifts both types of labour within as well as across industries. The within-industry effects identified above in the baseline model are present in both sectors. However, the cut-off productivity level for operation increases more in the industry of comparative advantage, so average productivity rises more in that sector than in the sector of comparative disadvantage. In addition, average firm size rises in the comparative advantage sector and labour moves into that sector from the sector of comparative disadvantage, further enhancing welfare gains from trade liberalization with economies of scale and more efficiently allocated resources. At the individual level, the traditional redistribution of income from the abundant factor to the scarce factor in a country takes place. However, the additional gains in productivity arising from firm heterogeneity may cause trade liberalization to increase the wages of both types of labour. This is an important contribution to the firm-based trade model with intra- and interindustry trade, providing new insights into the productivity effects and complex distributional effects of increased trade.

Other extensions

The gravity approach to trade literature often focuses on estimating the magnitude of the impact of trade costs on trade volumes — the so-called *trade elasticity*.[29] As

another avenue for both theoretical and empirical research, the emphasis on significant fixed costs of trade in modern models of trade opens up interesting issues about the link between firm credit and finance and participation in international markets, since firms may need to borrow to cover these start-up costs.[30]

There also is a growing literature that incorporates firm-level dynamics into trade models with firm heterogeneity, either by including changes to firms' productivity and exploring the dynamic responses,[31] or by examining models where firms obtain more information about international markets as they participate in those markets.[32]

Another area of research explores the implications of these new models for measures of the welfare effects of trade liberalization. Papers by Arkolakis, Costinot and Rodríguez-Clare (2012), Atkeson and Burstein (2010), and others argue that many of the models that incorporate firm heterogeneity, including Melitz, do not have new implications for the aggregate welfare gains from trade liberalization. However, as Melitz and Redding (2014) point out, the proposition that aggregate measures are sufficient for quantifying the overall welfare effects of trade liberalization holds only under fairly strong conditions. Indeed, other papers, such as those of Felbermayr, Jung and Larch (2013) and Ossa (2012), explore environments where this is not the case. Furthermore, even when this aggregate result holds, more recent models with heterogeneous firms have implications for the effects of trade liberalization on individual firms and on the shareholders of those firms. More work is needed to estimate the welfare effects of trade liberalization using firm-, industry- and country-level data sources.

Additional empirical relevance

Empirical studies document that only a fraction of firms export in a typical industry and exporters often export only a small portion of their output. Similar results have been documented for firms' importing of intermediates.[33] Furthermore, exporters, firms that use imported inputs and firms that engage in foreign direct investment all tend to be larger, more productive and relatively more intensive of capital and skilled labour, and to pay higher wages than firms that do not participate in international markets. These facts are consistent with predictions from models already outlined in this section.

As predicted by models of innovating firms described in the subsection above on trade and innovation, firms that enter export markets tend to grow faster than nonexporters.[34] Baldwin and Gu (2003), for example, estimate that among Canadian manufacturing plants, entrants to export markets exhibited

average annual growth rates that were over 4 percentage points above those of nonentrants. Empirical research also suggests that firms' technology adoption choices are linked to their decisions regarding participation in trading activities.[35] The evidence on this for Canada is summarized by Baldwin and Yan ("Trade and Productivity," in this volume), who show that trade liberalization has fostered learning by Canadian manufacturing exporters and that access to larger markets has raised the productivity of those firms by forcing them to become more competitive and by providing more innovation and investment opportunities.

