The Collapse of International Trade During the 2008-2009 Crisis: In Search of the Smoking Gun*

Andrei A. Levchenko
University of Michigan
and NBER

Logan T. Lewis
University of Michigan

Linda L. Tesar
University of Michigan
and NBER

May 5, 2010

Abstract

One of the most striking aspects of the recent recession is the collapse in international trade. This paper uses disaggregated data on U.S. imports and exports to shed light on the anatomy of this collapse. We find that the recent reduction in trade relative to overall economic activity is far larger than in previous downturns. Information on quantities and prices of both domestic absorption and imports reveals a 40% shortfall in imports, relative to what would be predicted by a simple import demand relationship. In a sample of imports and exports disaggregated at the 6-digit NAICS level, we find that sectors used as intermediate inputs experienced significantly higher percentage reductions in both imports and exports. We also find support for compositional effects: sectors with larger reductions in domestic output had larger drops in trade. By contrast, we find no support for the hypothesis that trade credit played a role in the recent trade collapse.

JEL Classifications: F41, F42

Keywords: 2008-2009 Crisis, International Trade

*Preliminary version of a paper prepared for the IMF/Banque de France/PSE Conference on "Economic Linkages, Spillovers and the Financial Crisis" and *IMF Economic Review*. We are grateful to Lionel Fontagné, Pierre-Olivier Gourinchas, Ayhan Kose, David Weinstein, two anonymous referees, and workshop participants at the University of Michigan, Federal Reserve Board of Governors, Dartmouth College, and the Paris conference for helpful suggestions. Çağatay Bircan provided excellent research assistance. Financial support from Cepremap is gratefully acknowledged.
E-mail: alev@umich.edu, ltlewis@umich.edu, ltesar@umich.edu.

1 Introduction

A remarkable feature of the recent crisis is the collapse in international trade. This collapse is global in nature (WTO 2009), and dramatic in magnitude. To give one example, while U.S. GDP has declined by 3.8% from its peak to the current trough, real U.S. imports fell by 21.4% and real exports fell by 18.9% over the same period. Though protectionist pressures inevitably increased over the course of the recent crisis, it is widely believed that the collapse is not due to newly erected trade barriers (Baldwin and Evenett 2009).

While these broad facts are well known, we currently lack both a nuanced empirical understanding of the patterns and a successful economic explanation for them. This paper has three main parts. The first uses high-frequency (quarterly and monthly) foreign trade data for the United States to document the patterns of collapse at a disaggregated level. We focus on the U.S. in part due to its central role in the global downturn and because it offers up-to-date, detailed monthly data. The second part uses data on domestic absorption, domestic price levels, as well as quantities and prices of imports to perform a simple "trade wedge" exercise in the spirit of Cole and Ohanian (2002) and Chari, Kehoe and McGrattan (2007). It allows us to assess whether the evolution of trade volumes is in line with overall domestic demand and relative prices. Finally, the third part uses monthly sector-level data to examine a range of potential explanations for the trade collapse proposed in the policy literature.

Our main findings can be summarized as follows. The recent collapse in international trade is indeed exceptional by historical standards. Relative to economic activity, the drop in trade is an order of magnitude larger than what was observed in the previous postwar recessions, with the exception of 2001. The collapse appears to be broad-based across trading partners: trade with virtually all parts of the world fell by double digits. Across sectors, the sharpest percentage drops in trade are in automobiles, durable industrial supplies and capital goods. Those categories also account for most of the absolute decrease in trade. Another way to assess whether the recent trade collapse is exceptional is to use information on prices and examine the wedges. The time series behavior of the international trade wedge exhibits a drastic deviation from the norm during the recent episode. In the second quarter of 2009, the overall trade wedge has reached −40%, revealing a collapse in trade well in excess of what is predicted by the pace of economic activity and prices. This is indeed exceptional: over the past 25 years the mean value of the wedge is only 1.6%, with a standard deviation of 6.6%. We conclude from this exercise that the recent trade collapse does represent a puzzle, in the sense that any import demand function derived from a standard international real business cycle model would predict a far smaller drop in imports given observed overall economic activity and prices.[1] Finally, using detailed trade data, we shed light on which explanations are consistent with cross-sectoral variation in trade flow changes. We find strong support for the role of vertical linkages, as well as for compositional effects. Sectors that are used intensively as intermediate inputs, and those with greater reductions in domestic output, experienced significantly greater reductions in trade. By contrast, trade credit does not appear to play a significant role: more trade credit-intensive sectors did not experience greater trade flow reductions.

We begin by presenting a comprehensive set of stylized facts about the trade collapse, across time, sectors, and destination countries, as well as separating movements in prices and quantities to examine whether the fall is mainly real or nominal. Moving beyond the stylized facts, our next goal is to establish whether the collapse in trade is indeed "extraordinary" relative to what we should expect. In order to do that, we need a benchmark. The starting point of the second exercise is the canonical international real business cycle model of Backus, Kehoe and Kydland (1995). It assumes that domestic agents value a CES aggregate of domestic and foreign varieties in a particular sector – a common feature of virtually every model in international macroeconomics. In this setup, we derive an import demand equation that expresses total imports as a function of overall domestic absorption, domestic prices, and import prices. The "trade wedge" is then defined as the deviation between actual imports and the imports as implied by these variables. Using this simple optimality condition allows us to explore two questions: first, is the recent trade collapse truly a puzzle? That is, the wedge exercise that accounts for both domestic and foreign prices and quantities is the appropriate benchmark to evaluate whether the recent decrease in international trade is in any sense extraordinary. Second, by pitting against the data conditions that would have to hold period-by-period in virtually any quantitative model of international transmission, we can offer a preliminary view on whether – and which – DSGE models can have some hope of matching the magnitude of the recent collapse in international trade.

