Trade and Development in a Globalized World: The Roadmap for a Research Agenda

Prepared in the context of

Cooperation in European Research in Economics Topic 11

by

Cecília Hornok

Miklós Koren

October 8, 2015

Hornok is at CERS-HAS. Koren (corresponding author) is at Central European University, CERS-HAS and CEPR and can be reached at korenm@ceu.edu. This survey has been funded by the European Union's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n° 320300 (COEURE). Koren is also grateful for funding from the European Research Council Starting Grant no 313164 (KNOWLEDGEFLOWS). The views expressed are those of the author(s) and do not necessarily reflect the views of the European Commission. We thank Pinelopi Goldberg, Pascal Lamy, Jonathan Eaton, Russell Hillberry, Riina Kerner, Paola Conconi, Hylke Vandenbussche, Lothar Ehring, Marc Auboin, Lucian Cernat, Peter Egger, Beata Javorcik, Marcel Timmer, László Mátyás and participants at the COEURE workshop at the Université Libre de Bruxelles for helpful comments. We are grateful for Andrea Kiss for excellent research assistance.

COEURE

CEU CENTRAL EUROPEAN UNIVERSITY

Executive Summary

The goal of this survey is to summarize the state of the art in research in international trade and global production, and discuss issues relevant to European policymakers. We begin by painting a portrait of Europe in the global economy and enumerating its policy challenges. Much of recent research on globalization is primarily empirical, owing to the proliferation of available data. We continue by discussing recent advances in measuring the causes and effects of globalization, and discussing the particular data challenges that have emerged. We then turn to theories of trade and global production, first summarizing the conclusions on which there is a broad consensus in the field. Next we discuss new insights that may be relevant for policymakers, and open research questions. We conclude this survey by enumerating and evaluating the tools for global policy analysis.

Research on international trade and global production is always applied in nature, so we found it natural to connect our survey of existing studies with the potential needs of policymakers. Nonetheless, we identify several areas where economics could develop to better aid policy discussion and analysis.

First, while there are many quantifiable models to evaluate the gains from trade, the welfare gains from global production sharing either via arm's length global value chains or via multinational production, are less clearly quantifiable. Understanding how multinational firms operate is a necessary first step to estimate their contribution to the costs and benefits of globalization.

Second, we think there would be a need for similar quantitative tools to assess the redistributional effects of globalization. Qualitatively, most studies point out that there will be winners and losers, but we feel we are very far from a quantitative consensus of how much income is redistributed by globalization.

Third, we need a better understanding of cross-border frictions. There is broad-based evidence that these frictions are large, but many of these cannot be captured by taxes and quotas, which are the standard tools to model them for policy analysis. We need to understand the nature of informational frictions and non-technical barriers such as lack of harmonization.

Fourth, we need more theories and measurement of the side effects of globalization. These might be positive, such as knowledge spillovers and learning by doing, but also negative such as environmental damage, laxer labor standards and consumer safety.

The following table summarizes our view of current research, highlighting the degree of consensus or the completeness of answers in four areas. Not all research can be categorized in these four areas, and we highlight exciting new directions below.

Topic	**Qualitative answers**	**Quantitative answers**	**Policy tools**
Gains from trade	consensus	several robust	well developed
Gains from global production	some	limited	some
Redistributional effects	several robust	limited	missing
Cross-border frictions	some	some	some
Side effects of globalization	some	limited	missing

Table 1. Summary of survey conclusions

We also review challenges in measurement. Recent initiatives to match data from various national sources are very promising, but the national fragmentation of data collection remains the primary data challenge facing analysts of globalization.

We conclude this survey by reviewing tools for quantitative policy analysis, including quantifiable equilibrium models, the gravity equation, structural models, natural and field experiments, and semi-structural approaches. We list below the challenges we identified for measurement, theory and policy analysis.

Challenges for measurement

1. Harmonize firm-level trade and balance sheet data across countries.
2. Develop statistical methods and computational tools to work with multidimensional data.
3. Develop new datasets on workers within firms, while ensuring privacy and consistency across studies.
4. Build harmonized firm-level data on services trade.
5. Collect data on buyer-supplier links within the EU.
6. Link national administrative data, harmonize data collection and reporting.
7. Synthesize research based on ad-hoc proprietary data.
8. Construct international input-output accounts from the ground up.

Challenges for theory

9. Reconcile model-based and reduced-form estimates of gains from trade.
10. Identify losers from globalization and quantify their losses.
11. Understand and quantify non-tax, non-quota frictions in trade.
12. Develop a toolbox for quantitative analysis of redistribution.
13. Understand and quantify the effects of standards and harmonization on trade and welfare.
14. Build a quantitative theory of supply-chain trade.
15. Build a quantitative theory of multinationals.
16. Reconcile macroeconomic calibrations with microeconomic evidence.

Challenges for policy analysis

17. Model trade adjustment dynamics in the gravity equation.
18. Identify natural and field experiments that can inform broad questions about trade theory and policy.
19. Extend semi-structural welfare analysis to non-tax frictions.

Table of contents

- Executive Summary
  - Challenges for Measurement
  - Challenges for Theory
  - Challenges for Policy Analysis
- Table of contents
- Introduction
- 1. A portrait of Europe in the global economy
  - 1.1. Current patterns in trade and global production
  - 1.2. Trends and anticipated changes
- 2. European policy challenges
- 3. Advances in measurement and data challenges
  - 3.1. Recent advances in measuring the causes and effects of globalization
    - 3.1.1. Firm-level measurement of trade flows and competitiveness
    - 3.1.2. Multidimensional trade data
    - 3.1.3. Using linked employer-employee data
    - 3.1.4. Trade in services
    - 3.1.5. Matched buyer-seller data
  - 3.2. Data challenges
    - 3.2.1. Data collection is fragmented across countries
    - 3.2.2. Collecting data within the firm is difficult
    - 3.2.3. Measuring trade and competitiveness in value added terms
- 4. Insights from theories of globalization
  - 4.1. Broad lessons about the causes and effects of globalization
    - 4.1.1. Gains from trade
    - 4.1.2. Distributional effects of globalization
    - 4.1.3. Cross-border frictions are large
  - 4.2. Insights for policy
    - 4.2.1. Traders are few and special
    - 4.2.2. Imports are important
    - 4.2.3. Multilateral agreements prevent trade wars
  - 4.3. Open questions
    - 4.3.1. How big are the redistributive effects of globalization?
    - 4.3.2. What are the side effects of globalization?
    - 4.3.3. What are the deep causes of cross-border frictions?
    - 4.3.4. How does supply-chain trade differ from traditional trade?
    - 4.3.5. What do multinational firms do?
- 5. Tools for quantitative policy analysis
  - 5.1. Quantifiable equilibrium models
  - 5.2. The gravity equation
  - 5.3. Structural models with lots of heterogeneity
  - 5.4. Natural and field experiments

5.5. Semi-structural approaches
6. Conclusion
References

Introduction

The fortune of workers, consumers and firms increasingly depends on what is going on in other countries. This global interdependence is driven by the flow of goods, capital, ideas and people across countries. This survey summarizes research about two aspects of globalization: international trade in goods and services, and the international fragmentation of production. We first summarize the overarching themes that are common to both topics. We conclude with a set of open questions, and propose an agenda for better connecting academic research with the needs of policy making. We also discuss data challenges facing economists and policymakers alike, and give a brief evaluations of various policy tools available for quantitative analysis.

The primary motivation of theories of globalization is to explain how international interactions differ from domestic interactions, and why they occur in the first place. Why do countries trade goods with one another? Why do some companies locate part of their production abroad? Canonical models of trade and globalization explain the magnitude and patterns of cross-country movements, and their welfare implications. An almost tautological conclusion of these models is that if countries choose to interact with one another, they have to be better off than being in isolation. Models may differ in the magnitude of the gains from trade they predict, but these gains are almost uniformly positive.

An overarching theme is that globalization benefits some more than others. In fact, some may even become worse off as their country becomes more open to the flow of goods, ideas, and people. For example, workers in import-competing industries stand to lose when countries open up to trade. These distributional effects of globalization are widely studied both theoretically and empirically.

Increased globalization, as any change in the economic environment, may have side effects on workers, consumers, and firms. Globalization may also interact with domestic market failures and externalities. It may challenge the national standards of consumer and worker protection and encourage cross-border harmonization. The impact of trade on labor standards and on the environment are particularly widely discussed. Other mechanisms include a change in competitive pressures and knowledge spillovers, such as learning by doing. These mechanisms all qualify the generally positive attitude of economists towards globalization. However, a toolbox for quantitative analysis of the side effects of globalization is still lacking.

Economists find it difficult to give definite answers to European policy challenges partly because the remaining policy barriers to cross-border transactions are difficult to quantify. The standard economics toolbox works with taxes and quotas. Advances in measurement and unifying theories have made it possible to robustly quantify the effects of such taxes and quotas with minimal theoretical assumptions. Less is known, however, about the role of non-tariff and non-quota barriers such as regulations and standards in limiting the side effects of globalization. We need to understand the costs of non-tariff barriers in limiting international transactions, but also their potential benefits in solving market failures. For example, most analysis of the Transatlantic Trade and Investment Partnership and similar agreements can say little about the effect of harmonized regulation and the investment dispute settlement mechanism, the key ingredients of the TTIP and other such deep agreements.

Given the scope of the task and the limited space, our survey is admittedly very selective. We have selected topics that we think are both important for European policy and are well covered in academic research. We have omitted some basic research that may be very influential in shaping our views and future work, but that are not in the forefront of current policy debate in Europe. We also do not discuss the topic of financial integration and international migration, which are the subject of other surveys. The survey "Cities, regional development and transport" complements our survey by studying agglomeration and location choices of firms as well as intra-EU regional development.

Even among the topics we cover, our discussion can only scratch the surface of the academic debate. We did not intend to (and certainly could not) give a comprehensive survey in all the topics. Instead, we just summarized the consensus if there is one, and judiciously discussed the open questions. We have relied on several excellent recent surveys of the literature (J. E. Anderson and Van Wincoop 2004; Pinelopi K. Goldberg and Pavcnik 2007a; Harrison 2007; J. E. Rauch 2001; Antràs and Rossi-Hansberg 2009; Yeaple 2013; M. J. Melitz and Trefler 2012; Johnson 2014; Andrew B. Bernard et al. 2007; G. Gopinath, E. Helpman, K. Rogoff 2014; E. Helpman, D. Marin, T. Verdier 2008; B. M. Hoekman and Javorcik 2006; O'Rourke and Williamson 1999; Andrew B. Bernard, Jensen, et al. 2012). When necessary, we tried to highlight the key papers, but often just refer to the conclusions of these surveys. Readers who want to follow up on any of the academic topics should turn to these surveys.

1. A portrait of Europe in the global economy

The 28 countries of the European Union (EU) are home to about 500 million people, 7 percent of world population. These countries together produced 24 percent of global GDP in 2013 (International Monetary Fund 2015). The EU is a large and well developed region of the world, tightly integrated in the global economy, specializing in advanced technology industries and financial services. It is also the largest economic union among sovereign countries. In this section, we paint the portrait of the European Union as a participant of the global economy.

1.1. Current patterns in trade and global production

Merchandise exports from the EU to non-EU countries constituted 15 percent of global trade in 2013 (European Commission 2015). This is higher than the 13.7 percent export share of China and the 12.9 share of the United States. Including services, the share of EU in global trade is even higher at 16.4 percent.

EU countries mostly trade with other EU countries. Almost two thirds of total exports from EU member countries have a destination within the EU. Also including this internal trade among EU members, the share of EU countries in global merchandise exports is 32 percent.

The two biggest trade partners of the EU are the United States and China. These two countries account for 28 percent of extra-EU merchandise exports and 30 percent of extra-EU merchandise imports. The European trade policy stance is shaped in relation to these two major trading partners.

The primary export commodities of the EU are machinery and transport equipment, accounting for 42 percent of extra-EU exports in 2014. Exports of non-fuel chemicals are also important: their share is 16 percent. Other miscellaneous manufactures account for most the of the remaining exports.

Merchandise imports are similarly distributed across commodities. The main difference is that a large share of imports (26 percent) is spent on mineral fuels, and the shares of other commodities are correspondingly smaller. This fact is a reflection of the relative fuel scarcity of Europe. Because this issue is discussed in more detail in the survey on "Energy, Environment and Sustainability," we do not devote special attention to energy trade in this survey.

Services are also important in the export basket of the EU. The 2013 value of extra-EU service exports was 710bn euros, making up 29 percent of total extra-EU exports. In 2013, the EU exported more than twice the value in financial and insurance services (EUR 105bn) than it imported (EUR 41bn). Exports of telecom, computer and information services were 72 percent higher than imports of such services. Other large service categories, such as travel, transport and business support services remained largely balanced in exports and imports.

To gauge Europe's position in the global value chain, we look at the amount of value added (GVC income) Europe is contributing to global production. (These figures are from Timmer et al. 2013.) As a fraction of global production of manufactures, the 27 members of the EU contributed 27 percent of value added in 2011. This is somewhat lower than Europe's share in the gross value of merchandise trade. The EU share in GVC income is higher than that of members of the North American Free Trade Agreement (NAFTA) (20 percent) and China (17 percent).

Looking at the distribution of GVC income across sectors and comparing it to the rest of the world, Europe has a comparative advantage in machinery, transport equipment and chemicals. (See Figure 2 below.) It is less competitive in electronics, food and non-durable production.

In 2008, there were about 50 million jobs in the EU directly or indirectly associated with producing manufactures for the global economy. As a share of all workers, they accounted for about 22 percent. This is higher than the number of export jobs reported by the European Commission (2015) (31 million and 14 percent), because some workers are indirectly contributing to producing export goods, for example, in the service sector.

The global integration of Europe is also reflected in the patterns of cross-border ownership of firms. The global linkages via FDI are even stronger than those via trade. Europe is both a source and a target of investment. Inward stocks of foreign direct investment (FDI) in the EU amounted to EUR 3.8 trillion, 21 percent of global FDI stock. This is about the level of the United States, which is host to EUR 3.7 trillion worth of inward FDI. European investors have an even higher propensity to invest outside the EU. Outward FDI stock from the EU amounted to EUR 4.9 trillion (again close to the U.S. level of EUR 4.8 trillion), contributing a quarter of global FDI stock.

1.2. Trends and anticipated changes

The export share of the EU has been steadily declining in the last decades. Between 2004 and 2013, it has decreased from 18 percent to 15 percent. The United States and Japan have seen similar declines, mostly at the expense of China and India.

In terms of GVC income, the EU has suffered similar losses in market share relative to China and India, especially since the Great Recession in 2008. (See Figure 1.) The share of global GVC income generated

in Europe declined from 32 percent in 1995 to 24 percent in 2011. During the same period, the combined share of China, India, Brazil, Russia, Indonesia, Australia and Turkey has grown from 13 percent to 31 percent.

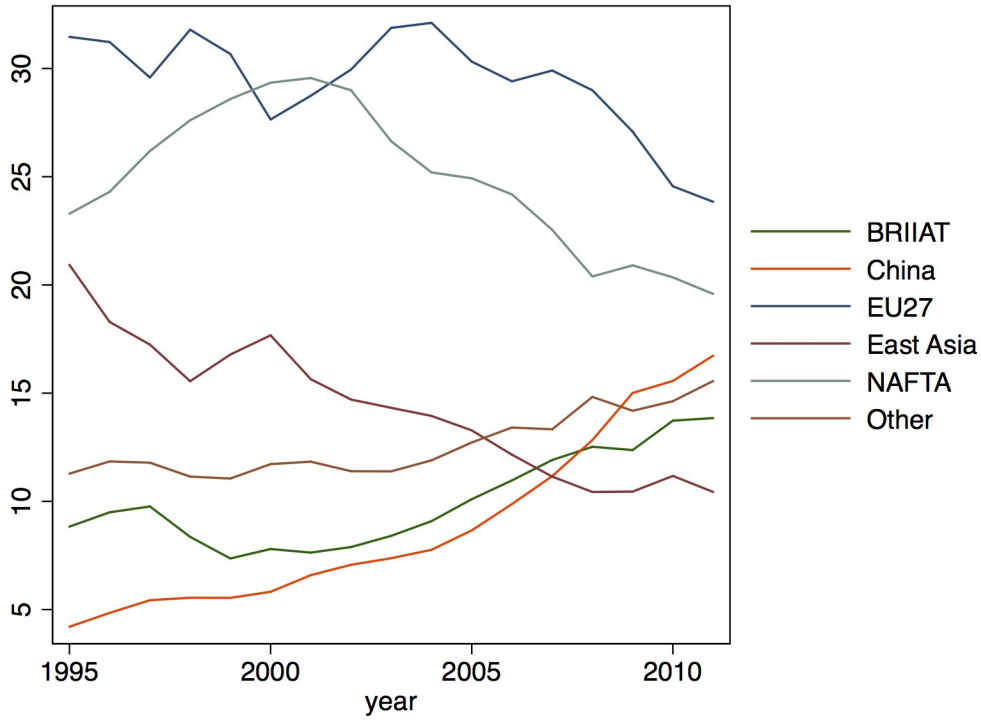

Figure 1. Regional share in world GVC income
Source: Timmer et al. 2013: 634

This trend is likely to continue. According to the World Trade Monitor (CPB Netherlands 2015), in 2014, exports of the Euro area grew only by 1 percent relative to the year before. This is in contrast to the 5.7 percent export growth in emerging Asia. It seems that Europe is losing competitiveness relative to China and other emerging Asian countries.

Figure 2 shows the revealed comparative advantage of Europe across sectors between 1995 and 2011. This indicator is calculated as the sectoral share of GVC income in Europe divided by the sectoral share in the average country. If the indicator is above one, Europe is contributing relatively more to global production in that particular sector. Lower numbers suggest lower competitiveness.