Firms' and industries' international activities exhibit considerable dynamics and volatility over time. That is, the magnitude of the existing trade flows of incumbent firms fluctuates, and industries exhibit significant firm entry and exit in export and domestic markets as well as changes in the composition and destination of exported products. Such dynamic adjustments are addressed in models that focus on firm and industry dynamics.[36]

Policy Implications when Firm Differences Matter

This rich new class of models emphasizing firm-level decisions and firm heterogeneity shows that trade policy impacts a wide range of business decisions including entry and exit, how production is organized and innovation expenditures, among several others. Through these varied decisions and channels, trade policy affects broader outcomes, such as firm, industry and aggregate variables for productivity; product variety; markups of price over cost; unemployment; and wage inequality. The important policy implications that arise from these models (summarized in box 2) can be classified into three categories: policy considerations (i.e., where to look and act); the need for new policy tools (how to better assess the impacts of trade policies); and policy cautions or potential pitfalls (what not to do).[37] The remainder of this section looks at each category in detail. For more on these issues, see Ciuriak, Lapham and Wolfe (2015).

Policy considerations

Take into account the impact on potential traders and trade flows

Firm-based trade theory and empirical studies stress the important role of extensive margin adjustments to trade policy. In response to trade liberalization, firms enter and exit international markets, alter which products they sell abroad and

Box 2
Policy implications of firm heterogeneity

Governments should

- consider the impacts of their policies on potential (not only existing) traders and trade flows;
- reduce the fixed costs for firms to participate in international markets (for instance, by addressing regulatory differences) in addition to lowering variable trade costs;
- emphasize the links between trade and productivity and communicate these benefits to the public;
- coordinate traditional trade policies with other trade-related policy areas such as productivity, innovation, investment and industrial policies;
- facilitate firms' imports of intermediate goods and services; and
- devote attention to the distributional impacts of trade policies for both firms and workers.

Tools trade analysts need

- improved access to firm-level data to better quantify firm heterogeneity within Canadian industries; used in conjunction with models, such analysis can improve assessments and predictions of the actual and expected impacts of trade policy changes; and
- employee-employer matched data for Canada, as is available in several other countries, which could provide important new insights on the distributional impacts of trade policies on the labour market.

Caution

- trade policies that simply reward firms for participating in international markets may have limited effects on trade and therefore may not be cost-effective.

where they sell them, and vary which goods and services they import. These models and a body of empirical evidence suggest that responses along these extensive margins are a significant contributor to aggregate productivity growth. This means that to properly evaluate the full economic gains from trade policy changes, governments and trade negotiators must look beyond the expansion of existing trade flows. They need to consider the potential expansion of imports and exports of goods and services that previously were not sold internationally, diversification into new markets, the entry of firms into importing and exporting, and changes in the international components of firms' production structures.

Moreover, if the extensive margin is the primary source of productivity gains from trade liberalization,[38] then it may make sense to focus negotiating resources on firms and markets where access is currently limited. This may provide larger returns than making marginal improvements in existing markets.

Reduce the fixed costs of participation in international markets

The notion that variable trade costs, such as transportation costs and tariffs, reduce trade flows has been discussed for a long time in the trade literature. However, a key contribution of the more recent research described above is its focus on the importance of fixed and sunk costs associated with simply entering and staying in an international market. These fixed trade costs can significantly limit firms' access to foreign markets (and the resulting productivity benefits), which implies that governments should focus on lowering obstacles that restrict market access for firms.

While there are various contributors to these fixed costs — including the need to acquire market-specific information and other frictions — addressing international regulatory differences is perhaps the most important component for policy-makers to address (particularly for firms engaged in global value chains). One concrete government action to lower the fixed costs of entry into trade is to make it easier for firms to understand and conform to the regulations that govern new products and services in new markets. Compatible and transparent regulation along the production chain is essential. For more on potential policy approaches in this area, see Hoekman (in this volume).

Firm size also takes on increased importance in the presence of large, up-front sunk and fixed trade costs. Larger, more productive firms are generally more able to cover the costs of adapting to relevant product- and market-specific standards — and they may even participate in the development of those standards. Smaller firms, on the other hand, are inherently standard-takers and often face significant adjustment costs when standards change in foreign markets. This is an important consideration for policies that focus on the role of small and medium enterprises (SMEs) in international markets, such as Canada's target to increase exporting by Canadian SMEs to emerging markets. For evidence and related policy recommendations on this issue, see Sui and Tapp (in this volume).