The analysis of wedges indeed reveals a large shortfall in imports relative to what would be expected based on the pace of economic activity and relative prices. In the third exercise, we test a series of hypotheses about the nature of the trade collapse using highly disaggregated trade data. We record the percentage changes in exports and imports during the crisis at the 6-digit NAICS level of disaggregation (about 450 distinct sectors), and relate the variation in these changes to sectoral characteristics that would proxy for the leading explanations. The first is that trade may

[1] Chinn (2009) estimates an econometric model of U.S. exports, and shows that the recent level of exports is far below what would be predicted by the model. Freund (2009) analyzes the behavior of trade in previous global downturns, and shows that the elasticity of trade to GDP has increased in recent decades, predicting a reduction in global trade in the current downturn of about 15%. Our methodology looks at U.S. imports rather than U.S. or global exports, and takes explicit account of domestic and import prices at the quarterly frequency.

be collapsing because of the transmission of shocks through vertical production linkages. When there is a drop in final output, the demand for intermediate inputs will suffer, leading to a more than proportional drop in trade flows.[2] To test for this possibility, we build several measures of intermediate input linkages at the detailed sector level based on the U.S. Input-Output tables, as well as measures of production sharing based on data on exports and imports within multinational firms. The second explanation we evaluate is trade credit: if during the recent crisis, firms in the U.S. are less willing to extend trade credit to partners abroad, trade may be disrupted.[3] We therefore use U.S. firm-level data to construct measures of the intensity of trade credit use in each sector. Finally, the collapse in trade could be due to compositional effects. That is, if international trade happens disproportionately in sectors whose domestic absorption (or production) collapsed the most, that would explain why trade fell more than GDP. Two special cases of the compositional story are investment goods (Boileau 1999, Erceg, Guerrieri and Gust 2008) and durable goods (Engel and Wang 2009). Since investment and durables consumption are several times more volatile than GDP, trade in investment and durable goods would be expected to experience larger swings than GDP as well. Thus, we collect measures of domestic output at the most disaggregated available level, and check whether international trade fell systematically more in sectors that also experienced the greatest reductions in domestic output. In addition, we build an indicator for whether a sector produces durable goods.

This paper is part of a growing literature on the features of the 2008-2009 global crisis in general, and on the collapse in international trade in particular. Blanchard, Faruqee and Das (2010) and Lane and Milesi-Ferretti (2010) analyze the crisis experience in a large sample of countries to establish which country characteristics can best explain the cross-sectional variation in the severity of downturns. Imbs (2009) documents the remarkable synchronicity of the crisis across a large set of countries. Chor and Manova (2009) demonstrate that credit conditions in exporting countries affected international trade during the current crisis. Bricongne, Fontagné, Gaulier, Taglioni and Vicard (2009) and Behrens, Corcos and Mion (2010) use detailed firm-level data to document the changes in trade at the micro level for France and Belgium, respectively. Alessandria, Kaboski and Midrigan (2010), Bems, Johnson and Yi (2010), and Eaton, Kortum, Neiman and Romalis (2010) assess whether particular channels, such as input-output linkages or inventory adjustment, can account for the trade collapse in quantitative models. Our approach is deliberately

[2] Hummels, Ishii and Yi (2001) and Yi (2003) document the dramatic growth in vertical trade in recent decades, and di Giovanni and Levchenko (2010) demonstrate that greater sector-level vertical linkages play a role in the transmission of shocks between countries.

[3] Raddatz (2009) shows that there is greater comovement between sectors that have stronger trade credit links, while Iacovone and Zavacka (2009) demonstrate that in countries experiencing banking crises, export fell systematically more in financially dependent industries. Amiti and Weinstein (2009) show that exports by Japanese firms in the 1990s declined when the bank commonly recognized as providing trade finance to the firm was in distress.

agnostic, testing empirically a wide range of hypotheses proposed in the literature. Our results thus complement quantitative modeling efforts, by highlighting which of the mechanisms appear most relevant empirically.

The rest of the paper is organized as follows. Section 2 presents a set of stylized facts on the recent trade collapse using detailed quarterly data on U.S. imports and exports. Section 3 describes the construction of the international trade wedges, and presents the behavior of those wedges over time and in different sectors. Section 4 uses detailed data on sectoral characteristics to assess whether the variation across sectors is consistent with the main explanations proposed in the policy literature. Section 5 concludes.

2 Facts

This section uses disaggregated quarterly data on U.S. imports and exports to establish a number of striking patterns in the data. We discuss three aspects of the recent episode: (i) its magnitude relative to historical experience; (ii) the sector- and destination- level breakdown; and (iii) the behavior of prices and quantities separately. Total imports, exports, and GDP data come from the U.S. National Income and Product Accounts (NIPA). The trade flows and prices disaggregated by sector are from the Bureau of Economic Analysis' Trade in Goods and Services Database, while trade flows disaggregated by partner are from the U.S. International Trade Commission's Tariffs and Trade Database.