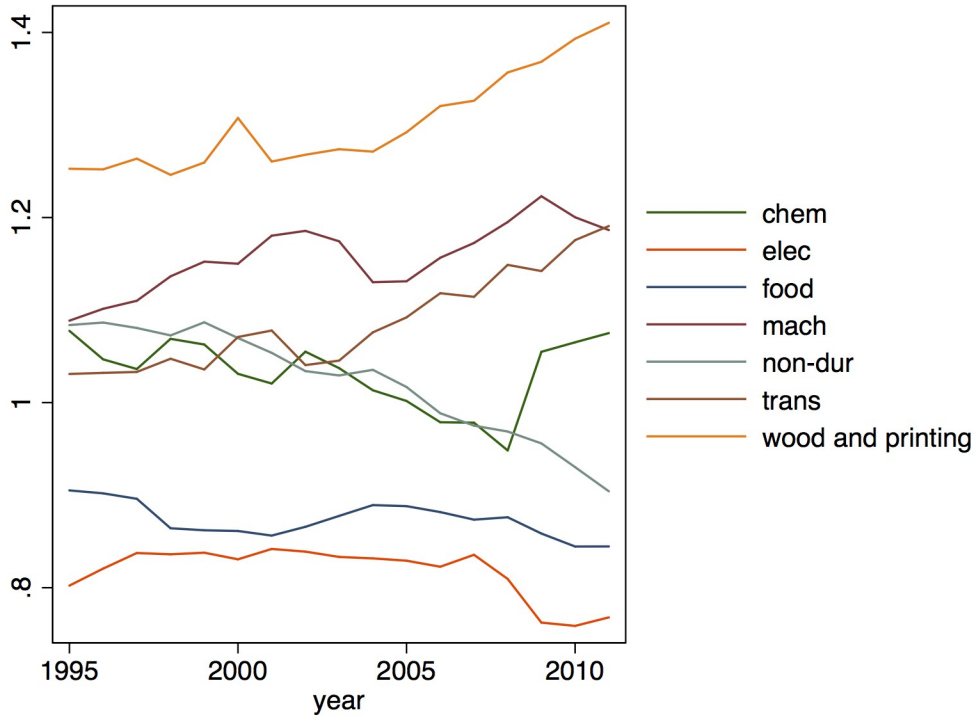

Figure 2. Revealed comparative advantage of the EU
Source: Timmer et al. 2013: 643

Revealed comparative advantage has almost steadily increased in machinery and transport equipment. Competitiveness in the chemical sector has declined until 2008, but has sharply increased since the Great Recession. Europe has steadily lost competitiveness in other non-durable products such as textiles. Electronics and food products have never been particularly competitive as indicated by their low revealed comparative advantage.

The number of GVC jobs associated with global manufactures production has declined in Europe by 3 percent between 1995 and 2008 (Timmer et al. 2013 Table 5). This slight decline masks substantial change across sectors. Services jobs associated with manufacturing for the global market have actually increased by 21 percent. Manufacturing export jobs have declined by 11 percent, agricultural exports jobs (associated with manufactured products) declined by 35 percent.

This increased role of services in global production is parallel to an increase in the demand for skilled workers. The total demand for European high-skill workers from global manufacturing has increased by 58 percent between 1995 and 2008 (Timmer et al. 2013 Table 6). This trend contributed to increased inequality of income and opportunities across workers, with low-skilled workers on the losing side.

2. European policy challenges

One challenge currently facing European trade policy is the formation of the Transatlantic Trade and Investment Partnership (TTIP) with the United States. Since tariffs in the EU-US trade are generally small, the focus of TTIP is on non-tariff barriers, most importantly standards and regulations. Unlike tariff

liberalization, trade research offers much less insight regarding the nature and magnitude of these latter types of trade policy barriers.

Eliminating trade frictions that stem from standards and regulation is also a more complex task than reducing tariffs or getting rid of quotas. Safety standards or environmental regulations are important means of consumer protection and not to be eliminated. Trade liberalization has to focus instead on reducing the cross-country differences in these measures and the way they are administered. This is going to be a sensitive task, where decision makers have to take into account national preferences in a democratic and transparent way. Meanwhile consumers in either country have to be assured that regulatory harmonization will not lead to an erosion of the level of national precaution (Lamy 2015).

Given these novel challenges, trade research has so far struggled to assess the likely economic impact of TTIP. Studies which transform the liberalization measures under TTIP into tariff equivalent terms and use CGE models find relatively small economic gains even under ambitious scenarios (Berden et al. 2009; Francois et al. 2013; Lionel Fontagné 2013; G. Felbermayr, Jung, and Larch 2013). For example, assuming complete tariff elimination and 25% reduction in non-tariff frictions, Francois et al. 2013 project roughly 0.5% GDP gain in ten years for both the EU and the US. In contrast, researchers who build on historical case studies like the formation of the EU internal market (Felbermayr et al., 2013) or earlier sectoral examples of standards harmonization (Simon J. Evenett M. Sait Akman, Patrick Low 2015; Gabriel Felbermayr et al. 2015; Freund and Oliver 2013) predict substantially larger economic gains.

Another issue is how TTIP (and similar bilateral deep agreements) will affect third countries. Though the above studies agree that TTIP will bring net gains for the world economy as a whole, there are concerns that some third countries can be affected adversely. This can happen through trade diversion or by eroding the current trade preferences of third countries on EU or US markets. There is also a risk that less developed countries will not be able to comply with the newly agreed standards and regulations or they will lose competitiveness due to increased production costs.

One of the main policy objectives of the European Commission is to foster the development of poorer countries around the world by giving them preferential access to European markets (Malmström 2015). The EU is indeed the world's largest importer of developing country products. How European trade policy can address the above concerns and make TTIP and other future deep agreements as inclusive for third countries as possible is still subject to intense debate (Simon J. Evenett M. Sait Akman, Patrick Low 2015; Gabriel Felbermayr et al. 2015.) We review below the theories and evidence on the gains from trade and the redistributional effects of globalization.

It is also a key question how Europe participates in the global supply chains and, in particular, whether it can compete with "Factory Asia" and "Factory America." We discuss measurement of supply chain trade, evaluate related theories, and argue for more quantitative analysis in this area.

3. Advances in measurement and data challenges

Data on international transactions is collected differently from domestic data, which both helps and hurts empirical analysis. On the one hand, international transactions are often more likely to leave a paper trail

than domestic ones. Historically, many countries relied on tariffs as an easy-to-collect source of government revenue, and built and maintained customs administrations to collect information about shipments and levy the appropriate taxes. This put unparalleled richness of data in the hands of governments, which then became available for economic research. On the other hand, the fact that customs administrations and statistical bureaus have no jurisdiction outside their sovereign borders limits their ability to collect good quality data on international flows.

3.1. Recent advances in measuring the causes and effects of globalization

3.1.1. Firm-level measurement of trade flows and competitiveness

The importance of firm-level information for understanding the causes and effect of globalization has been recognized for long. Firm-level data from balance sheets, earnings statements, customs records or surveys have become increasingly available in several countries throughout the past two decades. This led to a rich empirical literature, starting with the papers of A. B. Bernard, Jensen, and Lawrence 1995; Andrew B. Bernard and Bradford Jensen 1999, on the performance distribution of firms within countries and industries and on how the performance of firms relate to international involvement through trade or FDI.

Most related research on European firms, a recent assessment of which is provided by Wagner 2012, feature data on individual countries. A more systematic approach is of Mayer and Ottaviano 2007, who look at firm-level data from seven European countries. More recently, two EU-wide research projects (EFIGE, CompNet) generated internationally comparable data. Findings from the EFIGE firm-level survey in seven – mostly major – EU countries are assessed e.g. by Navaretti et al. 2011, while Berthou et al. 2015 discuss evidence from the CompNet firm-level panel of 15 EU countries.

The major findings prove to be remarkably robust across countries, industries and databases. First, firms are very heterogeneous in their performance measures even within narrowly defined industries. Second, this heterogeneity is to a significant extent explained by the international activity. Internationalized firms are larger both in terms of number of employees and sales, they are more productive and more capital and skill intensive than firms operating only on the domestic market. Third, the bulk of exports in any given country is usually generated by a handful of very big exporters, which at the same time also heavily import intermediate inputs.

Firm-level data is also increasingly used for policy analysis (Lucian Cernat 2014). This is helpful not only to identify the heterogeneous effects of trade policy on idividual firms, but also to better quantify the aggregate effects of policy. To understand aggregate effects, we need to rely on industry and macroeconomic models (discussed in Section 4), in particular, quantifiable equilibrium models (Section 5.1).

Challenge 1: Harmonize firm-level trade and balance sheet data across countries.

3.1.2. Multidimensional trade data

Recent empirical work has used customs transactions data to analyze the patterns of trade. The availability of such data has opened up to possibility to ask questions beyond the volume of trade and its

broad sectoral composition. A typical customs declaration (which serves as the primary unit of observation for most trade statistics) records the exporting and the importing firm, the precise classification of the product being shipped, the precise date of shipments, the mode of transport, and many other logistical details about shipment. This has made it possible, for example, to study the distribution of trade across products, destination markets and firms.

Bernard et al. 2007 survey the empirical evidence on multi-product and multi-country traders. They find that although most exporters (40 percent of the total) sell only one product to one destination, most exports are done by large multi-product, multi-destination exporters. The number of products and firms shipping to a particular market increases with market size and decreases with distance. Similar patterns emerge for imports.

Armenter and Koren 2014 caution that patterns in multidimensional trade data may be difficult to interpret because such data is sparse. That is, there are few observations relative to the number of product, firm, and country categories. In the year they study, 2005, the number of U.S. export shipments was about 22 million. Each of these 22 million observations belong to one of 167,217 firms, one of 8,867 products, and one of 229 destination countries, a total of almost 340 billion possible distinct categories. Clearly, with the number of categories exceeding the number of observations by four orders of magnitude, it is not surprising that not every firm exports every product to every country. (To observe such a pattern, we would need at least 340 billion observations, that is, about 16 thousand years worth of trade data.)

What is the quantitative relevance of the sparsity of trade data? Armenter and Koren 2014 build a statistical benchmark (which can be thought of as a special case of a wide class of economic models), in which trade shipments are “randomly” assigned to trade categories. The randomness is conditional on the size distribution of firms, countries, and products, so it does not imply that exporters behave erratically. Such a “balls-and-bins” model can quantitatively fit many of the statistics reported about the number exported products, exporting firms, and export destinations. For example, in the balls-and-bins benchmark, 72 percent of country-product exports are expected to go missing; the corresponding number in the data is 82 percent. However, given that many models are consistent with the balls-and-bins framework, we cannot distinguish among them on the basis of such simple statistics.

This issue becomes more severe as the number of dimensions increases without a corresponding increase in the number of observations. To see why, suppose that a new dataset also records the exact date of exports, one of 365 days of the year. The potential classifications (firms, products, countries and days) have increased to 124 *trillion* categories, or about 6 million times as much as the annual number of observations. The null hypothesis that every firm ships every product everywhere all the time clearly becomes untenable.

We hence need new statistical methods to deal with large multidimensional trade datasets. Armenter and Koren 2014 do not offer a universal tool, but their reliance on the statistical properties of the multinomial distribution may be a useful starting point for further analysis. A more structural approach is followed by Eaton et al. 2012 and Armenter and Koren 2013, who build trade models with infrequent purchases.

We note that customs data is very similar to transactional data collected by many businesses. Each transaction is characterized by many categorical variables ("dimensions") and few quantitative variables ("measures" or "facts"). The data can then be effectively represented by a star schema, where each fact is linked to its many dimensions. For example, an export of "$12,300" might have been of product "841012", from firm "Karbaldehid Ltd," going to firm "Chemicals Plc" in country "UK", leaving on "2014-01-03". Here, the value is the fact that we are usually after, all the other variables are dimensions that we often aggregate according to the need of the analysis. For example, we can sum all the exports of a firm by country in a given year.

We think this analogy to a business analytics schema is potentially useful, because there are well developed tools and methods to analyze transactional data with a star schema (for example, data cubes in Gray et al. 1997). Yet, we are not aware of any empirical work exploiting this nature of trade data.

The multi-dimensionality of most databases on international transactions (trade, investment, etc.) poses a challenge also in empirical applications. Panels of bilateral trade flows have at least three dimensions, while more detailed (micro) databases potentially more. Most empirical applications of the gravity equation on panel data, for example, include multiple sets of fixed effects to control for country, time, or country-pair unobservables. With large data, estimating out lots of fixed effects can become difficult or even practically impossible. To help overcome this problem Balázsi, Mátyás and Wansbeek 2014 derive, both for balanced and unbalanced data, the within transformations for several fixed effects models, while Mátyás, Hornok and Pus 2012; 2013 propose random effects estimation and derive the appropriate estimators.

A related estimation issue stems from the paired or dyadic nature of trade data. Models of dyadic data have a complex pattern of error correlations, for which the standard cluster-robust variance estimator is inadequate. More recently, Aronow, Samii and Assenova 2013 and Cameron and Miller 2013 developed cluster-robust variance estimators, which control for such dyadic error correlation.

Challenge 2: Develop statistical methods and computational tools to work with multidimensional data.

3.1.3. Using linked employer-employee data

Firm-level data had made it possible to analyze how differently firms behave in an industry. Recently, worker-level data permits us to go even deeper, and see how workers are affected within a firm.

The emergence of linked employer-employee datasets (LEEDs) (see Abowd and Kramarz 1999) has spurred a fast-growing research on the effect of trade, FDI and other modes of globalization on worker-level outcomes, such as wages and employment probabilities. This is useful, because it helps us understand the distributional effects of globalization more deeply.

The value added of LEEDs relative to firm-level studies is two-fold. First, they help measure the heterogeneity of responses by different worker types. In a typical research design, some firms are exposed to globalization, some firms are not, and the researchers study the evolution of wages for different classes of workers within the firm. For example, Frias et al. 2012 estimate the effect of increased exports by

Mexican firms after the 1994 peso devaluation on the wages of workers at these firms. They find that workers at the bottom of the wage distribution are not affected, but higher ranked workers see wage increases. That is, exports contribute to an increase in *within-firm* wage inequality. This would be impossible to measure with just firm-level data. See Schank, Schnabel, and Wagner 2007; Krishna, Poole, and Senses 2011; Baumgarten 2013 and D. Hummels et al. 2014 for studies with similar designs.

A second contribution of LEEDs is that we can measure the exposure to globalization directly at the worker level. Koren and Csillag 2011 use a Hungarian LEED to estimate the effect of machine imports on the wages of machine operators. Crucially, knowing the precise product classification of machines and the precise occupation classification of workers, they can identify which workers are directly exposed to machine imports. For example, importing a new printing machine should affect the printing machine operator, but not the forklift driver. Koren and Csillag 2011 find that this is indeed the case and operators exposed to imported machines receive higher wages.

We expect that even richer proprietary datasets within the firm will help us paint an even richer picture of the microeconomic effects of globalization.

Challenge 3: Develop new datasets on workers within firms, while ensuring privacy and consistency across studies.

3.1.4. Trade in services

Recently there have been important advances in the research of services trade, although – compared with merchandize trade – this field is still largely understudied. Services were earlier treated by economists as non-tradables, as they typically require the physical proximity of the consumer and the service provider. Recent advances in information and communication technologies, however, have made several services "disembodied" and enabled their cross-border trade. Where proximity is still important, international trade can take the form of sales through foreign affiliates or the (temporary) movement of persons.

Services are increasingly traded internationally. The EU is the largest exporter and importer of services in the world. The majority of the world services trade occurs inside the EU, while extra-EU trade in services is also substantial. In 2013 services accounted for roughly a quarter of the total extra-EU trade (Eurostat 2014).

Services are traded not only directly but also indirectly as components of traded manufactured product in the form of e.g. transport, telecommunication, banking, or retail services. According to an OECD estimate, the services value added content of exported manufactured goods is 20-30 percent. Hence, the liberalization of services trade, as long as it leads to cheaper, better quality services, can also improve the competitiveness of the manufacturing sector (see empirical evidence from Arnold et al. 2011 on the Czech Republic and Arnold et al. 2012 on India).

No distinct theory has been developed for understanding trade in services. Some argue that the existing theories of trade in goods and FDI can be applied to services trade as well, once we re-interpret transportation costs as costs associated with the need for geographical proximity (Francois and Hoekman 2010). The cost of this proximity burden in services is likely to be larger than the cost of distance in goods

trade. Anderson, Milot and Yotov 2014 find that geographical barriers alone reduce international services trade seven times more than goods trade. This finding is in accordance with the fact that services trade is mostly carried out via foreign affiliate sales (based on US data).

Recent firm-level studies on several large EU economies reveal important similarities between goods and services trade on the micro level (Breinlich and Criscuolo 2011; Federico and Tosti 2012; Kelle et al. 2013; Temouri, Vogel, and Wagner 2013). Like trade in goods, trade in services is also concentrated among a small group of traders. These firms are typically larger, more productive and pay higher wages than other firms. The most productive service exporters tend to be parts of multinational enterprises and export via foreign affiliates. All this suggests that self-selection through productivity into trading and FDI is also present in trade in services.

An important difference between goods and services trade is that most barriers to services trade are of regulatory nature. Service sectors are typically heavily regulated by national authorities (e.g. due to natural monopolies, asymmetric information, or equity concerns). To the extent that these regulations are different across countries or discriminatory to foreign providers, they can act as barriers to all forms of services trade (cross-border, FDI or movement of people). Drawing on policy experience with the WTO's General Agreement on Trade in Services (GATS) and other bilateral liberalization efforts, Hoekman and Mattoo 2013 emphasize that services trade liberalization cannot be separated from regulatory reform and international regulatory harmonization. The interaction between services trade policies and regulation is an important topic for future research.

During the recent years much has been done to overcome the serious data limitations in the field of trade in services. Bilateral service flow data from several different sources have been consolidated in a global database (Francois, Pindyuk, and Woerz 2009). Firm-level data on services trade are available for more and more countries. Information on barriers to services trade are summarized in two large-scale projects, the World Bank's Services Trade Restrictions Database (STRD) (World Bank 2015; Borchert, Mattoo, and Gootiiz 2012a; 2012b) and the OECD's Services Trade Restrictiveness Index (STRI) (OECD 2015). Nevertheless, there is still a lot to be done in the future to build and maintain comprehensive and reliable databases in this field.