Emphasize the links between trade and productivity

Trade models that incorporate firm heterogeneity emphasize the complex relationship between trade and productivity. At the firm level, higher-productivity firms trade more, and trade can lead to increased innovation, making firms more productive. At the industry level, increased trade leads to resource reallocations within industries away from the smallest, least productive firms and toward the

largest, most productive firms, increasing industry productivity. At the country level, these effects generate new sources of aggregate productivity gains, resulting from increased trade (in addition to traditional gains from more efficient resource allocation across industries due to comparative advantage and higher scales of production). Understanding these additional productivity-enhancing effects of trade and promoting them to the general public may make it easier to gather support for trade liberalization initiatives from economic players, key stakeholders and governments concerned with productivity growth.

Increase coordination

Incorporating firm-level dynamics into trade theory emphasizes the role of ongoing investment and innovation and the effects of those decisions on firm-level productivity and the ability of firms to participate effectively in international markets. Many of these models take account of the ongoing need for firms to invest in new technologies, products and markets in environments with considerable uncertainty. For firms, the outcomes of these investments can make the difference between a sustained or expanded presence in international markets and exit. The logical consequence of this realization is that firm-level innovation outcomes can alter the patterns of trade for countries, which in turn can change aggregate productivity growth. But causality can also flow in the other direction: just as innovation is important to trade success, entry into export markets can drive firms to innovate. Hence, there are strong and dynamic linkages among trade policy, investment policy and innovation policy. Although it has long been recognized by policy-makers that domestic and trade policies should be coordinated, the new developments in trade theory suggest that these linkages are stronger, more complex, more dynamic and more important than previously thought.

Facilitate imports

Many recent trade models with firm heterogeneity incorporate internationally traded intermediate goods and services. These developments provide a framework for analyzing international participation by firms as importers and as participants in global value chains. Because the theory predicts that increased access to imported intermediates increases firm-level productivity, policies that directly lower the fixed and variable costs — including import tariffs — facing firms in their role as importers can lead to aggregate productivity gains. While the impact

on a country's exports of its own import liberalization due to value chain linkages is already recognized by policy-makers, the newest theoretical developments suggest a need for increased quantitative evaluation of these effects.

The importance of imported intermediates in production varies considerably across industries according to the specifics of production technologies. Given the rising incidence of intermediate importing and participation in global value chains, an increasingly important policy objective should be to develop quantitative measures of the productivity impact of imports and domestic trade liberalization on firms that are two-way traders.[39] To guide policy, careful empirical studies that estimate the productivity effects of imported inputs on specific Canadian industries are needed. For example, Baldwin and Yan ("Global Value Chain Participation," in this volume) find that firms in the Canadian manufacturing sector enjoyed significant productivity benefits when they started two-way trading, and productivity declines of similar size when they stopped (both relative to the control groups).

Study the distributional impacts of trade policies for firms and workers

It has long been understood that trade policy changes can create winners and losers in an economy. While traditional trade models suggest they could be identified by industry or factor ownership, recent trade models suggest there will generally be winners and losers from trade liberalization *within* the same industry. For example, an import-competing industry that may shrink as a result of liberalization will nonetheless likely have firms that become winners.[40] This important nuance suggests that mobilizing industry associations in support of a unified position in trade negotiations will be difficult due to the inherent conflicts they face because they represent both winners and losers.

In theory at least, with aggregate gains from trade liberalization, winners can compensate losers (perhaps through government transfer schemes). In practice, however, such transfers face significant political and implementation difficulties. The latest developments in trade theory with firm heterogeneity show differential gains within industries that further complicate the design of such transfers. Recognizing these complexities makes it clear that Canadian trade negotiators face more significant challenges in evaluating policy in light of national interests, and broad consultations at the firm level are needed.