Fact 1 *As a share of economic activity, the collapse in U.S. exports and imports in the recent downturn is exceptional by historical standards. Only the 2001 recession is comparable.*

Figure 1(a) plots quarterly values of imports and exports normalized by GDP over the past 63 years, along with the recession bars. Visually, the 2008-09 collapse appears larger than most changes experienced in the past.[4] It is also clear, however, that a similar drop occurred in 2001, a fact that appears underappreciated. Table 1 reports the change in the ratios of imports and exports to GDP during the 2008 and 2001 recessions, as well as the average changes in those variables during the recessions that occurred between 1950 and 2000. For the 2008 and 2001 recessions, the total declines are calculated both during the official NBER recession dates, and with respect to the peak value of trade/GDP around the onset of the recession. It is apparent that both imports and exports to GDP decline by 14 to 30% during the last two recessions, depending on the measure. By contrast, in all the pre-2000 recessions, the average decline in exports is less than 1 percentage

[4]The concurrent change in the exchange rate is relatively subdued. Appendix Figure A1 plots the long-run path of the nominal and real effective exchange rates for the United States. Over the period coinciding with the trade collapse, the U.S. dollar appreciated slightly in real terms, but the change has been less than 10%.

point, and the average change in imports is virtually nil. As an alternative way of presenting the historical series, Figure 1(b) plots the deviations from trend in real imports, exports, and GDP over the same period. To detrend the series, we use the Hodrick-Prescott filter with the standard parameter of 1600. The recent period is characterized by large negative deviations from trend for both imports and exports. We can see that these are greater in magnitude than the deviation from trend in GDP.[5]

An important question is how large is the contribution of the collapse in the price of oil, and the consequent reduction in the value of oil imports. The dotted line in Figure 1(a) reports the evolution of non-oil imports as a share of GDP.[6] It appears that non-oil imports experience a similar percentage decline as a share of GDP as total imports do. This conclusion is confirmed in Table 1, which reports the change in non-oil imports as a share of GDP in the 2008-2009 and 2001 recessions. While the overall imports to GDP ratio does decline more than non-oil imports during the current crisis, non-oil imports to GDP still decline by more than 20%.

Fact 2 *For both U.S. exports and imports, the sharpest percentage drops are in the automotive and industrial supplies sectors, with consumer goods trade experiencing a far smaller percentage decrease. For imports, the decrease in the petroleum category alone accounts for one third of the total decline.*

Panel A of Table 2 reports the reductions in exports and imports by sector for the recent trade collapse. While the overall reduction in nominal exports is about 26%, exports in the automotive sector (which comprises both vehicles and parts) drop by 47%, and in industrial supplies by 34%. By contrast, exports of consumer goods (−12%), agricultural output (−19%), and capital goods (−20%) experience less than average percentage reductions. The table also reports the share of each of these sectors in total exports at the outset of the crisis, as well as the absolute reductions in trade. It is clear that industrial supplies and automotive sectors accounted for almost 40% of all U.S. goods exports, and their combined decrease accounts for more than half of the total collapse of U.S. exports.

[5]How much of this decline in international trade is due to the extensive margin, that is, disappearing import categories? While we do not have up-to-date information on the behavior of individual firms, we can use highly disaggregated data on trade flows to shed light on this question. To that end, we examined monthly import data at the Harmonized Tariff Schedule 8-digit classification, which contains about 10,000 sectors. The number of HTS 8-digit categories with non-zero imports does decline during this crisis, but the change is very small: while the U.S. recorded positive monthly imports in 9,200-9,300 categories during the year leading up to June 2008, in the first half of 2009 that number fell to about 9,100. These disappearing categories account for less than 0.5% of the total reduction in imports over this period. Thus, when measured in terms of highly disaggregated import categories, the role of the extensive margin in the current trade collapse appears to be minimal.

[6]This series starts in 1967, as the breakdown of imports into oil and non-oil is not available for the earlier period.

Total imports decline by 34%. The petroleum and products category has the largest percentage decrease at −54%. It also accounts for some 20% of the pre-crisis imports, and about 1/3 of the total absolute decline. Total non-oil imports decline by 29%. As with exports, the next largest percentage declines are in the automotive (−49%) and industrial supplies (−47%) sectors. By contrast, consumer goods decrease by only 15%, and agricultural products by 9%.

Figures 2 and 3 illustrate the collapse in real trade over time. Figure 2 displays the trade in real goods and services separately. We can see that goods trade is both larger in volume, and the decrease is more pronounced than in services. Figure 3 breaks total goods trade into real durables and non-durables, to highlight that the reduction in the trade categories considered durable is more pronounced, for both imports and exports. These figures indicate that in order to understand the collapse in real trade flows, it is reasonable to focus on goods trade and examine durable goods more closely. We follow this strategy in Sections 3 and 4.

Fact 3 *The collapse in U.S. foreign trade is significant across the major U.S. trading partners, all of whom register double-digit percentage reductions in both imports and exports.*

Panel B of Table 2 reports the reduction, in absolute and percentage terms, of exports and imports to and from the main regions of the world and the most important individual partners within those regions. To be precise, the first three columns, under "Exports," report the exports from the U.S. to the various countries and regions. Correspondingly, the columns labeled "Imports" report the imports to the U.S. from these countries. The broad-based nature of the collapse is remarkable. With virtually every major partner, U.S. exports are dropping by more than 20% (with China and India being the notable exceptions at −15% and −13%), while imports are dropping by 30% or more (with once again China and India as the main exceptions at −16% and −21% respectively).