Challenge 4: Build harmonized firm-level data on services trade.

3.1.5. Matched buyer-seller data

Just as data on individual firms revolutionized research in international trade, recently emerging data on individual transactions and buyer-supplier linkages will also have a big impact. Most theoretical frameworks, even when they deal with business-to-business transactions, treat one side of the market as anonymous. In these models, exporters sell to many anonymous buyers, and importers buy from many anonymous sellers. In reality, however, most firms are only linked with few buyers and few suppliers.

Understanding the nature of buyer-supplier linkages is crucial for two reasons. First, firms differ in their set of buyers and set of suppliers, and this heterogeneity may contribute to heterogeneity in performance (Eaton et al. 2013). We want to understand how firms with few and many links behave differently.

Second, the structure of the network may affect the behavior of the entire economic system (Acemoglu et al. 2012).

Bernard et al. 2014 analyze a novel two-sided dataset on trade. Using transaction-level trade data from Norway, they identify buying and selling firms, and document a number of facts about the distribution of trade flows across buyers and sellers. First, there is substantial variation in the number of buyers per seller. Most firms sell to a single buyer, but large firms sell to many buyers. Second, the distribution of sales across buyers does not vary systematically with firm size. Third, larger buyers sell to, on average, smaller sellers.

Carballo et al. 2013 study a similar buyer-seller dataset for Costa Rica, Ecuador and Uruguay. They show how the number of buyers varies across destination markets. Firms have more buyers in large and close markets. In markets with tougher competition, the distribution of sales is more skewed towards the largest buyer. Carballo et al. 2013 also build a model to show that increased international openness to competition leads to selection and reallocation across buyer-supplier relationships, increasing productivity and welfare.

Data on buyer-supplier links is also (if not more) difficult to obtain for domestic transactions. Bernard et al. 2014 work with a unique Japanese dataset, showing that the average firm has 4.9 suppliers and 5.6 (business) customers. They also study the geographic distribution of suppliers.

We discuss the theoretical questions raised by this new empirical work on buyer-supplier links in Section 4.3.4.

Challenge 5: Collect data on buyer-supplier links within the EU.

3.2. Data challenges

3.2.1. Data collection is fragmented across countries

To study globalization, it is important to have internationally comparable data, and to follow transactions outside country borders. The European Union is closer to this ideal than other free trade areas would be, as Eurostat coordinates the development, production and dissemination of European statistics (Eurostat 2011). However, most data wealth is still held by national statistical agencies.

There are several recent advances to improve data harmonization and data matching across countries. Lopez-Garcia et al. 2014 and Berthou et al. 2015 describe the CompNet project, which collects firm-level indicators of competitiveness across European countries in a harmonized manner. Researchers have also matched various datasets necessary for analysis. Andrew B. Bernard, Blanchard, et al. 2012 and Andrew B. Bernard, van Beveren, and Vandenbussche 2012 matched trade and production data for Belgium. Bernard et al. 2014 identify individual buyers of all exporters and sellers of all importers in Norway, which could serve as a first step to match this data with statistics outside Norway. Carballo et al. 2013 similarly identify buyers of exporters in Costa Rica, Ecuador and Uruguay. However, such matched data is not widely available for research.

Challenge 6: Link national administrative data, harmonize data collection and reporting.

3.2.2. Collecting data within the firm is difficult

A large fraction of global transactions are carried out by multinationals (Yeaple 2013). Correspondingly, economists have started to study the motivation of multinationals to keep production in house, rather than sourcing inputs at arm's length. (See Antràs and Rossi-Hansberg 2009 for a review.) Understanding the behavior of multinationals demands access to within-firm data: where foreign affiliates are located, how much they sell in various markets, what their transactions are with the parents. We only know of a few such datasets.

First, confidential microdata collected by the U.S. Bureau of Economic Analysis on Direct Investment and Multinational Enterprises is used by many researchers surveyed in Yeaple 2013. Second, the Deutsche Bundesbank collects and maintains the Microdatabase on Direct Investment of German parent companies (Lipponer 2006). Third, proprietary datasets published by private sector vendors have also been used in research: WorldBase published by Dun and Bradstreet (Alfaro and Chen 2014), or Orbis, published by Bureau van Dijk (Alfaro and Chen 2012).

We expect more reliance on private-sector data and within-firm case studies to inform the theories of multinationals.

Challenge 7: Synthesize research based on ad-hoc proprietary data.

3.2.3. Measuring trade and competitiveness in value added terms

The fragmentation of data collection across countries also makes it difficult to identify the real contribution of countries to global value added. The key challenge is that international trade is recorded in gross output terms, which do not necessarily reflect the local contribution of a country accurately. For example, a car assembly plant in Hungary might export to Germany. Exports are recorded as the total value of the car exported, whereas the Hungarian value added is but just a fraction of that value.

National statistical offices compile input-output tables to track how value is added along the supply chain within the country. Johnson 2014 summarizes recent efforts by researchers to estimate a similar global input-output table that also takes account of global trade flows. One such database is the GTAP (Global Global Trade Analysis Project) Database, which Koopman et al. (2014) used to break up country gross export into value added components. A more recently compiled and publicly available database is the World Input Output Database (Stehrer et al. 2014), which also has a full time series dimension.

The basic fact is that trade in value added is about 25 percent less than trade in gross output. Patterns of value added trade also differ in subtle ways from patterns of gross output trade. For example, in terms of value added, services are about as traded as manufactures. In fact, the final price of many high end manufacturing products includes a substantial portion of services, such as design and marketing. Second, some countries add relatively more value to their exports than others. Value added exports of Taiwan are about half of its gross exports, whereas for Brazil this ratio is 86 percent (Johnson 2014).

Timmer et al. 2013 discuss how measurement of value added trade affects our view on European competitiveness. They develop a measure of global value chain (GVC) income and GVC employment, as the value added that come from directly or indirectly from exporting manufactured goods, and the jobs that are directly or indirectly contributing to these goods. They show that GVC income grew slower in Europe than gross exports, that GVC income is biased towards services, increasingly over time, and that GVC jobs are increasingly higher and higher skilled.

Challenge 8: Construct international input-output accounts from the ground up.

4. Insights from theories of globalization

This section discusses the insights from theories of international trade and the international fragmentation of production. We first report broad lessons about the causes and effects of globalization, lessons in which there is a consensus among scientists, then discuss open questions.

4.1. Broad lessons about the causes and effects of globalization

The first such lesson is that countries gain when they open up to trade. There is an almost universal consensus among economists about this qualitative statement. We have also developed a thorough quantitative understanding of the gains from trade.

The second lesson is that trade always redistributes income. Some industries, some firms and some workers will gain, while others will lose. This is again a robust finding across many theories, although the qualitative consensus may not be as apparent as in the case of gains from trade. Moreover, a quantitative assessment of the redistributive effects of trade is still inadequate.

The third lesson is that frictions associated with cross-border transactions are quantitatively important to understand the patterns of trade. These frictions are typically modeled as ad-valorem taxes and other proportional costs of trading, but we discuss other approaches, too. We believe that a better qualitative and quantitative understanding of international frictions is essential for better policy analysis.

4.1.1. Gains from trade

Classical and neoclassical economics states that countries gain from trade because they can specialize according to their comparative advantage. If the country can produce more of what it produces cheaply, and consume more of what it produces expensively, its residents have to better off.

This basic result in trade theory can be derived with minimal assumptions about the structure of the economy other than what is usual in neoclassical economics: perfect competition and constant returns to scale (see, for example, Dixit and Norman 1980). Notably, it does not matter whether countries trade because they have access to different technologies, because they have different factor endowments, or because they differ in taste. Simply the fact that an open country faces prices different from its own in the world market establishes the gains from trade: it can sell whatever is more expensive abroad and buy whatever is cheaper.

What is the empirical content of this prediction? How can we take such a general theoretical statement to the data? And how can we quantify the gains from trade thus arising? Deardorff 1980 derived a general law of comparative advantage that is useful in both predicting the patterns of trade (although it puts minimal restrictions on this pattern) and in quantifying the gains from trade. The basic idea behind the law of comparative advantage is that the prices that would prevail in the country were it completely closed ("autarky prices") provide a summary statistic for the state of technology, endowments and tastes. If a country is very inefficient in producing high-tech goods, such goods will be expensive in autarky. If a country faces a scarcity of wood, wood-based products will be expensive in autarky. And if residents of a country are very fond of a particular type of fabric, this fabric will be expensive in autarky. All three are motives for the country to import the product with a relatively high autarky price, and the difference between the autarky and the world price captures the attainable gains from trade.

Directly measuring comparative advantage in this way is difficult because we rarely observe countries in complete autarky. Some notable natural experiments in history provide a rare opportunity to directly test the law of comparative advantage and measure the gains from trade. Irwin 2005 studies the evolution of export and import prices in the U.S. during the self-embargo imposed by the Jefferson administration between 1807 and 1809. Irwin finds that the price of goods previously exported dropped by 27 percent on average after moving to autarky; similarly, the price of products previously imported increased by 30-35 percent because of the self-embargo. The total economic cost of the embargo amounted to about 5 percent of 1807 GNP of the U.S.

Bernhofen and Brown 2004; 2005 study the sudden opening of Japan to trade under the Meiji Restoration Period. Before 1859 Japan was almost completely isolated from the world. Only the Dutch had a trading post in the port of Nagasaki, but the volume of the trade was negligible. Following the Kanagawa Treaty (1854) with the U.S., and similar treaties with other Western powers, Japan had to open many of its ports, and was not allowed to impose high ad valorem taxes, tariffs on export or import goods.

Using historical sources, Bernhofen and Brown find that goods that Japan came to export, such as silk and silkworm eggs, appreciated substantially in price after opening. Goods to be imported, such as cotton yarn and cloth and manufactured iron, depreciated substantially. These patterns are in line with the general theory of comparative advantage. Moreover, Bernhofen and Brown 2005 quantify the gains from trade at 8 to 9 percent of Japanese GDP.

New trade theory has provided new explanations for why countries trade. Krugman 1979; 1980 argues that even identical countries may gain from trade if firms exploit internal economies of scale. Such economies of scale may arise in high tech sectors, where costs of product development and marketing are large relative to actual production costs. Cars, computers and pharmaceuticals are prime examples.

In an open economy, each firm has an incentive to produce at bigger scale and economize on fixed costs. As a result, more firms will enter and consumers will have more variety at their disposal. To the extent that consumers value variety of choice, they will gain even by integrating with an identical economy. Such models are capable of explaining the large volume of trade between similar economies such as the EU and the U.S. They are also consistent with large volumes of simultaneous exports and imports of

similar products (“intraindustry trade”). An additional prediction of the theory is that whenever trade is costly, producers will want to locate and bear the fixed cost close to their final consumers.

Head and Ries 2001 and Davis and Weinstein 1999 provide evidence for the qualitative conclusions of new trade theory. They find that industries subject to product differentiation are overrepresented in countries and regions with high local demand. Hanson and Xiang 2004 also find that industries with more product differentiation and with higher transport costs are overrepresented in large countries.

Broda and Weinstein 2006 quantify the gains from increased variety, which is at the heart of the gains from trade in models with economies of scale. They compute a variety-corrected import price index to account for the fact that consumers value goods from different countries differently. They estimate that U.S. consumers gained 2.6 percent of GDP from increased import variety between 1972 and 2001.

Old trade theory has been concerned mainly with aggregate trade patterns. New trade theory has focused instead on the export decision: Which firms export, how many products and destinations they serve. We have now finely disaggregated data to answer these questions. New trade offers the promise of building aggregate models from the bottom up. M. J. Melitz 2003 is the workhorse model in the new trade literature. The theory is built on two key blocks: Firm heterogeneity in productivity and economies of scale (fixed costs) in exporting. The model's tractability makes it possible to bring together micro facts and macro analysis.

The key mechanism of the model is selection: Fixed costs prevent many firms from exporting, and only the more productive firms can recover the fixed cost. In the model as in the data, exporters are few and larger than non-exporters. Selection is also at work on the key implication of Melitz 2003 in the event of a trade liberalization: Existing exporters will sell more (the intensive margin), new firms will start exporting (the extensive margin). Resources are reallocated from non-exporters to exporters and thus to the more productive firms, and the least productive non-exporters are driven out of business. This reallocation leads to gains in aggregate productivity.

Firms can also gain from engaging in other forms of international production. They can substitute export sales and economize on trade costs by setting up production affiliates abroad. The incentive to do such horizontal FDI is characterized by the “proximity-concentration tradeoff” (Brainard 1997). Firms want to produce close to their consumers (proximity) to economize on trade costs, but also want to concentrate production to exploit economies of scale. A special case of horizontal FDI aims to serve other countries from the foreign production plant: export platform FDI. While there is empirical evidence that firms locate their production plants in response to export-platform, not just host country demand (Feinberg and Keane 2001; Head and Mayer 2004), a quantitative modeling of this channel has been lacking due to computational complexities. The question of where to optimally locate a number of production facilities given a distribution of consumers is a computationally difficult problem to solve. New approaches have been proposed by Arkolakis et al. 2013; Tintelnot 2014.

Much of the trade literature focuses on gains accruing to final consumers. However, firms also source some of their inputs from abroad, so they also stand to gain with lower trade barriers (D. Hummels, Ishii, and Yi 2001).

Grossman and Rossi-Hansberg 2008 build a theory of offshoring based on the idea that firms decide on the set of tasks they want to source from abroad. These tasks differ in their costs of offshoring. In the model, firms that offshore a wider range of tasks become more productive and will expand. Surprisingly, they may even increase their demand for local labor, if the productivity effect is large enough. Halpern, Koren, and Szeidl 2015 build a model of firms using imported inputs and quantify the productivity gains from the access to foreign inputs. Antràs et al. 2014 combine these theories in a general equilibrium setting, and characterize the complex sourcing strategy of firms.

Some of this input trade may take place within the firm. When a firm opens an affiliate abroad (typically in a low wage country, Yeaple 2013) to produce some of its intermediate inputs, it engages in vertical FDI. Gordon H. Hanson, Mataloni, and Slaughter 2005 find that such vertical FDI is higher in low-wage countries that can be reached by lower trade costs. The growth of vertical production networks has spurred further research, and we return to it in Section 4.3.4 and 4.3.5.

Several recent studies have contributed to policy analysis with quantifiable models of the gains from trade. They simulate counterfactual scenarios by setting trade costs to prohibitively large (so that countries are in autarky), or setting them to zero (so that countries engage in free trade). These losses from autarky and gains from further trade liberalization are the easiest to compute, but concrete tariff scenarios have also been worked out.

Eaton and Kortum 2002 build a model with Ricardian motives for trade. That is, countries face different productivities. Trade is also subject to trade costs, which can vary across pairs of countries. They derive that the pattern of trade follows a gravity equation: large and close countries trade more with one another. They also highlight subtle trade diversion effects of trade costs, as in James E. Anderson and van Wincoop 2003. Theirs is a multi-country general equilibrium model suitable for analysing the effects of bilateral and multilateral trade agreements, for example.

Alvarez et al. 2007 quantify the gains from trade in a calibrated general equilibrium Eaton-Kortum model. They estimate that eliminating all tariffs among the 60 largest economies would increase their GDP by 0.50 percent, on average (Table 2, weighted average). This estimate is much smaller than those of the historical case studies mentioned above and the reduced-form estimates discussed below.

In an important recent contribution, Arkolakis et al. 2012 show how to quantify the gains from trade in a wide class of models, which includes the Eaton-Kortum model of technology differences, the Krugman model of scale economies and increased varieties, and a variant of the Melitz model due to Chaney 2008. In these models, the gains from trade of a country can be summarized by two important statistics: the share of income it spends on domestic goods and services, and the elasticity of trade volumes to trade costs. Intuitively, spending much on imported goods (and correspondingly little on domestic goods) signals a high willingness to pay for imports, whether because of lower prices, increased variety or selection based on productivity.

This unifying framework is promising for policy analysis, because these statistics are easy to measure or estimate. For example, the U.S. spend 7 percent of its income on imports in 2000. Using the domestic

share of 93 percent and elasticities of trade between 5 and 10, Arkolakis et al. 2012 estimate that American consumers were 0.7 to 1.4 percent better off in 2000 than in complete autarky. Relative to the likely disruptions that a complete cessation of American exports and imports would entail, this estimate seems incredibly low.

Existing quantifiable models estimate the gains from trade to be implausibly small. They find that the typical country of the global economy is only about 1 to 2 percent richer due to trade than it would be in complete isolation. (For other calibrations with different treatments of heterogeneity, multiple sectors, and intermediates, see M. J. Melitz and Trefler 2012; M. J. Melitz and Redding 2014; Ossa 2012; Costinot and Rodriguez-Clare 2014.) This is at odds with global efforts to reduce trade barriers and increase trade among countries, such as the creation and expansion of the World Trade Organization and the recent agreement on trade facilitation in the Bali Package. It is also inconsistent with credible reduced-form estimates of the GDP-enhancing effects of openness to trade.

Feyrer 2009b; 2009a exploit natural experiments in the variation in trade costs between countries to estimate how trade affects income per capita. Feyrer 2009b uses the closure of the Suez Canal between 1969 and 1975 to generate quasi-random variation in trade costs between countries that were not part of the Suez conflict. He finds that the most affected countries, for which the closure of the canal made sea shipping most expensive, witnessed declines in their volume of trade and smaller-than-average income growth. He estimates the elasticity of income to trade around 0.16, that is, a 10 percent increase in trade volumes increases income per capita by 1.6 percent. Feyrer 2009a exploits variation in the relative cost of air and sea freight over time. Landlocked countries are now better accessible than they were before a dramatic fall in air transport costs. This made them (exogenously) more open to trade and have higher income. Feyrer estimates the elasticity of income to trade to be about twice as high in this study. One potential reason is that airplanes made it easy to not only transport goods, but also people across countries.

We believe that the quantitative fit between model-based and reduced-form estimates of the gains from trade could be further improved.

Challenge 9: Reconcile model-based and reduced-form estimates of gains from trade.