At the aggregate level, increased trade and trade-enhancing policies generally improve economic performance. Some recent empirical work inves-

tigates the extent to which different types of workers are benefiting from these developments. One concern, at least in the US context, is that increased trade may be associated with increased wage inequality, both within and across worker groups. Research using Canadian data on this issue is limited, and additional analysis on distributional implications for Canadian workers would be welcome.

Policy tools

Emphasize firm-level data and analysis

Recent research demonstrates that the impact of trade liberalization is significantly influenced by both the degree of heterogeneity in productivity across firms and the size of the elasticity of substitution across products in an industry. For example, Chaney (2008) demonstrates that a higher elasticity of substitution magnifies the intensive margin response but dampens the extensive margin response. He also shows that the size of the effect of a decrease in trade barriers on trade flows depends crucially on the degree of firm productivity heterogeneity within an industry. For example, using data on the distribution of US manufacturing firms, he argues that the elasticity of trade flows with respect to variable trade costs is twice as large as it would have been in the absence of firm heterogeneity. These types of theoretical results strongly suggest that to be able to quantify the predicted and actual effects of policy changes, Canadian policy-makers need estimates of industry-level variables that characterize the empirical distribution of Canadian firms and the degree of product substitutability within industries.

In addition, much of the firm- and plant-level data analysis to date uses data exclusively from manufacturing firms — indeed, much of what we know about the characteristics of firms that participate in international markets is based solely on manufacturing. However, the international activities of firms in agriculture, services, retail and other sectors are also economically important for formulating and assessing the impact of trade policy in Canada. The work on SMEs by Sui and Tapp (in this volume) represents a valuable contribution to increasing our understanding in this direction, but additional empirical research is needed. Moreover, while trade negotiations tend to focus on mature industries, the newest developments in trade theory and policy suggest that empirical attention should also be paid to emerging products, firms and industries.

In acknowledging the role of firm heterogeneity in influencing outcomes, we must also recognize that trade negotiators need access to quantitative studies based on firm- as well as industry-level data analysis to obtain information on how individual firms may be affected by changes in policy. Indeed, highly disaggregated data and a value-added approach to measuring trade flows are essential for quantitative assessments of the impact of trade liberalization policies. Although the latest developments in trade theory were driven in part by the increased availability of firm- and plant-level data, testing and applying of the ideas of the new theory to real-world policy problems in a Canadian context requires more extensive microlevel datasets and analysis. The traditional macrolevel approach to measuring the impacts of trade agreements, focusing on quantifying expansions of existing trade flows, is no longer adequate.

Develop employee-employer matched data

Much as firm-level data has helped us to better understand the mechanisms through which trade affects firms, we similarly need better matched worker-firm data in Canada to better understand how trade affects workers and different parts of the wage/income distribution. To the extent that there are important distributional impacts of trade, designing optimal trade policy is likely to become more complicated and may ultimately extend into the domains of labour markets, training and education policies.

Policy caution

Do not reward firms simply for participating in international markets

Government policies, such as tax credits, that simply reward the act of participating in international markets through exporting or importing may have only limited effects on the extensive margin and, therefore, on trade and productivity. According to the theory outlined earlier in this chapter, such a policy will disproportionately affect entry by the most productive of those firms that previously only served the domestic market. Because of government budget constraints on the feasible size of such a reward for each firm, we would generally expect a relatively minor entry response into international markets by firms.

Furthermore, such a policy, which rewards all firms for international market participation (as opposed to new entrants only), might entail significant inefficiencies because a considerable part of the payments under such a program would

tend to go to firms that would be exporting even in the absence of that policy. A more cost-effective policy to increase international participation — especially for small and medium enterprises — would be to target lowering the sunk, fixed and variable costs of international participation for all firms.