Fact 4 *Both quantities and prices of exports and imports decreased, with changes in real quantities explaining the majority of the nominal decrease in trade.*

Figure 4 plots both nominal and real trade, each normalized to its 2005q1 value. While nominal exports fall by 26% from its peak, the fall in real exports accounts for about three quarters of that decline, 19%. For imports, the role of declining import prices is greater. In addition, the peak in real imports occurred 3 quarters earlier than the peak of nominal imports, due largely to the timing of the oil price collapse. Nonetheless, real quantities account for about 60% of the total nominal decline in imports. In order to abstract from the role of oil in the evolution of total imports, the dotted lines report real and nominal non-oil imports. The evolution of non-oil trade is similar to the total, though the run-up in nominal trade and the subsequent reduction are less pronounced.

Table 3 presents the nominal, real, and price level changes in each export and import category. It is remarkable that in some important sectors, such as automotive, capital goods, and consumer goods, prices did not move much at all, and the entire decline in nominal exports and imports is accounted for by real quantities. By contrast, prices moved the most in industrial supplies and especially petroleum. Figure 5 presents the contrast between nominal and real graphically. It plots the nominal declines in each sector against the real ones, along with the 45-degree line. For points on the 45-degree line, all of the nominal decrease in trade is accounted for by movements in real quantities, with no change in prices. For points farther from the line, price changes account for more of the nominal change in trade. There are several things to take away from this figure. First, we can see that some important sectors are at or very near the 45-degree line: all of the change in nominal trade in those sectors comes from quantities. Second, petroleum imports is by far the biggest exception, as the only sector in which most of the change comes from prices. Finally, in most cases import and export prices experienced a drop – the bulk of the points are below the 45-degree line. This implies that in the recent episode, trade prices and quantities are moving in the same direction.

3 Wedges

The discussion of nominal and real quantities foreshadows the exercise in this section. In particular, we ask, is there any way to assess whether the trade changes during the recent crisis are in some sense "exceptional" or "abnormal"? That is, how would we expect trade flows to behave in the recent recession? To provide a model-based benchmark for the behavior of trade flows, we follow the "wedge" methodology of Cole and Ohanian (2002) and Chari et al. (2007). We set down an import demand equation that would be true in virtually any International Real Business Cycle (IRBC) model, and check how the deviation from this condition, which we call the "trade wedge," behaves in the recent crisis relative to historical experience. As the derivation is standard, we detail it in Appendix A.

The import demand relationship, in log changes denoted by a caret, is given by:

$$\widehat{y}^f = \varepsilon \left(\widehat{P} - \widehat{p}^f \right) + (\widehat{C + I}), \tag{1}$$

where y^f is demand for imports, $C + I$ is overall aggregate demand (consumption plus investment), P is the overall domestic price level, and p^f is the price of imports. This equation provides a benchmark for evaluating whether the recent trade collapse represents a large deviation from business as usual.[7] They will hold exactly in any model that features CES aggregation of foreign

[7]Our approach is related to another benchmark for analyzing trade volumes: the gravity equation. Starting from

and domestic goods, a quite common one in the IRBC literature. Economically, it ties real import demand to (i) overall real domestic absorption $(C + I)$; (ii) the overall domestic price level (P); and (iii) import prices p^f. Since all of these are observable, we proceed by using equation (1) to compute the log deviation from it holding exactly, calling it the "trade wedge." On the left-hand side is the log change in real imports. The term $(\widehat{C+I})$ is captured by the log change in the sum of real consumption and real investment in the national accounts data; $\widehat{P}$ is the change in the GDP deflator,[8] and $\widehat{p}^f$ is the change in the import price deflator. We must also choose a value of the elasticity of substitution ε. We report results for two values: $\varepsilon = 1.5$, which is the "classic" IRBC value of the elasticity of substitution between domestic and foreign goods (Backus et al. 1995); and $\varepsilon = 6$, which is a common value in the trade literature (Anderson and van Wincoop 2004).[9]

We use quarterly data and compute year-to-year log changes in each variable. Column 1 in Table 4 presents the value of the year-to-year wedge for 2009q2 (computed relative to 2008q2) for the two elasticities. We choose to report the values for 2009q2 because it represents the trough in both international trade and the wedges during the current trade collapse episode. The wedge is indeed quite large, at −40% for the more conservative choice of ε. The negative value indicates, not surprisingly, that imports fell by 40% *more* than overall U.S. domestic demand and price movements would predict. To get a sense whether the current level of the wedge is out of the ordinary, Figure 6 plots the quarterly values of the year-on-year wedge for the period 1968 to the present. The recent period is indeed exceptional. Over the entire sample period going back to 1968, the long-run average of the wedge is actually slightly positive, at 2.9%, with a standard deviation