4.1.2. Distributional effects of globalization

Almost any change in openness to global competition is going to create winners and losers. A reduction in import tariffs makes consumers better off, while import competing producers worse off.

Eli Heckscher and Bertil Ohlin, the founders of a theory of trade based on factor endowment differences already highlighted the distributional effects of trade opening:

> “Australia has a small population and an abundant supply of land, much of it not very fertile. Land is consequently cheap and wages high, in relation to most other countries. [...] Australian land is thus exchanged for European labor. [...] Thus trade increases the price of land in Australia

> and lowers it in Europe, while tending to keep wages down in Australia and up in Europe." (Ohlin 1924, quoted in O'Rourke and Williamson 1999: 57–58)

The result that trade leads to a convergence of factor prices, and thus benefits the abundant (and hence previously cheap) factor, is known as the Stolper-Samuelson theorem (Stolper and Samuelson 1941). It identifies the winners of globalization as the factor in abundance in the country (land for Australia), and the losers as the scarce factor (labor for Australia, land for Europe), which previously commanded high prices.

O'Rourke and Williamson (1999: chap. 4) find evidence for this pattern of factor price convergence in the late 19th century atlantic economy. The ratio of wages to land rents has steadily increased for open European countries such as England, Denmark, Sweden and Ireland. Hence in these countries, landed interests lost at the expense of workers. The wage-rent ratio has fallen for new land abundant countries such as Australia, Argentina and the U.S. This confirms the original predictions by Heckscher, Ohlin, Stolper and Samuelson.

In the more recent wave of globalization, it is not as easy to identify the losers. Pinelopi K. Goldberg and Pavcnik 2007a review the evidence on the distributional effects of globalization in several developing countries (Argentina, Brazil, Chile, Colombia, India, Hong Kong, Mexico) for the time period between the 1970s and the 1990s. All of these countries liberalized international trade some time in this period and saw a surge of both imports and exports. The countries also hosted increasing amounts of FDI. Pinelopi K. Goldberg and Pavcnik 2007a study various measures of inequality, but the broad pattern is that inequality increased everywhere. It seems that the losers are the workers who already had lower wages. This is surprising given that such workers had supposedly been in abundance in developing countries. Pinelopi K. Goldberg and Pavcnik 2007a investigate several explanations for this pattern, to which we return later in Section 4.3.1.

Focusing on the low end of the income distribution, Harrison 2007 reviews both cross-country and within-country studies of how poverty is affected by globalization. They also find that "[t]he poor in countries with an abundance of unskilled labor do not always gain from trade reform." (Harrison 2007: 3) In fact, even among the poor, there are generally winners and losers. Topalova 2007 finds that rural districts in India with higher-than-average concentration of sectors exposed to import competition witnessed an increase in poverty. Among urban households in Colombia, there is weak evidence that working in an import-competing sector and lower tariffs are associated with higher poverty (Pinelopi K. Goldberg and Pavcnik 2007b). In Mexico (Gordon H. Hanson 2007) and Poland (Goh and Javorcik 2007), however, higher exposure to trade was associated with lower poverty.

Models with increasing returns and firm heterogeneity also produce losers, not only winners. In Melitz 2003, a reduction in trade costs increases profit opportunities abroad. When exporting entails a fixed cost, only a subset of firms will be exporters who can capitalize on these profit opportunities. Their increased demand for local resources (such as labor needed for production and R&D) will hurt the smaller firms that only sell in the domestic market. They will either shrink or exit the market. Bernard et al. 2003 and Melitz and Ottaviano 2008 arrive at similar conclusions in different models of industry competition and

trade. Such reallocation effects across firms have been empirically documented by Pavcnik 2002 and many authors since.

It is important to note that the redistribution effects of globalization are not secondary to the aggregate gain from trade. Often it is exactly the redistribution that brings about the overall gain. Given the amount of resources in the economy, an export sector cannot expand without an import sector shrinking. Similarly, large productive firms cannot grow without the small unproductive shrinking or exiting. For too long we have assumed these reallocations to be frictionless: workers fired in shrinking sectors and firms will instantaneously get rehired in expanding sectors and firms. We now have the theoretical tools and measurements to show that this is not the case.

For policy analysis, we first have to identify the losers from globalization. There is broad agreement across theories on who loses in some cases. Across industries, partial equilibrium analysis (including trade models with quasilinear preferences) and models with sector-specific factors of production (Ricardo-Viner models) tell us that import competing sectors will shrink after opening up to trade. This reduces income to all factors (workers, firm owners) attached to those sectors. Within an industry, most models of competition tell us that the least productive, smallest firms will lose market share and will fire workers and other inputs.

One reason for focusing on the gains from trade and neglecting redistributive effects could be that general equilibrium models make predictions for the long run, after the necessary reallocations have taken place. In the long run, workers can find jobs in the expanding export industries and firms, or retrain for the type of jobs that are in higher demand. If costs of reallocations are small and transitory, this focus is the right one. The measurement of these costs, however, is scant.

One exception is Artuç, Chaudhuri, and McLaren 2010, who estimate a structural model of industry choice of workers with switching costs in U.S. data. They build a model where workers pick an industry in order to maximize lifetime discounted income. If they switch to a different industry, however, they have to pay a fixed cost. Artuç et al. 2010 estimate the mean and variance of these fixed costs in a panel of workers from the Current Population Survey by matching both the number of workers that switch sectors and the sensitivity of cross-sector worker flows to wage gains. The estimates reveal very large switching costs, equivalent to between 4 and 13 years of wage income.

More recently, Dix-Carniero 2014 refines the above model by, among others, incorporating worker heterogeneity and estimates the switching cost on Brazilian data. He finds that the median switching cost is 1.4--2.7 times the annual wage, but with a high dispersion across the population. He argues that in certain segments of the labor market the adjustment process after a trade liberalization can take a long time, which can significantly offset the gains from trade. On the same Brazilian data Dix-Carniero and Kovak 2015 show that the labor market outcomes of the most affected regions deteriorated compared to other regions for more than a decade before beginning to level off.

Antràs et al. 2015 study the welfare implications of trade in an economy where redistribution is subject to information constraints. Their conclusion is that even though progressive taxation might mitigate the effects of trade on inequality, in general inequality will go up after opening up to trade.

In a sequence of papers, Elhanan Helpman and Itskhoki 2010, Elhanan Helpman, Itskhoki, and Redding 2010 and Elhanan Helpman et al. 2012 develop a new framework to think about trade, unemployment and wage inequality. (Also see Amiti and Davis 2012; Egger and Kreickemeier 2009; Gabriel Felbermayr, Prat, and Schmerer 2011 on trade, unemployment and wages.) The key result of Elhanan Helpman, Itskhoki, and Redding 2010 is that opening a closed economy up to trade increases inequality as better-paying exporting firms expand. However, this effect turns around when almost all firms export, and their expansion also pulls up the bottom of the wage distribution. The response of unemployment to trade is ambiguous. Helpman et al. 2012 find that the model describes well the evolution of wage inequality in Brazil, and that trade can contribute to large increases in inequality.

Challenge 10: Identify losers from globalization and quantify their losses.

4.1.3. Cross-border frictions are large

The third broad lesson from research on international trade is that frictions that impede the flow of goods and other interactions are large. Some of these friction are related to geography, but many of them are associated with crossing borders.

Anderson and van Wincoop 2004 provide a survey of the estimated trade costs. They report three sets of estimates. The first includes direct measures of transaction costs, such as charges for freight, insurance, tariffs, as well as costs of distribution and local taxes. For the average country, these amount to 170 percent of the value of international trade. Distribution costs also arise in domestic trade, so the cross-border component of costs is “only” 74 percent.

The second method to estimate trade costs exploits the cross-country disparity in prices. If the price of a good in the destination market is 4 percent higher than in the source market, trade costs between these countries are at least 4 percent. (In imperfectly competitive markets, the producer may be willing to swallow some of the trade costs by reducing its markup abroad. They would not charge higher markups abroad for fear of parallel imports.) Estimates of the dispersion of log prices across locations vary between 20 and 40 percent (J. E. Anderson and Van Wincoop 2004: 745).

The third method infers trade costs from the volume of trade relative to a frictionless benchmark. This method has been immensely popular, relying mostly on the gravity equation as the benchmark trade model. (See Anderson and van Wincoop 2003; 2004, Head and Mayer 2014 and Section 5.2 below, as well as Chapter 3 of Proost and Thisse 2015.)

Cost component	Percentage
Transportation	21
Policy barrier	8
Language barrier	7
Currency barrier	14
Information barrier	6
Security barrier	3
Total border costs	44
Distribution	55

Table 2. Percentage equivalents of trade costs
Source: J. E. Anderson and Van Wincoop 2004: 692

Theories of the past decades have incorporated these frictions mostly as taxes or wedges on import prices. These are often modeled as an ad-valorem cost, following Samuelson 1954. Recently, other forms of trade costs have also been modeled and estimated: fixed entry costs of operating in a market, time costs associated with shipping, fixed costs accruing per shipment, and additive rather than proportional shipping charges. We will briefly discuss estimates of each.

Fixed entry costs.

Entry costs are useful in explaining why many firms do not export. If a firm is too small, it would not find it profitable to bear the fixed costs associated with distribution in a given market. Das et al. 2007 estimate a structural model of exporters with sunk market entry costs, and find that these costs are substantial, on the order of $400,000. The primary fact identifying such large sunk costs is that many large firms seem to forego large profit opportunities in foreign markets and do not enter.

Helpman et al. 2008 estimate a model of heterogeneous firms with fixed costs of market entry from macro data: the volume of trade between pairs of countries. Their estimation is based on the idea that only fixed costs can generate zero trade flows in the data, variable costs cannot. They show how fixed costs vary across countries, and that FTAs, a common language, and a common religion predominantly reduce the fixed costs of trade, not the variable cost.

Armenter and Koren 2015 emphasize that there is large heterogeneity in the market entry costs across firms. By matching the size distribution of firms and the number and average size of exporters, they estimate that the 75th percentile of fixed costs is 32 thousand times as much as the 25th percentile. This huge variation suggests that a simple fixed entry cost is not a suitable structural model of export entry.

Arkolakis 2010 develops a theory with convex market access cost. This model is consistent with the fact that some firms do not enter export markets (because the marginal market access cost is bounded away from zero), but fits the pattern of small exporters better than models with fixed costs.

Time costs.

Trading time, i.e. the time it takes to send a shipment from the origin to the destination, represents another form of trade costs. Firms are willing to pay significantly above the interest cost to get faster deliveries. Hummels and Schaur 2013 estimate that US importers pay 0.6-2.3 percent of the traded value to reduce trading time by one day. Other empirical studies that use different data and methodology also confirm the importance of time costs in trade (Djankov, Freund, and Pham 2010; Hornok 2012). Internationally fragmented production processes, which involve the multiple shipping of intermediate inputs, are especially sensitive to the length and variation of shipping time (Harrigan and Venables 2006).

Per-unit costs.

Recent research emphasizes that part of international trade costs are additive costs, i.e. fixed cost per unit traded (D. Hummels and Skiba 2004; Irarrazabal, Moxnes, and Opromolla 2013a). These may include per-unit tariffs, quotas, or transport costs proportional to the physical quantity of the cargo. The magnitude of these costs is likely substantial. Irarrazabal, Moxnes and Opromolla estimate it to be 14 percent of the median product price, which is a lower bound estimate. The presence of additive costs can have important welfare implications. Compared to ad valorem trade costs, per unit costs may create additional welfare losses, as they distort the within-market relative prices and consumption of different product varieties ("Alchian-Allen hypothesis").

Per-shipment costs.

Other trade costs are fixed per shipment. They include the costs of the bureaucratic procedures of sending a shipment and the shipping time. According to direct cost measures from the World Bank's Doing Business database these costs exceed 10 percent of the value of a typical shipment (Hornok and Koren 2015a). Alternatively, Kropf and Sauré 2014 infer per shipment costs from trade flows and find them to be broadly 1 to 5 percent of the traded value. Empirical evidence shows that trading firms facing these costs respond by sending fewer and larger shipments. This creates losses in the form of higher inventory expenses (Alessandria, Kaboski, and Midrigan 2010) or less consumer satisfaction (Hornok and Koren 2015b).

Challenge 11: Understand and quantify non-tax, non-quota frictions in trade.

4.2. Insights for policy

4.2.1. Traders are few and special

Firms that trade are different from firms that do not. There are only few traders, but they tend to be special (Andrew B. Bernard, Jensen, et al. 2012; Freund and Pierola). This has two implications for the effect of trade policy. First, much of the trade adjustment after trade liberalization happens on the extensive margin: new firms entering new markets with new products. Second, there will be a reallocation from less productive to more productive firms when trade is liberalized (see our discussion of Melitz 2003 and related models in Section 4.1.1 above).

Based on these ideas and the empirical evidence to date, Mayer and Ottaviano 2007: 3 make six proposals for policy makers: “Policy-oriented research should prioritise six key issues that are likely to determine the global competitiveness of European firms in the future: the external benefits of the internal market, the speed of intra-industry reallocations, the relative impact of fixed versus variable costs of internationalisation, the relevance of learning through international operations, the opportunities provided by regional production networks, and the political economy of the single market.”

At the same time, the trade potential of small and medium enterprises should not be neglected either (L. Cernat, Norman-Lopez, and T-Figueras 2014).

4.2.2. Imports are important

Earlier empirical studies in trade discussed patterns of exports disproportionately more than patterns of imports. This might be explained by two reasons. First, export data was easier to come by, especially at the firm level. Second, the supply side of what we produce and sell might have seemed a more interesting question than the demand side of what we buy and consume.

With the emergence of new firm-level data, it has become clear that imports are as important as export, especially when we think of imports used by firms in their production. Bernard et al. 2007; 2009 show that importers are just as special as exporters: they tend to be larger and more productive than non-trading firms

The bigger size and better performance of importers is not only due to self-selection into importing. Studies show that improved access to foreign inputs has increased firm productivity in several countries, including Indonesia (Amiti and Konings 2007), Chile (Kasahara and Rodrigue 2008), India (Topalova and Khandelwal 2011) and Hungary (Halpern, Koren, and Szeidl 2015). Results are conflicting for Brazil: Schor 2004 estimates a positive effect while Muendler 2004 finds no effect of imported inputs on productivity. And for Argentina Gopinath and Neiman 2013 show that variation in imported inputs may have contributed to fluctuations in aggregate productivity.

To understand why importers are better, Halpern, Koren and Szeidl 2015 formulate a model of firms who use differentiated inputs to produce a final good. Firms must pay a fixed cost each period for each variety they choose to import. Imported inputs affect firm productivity through two distinct channels: as in quality-ladder models they may have a higher price-adjusted quality, and as in product-variety models they imperfectly substitute domestic inputs. Because of these forces, firm productivity increases in the number of varieties imported. They estimate that importing all tradable inputs raises firm-level productivity by 22 percent relative to not importing at all, about half of which is due to imperfect substitution between foreign and domestic inputs.

4.2.3. Multilateral agreements prevent trade wars

The canonical view of free trade agreements is that they provide reciprocal market access to countries participating in them. (See Maggi 2014 for a survey of theories of trade agreements.) Theory provides three reasons for why countries sign trade agreements. First, they want to internalize “terms of trade externality.” Binding trade agreements may stop trade partners from manipulating their terms of trade by restricting trade. Second, with imperfectly competitive industries, trade agreements also help stop a

"profit stealing externality." Third, trade agreements may serve as a form of commitment guarding against lobbying of special interests.

Empirical work on trade agreements falls into two categories. There is reduced-form evidence on the effect of trade agreements on trade volumes and other economic outcomes (Subramanian and Wei 2007; Liu 2007; Dutt, Mihov, and Van Zandt 2011). The majority of papers (with the exception of Rose 2004) finds positive association between trade agreements and trade flows, that is, trade flows increase after a trade agreement is signed.

A key challenge of these reduced-form studies is identification of causal effect. Countries signing trade agreements are likely better integrated in other, unobserved ways, as well. One way to get around this omitted variable bias is to use only the timing of trade agreements, and see how trade increases in the years following its implementation (Eicher and Henn 2011).

A second group of studies try to identify the particular theoretical motivations for why countries sign trade agreements. There is some supporting evidence for all three theories: terms-of-trade externalities (Christian Broda, Limao, and Weinstein 2008; Ludema and Mayda 2010; Bagwell and Staiger 2011), profit-stealing externalities (Ossa 2014) and domestic commitments (Handley and Limão 2012; Handley 2014).

While there are competing interpretations of how and why trade agreements work, one broad lesson is that without binding trade agreements, countries would be prone to occasional escalating trade wars. Ossa 2014 conducts counterfactual analysis with two scenarios. In the trade talks scenario, WTO members (modeled as seven countries and regions: Brazil, China, EU, India, Japan, US, and the rest of the world) come to an efficient agreement about further tariff reductions relative to the status quo in 2007. This would increase global welfare by $26 bn per year. In the trade wars scenario, members engage in escalated tariff wars. This would reduce global welfare by $340bn a year. Hence Ossa 2014 argues that primary success of the WTO is preventing trade wars.

4.3. Open questions

In this section we discuss the open questions of recent research in trade. These are questions in which the theories and the data are in apparent disconnect, in which competing theories disagree, or for which we lack compelling theories altogether.

4.3.1. How big are the redistributive effects of globalization?

Most models of the redistributive effects are way too stylized to be used for quantitative analysis. The usual approach posits two types of workers, skilled and unskilled and finds some empirical counterpart for these worker groups. In reality, there is a much larger heterogeneity of worker skills that needs to be captured in the model.

Capturing the large heterogeneity across firms has become quite standard after M. J. Melitz 2003 and Andrew B. Bernard et al. 2003 and many quantitative studies calibrate firm heterogeneity to the data when studying trade liberalization (Balistreri, Hillberry, and Rutherford 2011; Breinlich and Cuñat 2013; Corcos et al. 2012). A similar approach at the worker level has been lacking.

Costinot and Vogel 2010 build a matching model of heterogeneous workers and sectors to study the evolution of inequality in various globalization scenarios. They work with a continuous distribution of worker skills, so they can study the changes along the entire wage distribution. Antras et al. 2015 also permit rich heterogeneity across economic agents.