Conclusions

This chapter has discussed some developments in modern theoretical approaches to understanding international trade. The literature emphasizes the effects of trade reforms on firm, industry and aggregate productivity due to the shifting of resources within and between heterogeneous firms. These models increase our understanding of the complex, two-way relationships between trade and productivity and the varied roles of firms in international markets as exporters and importers. The new insights from a firm-based approach to trade theory, along with firm-level data, have the potential to improve a government's ability to use its suite of trade-related policies to improve economic performance.

The developments reviewed in this chapter are also beginning to increase our understanding of the distributional effects of trade policy on different groups within a country. In many recent models, trade reforms produce differential effects across firms. Furthermore, when new models relax restrictive assumptions and allow wages to vary across firms and workers due to heterogeneity, then trade liberalization can have distributional income effects that extend beyond the scope of traditional trade models.

Trade patterns have changed significantly in recent years with the growth in trade of services, increased use of global value chains and the expanded role of firms as importers of intermediates. As trade policy and trade negotiations adjust to these rapidly changing ways of conducting global commerce, firm-based approaches make the theoretical and empirical prediction of the effects of policy changes on individual and aggregate outcomes more challenging — and more important.

This continues to be an active and exciting area of research with many important and unresolved questions. To better inform policy, we need to develop more focused firm-based models of trade that capture the unique features of the Canadian economy. These include regional concerns, the importance of natural resource industries and agriculture, and the changing international production structure for Canadian firms.

Researchers are continuing to improve the empirical relevance of their theories by using firm-level data to motivate and test them. Baldwin and Yan ("Trade and Productivity") and Sui and Tapp, both in this volume, as well as Lileeva and Trefler (2010) and Trefler (2004), are important empirical contributions on Canadian firms and industries. However, more work is needed to better document the characteristics of the Canadian economy and guide policies. Improving our understanding of the intricate links between theory, data and policy is essential as researchers and policy-makers endeavour to undertake policy analysis through the lens of these new models.

Notes

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1. This literature developed primarily following the theoretical foundations of Helpman (1981), Helpman and Krugman (1985), Krugman (1980, 1979), Lancaster (1980), and Markusen (1981).
2. Eaton and Kortum (2002) have developed an influential model with productivity heterogeneities that cannot be easily classified into one of these categories. Their model is in the Ricardian style, with cross-country technological differences and perfectly competitive, constant-returns-to-scale industries. Arguably, their original model is not a firm-based model but is primarily country-based and has much in common with traditional models of trade. Subsequent papers that extend their model to include multiple heterogeneous industries producing differentiated products within industries are more in the spirit of firm-based models (Levchenko and Zhang [2014], for example). This approach is discussed in more detail later in the chapter.
3. For a more technical presentation of this model and closely related models, see Melitz and Redding (2014).
4. Any aggregate "shock" to the economy such as a change in the costs of trade will change aggregate variables and move the economy to a new equilibrium. This is the way in which this model analyzes the effects of trade liberalization.
5. In equilibrium, the expected benefit from entering the industry equals the cost of entry, so some individual firms earn accounting profits, but aggregate profits net of aggregate fixed entry costs equal zero. This implies that if all individuals hold equal shares in all firms, their net dividend income equals zero.
6. A later section discusses models in which the causality also goes in the opposite direction because exporting affects a firm's technology choices, and therefore its productivity.
7. The focus here is on multilateral rather than unilateral trade liberalization policies, as this maintains the symmetry across the two countries.
8. The fall in trade costs has no effect on the markup of price over marginal cost because the assumed structure of preferences is such that the markup depends only on the *constant* elasticity of demand.
9. Recall that the exporters in groups 3, 4 and 5 are also simultaneously selling into the domestic market.
10. The impact on product variety is unclear: the number of foreign varieties increases due to the entry of new exporters, but the number of domestic varieties falls as some domestic firms exit. Product variety usually increases, but even if it does not, the positive real wage effect dominates and individual welfare increases.
11. This occurs because a firm's prices depend only on the elasticity of demand, the wage, the firm's productivity and the variable costs of trade. Hence, a change in the fixed costs of trade will not affect an incumbent firm's prices or sales (output). However, the fall in fixed trade costs increases the expected profits from exporting and so induces export entry.
12. In addition, Bernard, Jensen, Redding and Schott (2012) provide a survey of empirical

studies that use firm-level data to document many of the facts listed here — particularly studies using US firm-level data.