equation (A.2), the total nominal trade volumes can be expressed in terms of prices and the nominal output as: $p_t^f y_t^f = (1-\omega)\left(\frac{P_t}{p_t^f}\right)^{\varepsilon-1} X_t$, where $X_t \equiv P_t (C_t + I_t)$ is nominal GDP. The gravity approach proceeds to express p_t^f as a function of trade costs and the source country characteristics, usually the source country nominal GDP, X_t^*. The advantage of the gravity approach is that it uses less information, as it does not rely on knowing domestic and import prices. The main disadvantage is that it imposes additional assumptions on the supply side, by taking a stand on what determines p_t^f. This leads to an unnecessarily restrictive interpretation of the current experience: any shortfall of actual imports from what is implied by the evolution of nominal GDPs must be attributed to an increase in trade costs (see, e.g., Jacks, Meissner and Novy 2009). In a sense, by subsuming domestic prices and making strong assumption on import prices, the gravity approach forces actual trade to be on the model-implied demand and supply curves exactly. By contrast, our approach uses explicit information on domestic and import prices to gauge how far we are from the model-implied demand curve.

[8] We also constructed a price index for just consumption and investment based on the consumption and investment prices in the National Income and Product Accounts, and used that instead of the GDP deflator. The results were virtually unchanged.

[9] Throughout this section, we assume that the taste parameter ω is not changing. If ω is thought of as a taste shock in the demand for foreign goods, an alternative interpretation of the wedge would be that it reveals what this taste shock must be in each period to satisfy the first-order condition for import demand perfectly. In the IRBC literature, the parameter ω is sometimes thought of as a trade cost, and its value calibrated to the observed share of imports to GDP. Under this interpretation, it may be that during this crisis trade costs went up, thereby lowering imports. While we do not have comprehensive data on total trade costs at high frequencies, anecdotal evidence suggests that if anything shipping costs decreased dramatically in the course of the recent crisis, due in part to the oil price collapse (Economist 2009). Thus, taking explicit account of shipping costs would make the wedge even larger.

of 10.2%.[10] After 1984 – a year widely considered to be a structural break, also evident in Figure 6 – the average wedge is 1.6%, with a standard deviation of 6.6%. Thus, the current value of the wedge is more than 6 standard deviations away from the mean, and from zero, when compared to the post-1984 period. Note that a more muted instance of the "collapse in the wedge" occurred in the 2001 recession. However, in that episode the wedge reached −20%, well short of the current value.[11]

We can also determine whether price or quantity movements make up the bulk of the current wedge. Real imports (the left-hand side of equation 1) fell by 21%, while the total final demand ($\widehat{C+I}$) fell by 6.7%. This implies that in the absence of any relative price movements, the wedge would have been about −14%. The price movements conditioned by the elasticity of substitution make up the rest of the difference: the GDP deflator went up by 1.5%, while import prices actually fell by 16%.

The second column of Table 4 repeats the exercise for non-oil imports. Abstracting from oil reduces the wedge to −28%, a value that is still quite exceptional. The post-1984 standard deviation in the non-oil wedge is 5.2%, with a mean of 1.3%. Thus, the 2009q2 value of the non-oil wedge is more than 5 standard deviations away from either its historical mean or zero.

3.1 Durable Goods

Beyond the simple structure of the canonical IRBC model, this methodology can be applied to construct a wedge for any sector that would be modelled as a CES aggregate of domestic and foreign varieties. The key data limitation that prevents the construction of wedges for disaggregated industries is the availability of domestic absorption and price levels at the detailed level. We can make progress, however, for one important sector: durable goods. Engel and Wang (2009) demonstrate that both imports and exports are about 3 times more volatile than GDP in OECD countries, and propose a compositional explanation. It is well known that durable goods consumption is more volatile than overall consumption, and that much of international trade is in durable goods. Putting the two together provides a reason for why trade is more volatile than GDP: it is composed of the more volatile durables. This hypothesis can be extended to apply to the recent

[10] We conjecture that the positive long-run average value over this period may reflect a secular reduction in trade costs, which we do not incorporate explicitly into our exercise.

[11] In the baseline analysis we compute the wedges based on log changes over time – in our case, year-on-year changes in quarterly data. An alternative would be to compute them based on deviations from trend in each variable. To do this, we HP-detrended each series, and built a wedge using equation (1) such that the caret means the log deviation from trend. This procedure yields qualitatively similar results. In 2009q2 the overall wedge stands at −20%. This is considerably smaller in magnitude than the baseline value we report. However, it is still quite exceptional by historical standards. In the post-1984 period, the standard deviation of the deviation-from-trend wedge is 4.8%, and its mean is very close to zero. This implies that the value of 2009q2 wedge is 4.3 standard deviations away from the historical average.

crisis. It may be that imports and exports fell so much relative to GDP because their composition is different from the composition of GDP.