Challenge 12: Develop a toolbox for quantitative analysis of redistribution.

4.3.2. What are the side effects of globalization?

We have so far mostly discussed the pecuniary effects of globalization: how prices and incomes change, and who wins and who loses in terms of real income. The policy stance towards globalization, however, is often motivated by the presence of non-pecuniary externalities (Harrison and Rodríguez-Clare 2010), what we colloquially term the "side effects of globalization." Exposure to foreign trade and investment may bring about both positive and negative side effects. Below we discuss one example for each, namely productivity enhancements from knowledge spillovers, and environmental pollution. We note that, given the intense policy interest, this is a very active field which we anticipate to flourish in the future.

A body of literature documents the empirical connection between imported technology and productivity. For example, Coe and Helpman 1995 find that countries importing from R&D abundant trade partners are more productive (also see Coe, Helpman, and Hoffmaister 1997 and Bayoumi, Coe, and Helpman 1999), while Keller 2002, Keller and Yeaple 2009, and Acharya and Keller 2009 obtain similar findings at the industry level. Less is known, however, about the effects of technology imports on firm productivity. Firm-level evidence is useful because it can help isolate the effect of imported technology from other confounding factors such as investment or FDI, thus allowing us to identify the mechanism more directly.

Knowledge spillovers from multinationals to local suppliers is thought to be important for foreign knowledge to take hold in the host country (see Pack and Saggi 2006 for a review of the case-study literature). There is, however, no consensus if and how these spillovers take place. Görg and Greenaway 2004 survey the evidence to date on spillovers from foreign investment, finding a mix of results with both positive and negative effects.

Arnold and Javorcik 2009 document that Indonesian firms taken over by multinationals improve their productivity after acquisition, which is suggestive of technology transfer from the parent company. Blalock and Gertler 2009 utilize the same dataset to show that firms with more own R&D and skilled workers benefit more from FDI. Javorcik 2004 finds that multinationals entering Lithuania have a positive productivity effect on local firms in upstream sectors. In that study, buyer-supplier links are inferred from input-output tables (also see Bloom, Schankerman, and Van Reenen 2013). Javorcik and Spatareanu 2009 use a survey in the Czech Republic to measure buyer-supplier links at the firm level, and also find positive effects. Guadalupe et al. 2012 show that Spanish subsidiaries innovate more after foreign acquisition.

Knowledge may also spill over to the host country via worker mobility. If the technological and organizational knowledge is not too specific to the firm, then a worker moving from a foreign-owned, foreign-managed, or import-intensive firm will also have a higher marginal product at the new firm. This can serve as an indirect channel through which domestic firms acquire foreign knowledge. Stoyanov and

Zubanov 2012 find evidence in Danish data that workers moving from more productive firms tend to enhance productivity of the host firm. Mion and Opromolla 2014 show that, in Portugal, managers leaving exporting firms take their exporting knowledge with them: the new host companies become more likely to export; they also reward the new managers for their export experience.

This body of literature, and further studies in this area, help both distinguish the particular channels of technology spillovers and identify the barriers of such spillovers.

Trade may also have negative side effects, for example via environmental pollution. It is a firmly established empirical relationship that environmental pollution depends on economic development in an inverted U-shape pattern ("Environmental Kuznets Curve" Grossman and Krueger 1993). In the development process pollution rises as the scale of activity increases, but above a certain income level the relationship reverses, because the economy moves to more environmentally friendly technologies and sectors. Hence, to the extent that trade promotes economic growth, trade openness should eventually also contribute to better environmental quality. See further discussion on trade, growth and the environment in Ekins, Drummond, and Watson 2015, Section 5.2-3.

International trade can also have direct effects on the environment, which may be negative or positive. A negative effect may occur if the global competitive pressure makes countries adopt looser environmental policies. On the contrary, if globalization helps spread environmentally friendly technologies, rules and standards across the world, trade can lead to less pollution. Country-level empirical studies show that, regarding most measures of pollution, trade is not detrimental to the environment (Antweiler and Copeland 2001; Frankel and Rose 2005), suggesting that the second effect offsets the first. One important exception though is CO2 emission, which increases with globalization even after controlling for income growth (Frankel 2009).

An issue, which received most attention recently, is the distributional impact of globalization on pollution. Polluting activity is increasingly concentrated in some developing countries ("pollution havens"), fleeing developed countries with stringent environmental regulation. An example is the so-called carbon leakage, when CO2 emission targets lead firms to relocate from Kyoto countries. The consequence is the rise of pollution-embodying imports in the developed world, which has recently been documented by several empirical studies (Babiker 2005; Kellenberg 2009; Grether, Mathys, and De Melo 2010; Aichele and Felbermayr 2015).

Standards and regulations also have side effects. Sanitary and safety inspections may add to the time and monetary costs of importing, but can also be important for customer safety. Technical regulations for passenger cars may be difficult and costly to meet in each destination market, but they may also reflect valid safety concerns.

Reduced-form empirical evidence on the role of standards in trade have yielded several interesting lessons. (See Swann 2010 for a survey.) First, internationally harmonized standards are associated with higher trade. Second, national standards may promote exports, but harm imports, especially if these standards are mandatory (regulation).

Challenge 13: Understand and quantify the effects of standards and harmonization on trade and welfare.

4.3.3. What are the deep causes of cross-border frictions?

The large estimates of cross-border frictions surveyed in Section 4.1.3 suggest that international transactions are hampered by more than transportation costs. In fact, even after controlling for transport costs, crossing a country border is associated with a 44 percent ad-valorem trade cost. Only 8 percent of this is related to policy barriers (tariffs and quotas), the rest remain to be explained.

We need better theories and measurement of frictions that are neither a tax nor a quota. One candidate is the limited access to information across border (James E. Rauch 1999).

Information frictions.

Allen 2014 builds a model of information frictions and trade, in which producers sequentially search for the best place to sell their product. Estimating the model on agricultural trade in the Philippines, he finds that about half of the price dispersion can be attributed to information frictions.

Chaney 2014 proposes a theory in which firms find new buyers via the network of their existing buyers. This assumption is motivated by the patterns of export market entry of French firms. The model predicts a relationship between international trade and distance close to what we observe in the data.

There are also several empirical studies finding evidence for the qualitative conclusion that better access to information increases trade. The maintained assumption in many studies is that immigrants facilitate trade between their source and their host country. Rauch and Trindade 2002 exploit spatial variation in the number of Chinese immigrants, Cohen et al. 2012 use the placement of Japanese internment camps as a natural experiment, Felbermayr et al. 2010 extend the analysis to other ethnicities such as Polish and Mexican. The broad conclusion is that regions with a large share of immigrants trade more with their source country. More work is needed, however, on identifying the specific channels through which immigrant networks facilitate trade.

Local infrastructure.

Another recent strand of literature suggests that local transportation also matters for international trade and development. This has been documented for railroads in India (Donaldson 2010) and the U.S. (Donaldson and Hornbeck 2013), roads in Peru (Volpe Martincus, Carballo, and Cusolito 2013), Turkey (Cosar and Demir 2014) and the U.S. (Duranton, Morrow, and Turner 2013), and bridges for Argentina and Uruguay (Volpe Martincus et al. 2014) and the U.S. (Roc Armenter, Koren, and Nagy 2014). G. J. Felbermayr and Tarasov 2015 also show that there is underinvestment in transport infrastructure in border regions of France.

4.3.4. How does supply-chain trade differ from traditional trade?

An increasing share of international trade is in intermediates D. Hummels, Ishii, and Yi 2001, owing to the increased international fragmentation of production. Companies break up their production process in smaller stages, and source from a larger number of suppliers both at home and abroad. The international trade associated with such production processes is termed “supply-chain trade.”

Baldwin 2006 and Baldwin and Lopez-Gonzalez 2014 describe the patterns of supply-chain trade across countries and over time. They use several measures of supply-chain trade, such as imported intermediate inputs, re-exports and re-imports and value added trade. They argue that supply-chain trade between technologically advanced and low-wage countries is a relatively recent phenomenon, taking off in the early 1990s. This is the “second unbundling of globalization,” in which the technological and management expertise of developed countries is matched with cheap labor in developing ones (R. Baldwin 2006).

Supply-chain trade tends to be very regional, potentially because the costs of coordinating production increase sharply in distance. There are regional production clusters around the U.S., within Europe, and, to a lesser extent, Japan. Data on re-exports and re-imports helps identify headquarter and production countries. Within Europe, Germany is clearly a headquarter economy, tightly linked with several low-wage EU members, but also with high-wage neighboring countries. Britain and France also act mostly as headquarters, the role of Italy is less clear.

In a recent paper, Barrot and Sauvagnat 2014 study the propagation of idiosyncratic shocks along the supply chain. Identifying buyer-supplier links from the SEC filings of publicly listed American firms, they estimate the effects of a local natural disaster on downstream firms and competing suppliers. Natural disasters (such as floods or hurricanes) reduce the sales growth of supplying firms by about 3-4pp. They also reduce the sales growth of downstream buyers by about 2-3pp. This propagation only happens for suppliers of specific inputs. Related suppliers, that ship to buyers of disaster-hit suppliers, are also hurt. The potential macroeconomic effects of idiosyncratic shocks are found to be large.

Andrew B. Bernard, Moxnes, and Saito 2014 also study buyer-supplier links, but have a broader network coverage. Using data from a Japanese credit report agency, they show links are distributed across firms and over space. They build a model where firms choose the number of suppliers. More suppliers make the firm more productive, because they can use cheaper inputs (also see Eaton et al. 2013 for a similar model). Exploiting the spatial variation caused by a new high-speed rail line, they find that firms that could expand their supplier base have increased productivity and sales.

Understanding supply-chain trade better is important, because it has distinct implications for trade policy. Baldwin 2011 and Blanchard 2015 summarize the key policy challenges associated with supply-chain trade. First, there is a complementarity between liberalizing trade and liberalizing global production (foreign direct investment). When a multinational company invests in a host country, this raises the incentives of the source country to give preferential market access to the host country. Second, countries may opportunistically manipulate policies behind the border to shift rent from foreign investors. Some form of investor protection may be beneficial, but the current wave of bilateral and regional investment agreements may give excess powers to current technology leaders. Third, long supply chains magnify the

effect of trade barriers, especially if regulations concerning international transactions are complex and not harmonized across countries.

Challenge 14: Build a quantitative theory of supply-chain trade.

4.3.5. What do multinational firms do?

Production can be shared internationally not only by shipping the final product, but also by carrying out (parts of) the production process abroad. The research on global production revolves around several key questions (Yeaple 2013). Why do some firms open production facilities abroad? Where do these multinationals go? What determines whether firms source their inputs from independent suppliers, or whether they vertically integrate with their supplier?

A surprising fact is that most economic activity of multinationals is concentrated at their headquarters and regions close to the headquarter (Keller and Yeaple 2013). Alfaro and Chen 2014 also find strong agglomeration of multinational plants. This is at odds with models of horizontal FDI, which would predict that multinational production is a way of getting around trade barriers, geographical or other. It is therefore important to understand what frictions multinationals are subject to.

Ramondo et al. 2013 study the trade flows between U.S. multinationals and their foreign affiliates. Surprisingly, they find that the median affiliate does not sell to its parent. Across all affiliates, the average share of sales to the parent company is 7 percent. This does not vary substantially with the degree of input-output linkages between the parent and the affiliate.

One limitation of the analysis is that the U.S. is geographically isolated from most countries except Canada and Mexico, and supply-chain trade tends to be very regionalized (Richard Baldwin and Lopez-Gonzalez 2014). In this respect it is not surprising that most U.S. affiliates sell primarily to their host countries. However, the finding of Ramondo et al 2013 is consistent with those of Atalay et al. 2014, who study domestic shipments of vertically integrated firms. They estimate an upper bound for the shipments from upstream plants to downstream plants within the same firm, and find this to be less than 0.1 percent of all upstream sales for the median firm. They argue that firms share intangible assets among establishments.

Irarrazabal et al. 2013b estimate a model of multinational production in which the affiliates use an input provided by the parent company. Because of the above patterns in the movement of goods, it is best to think of these inputs as intangible inputs, yet they are subject to the same trade costs. Irarrazabal et al. 2013b estimate the share of these parental inputs in the production by matching the rate at which affiliate sales falls off with distance. They find that about 90 percent of an affiliate's cost is spent on this parental input. The welfare implications of this is that multinational companies cannot jump trade barriers very effectively, since parental inputs are also subject to these barriers. That is, multinational production add little welfare relative to trade.

Keller and Yeaple 2013 build a similar model of knowledge transfer within the multinational firm. Their model has the additional implication that affiliate sales should fall off with distance faster for knowledge-intensive goods. They confirm this and related predictions in the data.

We hence need a better understanding of what vertically integrated firms do, what supply chains are used for, and the potential interaction of these two questions.

Challenge 15: Build a quantitative theory of multinationals.

5. Tools for quantitative policy analysis

5.1. Quantifiable equilibrium models

Computable general equilibrium (CGE) models have been widely used in trade policy analysis Dixon and Jorgenson 2013. It is important to study the equilibrium feedback effects from globalization, which can only be done in general equilibrium frameworks. Hertel 2013 provides an overview of the Global Trade Analysis Project (GTAP), a collaborative project and a database suitable for multi-sector, multi-region modeling of economic interactions. A typical CGE model starts with the Armington assumption: that goods are differentiated by the country of origin so that every country is fully specialized in its particular product (Berden et al. 2009; Francois et al. 2013; Lionel Fontagné 2013; Gabriel J. Felbermayr and Larch 2013).

Kehoe 2005 evaluates the ex-post performance of three CGE models in predicting the effects of the North American Free Trade Agreement. He finds that these models vastly underpredicted the growth in the volume of trade, and calls for new models that can capture sectoral heterogeneity and the productivity-enhancing effects of trade.

Many models have incorporated heterogeneity across sectors, and different ways of capturing comparative advantage across countries (see Costinot and Rodriguez-Clare 2014 for a review). Recent approaches (Balistreri, Hillberry, and Rutherford 2011; Corcos et al. 2012; Balistreri and Rutherford 2013) have incorporated firm heterogeneity in CGE models and showed that trade liberalization has a much bigger effect on trade and welfare than in previous CGE models with an Armington assumption. (Also see our discussion in Section 5.5 below.) Breinlich and Cuñat 2013 perform an ex-post evaluation of the Canada-US Free Trade Agreement with such a Melitz-type model and find that it grossly overpredicts the increase in trade flows, but underpredicts the increase in sectoral productivity. Armenter and Koren 2015 note that when a Melitz model is calibrated to include two sources of heterogeneity, in productivity and in fixed costs of exporting, it will have much more muted response to trade liberalization, both in trade volume and in average productivity. There is, at present, no consensus on the quantitative performance of these models.

General equilibrium modeling is inherently hard. One of the computational complexities is to find solutions to interdependent decisions in a multi-region economy. For example, an American firm sourcing its inputs from Mexico will increase its scale and may then find it beneficial to also start sourcing from China. Or a European firm setting up a plant in Canada can use it as an export platform and has no need for a U.S. plant.

Recent advances have made it possible to model these interdependent location choices. Antràs et al. 2014 models the equilibrium of input sourcing choices. Arkolakis et al. 2013 and Tintelnot 2014 model the

plant location choices of multinationals by putting structure on the productivities of firms across the different locations. We view this as a promising research agenda and welcome further developments to better quantify international linkages.

Challenge 16: Reconcile macroeconomic calibrations with microeconomic evidence.

5.2. The gravity equation

The gravity equation, which links bilateral trade flows with economic sizes and bilateral trade barriers, has been for long a popular method for quantifying trade policy effects. (Also see Chapter 3 of the related survey by Proost and Thisse 2015.) Although a robust empirical relationship, its usefulness was limited in its traditional (naïve) form, because of the lack of theoretical foundations. Since Anderson 1979, Eaton and Kortum 2002 and Anderson and van Wincoop 2003, who first derived theoretical gravity equations, several studies have shown that essentially the same gravity equation can be derived from most trade models. (Also see Allen, Arkolakis, and Takahashi 2014 for general conditions under which the gravity equation can be derived.)

A major difference between the theory-based gravity equation and the traditional gravity is that in the former bilateral trade flows do not depend on the level of bilateral trade barriers, but on the ratio of bilateral trade barriers to multilateral barriers with all the countries in the world. The inclusion of the multilateral resistance (MR) terms of the exporter and importer countries in the empirical gravity equation is crucial, otherwise the coefficient estimates on all trade cost variables are biased toward zero (James E. Anderson and van Wincoop 2003).

Accounting for the MR terms in the gravity estimation is not straightforward, because they are not observed. The most popular method has become the LSDV (Least Squares Dummy Variables) estimation, where full sets of country or country-time fixed effects control for the (potentially time-varying) MR terms. Head and Mayer 2014 compare several alternative estimation methods with Monte Carlo simulations and find that the LSDV yields the most precise estimates, also in the presence of missing observations. But LSDV also has its drawbacks. The inclusion of many country and time fixed effects may make estimation computationally infeasible or the policy dummy of interest can become (near-)perfectly collinear with the fixed effects (Hornok 2012). Alternative estimation methods include the demeaning of the data with the appropriate within transformation (Balázsi, Mátyás, and Wansbeek 2014), a “ratio-type” estimation (Head and Mayer 2014; Jacks, Meissner, and Novy 2011), or the method of Baier and Bergstrand 2009 and Santos Silva and Tenreyro 2006.

As opposed to the naïve gravity estimation, structural gravity allows for general equilibrium comparative statics, i.e. one can solve for the full impact of a policy variable (e.g. FTA or common currency dummy) on trade flows. Unlike partial equilibrium the general equilibrium impact also takes into account the changes in the multilateral resistances and country incomes. The standard way to calculate it is to do a counterfactual exercise with the gravity model to see how trade flows would differ if the policy variable was “switched off.” Head and Mayer 2014 compare the partial and the full impacts of several trade policy variables on bilateral trade and concludes that the latter is smaller, because the effect through the multilateral resistances mitigates the impact of the policy.