13. Papers that provide evidence of these findings include Bernard, Eaton, Jensen and Kortum (2003), Bernard and Jensen (1999, 1997, 1995), Bernard, Jensen and Schott (2009), and Bernard, Jensen, Redding and Schott (2007) for US plants; Eaton, Kortum and Kramarz (2011) for French firms; Kasahara and Lapham (2013) for Chilean plants; and Lu (2010) for Chinese firms.
14. However, the baseline model does not address the correlation between a firm's export status and its factor intensities or the average wage it pays its workers.
15. The Canada-US FTA was the predecessor to the North American Free Trade Agreement (NAFTA) of 1994, created with the addition of Mexico. Evidence that increased trade shifts inputs and market share from low- to high-productivity firms within sectors is provided for other countries in Bernard, Jensen and Schott (2006) for the US; Fernandes (2007) for Colombia; Khandelwal and Topalova (2011) for India; and Pavcnik (2002) for Chile.
16. More extensive summaries of some of the theoretical developments in models of firm heterogeneity and trade can be found in Greenaway and Kneller (2007), Helpman (2006), Melitz and Redding (2014), Melitz and Trefler (2012), and Redding (2011).
17. This issue is examined in Anderson, Lööf and Johansson (2008), Amiti, Itskhoki and Konings (2014), Amiti and Konings (2007), Baldwin and Yan ("Global Value Chain Participation," in this volume), Kasahara and Lapham (2013), and Kugler and Verhoogen (2008), among others.
18. International outsourcing is explored in papers such as Antràs and Helpman (2008, 2004), Baldwin and Robert-Nicoud (2010), Caliendo and Rossi-Hansberg (2012), Grossman and Rossi-Hansberg (2008), and Ma, Van Assche and Hong (2009).
19. Papers in this area include Arkolakis and Muendler (2011), Bernard, Redding and Schott (2011), Eckel and Neary (2010), Goldberg et al. (2010), Mayer, Melitz and Ottaviano (2012), and Verhoogen (2008).
20. See Fortin et al. (2012) for Canadian trends.
21. Examples include Amiti and Davis (2012), Davis and Harrigan (2011), and Egger and Kreickemeier (2009).
22. Examples include Felbermayr, Prat and Schmerer (2011), Helpman and Itskhoki (2010), Helpman, Itskhoki and Redding (2013, 2010), and Mitra and Ranjan (2010).
23. See, for example, Attanasio, Goldberg and Pavcnik (2004), Autor, Dorn and Hanson (2013), Bernard and Jensen (1997), Firpo, Fortin and Lemieux (2011), Goldberg and Pavcnik (2007), Helpman et al. (2014), and Menezes-Filho and Muendler (2007).
24. Papers using firm-level data to estimate the effects of trade on within-group inequality include Akerman, et al. (2013), Fraís, Kaplan and Verhoogen (2012), and Helpman et al. (2014). I am unaware of papers that use Canadian firm-level data to estimate the effects of increased trade on within-group wage inequality in Canada. There is also a large literature that uses industry- and country-level data (primarily for the US) to estimate the impact of trade on across-group measures of wage inequality (typically focused on differences between high- and low-skilled workers' wages). Kurokawa (2012) provides a survey of earlier research, while more recent papers in this area include Amiti and Davis (2012) and Autor, Dorn and Hanson (2013).
25. A second industry producing a homogeneous good under perfect competition is included to improve the tractability of the model so that there are no income effects in the consumption of differentiated goods. However, this second sector is relatively unimportant for our discussion.
26. Other papers, such as Bernard, Eaton, Jensen and Kortum (2003), Feenstra (2003), and Behrens and Murata (2006), have studied models with quite different market structures that also incorporate procompetitive effects of increased trade.
27. Eaton and Kortum's model incorporates differences in productivity, but whether that

heterogeneity is at the industry level or the firm level is a matter of interpretation (the meaning of a "firm" in models with constant returns is unclear).