The wedges methodology can be used to shed light on the potential for this explanation to work. If the reason for the fall in trade is compositional, then the wedges should disappear (or at least get smaller) when we compute them on the durable goods separately. By standard CES cost minimization, the "durable trade wedge" has the familiar form:

$$\widehat{d^f} = \varepsilon \left(\widehat{P_D} - \widehat{p}^f_D \right) + \widehat{D}, \tag{2}$$

where, as above, P_D is the domestic price level of the durable spending, and p^f_D is the price of the foreign durables. To construct the durable wedge, we use the BEA definition of durable goods imports.[12] Using sector-level price and quantity import data, we construct the log change in real durable imports $\widehat{d^f}$ and in the prices of durable imports $\widehat{p}^f_D$. To proxy for real durable demand $\widehat{D}$ we combine domestic spending on consumer durables and fixed investment, building the corresponding domestic durable price level.[13]

The third column of Table 4 reports the 2009q2 (to-date trough) value of the year-to-year wedge. It is clear that the compositional explanation does have some bite: for $\varepsilon = 1.5$ the durable wedge stands at -21%, or about half of the overall wedge value. At the same time, even the durable wedge's value is exceptional in this period: it is about 4 standard deviations away from its post-1984 mean. Relative to the overall wedge, the contribution of the real quantities to the durable wedge is greater. Real durable imports fell by 34%, while the real durable domestic spending fell by 18%. This implies that in the complete absence of relative price movements, the "quantity wedge" would be about 16%. The rest of the wedge comes from relative prices.

3.2 Final Goods

We can make progress in shedding light on the compositional explanations in another way. It may be that equation (A.1) is not a good description of the production structure of the economy. One immediate possibility is that consumption and investment goods are very different. Indeed, Section 2 shows that consumption and capital goods experienced different price and quantity movements. We can glean further where the data diverge from the model by positing a production structure in which investment and consumption goods are different, but both are produced from domestic

[12] This roughly corresponds to the sum of capital goods; automotive vehicles, engines, and parts; consumer durables; and durable industrial supplies and materials.

[13] Our calculation includes in $\widehat{D}$ structures and residential investment in addition to machinery and equipment. This inclusion tends to make the durable wedge smaller, as real estate prices fell more than overall investment goods prices, shrinking the price component of the durable wedge.

and foreign varieties (see, e.g., Boileau 1999, Erceg et al. 2008). Going through the same cost minimization calculation, we obtain import demand for consumption and investment goods expressed in log changes:

$$\widehat{c}^f = \varepsilon\left(\widehat{P}_C - \widehat{p}_C^f\right) + \widehat{C}, \tag{3}$$

$$\widehat{i}^f = \sigma\left(\widehat{P}_I - \widehat{p}_I^f\right) + \widehat{I}. \tag{4}$$

These equations now relate the real reduction in consumption goods imports to overall domestic real consumption, the consumption price index, and the price index of imported consumption goods, and do the same for investment. Provided that we have data on all of these prices and quantities, we can calculate the "consumption trade wedge" and the "investment trade wedge," and determine which one reveals greater deviations from the theoretical benchmark.

To construct these, we isolate imports of consumer goods (about 20% of total U.S. imports at the outset of the crisis), and compute the real change in consumer goods imports $\widehat{c}^f$, and the corresponding import price change $\widehat{p}_C^f$. We then match these up to the change in real consumption expenditures on goods $\widehat{C}$, and the domestic consumption price index. Column 4 of Table 4 reports the results. The consumption wedge is much smaller, at -6.4%. Figure 7 displays the time path of the year-on-year consumption wedge since 1968. It is clear that the recent episode is completely unexceptional if we confine our attention to consumer goods trade. The consumption wedge has a post-1984 mean of 4.4% and a standard deviation of 5.6%.

To construct the investment trade wedge, we isolate imports of capital goods (also about 20% of U.S. imports at the outset of the crisis), and match them up with investment data in the National Accounts. Column 5 of Table 4 presents the results. The investment wedge is also quite small, at -10%. As Figure 7 shows, it is unexceptional by historical standards: the mean investment wedge post-1984 is 2.5%, with a standard deviation of 5.9%. This implies that the current level of the investment wedge is about one and a half standard deviations away from the historical mean, or from the model implied value of zero.

These results tell us that the puzzle in the recent trade collapse is not in final goods, be it consumption or investment. Instead, the discrepancy between the large overall wedge and the small consumption and investment wedges appears to be in the intermediate goods sectors, and these partially overlap with durable goods. This suggests that modeling exercises that focus on movements in the final domestic demand are unlikely to match the data well. Instead, explanations that focus on trade in intermediates appear potentially more fruitful.

3.3 Other Countries

Figure 8 reports the overall trade wedge, (1), for other major developed countries: Japan, Germany, U.K., France, Italy, and Canada. Within this group, there is a fair bit of variation in the current behavior of the wedge.[14] In only one country, Japan, the current wedge has reached the level comparable to that or the U.S., exceeding -60%. Germany, France, and Italy all experience large negative wedges, of about -25%. While this does point to a shortfall in imports relative to what would be predicted by the simple model, it is clearly much less drastic when compared to both the current shortfalls in the U.S. and Japan, as well as these countries' historical variation in the wedge. By contrast, Canada and the U.K. exhibit only a small departure from the norm in the current crisis, suggesting that the behavior of imports in these countries is easily rationalized simply by movements in aggregate demand and relative prices. Figure 9 reports the overall trade wedges for selected emerging markets. Here, the experiences are just as diverse: while Korea, Turkey, and the Czech Republic record wedges in the range of -20% to -30%, in Mexico, for instance, the wedge is very close to zero.

To summarize, in both developed countries and emerging markets, there appears to be a great deal of heterogeneity in the behavior of the trade wedges. This is in spite of the fact that international trade itself collapsed in all of these countries to a similar degree. This suggests that behind the superficial similarity in country experiences, there is important heterogeneity in the underlying shocks and transmission mechanisms. Sorting out this variation remains a fruitful direction for future research.