A potential concern with gravity-based policy analysis is that trade policy variables are not necessarily exogenous to trade flows. For example, countries which enter into an FTA have often been trading a lot before. This suggests that FTA membership is not an exogenous choice, but driven by factors which are likely to correlate with the initial level of trade. Baier and Bergstrand 2007 argue that most estimates of the FTA effect on trade flows are typically underestimated by around 80% due to endogeneity. The literature has not yet offered a convincing solution to this problem.

An additional issue with the theoretically founded gravity equation is that it does not specify the dynamics of adjustment for trade flows. In practice, however, many economists exploit the panel nature of the data to control for time-invariant unobserved heterogeneity across pairs of countries (see Glick and Rose 2002 for an example on how currency unions affect trade in the time series).

Challenge 17: Model trade adjustment dynamics in the gravity equation.

5.3. Structural models with lots of heterogeneity

Structural econometric models of the type that have been used in industrial organization have proven successful in measuring the links between firm performance and trade (Roberts and Tybout 1997; Clerides, Lach, and Tybout 1998; Das, Roberts, and Tybout 2007), and the transmission of international shocks (Pinelopi Koujianou Goldberg and Verboven 2001). A key challenge in these models is the many facets of heterogeneity across firms and trying to describe the data with as few parametric assumptions as possible (Eaton, Kortum, and Kramarz 2011). In particular, the firm heterogeneity opens up the possibility of omitted variable bias: for example, without a measure of productivity, one would attribute the positive correlation of exporter status with firm performance to a causal effect of learning from exporting.

An often used solution is to structurally estimate a production function using a variant of Olley and Pakes 1996. Furthermore, the full industry equilibrium including demand feedback can also be estimated (De Loecker 2011). Then we obtain a proxy for productivity, and, to the extent that model assumptions are valid, the omitted variable bias is no longer relevant. The benefit of a structural model is that one can conduct counterfactual scenario analysis. See examples in Pavcnik 2002; De Loecker 2007; De Loecker 2011; De Loecker and Warzynski 2012; De Loecker et al. 2012; Morales, Sheu, and Zahler 2014 for models of exporting, Kasahara and Rodrigue 2008, Halpern, Koren, and Szeidl 2015 and Bøler, Moxnes, and Ulltveit-Moe 2012 for models of importing.

We see two limitations of this approach. First, the structure of these models is often rigid, and it is not immediately apparent what primary variation in the data identifies the key parameters of the model. This limits the argumentative use of these models in policy discussion, but also the evaluation of their robustness to other policy environments. For example, the fact that many firms do not participate in export markets might be interpreted as a large monetary cost of market entry. But it may also be the case in the country of analysis that firms have little information about trading opportunities abroad. The two call for very different policy interventions, yet both would show up as high estimates of fixed costs in a structural model.

Second, because structural estimation exploits the within-industry and often within-firm variation to estimate model parameters, it is ill suited to study the general equilibrium responses resulting from globalization. For example, while such a study might establish how trading firms evolved relative to non-trading firms, it cannot identify the overall productivity improvement from trade in the entire economy.

We still see such methods useful to study specific policy proposals (that would affect certain industries disproportionately), the heterogeneous firm response to policy, and to identify the specific mechanism via which globalization affects firms. These insights can then be built into quantitative equilibrium models for predictive analysis.

5.4. Natural and field experiments

Historical natural experiments (e.g.,Bernhofen and Brown 2004 and Bernhofen and Brown 2005; Irwin 2005; Feyrer 2009b; Feyrer 2009a) as well as field experiments (Atkin, Khandelwal, and Osman 2014; Atkin, Faber, and Gonzalez-Navarro 2014) help us not only quantify some of the trade effects proposed by theories, but also understand better the channels through which international trade affects the fortunes of many. (Fuch-Schündeln and Hassan 2015 discuss the role of natural experiments in establishing causal effects in macroeconomics.)

In a recent field experiment, Atkin et al. 2014 randomly offered the possibility to trade with OECD markets to small rug producer enterprises in Egypt. They found that the profit of the treated group increased significantly (by 15-25%), even though their produced quantity decreased. Their results are in line with the learning-by-exporting hypothesis, suggesting that profits of the treated increased due to increased quality, which was enhanced by a massive learning mechanism. In addition to achieving its academic goal (i.e. measuring the effect of international trade), this field experiment is an example of a meaningful intervention with long-lasting positive effects on participants.

Field experiments have the benefit of identifying the causal effect of a particular policy, but they are limited in taking account of equilibrium feedback effects. For example, if other firms learn from the treated exporters, this spillover may not be picked up in the experimental design. (Randomization might also take place at a higher level of aggregation, such as municipalities, in order to account for spillovers.) However, policies related to globalization are of a macroeconomic nature, where equilibrium feedback cannot be ignored. We therefore see field experiments as complementing the toolbox of policy makers, but they will not replace existing tools.

> **Challenge 18**: Identify natural and field experiments that can inform broad questions about trade theory and policy.

5.5. Semi-structural approaches

A promising recent direction is to focus on sufficient statistics as a way to evaluate policy. Chetty 2009 surveys semi-structural methods in public finance, such as measuring deadweight losses from taxation using Harberger 1964 triangles. The basic idea is that, for small changes in taxes, changes in firm and consumer behavior also help trace out changes in firm and consumer surplus. Given an elasticity of how they respond to taxes, one can characterize the welfare costs of taxes in a straightforward manner.

A similar idea has been put to use in international trade. Arkolakis, Costinot, and Rodríguez-Clare 2012 derive a characterization of the gains from trade under a wide class of models using two sufficient statistics: the import penetration ratio, and the elasticity of trade with respect to trade costs. These are statistics that are in principle easy to measure and compute for most policy scenarios.

Further research is needed, however, to determine the robustness of these methods. Adao, Costinot, and Donaldson 2015 derive semi-structural welfare measures for general reduced form demand systems across global factor endowments. It would also be important to extend the analysis to non-tax policy instruments. Hornok and Koren 2015b, for example, show how to quantify the welfare losses from administrative costs that accrue per each shipment.

Challenge 19: Extend semi-structural welfare analysis to non-tax frictions.

6. Conclusion

We surveyed the recent economics literature on international trade and global production. We identified five areas where further research would help policy makers: gains from global production sharing, more quantitative analysis of the redistribution effects of globalization, a better understanding of cross-border frictions, and estimates of the side effect of trade. With the goal of providing a research agenda, we identified nineteen specific challenges for measurement, theory, and policy analysis, and look forward to future research on trade and globalization.

References

Abowd, John M., and Francis Kramarz. 1999. “Chapter 40 The Analysis of Labor Markets Using Matched Employer-Employee Data.” In *Handbook of Labor Economics*, edited by Orley C. Ashenfelter and David Card, Volume 3, Part B:2629–2710. Elsevier.

Acemoglu, Daron, Vasco M. Carvalho, Asuman Ozdaglar, and Alireza Tahbaz-Salehi. 2012. “The Network Origins of Aggregate Fluctuations.” *Econometrica: Journal of the Econometric Society* 80 (5) (September 1): 1977–2016.

Acharya, Ram C., and Wolfgang Keller. 2009. “Technology Transfer through Imports.” *Canadian Journal of Economics/Revue Canadienne D’économique* 42 (4) (November 1): 1411–48.

Adao, Rodrigo, Arnaud Costinot, and Dave Donaldson. 2015. “Nonparametric Counterfactual Predictions in Neoclassical Models of International Trade.”

Aichele, Rahel, and Gabriel Felbermayr. 2015. “Kyoto and Carbon Leakage: An Empirical Analysis of the Carbon Content of Bilateral Trade.” *The Review of Economics and Statistics* 97 (1): 104–15.

Alessandria, George, Joseph P. Kaboski, and Virgiliu Midrigan. 2010. “Inventories, Lumpy Trade, and Large Devaluations.” *The American Economic Review* 100 (5) (December): 2304–39.

Alfaro, Laura, and Maggie X. Chen. 2012. “Selection and Market Reallocation: Productivity Gains from Multinational Production!” National Bureau of Economic Research.

Alfaro, Laura, and Maggie Xiaoyang Chen. 2014. “The Global Agglomeration of Multinational Firms.” *Journal of International Economics* 94 (2) (November): 263–76.

Allen, Treb. 2014. “Information Frictions in Trade.” *Econometrica: Journal of the Econometric Society* 82 (6): 2041–83.

Allen, Treb, Costas Arkolakis, and Yuta Takahashi. 2014. “Universal Gravity.”

Alvarez, Fernando, Lucas, Jr., and E. Robert. 2007. “General Equilibrium Analysis of the Eaton–Kortum Model of International Trade.” *Journal of Monetary Economics* 54 (6) (September): 1726–68.

Amiti, Mary, and Donald R. Davis. 2012. “Trade, Firms, and Wages: Theory and Evidence.” *The Review of Economic Studies* 79 (1) (January 1): 1–36.

Amiti, Mary, and Jozef Konings. 2007. “Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia.” *The American Economic Review* 97 (5) (December 1): 1611–38.

Anderson, James E. 1979. “A Theoretical Foundation for the Gravity Equation.” *The American Economic Review* 69 (1) (March 1): 106–16.

Anderson, James E., Catherine A. Milot, and Yoto V. Yotov. 2014. “How Much Does Geography Deflect Services Trade? Canadian Answers.” *International Economic Review* 55 (3) (August 1): 791–818.

Anderson, James E., and Eric van Wincoop. 2003. “Gravity with Gravitas: A Solution to the Border Puzzle.” *The American Economic Review* 93 (1) (March): 170–92.

Anderson, J. E., and E. Van Wincoop. 2004. “Trade Costs.” *Journal of Economic Literature* 42: 691–751.

Antràs, Pol, Teresa C. Fort, and Felix Tintelnot. 2014. “The Margins of Global Sourcing: Theory and Evidence from US Firms.”

Antras, Pol, Alonso de Gortari, and Oleg Itskhoki. 2015. “Trade, Inequality and Costly Redistribution.”

Antràs, Pol, and Esteban Rossi-Hansberg. 2009. “Organizations and Trade.” *Annual Review of Economics* 1 (1): 43–64.

Antweiler, W., and B. R. Copeland. 2001. “Is Free Trade Good for the Environment.” *American Economic Journal. Applied Economics* 91 (4): 877–908.

Arkolakis, Costas. 2010. “Market Penetration Costs and the New Consumers Margin in International Trade.” *The Journal of Political Economy* 118 (6): 1151–99.

Arkolakis, Costas, Arnaud Costinot, and Andrés Rodríguez-Clare. 2012. “New Trade Models, Same Old Gains?” *The American Economic Review* 102 (1) (February): 94–130.

Arkolakis, Costas, Natalia Ramondo, Andrés Rodríguez-Clare, and Stephen Yeaple. 2013. “Innovation and Production in the Global Economy.” National Bureau of Economic Research.
Armenter, R., and M. Koren. 2013. “Everything All the Time? Entry and Exit in US Import Varieties.” Citeseer.
Armenter, Roc, and Miklós Koren. 2014. “A Balls-and-Bins Model of Trade.” *The American Economic Review* 104 (7) (July): 2127–51.
---. 2015. “ECONOMIES OF SCALE AND THE SIZE OF EXPORTERS.” *Journal of the European Economic Association* 13 (3) (June 1): 482–511.
Armenter, Roc, Miklós Koren, and Dávid Krisztián Nagy. 2014. “Bridges.”
Arnold, Jens Matthias, Beata Javorcik, Molly Lipscomb, and Aaditya Mattoo. 2012. “Services Reform and Manufacturing Performance: Evidence from India.” 5948. The World Bank.
Arnold, Jens Matthias, and Beata S. Javorcik. 2009. “Gifted Kids or Pushy Parents? Foreign Direct Investment and Plant Productivity in Indonesia.” *Journal of International Economics* 79 (1): 42–53.
Arnold, Jens M., Beata S. Javorcik, and Aaditya Mattoo. 2011. “Does Services Liberalization Benefit Manufacturing Firms?: Evidence from the Czech Republic.” *Journal of International Economics* 85 (1) (September): 136–46.
Aronow, Peter M., Cyrus Samii, and Valentina A. Assenova. 2013. “Cluster-Robust Variance Estimation for Dyadic Data.” *arXiv [stat.ME]*. arXiv.
Artuç, Erhan, Shubham Chaudhuri, and John McLaren. 2010. “Trade Shocks and Labor Adjustment: A Structural Empirical Approach.” *The American Economic Review* 100 (3) (June): 1008–45.
Atalay, Enghin, Ali Hortaçsu, and Chad Syverson. 2014. “Vertical Integration and Input Flows.” *The American Economic Review* 104 (4) (April 1): 1120–48.
Atkin, David, Benjamin Faber, and Marco Gonzalez-Navarro. 2014. “Retail Globalization and Household Welfare: Evidence from Mexico.”
Atkin, David, Amit K. Khandelwal, and Adam Osman. 2014. “The Impact of Exporting: Evidence from a Randomized Trial.”
Babiker, Mustafa H. 2005. “Climate Change Policy, Market Structure, and Carbon Leakage.” *Journal of International Economics* 65 (2) (March): 421–45.
Bagwell, Kyle, and Robert W. Staiger. 2011. “What Do Trade Negotiators Negotiate About? Empirical Evidence from the World Trade Organization.” *The American Economic Review* 101 (4) (June): 1238–73.
Baier, Scott L., and Jeffrey H. Bergstrand. 2007. “Do Free Trade Agreements Actually Increase Members’ International Trade?” *Journal of International Economics* 71 (1) (March 8): 72–95.
---. 2009. “Bonus Vetus OLS: A Simple Method for Approximating International Trade-Cost Effects Using the Gravity Equation.” *Journal of International Economics* 77 (1) (February): 77–85.
Balázsi, László, László Mátyás, and Tom Wansbeek. 2014. “The Estimation of Multi-Dimensional Fixed Effects Panel Data Models.” 2014_1. Department of Economics, Central European University.
Baldwin, R. 2006. “Globalisation: The Great Unbundling (s).” *Economic Council of Finland*. http://appli8.hec.fr/map/files/globalisationthegreatunbundling(s).pdf.
Baldwin, Richard E. 2011. “21st Century Regionalism: Filling the Gap between 21st Century Trade and 20th Century Trade Rules.” *Available at SSRN 1869845* (June 22). doi:10.2139/ssrn.1869845. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1869845.
Baldwin, Richard, and Javier Lopez-Gonzalez. 2014. “Supply-Chain Trade: A Portrait of Global Patterns and Several Testable Hypotheses.” *The World Economy*. http://onlinelibrary.wiley.com/doi/10.1111/twec.12189/full.
Balistreri, Edward J., Russell H. Hillberry, and Thomas F. Rutherford. 2011. “Structural Estimation and Solution of International Trade Models with Heterogeneous Firms.” *Journal of International Economics* 83 (2) (March): 95–108.
Balistreri, Edward J., and Thomas F. Rutherford. 2013. “Chapter 23 - Computing General Equilibrium Theories of Monopolistic Competition and Heterogeneous Firms.” In *Handbook of Computable General Equilibrium Modeling SET, Vols. 1A and 1B*, edited by Peter B. Dixon and Dale W.

Jorgenson, Volume 1:1513–70. Elsevier.
Barrot, Jean-Noel, and Julien Sauvagnat. 2014. “Input Specificity and the Propagation of Idiosyncratic Shocks in Production Networks.” *Available at SSRN 2427421* (April 22). doi:10.2139/ssrn.2427421. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2427421.
Baumgarten, Daniel. 2013. “Exporters and the Rise in Wage Inequality: Evidence from German Linked Employer–employee Data.” *Journal of International Economics* 90 (1) (May): 201–17.
Bayoumi, Tamim, David T. Coe, and Elhanan Helpman. 1999. “R&D Spillovers and Global Growth.” *Journal of International Economics* 47 (2) (April 1): 399–428.
Berden, Koen G., Joseph Francois, Mr Martin Thelle, Mr Paul Wymenga, and Ms Saara Tamminen. 2009. “Non-Tariff Measures in EU-US Trade and Investment – An Economic Analysis.” OJ 2007/S 180-219493 . ECORYS Nederland BV.
Bernard, A. B., J. B. Jensen, and R. Z. Lawrence. 1995. “Exporters, Jobs, and Wages in US Manufacturing: 1976-1987.” *Brookings Papers on Economic Activity* 1995: 67–119.
Bernard, A. B., J. B. Jensen, and P. K. Schott. 2009. “Importers, Exporters and Multinationals: A Portrait of Firms in the US That Trade Goods.” In *Producer Dynamics: New Evidence from Micro Data*, edited by Timothy Dunne, J. Bradford Jensen, and Mark J. Roberts, 513–52. nber.org.
Bernard, A. B., A. Moxnes, and K. H. Ulltveit-Moe. 2014. “Two-Sided Heterogeneity and Trade.” 20136. NBER.
Bernard, Andrew B., Ilke van Beveren, and Hylke Vandenbussche. 2012. “Concording EU Trade and Production Data over Time.” 9254. C.E.P.R. Discussion Papers.
Bernard, Andrew B., Emily Blanchard, Ilke van Beveren, and Hylke Vandenbussche. 2012. “Carry-Along Trade.” 9067. C.E.P.R. Discussion Papers.
Bernard, Andrew B., and J. Bradford Jensen. 1999. “Exceptional Exporter Performance: Cause, Effect, or Both?” *Journal of International Economics* 47 (1) (February 1): 1–25.
Bernard, Andrew B., Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum. 2003. “Plants and Productivity in International Trade.” *The American Economic Review* 93 (4) (September): 1268–90.
Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott. 2007. “Firms in International Trade.” *The Journal of Economic Perspectives: A Journal of the American Economic Association* 21 (3) (September): 105–30.
---. 2012. “The Empirics of Firm Heterogeneity and International Trade.” *Annual Review of Economics* 4 (1): 283–313.
Bernard, Andrew B., Andreas Moxnes, and Yukiko U. Saito. 2014. “Production Networks, Geography and Firm Performance.”
Bernhofen, Daniel M., and John C. Brown. 2004. “A Direct Test of the Theory of Comparative Advantage: The Case of Japan.” *The Journal of Political Economy* 112 (1) (February 1): 48–67.
---. 2005. “An Empirical Assessment of the Comparative Advantage Gains from Trade: Evidence from Japan.” *The American Economic Review* 95 (1) (March 1): 208–25.
Berthou, Antoine, Emmanuel Dhyne, Matteo Bugamelli, Ana-Maria Cazacu, Calin-Vlad Demian, Peter Harasztosi, Tibor Lalinsky, Jaanika Meriküll, Filippo Oropallo, and Ana Cristina Soares. 2015. “Assessing European Firms’ Exports and Productivity Distributions : The CompNet Trade Module.” 282. National Bank of Belgium.
Blalock, Garrick, and Paul J. Gertler. 2009. “How Firm Capabilities Affect Who Benefits from Foreign Technology.” *Journal of Development Economics* 90 (2): 192–99.
Blanchard, Emily J. 2015. “A Shifting Mandate: International Ownership, Global Fragmentation, and a Case for Deeper Integration under the WTO.” *World Trade Review* 14 (01) (January 1): 87–99.
Bloom, Nicholas, Mark Schankerman, and John Van Reenen. 2013. “Identifying Technology Spillovers and Product Market Rivalry.” *Econometrica: Journal of the Econometric Society* 81 (4): 1347–93.
Bøler, Esther Ann, Andreas Moxnes, and Karen Helene Ulltveit-Moe. 2012. “Technological Change, Trade in Intermediates and the Joint Impact on Productivity.”
Borchert, Ingo, Aaditya Mattoo, and Batshur Gootiiz. 2012a. “Guide to the Services Trade Restrictions Database.” WPS6108. The World Bank.