28. See, for example Alverez and Lucas (2007), Finicelli, Pagano and Sbracia (2013), and Levchenko and Zhang (2014).
29. Papers examining the implications of firm heterogeneity for measures of trade elasticity (among other things) include Arkolakis, Costinot and Rodríguez-Clare (2012), Chaney (2008), Crozet and Koenig (2010), Helpman, Melitz and Rubinstein (2008), and Levchenko and Zhang (2014).
30. Some theoretical and empirical papers that explore these links in the presence of firm heterogeneity include Amiti and Weinstein (2011), Greenaway, Guariglia and Kneller (2007), Manova (2013), and Minetti and Zhu (2011).
31. This approach is taken in Arkolakis (2011), Ghironi and Melitz (2007, 2005), and Ruhl and Willis (2014).
32. Albornoz et al. (2012) and Eaton et al. (2014) take the latter approach.
33. See Bernard and Jensen (1999, 1997, 1995) for evidence regarding US plants.
34. Papers that provide evidence of these findings include Bernard, Eaton, Jensen and Kortum (2003), Bernard and Jensen (1999, 1997, 1995), Bernard, Jensen and Schott (2009), and Bernard, Jensen, Redding and Schott (2007) for US plants; Eaton, Kortum and Kramarz (2011) for French firms; Kasahara and Lapham (2013) for Chilean plants; and Lu (2010) for Chinese firms.
35. Papers in this area include Aw, Roberts and Xu (2011), Baldwin and Gu (2003), Bernard, Redding and Schott (2011), Bustos (2011), De Loeker (2007), Keller (2009, 2004), Lileeva and Trefler (2010), and Pavcnik (2002).
36. For a sample of papers that document these types of firm and industry dynamics, see Bernard, Jensen, Redding and Schott (2012), Dunne, Roberts and Samuelson (1989), Eaton, Kortum and Kramarz (2011) and Kasahara and Lapham (2013).
37. Several papers examine the effects of specific trade policies in models with firm-level heterogeneity, including Abel-Koch (2013), Das, Roberts and Tybout (2007), Demidova and Rodríguez-Clare (2009), and Felbermayr, Jung and Larch (2013). Other papers, such as Baldwin and Gu (2004), Baldwin and Yan (2012), Head and Ries (1999), Kasahara and Lapham (2013), Pavnick (2002), and Trefler (2004), use plant-level data to quantify the size of trade policy impacts.
38. The dominance of extensive margin adjustments over intensive margin adjustments is a feature of some papers, such as Chaney (2008) and Lawless (2010).
39. The increased use of imported intermediates and the growth of global value chains increases the challenges associated with accurately measuring the value of trade flows. Allocating the full value of the product to the country from which it is exported to its final destination market will give an exaggerated idea of the importance of trade with that country in the presence of imported intermediates and global value chains. Trade statistics need a value-added concept of exports and imports, recognizing that imports might embody our previously exported components. Accurate measures of trade flows are essential for quantifying and predicting the effects of trade liberalization methods. Fortunately, the World Trade Organization and the Organization for Economic Co-operation and Development are formulating methods to better measure trade flows given the issues raised here, and Canadian trade and statistical agencies can benefit from and contribute to these advances in measurement (see De Backer and Miroudot, in this volume).
40. See Trefler (2004) for empirical evidence of this type of effect on Canadian manufacturing firms following the Canada-US FTA of 1988.

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