4 Empirical Evidence

The framework set out in Section 3 is useful for framing a set of possible explanations for the trade collapse and of hypotheses to test. When we focus on overall trade, we uncover a large shortfall in real imports, relative to what would be implied by final demand $(C+I)$. What could be responsible for this large divergence between the model and the data? The first possibility is that the model is not rich enough. For instance, confining our attention to final goods imports reveals that for consumption and investment goods, the shortfall is far less dramatic. Thus, one of the potential explanations is trade in intermediate inputs and vertical linkages. Second, it may be that the model is adequate, but agents – be it households or firms – face additional constraints that prevent them from being on their demand curve. This suggests that another potential explanation for the increase in the wedge is a tightening of a financial constraint. Finally, it may be that when we

[14] All the data used in this subsection come from the OECD.

compare the total imports to total domestic demand, we are not comparing the same bundle of goods, and thus it is important to examine the composition of trade. This last hypothesis also points to the importance of looking at this phenomenon at a more disaggregated level.

This is what we do in this section. In order to carry out empirical analysis, we collect monthly nominal data for U.S. imports and exports vis-à-vis the rest of the world at the NAICS 6-digit level of disaggregation from the USITC. This the most finely disaggregated NAICS trade data available at monthly frequency, yielding about 450 distinct sectors. To reduce the noise in the monthly trade data, we aggregate it to the quarterly frequency. For each sector, we compute the percentage drop in trade flows over the course of a year ending in June 2009, and estimate the following specification:

$$\gamma_i^{trade} = \alpha + \beta \text{CHAR}_i + \boldsymbol{\gamma}\mathbf{X}_i + \epsilon_i.$$

In this estimating equation i indexes sectors, γ_i^{trade} is the percentage change in the trade flow, which can be exports or imports, and CHAR_i is the sector-level variable meant to capture a particular explanation proposed in the literature.[15]

We include a vector of controls $\mathbf{X}_i$ in each specification. Because we do not have the required data at this level of disaggregation to construct the sector-level wedges and their components, our regression estimates do not have a structural interpretation. However, the functional form of the import demand equation, (1), is informative about the kinds of variables we should control for. First, we control for the elasticity of substitution between goods within a sector, sourced from Broda and Weinstein (2006). Second, we must try to proxy for the movements in domestic demand and sector-level prices. To control for sector size, we include each industry's share in total imports (resp. exports) over the period 2002-2007, as well as labor intensity computed from the U.S. Input-Output table. These are indicators available for both non-manufacturing and manufacturing industries. To check robustness, we also control for skill and capital intensity sourced from the NBER productivity database, and the level of inventories from the BEA, which are unfortunately only available for manufacturing industries.[16]

Our strategy is to exploit variation in sectoral characteristics to evaluate three main hypotheses: vertical production linkages, trade credit, and compositional effects/durables demand. We now describe each of them in turn. The vertical linkages view, most often associated with Yi (2003),

[15] The change in trade is computed using the total values of exports and imports in each sector, implying that it is a nominal change. As an alternative, we used import price data from the BLS at the most disaggregated available level to deflate the nominal flows. The shortcoming of this approach is that the import price indices are only available at a more coarse level of aggregation (about 4-digit NAICS). This reduces the sample size, especially for exports, and implies that multiple 6-digit trade flows are deflated using the same price index. Nonetheless, the main results were unchanged.

[16] We also re-estimated all of the specifications while dropping oil sectors: NAICS 211111 (Crude Petroleum and Natural Gas Extraction), 211112 (Natural Gas Liquid Extraction), and 324110 (Petroleum Refineries). All of the results below were unchanged.

suggests that since much of international trade is in intermediate inputs, and intermediates at different stages of processing often cross borders multiple times, a drop in final consumption demand associated with the recession will decrease cross-border trade in intermediate goods. This can matter for the business cycle: di Giovanni and Levchenko (2010) show that trade in intermediate inputs leads to higher comovement between countries, both at sectoral and aggregate levels. The simplest way to test the vertical linkage hypothesis is to classify goods according to the intensity with which they are used as intermediate inputs. We start with the 2002 benchmark version of the detailed U.S. Input-Output matrix available from the Bureau of Economic Analysis, and construct our measures using the Direct Requirements Table. The (i, j)th cell in the Direct Requirements Table records the amount of a commodity in row i required to produce one dollar of final output in column j. By construction, no cell in the Direct Requirements Table can take on values greater than 1. To build an indicator of "downstream vertical linkages," we record the average use of a commodity in row i in all downstream industries j: the average of the elements across all columns in row i. This measure gives the average amount of good i required to produce one dollar's worth of output across all the possible final output sectors. In other words, it is the intensity with which good i is used as an intermediate input by other sectors.

We build two additional indicators of downstream vertical linkages: the simple number of sectors that use input i as an intermediate, and the Herfindahl index of downstream intermediate use. The former is computed by simply counting the number of industries for which the use of intermediate input i is positive. The latter is an index of diversity with which different sectors use good i: it will take the maximum value of 1 when only one sector uses good i as an input, and will take the minimum value when all sectors use input i with the same intensity.