---. 2012b. “Policy Barriers to International Trade in Services : Evidence from a New Database.” WPS6109. The World Bank.
Brainard, S. Lael. 1997. “An Empirical Assessment of the Proximity-Concentration Trade-off Between Multinational Sales and Trade.” *The American Economic Review* 87 (4) (September 1): 520–44.
Breinlich, Holger, and Chiara Criscuolo. 2011. “International Trade in Services: A Portrait of Importers and Exporters.” *Journal of International Economics* 84 (2) (July): 188–206.
Breinlich, Holger, and Alejandro Cuñat. 2013. “Tariffs, Trade and Productivity: A Quantitative Evaluation of Heterogeneous Firm Models.” 20. Center for Firms in the Global Economy.
Broda, Christian, Nuno Limao, and David E. Weinstein. 2008. “Optimal Tariffs and Market Power: The Evidence.” *The American Economic Review* 98 (5) (December): 2032–65.
Broda, C., and D. E. Weinstein. 2006. “Globalization and the Gains from Variety.” *The Quarterly Journal of Economics* 121 (2): 541–85.
Cameron, A. Colin, and Douglas L. Miller. 2013. “A Practitioner’s Guide to Cluster-Robust Inference.” *Forthcoming in Journal of Human Resources*: 221–36.
Carballo, Jerónimo, Gianmarco I. P. Ottaviano, and Christian Volpe Martincus. 2013. “The Buyer Margins of Firms’ Exports.” dp1234. Centre for Economic Performance, LSE.
Cernat, L., A. Norman-Lopez, and A. Duch T-Figueras. 2014. “SMEs Are More Important than You Think! Challenges and Opportunities for EU Exporting SMEs.” 2014-3. DG TRADE Chief Economist Note.
Cernat, Lucian. 2014. “Towards ‘Trade Policy Analysis 2.0’: From National Comparative Advantage to Firm-Level Trade Data.” 2014-4. Directorate General for Trade, European Commission.
Chaney, Thomas. 2008. “Distorted Gravity: The Intensive and Extensive Margins of International Trade.” *The American Economic Review* 98 (4): 1707–21.
---. 2014. “The Network Structure of International Trade.” *The American Economic Review* 104 (11) (November): 3600–3634.
Chetty, Raj. 2009. “Sufficient Statistics for Welfare Analysis: A Bridge between Structural and Reduced-Form Methods.” *Annual Review of Economics* 1: 451–88.
Clerides, Sofronis K., Saul Lach, and James R. Tybout. 1998. “Is Learning By Exporting Important? Micro-Dynamic Evidence From Colombia, Mexico, And Morocco.” *The Quarterly Journal of Economics* 113 (3): 903–47.
Coe, David T., and Elhanan Helpman. 1995. “International R&D Spillovers.” *European Economic Review* 39 (5) (May): 859–87.
Coe, David T., Elhanan Helpman, and Alexander W. Hoffmaister. 1997. “North-South R & D Spillovers.” *The Economic Journal of Nepal* 107 (440): 134–49.
Cohen, Lauren, Umit G. Gurun, and Christopher J. Malloy. 2012. “Resident Networks and Firm Trade.” National Bureau of Economic Research.
Corcos, Gregory, Massimo Del Gatto, Giordano Mion, and Gianmarco I. P. Ottaviano. 2012. “Productivity and Firm Selection: Quantifying the ‘New’ Gains from Trade*.” *The Economic Journal of Nepal* 122 (561) (June 1): 754–98.
Cosar, A. Kerem, and Banu Demir. 2014. “Domestic Road Infrastructure and International Trade: Evidence from Turkey.” *Chicago Booth School of Business, Mimeograph.* http://faculty.chicagobooth.edu/kerem.cosar/research/cd_roadsandtrade.pdf.
Costinot, Arnaud, and Andres Rodriguez-Clare. 2014. “Trade Theory with Numbers: Quantifying the Consequences of Globalization.” In *Handbook of International Economics*, edited by Kenneth Rogoff And Gita Gopinath Elhanan Helpman, 4:197–261. Elsevier.
Costinot, Arnaud, and Jonathan Vogel. 2010. “Matching and Inequality in the World Economy.” *J. Polit. Econ.* 118 (4): 747–86.
CPB Netherlands. 2015. “CPB World Trade Monitor February 2015.” Bureau for Economic Policy Analysis.
Das, Sanghamitra, Mark J. Roberts, and James R. Tybout. 2007. “Market Entry Costs, Producer Heterogeneity, and Export Dynamics.” *Econometrica: Journal of the Econometric Society* 75 (3):

837–73.
Davis, Donald R., and David E. Weinstein. 1999. “Economic Geography and Regional Production Structure: An Empirical Investigation.” *European Economic Review* 43 (2) (February 15): 379–407.
Deardorff, Alan V. 1980. “The General Validity of the Law of Comparative Advantage.” *The Journal of Political Economy* 88 (5) (October 1): 941–57.
Dix-Carneiro, Rafael. 2014. “Trade Liberalization and Labor Market Dynamics.” *Econometrica: Journal of the Econometric Society* 82 (3) (May 1): 825–85.
Dix-Carneiro, Rafael, and Brian K. Kovak. 2015. “Trade Reform and Regional Dynamics: Evidence from 25 Years of Brazilian Matched Employer-Employee Data.” National Bureau of Economic Research.
Dixit, Avinash, and Victor Norman. 1980. *Theory of International Trade: A Dual, General Equilibrium Approach*. Cambridge University Press.
Dixon, Peter B., and Dale W. Jorgenson. 2013. “Chapter 1 - Introduction.” In *Handbook of Computable General Equilibrium Modeling SET, Vols. 1A and 1B*, edited by Peter B. Dixon and Dale W. Jorgenson, Volume 1:1–22. Elsevier.
Djankov, Simeon, Caroline Freund, and Cong S. Pham. 2010. “Trading on Time.” *The Review of Economics and Statistics* 92 (1): 166–73.
Donaldson, D. 2010. “Railroads of the Raj: Estimating the Impact of Transportation Infrastructure.” http://www.nber.org/papers/w16487.
Donaldson, D., and R. Hornbeck. 2013. “Railroads and American Economic Growth: A ‘market Access’ Approach.” http://www.nber.org/papers/w19213.
Duranton, Gilles, Peter M. Morrow, and Matthew A. Turner. 2013. “Roads and Trade: Evidence from the US.” *The Review of Economic Studies* (November 6). doi:10.1093/restud/rdt039. http://restud.oxfordjournals.org/content/early/2013/11/06/restud.rdt039.abstract.
Dutt, Pushan, Ilian Mihov, and Timothy Van Zandt. 2011. “Does WTO Matter for the Extensive and the Intensive Margins of Trade?” (March 28). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1794883.
Eaton, Jonathan, and S. Kortum. 2002. “Technology, Geography, and Trade.” *Econometrica* 70 (5) (September): 1741–79.
Eaton, Jonathan, Samuel Kortum, and Francis Kramarz. 2011. “An Anatomy of International Trade: Evidence From French Firms.” *Econometrica: Journal of the Econometric Society* 79 (5): 1453–98.
Eaton, Jonathan, Samuel Kortum, Francis Kramarz, and Raul Sampognaro. 2013. “Firm-to-Firm Trade: Imports, Exports, and the Labor Market.”
Eaton, Jonathan, Samuel S. Kortum, and Sebastian Sotelo. 2012. “International Trade: Linking Micro and Macro.” National bureau of economic research.
Egger, Hartmut, and Udo Kreickemeier. 2009. “FIRM HETEROGENEITY AND THE LABOR MARKET EFFECTS OF TRADE LIBERALIZATION*.” *International Economic Review* 50 (1) (February 1): 187–216.
Eicher, Theo S., and Christian Henn. 2011. “In Search of WTO Trade Effects: Preferential Trade Agreements Promote Trade Strongly, but Unevenly.” *Journal of International Economics* 83 (2): 137–53.
Ekins, Paul, Paul Drummond, and Jim Watson. 2015. “Economic Approaches to Energy, Environment and Sustainability.” 8. COEURE.
European Commission. 2015. “How Trade Policy and Regional Trade Agreements Support and Strengthen EU Economic Performance.”
---. 2015. “European Union Trade in the World.” Accessed June 4. http://trade.ec.europa.eu/doclib/docs/2006/september/tradoc_122532.pdf.
Eurostat. 2011. “European Statistics Code of Practice.”
---. 2014. “International Trade in Services - Statistics Explained.” http://ec.europa.eu/eurostat/statistics-explained/index.php/International_trade_in_services.
Federico, Stefano, and Enrico Tosti. 2012. “Exporters and Importers of Services: Firm-Level Evidence on Italy.” 877. Banca d’Italia.

Feinberg, Susan E., and Michael P. Keane. 2001. “U.S.-Canada Trade Liberalization And Mnc Production Location.” *The Review of Economics and Statistics* 83 (1): 118–32.
Felbermayr, Gabriel, Benedikt Heid, Mario Larch, and Others. 2015. “TTIP: Small Gains, High Risks?” In *CESifo Forum*, 15:20–30. Ifo Institute for Economic Research at the University of Munich.
Felbermayr, Gabriel J., Benjamin Jung, and Farid Toubal. 2010. “Ethnic Networks, Information, and International Trade: Revisiting the Evidence.” *Annals of Economics and Statistics* (97/98) (January 1): 41–70.
Felbermayr, Gabriel J., and Mario Larch. 2013. “The Transatlantic Trade and Investment Partnership (TTIP): Potentials, Problems and Perspectives.” *CESifo Forum* 14 (2): 49–60.
Felbermayr, Gabriel, Julien Prat, and Hans-Jörg Schmerer. 2011. “Globalization and Labor Market Outcomes: Wage Bargaining, Search Frictions, and Firm Heterogeneity.” *Journal of Economic Theory* 146 (1) (January): 39–73.
Felbermayr, G. J., and A. Tarasov. 2015. “Trade and the Spatial Distribution of Transport Infrastructure.” *Sbb-Lab.idt.unisg.ch*. http://www.sbb-lab.idt.unisg.ch/~/media/Internet/Content/Dateien/Unisg/Schools/SEPS/Economics/Forschungsseminar/HS13/Tarasov_paper.ashx.
Felbermayr, G., B. Jung, and M. Larch. 2013. “Optimal Tariffs, Retaliation, and the Welfare Loss from Tariff Wars in the Melitz Model.” *Journal of International Economics* 89: 13–25.
Feyrer, James. 2009a. “Trade and Income -- Exploiting Time Series in Geography.” 14910. National Bureau of Economic Research, Inc.
---. 2009b. “Distance, Trade, and Income - The 1967 to 1975 Closing of the Suez Canal as a Natural Experiment.” 15557. National Bureau of Economic Research, Inc.
Francois, Joseph, and Bernard Hoekman. 2010. “Services Trade and Policy.” *Journal of Economic Literature* 48 (3) (September 1): 642–92.
Francois, Joseph, Miriam Manchin, Hanna Norberg, Olga Pindyuk, and Patrick Tomberger. 2013. “Reducing Transatlantic Barriers to Trade and Investment: An Economic Assessment.” 20130401. Institue for International and Development Economics.
Francois, Joseph, Olga Pindyuk, and Julia Woerz. 2009. “Trends in International Trade and FDI in Services: A Global Database of Services Trade.” 20090802. Institue for International and Development Economics.
Frankel, Jeffrey A. 2009. “Environmental Effects of International Trade.” http://dash.harvard.edu/handle/1/4481652.
Frankel, Jeffrey A., and Andrew K. Rose. 2005. “Is Trade Good or Bad for the Environment? Sorting out the Causality.” *The Review of Economics and Statistics* 87 (1) (February 1): 85–91.
Freund, Caroline, and Sarah Oliver. 2013. “Gains from Harmonizing US and EU Auto Regulations under the Transatlantic Trade and Investment Partnership.”
Freund, Caroline, and Martha Denisse Pierola. “Export Superstars.” *The Review of Economics and Statistics* 0 (ja): null.
Frias, Judith A., David S. Kaplan, and Eric Verhoogen. 2012. “Exports and Within-Plant Wage Distributions: Evidence from Mexico.” *The American Economic Review* 102 (3): 435–40.
Fuchs-Schundeln, Nicola, and Tarek A. Hassan. 2015. “Natural Experiments in Macroeconomics” (March 25). doi:10.2139/ssrn.2583876. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2583876.
Glick, Reuven, and Andrew K. Rose. 2002. “Does a Currency Union Affect Trade? The Time-Series Evidence.” *European Economic Review* 46 (6) (June): 1125–51.
Goh, Chor-Ching, and Beata S. Javorcik. 2007. “Trade Protection and Industry Wage Structure in Poland.” In *Globalization and Poverty*, 337–72. University of Chicago Press.
Goldberg, Pinelopi Koujianou, and Frank Verboven. 2001. “The Evolution of Price Dispersion in the European Car Market.” *The Review of Economic Studies* 68 (4) (October 1): 811–48.
Goldberg, Pinelopi K., and Nina Pavcnik. 2007a. “Distributional Effects of Globalization in Developing Countries.” *Journal of Economic Literature*. http://www.nber.org/papers/w12885.
---. 2007b. “The Effects of the Colombian Trade Liberalization on Urban Poverty.” In *Globalization and*

Poverty, 241–90. University of Chicago Press.
G. Gopinath, E. Helpman, K. Rogoff. 2014. *Handbook of International Economics, Volume 4.* Elsevier.
Gopinath, Gita, and Brent Neiman. 2013. “Trade Adjustment and Productivity in Large Crises.”
Görg, Holger, and David Greenaway. 2004. “Much Ado about Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment?” *The World Bank Research Observer* 19 (2) (September 1): 171–97.
Gray, Jim, Surajit Chaudhuri, Adam Bosworth, Andrew Layman, Don Reichart, Murali Venkatrao, Frank Pellow, and Hamid Pirahesh. 1997. “Data Cube: A Relational Aggregation Operator Generalizing Group-By, Cross-Tab, and Sub-Totals.” *Data Mining and Knowledge Discovery* 1 (1): 29–53.
Grether, Jean-Marie, Nicole A. Mathys, and Jaime De Melo. 2010. “Global Manufacturing SO2 Emissions: Does Trade Matter?” *Review of World Economics* 145 (4): 713–29.
Grossman, Gene M., and Alan B. Krueger. 1993. “Environmental Impacts of a North American Free Trade Agreement.” In *Mexican-U.S. Free Trade Agreement*, edited by Peter M. Garber, 13–56. MIT Press.
Grossman, Gene M., and Esteban Rossi-Hansberg. 2008. “Trading Tasks: A Simple Theory of Offshoring.” *The American Economic Review* 98 (5) (December): 1978–97.
Guadalupe, Maria, Olga Kuzmina, and Catherine Thomas. 2012. “Innovation and Foreign Ownership.” *The American Economic Review* 102 (7) (December): 3594–3627.
Halpern, László, Miklós Koren, and Adam Szeidl. 2015. “Imported Inputs and Productivity.” *American Economic Review* 105 (12). doi:10.1257/aer.20150443. http://dx.doi.org/10.1257/aer.20150443.
Handley, Kyle. 2014. “Exporting under Trade Policy Uncertainty: Theory and Evidence.” *Journal of International Economics* 94 (1): 50–66.
Handley, Kyle, and Nuno Limão. 2012. “Trade and Investment under Policy Uncertainty: Theory and Firm Evidence.” w17790. National Bureau of Economic Research.
Hanson, G. H., and C. Xiang. 2004. “The Home-Market Effect and Bilateral Trade Patterns.” *The American Economic Review* 94 (4): 1108–29.
Hanson, Gordon H. 2007. “Globalization, Labor Income, and Poverty in Mexico.” In *Globalization and Poverty*, 417–56. University of Chicago Press.
Hanson, Gordon H., Raymond J. Mataloni, and Matthew J. Slaughter. 2005. “Vertical Production Networks in Multinational Firms.” *The Review of Economics and Statistics* 87 (4): 664–78.
Harberger, Arnold C. 1964. “The Measurement of Waste.” *The American Economic Review* 54 (3) (May 1): 58–76.
Harrigan, James, and Anthony J. Venables. 2006. “Timeliness and Agglomeration.” *Journal of Urban Economics* 59 (2) (March): 300–316.
Harrison, Ann. 2007. “Globalization and Poverty: An Introduction.” In *Globalization and Poverty*, 1–32. University of Chicago Press.
Harrison, Ann, and Andrés Rodríguez-Clare. 2010. “Trade, Foreign Investment, and Industrial Policy for Developing Countries.” *Handbook of Development Economics* 5: 4039–4214.
Head, Keith, and Thierry Mayer. 2004. “Market Potential and the Location of Japanese Investment in the European Union.” *The Review of Economics and Statistics* 86 (4): 959–72.
---. 2014. “Gravity Equations: Workhorse, Toolkit, and Cookbook.” In *Handbook of International Economics*, edited by Gopinath, Gita, Elhanan Helpman, and Kenneth Rogoff, 4:131–95. Elsevier.
Head, Keith, and John Ries. 2001. “Increasing Returns versus National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade.” *The American Economic Review* 91 (4) (September): 858–76.
Helpman, Elhanan, and Oleg Itskhoki. 2010. “Labour Market Rigidities, Trade and Unemployment.” *The Review of Economic Studies* 77 (3) (July 1): 1100–1137.
Helpman, Elhanan, Oleg Itskhoki, Marc-Andreas Muendler, and Stephen J. Redding. 2012. “Trade and Inequality: From Theory to Estimation.” National Bureau of Economic Research.
Helpman, Elhanan, Oleg Itskhoki, and Stephen Redding. 2010. “Inequality and Unemployment in a Global Economy.” *Econometrica: Journal of the Econometric Society* 78 (4): 1239–83.

Helpman, Elhanan, Marc Melitz, and Yona Rubinstein. 2008. “Estimating Trade Flows: Trading Partners and Trading Volumes.” *The Quarterly Journal of Economics* 123 (2): 441–87.
E. Helpman, D. Marin, T. Verdier. 2008. *The Organization of Firms in a Global Economy*. Harvard University Press.
Hertel, Thomas. 2013. “Chapter 12 - Global Applied General Equilibrium Analysis Using the Global Trade Analysis Project Framework.” In *Handbook of Computable General Equilibrium Modeling SET, Vols. 1A and 1B*, edited by Peter B. Dixon and Dale W. Jorgenson, Volume 1:815–76. Elsevier.
Hoekman, Bernard, and Aaditya Mattoo. 2013. “Liberalizing Trade in Services: Lessons from Regional and WTO Negotiations.” *International Negotiation* 18 (1) (January 1): 131–51.
Hoekman, Bernard M., and Beata K. Smarzynska Javorcik. 2006. *Global Integration and Technology Transfer*. World Bank Publications.
Hornok, Cecília. 2012. “Need for Speed: Is Faster Trade in the EU Trade-Creating?” 4. MNB Working Papers.
Hornok, Cecília, and Miklós Koren. 2015a. “Per-Shipment Costs and the Lumpiness of International Trade.” *The Review of Economics and Statistics* 97 (2): 525–30.
---. 2015b. “Administrative Barriers to Trade.” *Journal of International Economics* 96, Supplement 1 (0) (July): S110–22.
Hummels, David, Jun Ishii, and Kei-Mu Yi. 2001. “The Nature and Growth of Vertical Specialization in World Trade.” *Journal of International Economics* 54 (1) (June): 75–96.
Hummels, David, Rasmus Jørgensen, Jakob Munch, and Chong Xiang. 2014. “The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data.” *The American Economic Review* 104 (6) (June): 1597–1629.
Hummels, David L., and Georg Schaur. 2013. “Time as a Trade Barrier.” *The American Economic Review* 103 (7): 2935–59.
Hummels, David, and Alexandre Skiba. 2004. “Shipping the Good Apples Out? An Empirical Confirmation of the Alchian-Allen Conjecture.” *The Journal of Political Economy* 112 (6) (December 1): 1384–1402.
International Monetary Fund. 2015. “World Economic Outlook Database.”
Irarrazabal, Alfonso, Andreas Moxnes, and Luca David Opromolla. 2013a. “The Tip of the Iceberg: A Quantitative Framework for Estimating Trade Costs.” National Bureau of Economic Research.
---. 2013b. “The Margins of Multinational Production and the Role of Intrafirm Trade.” *The Journal of Political Economy* 121 (1) (February 1): 74–126.
Irwin, D. A. 2005. “The Welfare Cost of Autarky: Evidence from the Jeffersonian Trade Embargo, 1807–09.” *International Review of Law and Economics*. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9396.2005.00527.x/full.
Jacks, David S., Christopher M. Meissner, and Dennis Novy. 2011. “Trade Booms, Trade Busts, and Trade Costs.” *Journal of International Economics* 83 (2) (March): 185–201.
Javorcik, Beata S. 2004. “Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward Linkages.” *The American Economic Review* 94 (3) (June): 605–27.
Javorcik, Beata S., and Mariana Spatareanu. 2009. “Tough Love: Do Czech Suppliers Learn from Their Relationships with Multinationals?*.” *The Scandinavian Journal of Economics* 111 (4) (December 1): 811–33.
Johnson, Robert C. 2014. “Five Facts about Value-Added Exports and Implications for Macroeconomics and Trade Research.” *The Journal of Economic Perspectives: A Journal of the American Economic Association* 28 (2) (May): 119–42.
Kasahara, Hiroyuki, and Joel Rodrigue. 2008. “Does the Use of Imported Intermediates Increase Productivity? Plant-Level Evidence.” *Journal of Development Economics* 87 (1) (August): 106–18.
Kehoe, Timothy J. 2005. *Frontiers in Applied General Equilibrium Modeling: An Evaluation of the Performance of Applied General Equilibrium Models on the Impact of NAFTA*.
Kelle, Markus, Jörn Kleinert, Horst Raff, and Farid Toubal. 2013. “Cross-Border and Foreign Affiliate

Sales of Services: Evidence from German Microdata." *The World Economy* 36 (11): 1373–92.
Kellenberg, Derek K. 2009. "An Empirical Investigation of the Pollution Haven Effect with Strategic Environment and Trade Policy." *Journal of International Economics* 78 (2) (July): 242–55.
Keller, Wolfgang. 2002. "Trade and the Transmission of Technology." *Journal of Economic Growth* 7 (1) (March 1): 5–24.
Keller, Wolfgang, and Stephen Yeaple. 2009. "Multinational Enterprises, International Trade, and Technology Diffusion: A Firm-Level Analysis of the Productivity Effects of Foreign Competition in the United States." *The Review of Economics and Statistics* 91 (4): 821–31.
Keller, Wolfgang, and Stephen Ross Yeaple. 2013. "The Gravity of Knowledge." *The American Economic Review* 103 (4) (June): 1414–44.
Koren, Miklós, and Márton Csillag. 2011. "Machines and Machinists: Capital-Skill Complementarity from an International Trade Perspective." CEPR.
Krishna, Pravin, Jennifer P. Poole, and Mine Zeynep Senses. 2011. "Trade Liberalization, Firm Heterogeneity, and Wages: New Evidence from Matched Employer-Employee Data." *World Bank Policy Research* (June 30). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1875416.
Kropf, Andreas, and Philip Sauré. 2014. "Fixed Costs per Shipment." *Journal of International Economics* 92 (1): 166–84.
Krugman, Paul. 1980. "Scale Economies, Product Differentiation, and the Pattern of Trade." *The American Economic Review* 70 (5): 950–59.
Krugman, Paul R. 1979. "Increasing Returns, Monopolistic Competition, and International Trade." *Journal of International Economics* 9 (4) (November): 469–79.
Lamy, Pascal. 2015. "The New World of Trade." *JAN TUMLIR POLICE ESSAYS* (1). http://ecipe.org/app/uploads/2015/05/JAN-Tumlir-POLICE-Essays-%E2%80%94-20151.pdf.
Lionel Fontagné, Julien Gourdon &. Sébastien Jean. 2013. "Transatlantic Trade: Whither Partnership, Which Economic Consequences?" 1. CEPII.
Lipponer, Alexander. 2006. "Microdatabase Direct Investment-MiDi. A Brief Guide." *Economic Research Centre, Deutsche Bundesbank, Mimeo.* https://www.bundesbank.de/Redaktion/EN/Downloads/Bundesbank/Research_Centre/research_data_micro_data_midi_2011_lipponer_microdatabase_direct_investment.pdf?__blob=publicationFile.
Liu, Tianshu. 2007. "The Impact of Regional Trade Agreements on Trade: The Case of China." *The Chinese Economy* 40 (2): 70–96.
De Loecker, Jan. 2007. "Do Exports Generate Higher Productivity? Evidence from Slovenia." *Journal of International Economics* 73 (1): 69–98.
---. 2011. "Product Differentiation, Multiproduct Firms, and Estimating the Impact of Trade Liberalization on Productivity." *Econometrica: Journal of the Econometric Society* 79 (5): 1407–51.
De Loecker, Jan, Pinelopi K. Goldberg, Amit K. Khandelwal, and Nina Pavcnik. 2012. "Prices, Markups and Trade Reform." 17925. National Bureau of Economic Research.
De Loecker, Jan, and Frederic Warzynski. 2012. "Markups and Firm-Level Export Status." *The American Economic Review* 102 (6): 2437–71.
Lopez-Garcia, Paloma, Filippo di Mauro, Nicola Benatti, Chiara Angeloni, Carlo Altomonte, Matteo Bugamelli, Leandro D'Aurizio, et al. 2014. "Micro-Based Evidence of EU Competitiveness: The CompNet Database." 1634. European Central Bank.
Ludema, Rodney D., and Anna Maria Mayda. 2010. "Do Terms-of-Trade Effects Matter for Trade Agreements? Evidence from WTO Countries." 7695. C.E.P.R. Discussion Papers.
Maggi, Giovanni. 2014. "International Trade Agreements." In *Handbook of International Economics, Volume 4*, edited by Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff.
Malmström, Cecilia. 2015. "The Commission's Future Trade Strategy."
Matyas, Laszlo, Cecilia Hornok, and Daria Pus. 2012. "The Formulation and Estimation of Random Effects Panel Data Models of Trade." 36789. MPRA.
Mátyás, László, Cecilia Hornok, and Daria Pus. 2013. "The Formulation and Estimation of Random Effects Panel Data Models of Trade." 2012_1. Department of Economics, Central European

University.
Mayer, Thierry, and Gianmarco I. P. Ottaviano. 2007. *The Happy Few: The Internationalisation of European Firms*. Bruegel Brussels.
Melitz, Marc J., and Gianmarco I. P. Ottaviano. 2008. "Market Size, Trade, and Productivity." *The Review of Economic Studies* 75 (1) (January 1): 295–316.
Melitz, M. J. 2003. "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity." *Econometrica: Journal of the Econometric Society* 71 (6) (November): 1695–1725.
Melitz, M. J., and S. J. Redding. 2014. "New Trade Models, New Welfare Implications." *American Economic Review* (August). http://scholar.harvard.edu/files/melitz/files/hhgft_012514_figs.pdf.
Melitz, M. J., and D. Trefler. 2012. "Gains from Trade When Firms Matter." *The Journal of Economic Perspectives: A Journal of the American Economic Association* 26 (2): 91–118.
Mion, Giordano, and Luca David Opromolla. 2014. "Managers' Mobility, Trade Performance, and Wages." *Journal of International Economics* 94 (1): 85–101.
Morales, Eduardo, Gloria Sheu, and Andrés Zahler. 2014. "Gravity and Extended Gravity: Using Moment Inequalities to Estimate a Model of Export Entry." National Bureau of Economic Research.
Simon J. Evenett M. Sait Akman, Patrick Low. 2015. *Catalyst? TTIP's Impact on the Rest*. VoxEU.org eBook. CEPR Press.
Muendler, Marc-Andreas. 2004. "Trade, Technology and Productivity: A Study of Brazilian Manufacturers 1986-1998" (April 7). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=525924.
Navaretti, Giorgio Barba, Matteo Bugamelli, Fabiano Schivardi, Carlo Altomonte, Daniel Horgos, and Daniela Maggioni. 2011. "The Global Operations of European Firms - The Second EFIGE Policy Report." *Blueprints*. http://ideas.repec.org/b/bre/bluprt/581.html.
OECD. 2015. "Services Trade Restrictiveness Index." Accessed June 4. http://www.oecd.org/tad/services-trade/services-trade-restrictiveness-index.htm.
Ohlin, Bertil. 1924. "The Trade Theory." *Flam, Harry and Flanders, M June (Eds.), Heckscher-Ohlin Trade Theory*: 82–213.
Olley, G. Steven, and Ariel Pakes. 1996. "The Dynamics of Productivity in the Telecommunications Equipment Industry." *Econometrica: Journal of the Econometric Society* 64 (6): 1263–97.
O'Rourke, Kevin H., and Jeffrey G. Williamson. 1999. "Globalization and History." Cambridge, Mass.: MIT Press.
Ossa, R. 2012. "Why Trade Matters after All." http://www.nber.org/papers/w18113.pdf.
---. 2014. "Trade Wars and Trade Talks with Data." *American Economic Review*. http://www.nber.org/papers/w17347.
Pack, Howard, and Kamal Saggi. 2006. "Is There a Case for Industrial Policy? A Critical Survey." *The World Bank Research Observer* 21 (2) (September 21): 267–97.
Pavcnik, Nina. 2002. "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants." *The Review of Economic Studies* 69 (1) (January 1): 245–76.
Proost, Stef, and Jacques-François Thisse. 2015. "Cities, Regional Development, and Transport." In . COEURE.
Ramondo, Natalia, Veronica Rappoport, and Kim J. Ruhl. 2013. "Horizontal versus Vertical Foreign Direct Investment: Evidence from Us Multinationals." *UC San Diego Typescript Manuscript*. http://www.cemfi.es/ftp/pdf/papers/wshop/VerticalHorizontal.pdf.
Rauch, James E. 1999. "Networks versus Markets in International Trade." *Journal of International Economics* 48 (1): 7–35.
Rauch, James E., and Vitor Trindade. 2002. "Ethnic Chinese Networks in International Trade." *The Review of Economics and Statistics* 84 (1) (February 1): 116–30.
Rauch, J. E. 2001. "Business and Social Networks in International Trade." *Journal of Economic Literature* 39 (4): 1177–1203.
Roberts, M. J., and J. R. Tybout. 1997. "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs." *The American Economic Review* 87 (4): 545–64.
Rose, Andrew K. 2004. "Do We Really Know That the WTO Increases Trade?" *The American Economic*

Review 94 (1) (March): 98–114.
Samuelson, Paul A. 1954. “The Transfer Problem and Transport Costs, II: Analysis of Effects of Trade Impediments.” *The Economic Journal of Nepal* 64 (254) (June 1): 264–89.
Santos Silva, J. M., and Silvana Tenreyro. 2006. “The Log of Gravity.” *The Review of Economics and Statistics* 88 (4): 641–58.
Schank, Thorsten, Claus Schnabel, and Joachim Wagner. 2007. “Do Exporters Really Pay Higher Wages? First Evidence from German Linked Employer–employee Data.” *Journal of International Economics* 72 (1) (May): 52–74.
Schor, Adriana. 2004. “Heterogeneous Productivity Response to Tariff Reduction. Evidence from Brazilian Manufacturing Firms.” *Journal of Development Economics* 75 (2) (December): 373–96.
Stehrer, Robert, Gaaitzen J. de Vries, Bart Los, H. W. A. Dietzenbacher, and Marcel Timmer. 2014. “The World Input-Output Database: Content, Concepts and Applications.” GD-144. Groningen Growth and Development Centre, University of Groningen.
Stolper, Wolfgang F., and Paul A. Samuelson. 1941. “Protection and Real Wages.” *The Review of Economic Studies* 9 (1) (November 1): 58–73.
Stoyanov, Andrey, and Nikolay Zubanov. 2012. “Productivity Spillovers across Firms through Worker Mobility.” *American Economic Journal. Applied Economics* 4 (2) (April): 168–98.
Subramanian, Arvind, and Shang-Jin Wei. 2007. “The WTO Promotes Trade, Strongly but Unevenly.” *Journal of International Economics* 72 (1): 151–75.
Swann, G. M. 2010. “International Standards and Trade: A Review of the Empirical Literature.” Vol. 97. OECD Trade Policy Papers.
Temouri, Yama, Alexander Vogel, and Joachim Wagner. 2013. “Self-Selection into Export Markets by Business Services Firms--Evidence from France, Germany and the United Kingdom.” 183. Vol. 25. University of Lüneburg.
Timmer, Marcel P., Bart Los, Robert Stehrer, and Gaaitzen J. Vries. 2013. “Fragmentation, Incomes and Jobs: An Analysis of European Competitiveness.” *Economic Policy* 28 (76): 613–61.
Tintelnot, Felix. 2014. “Global Production with Export Platforms.” WTO Staff Working Paper.
Topalova, Petia. 2007. “Trade Liberalization, Poverty and Inequality: Evidence from Indian Districts.” In *Globalization and Poverty*, 291–336. University of Chicago Press.
Topalova, Petia, and Amit Khandelwal. 2011. “Trade Liberalization and Firm Productivity: The Case of India.” *The Review of Economics and Statistics* 93 (3): 995–1009.
Volpe Martincus, Christian, Jerónimo Carballo, and Ana Cusolito. 2013. “Routes, Exports, and Employment in Developing Countries: Following the Trace of the Inca Roads.” *Inter-American Development Bank, Mimeo*. http://econweb.umd.edu/~carballo/Routes_Incas_Exports.pdf.
Volpe Martincus, Christian, Jerónimo Carballo, Pablo M. Garcia, and Alejandro Graziano. 2014. “How Do Transport Costs Affect Firms’ Exports? Evidence from a Vanishing Bridge.” *Economics Letters* 123 (2) (May): 149–53.
Wagner, Joachim. 2012. “International Trade and Firm Performance: A Survey of Empirical Studies since 2006.” *Review of World Economics* 148 (2) (January 12): 235–67.
World Bank. 2015. “Services Trade Dataset.” Accessed June 4. http://iresearch.worldbank.org/servicetrade/.
Yeaple, Stephen Ross. 2013. “The Multinational Firm.” *Annual Review of Economics* 5 (1): 193–217.