A related type of the vertical linkage story is the "disorganization" hypothesis (Kremer 1993, Blanchard and Kremer 1997). In a production economy where intermediate inputs are essential, following a disruption such as the financial crisis, shocks to even a small set of intermediate inputs can create a large drop in output. For instance, Blanchard and Kremer (1997) document that during the collapse of the Soviet Union, output in more complex industries – those that use a greater number of intermediate inputs – fell by more than output in less complex ones. This view suggests that we should construct measures of "upstream vertical linkages," that would capture the intensity and the pattern of intermediate good use by industry (in column) j. The three indices we construct parallel the downstream measures described above. We record the intensity of intermediate good use by industry j as total spending on intermediates per dollar of final output. We also measure an industry's complexity in two ways: by counting the total number of intermediate inputs used by industry j, and by computing the Herfindahl index of intermediate use shares in industry j.[17]

Burstein, Kurz and Tesar (2008) propose another version of the vertical linkage hypothesis. They argue that it is not trade in intermediate inputs per se, but how production is organized. Under "production sharing," inputs are customized and the factory in one country depends crucially on output from a particular factory in another country. In effect, inputs produced on different sides of the border become essential, and a shock to one severely reduces the output of the other. To build indicators of production sharing, we follow Burstein et al. (2008) and use data on shipments by multinationals from the BEA. In particular, we record imports from foreign affiliates by their U.S. parent plus imports from a foreign parent company by its U.S. affiliate as a share of total U.S. imports in a sector. Similarly, we record exports to the foreign affiliate from their U.S. parents plus exports to a foreign parent from a U.S. affiliate as a share of total U.S. exports. In effect, these measures of production sharing are measures of intra-firm trade relative to total trade in a sector. We use the BEA multinational data at the finest level of disaggregation publicly available, which is about 2 or 3 digit NAICS, and take the average over the period 2002-2006 (the latest available years).

The second suggested explanation for the collapse in international trade is a contraction in trade credit (see, e.g., Auboin 2009, IMF 2009). Under this view, international trade is disrupted because importing domestic companies no longer extend trade credit to their foreign counterparties. Without trade credit, foreign firms are unable to produce and imports do not take place. Indeed, there is some evidence that sectors more closely linked by trade credit relationships experience greater comovement (Raddatz 2009). To test this hypothesis, we used Compustat data to build standard measures of trade credit intensity by industry. The first is accounts payable/cost of goods sold. This variable records the amount of credit that is extended to the firm by suppliers, relative to the cost of production. The second is accounts receivable/sales. This is a measure of how much the firm is extending credit to its customers. These are the two most standard indices in the trade credit literature (see, e.g., Love, Preve and Sarria-Allende 2007). To construct them, we obtain quarterly data on all firms in Compustat from 2000 to 2008, compute these ratios for each firm in each quarter, and then take the median value for each firm across all the quarters for which data are available. We then take the median of this value across firms in each industry.[18] Since coverage is uneven across sectors, we ensure that we have at least 10 firms over which we calculate trade credit intensity. This implies that sometimes the level of variation is at the 5-, 4-, and even 3-digit level, though the trade data are at the 6-digit NAICS level of disaggregation.[19]

[17] For more on these product complexity measures, see Cowan and Neut (2007) and Levchenko (2007).

[18] We take medians to reduce the impact of outliers, which tend to be large in firm-level data. Taking the means instead leaves the results unchanged.

[19] Amiti and Weinstein (2009) emphasize that trade credit in the accounting sense and trade finance are distinct.

Finally, another explanation for the collapse of international trade has to do with composition. It may be that trade fell by more than GDP simply because international trade occurs systematically in sectors that fell more than overall GDP. A way to evaluate this explanation would be to control for domestic absorption in each sector. While we do not have domestic absorption data, especially at this level of aggregation, we instead proxy for it using industrial production indices. These indices are compiled by the Federal Reserve, and are available monthly at about the 4-digit NAICS level of disaggregation. They are not measured in the same units as import and export data, since industrial production is an index number. Our dependent variables, however, are percentage reductions in imports and exports, thus we can control for the percentage reduction in industrial production to measure the compositional effect. Two special cases of the compositional channel are due to Boileau (1999), Erceg et al. (2008), and Engel and Wang (2009). These authors point out that a large share of U.S. trade is in investment and durable goods, which tend to be more volatile than other components of GDP. In order to explore this possibility, we classify goods according to whether they are durable or not, and examine whether durable exports indeed fell by more than nondurable ones.[20]

Appendix Table A1 reports the summary statistics for all the dependent and independent variables used in estimation.

4.1 Vertical Linkages

Table 5 describes the results of testing for the role of downstream vertical linkages in the reduction in trade. In this and all other tables, the dependent variable is the percentage reduction in imports (Panel A) or exports (Panel B) from 2008q2 to 2009q2.[21] All throughout, we report the standardized beta coefficients, obtained by first demeaning all the variables and normalizing each to have a standard deviation of 1. Thus, the regression coefficients correspond to the number of standard deviations change in the left-hand side variable that would be due to a one standard deviation change in the corresponding independent variable. We do this to better gauge the relative importance of the various competing explanations, especially since the right-hand side variables of interest have very different scales. In addition, in each column we report the partial R^2 associated with the

Trade credit refers to payments owed to firms, while trade finance refers to short-term loans and guarantees used to cover international transactions. We are not aware of any reliable sector-level measures of trade finance used by U.S. firms engaged in international trade.

[20]We created a classification of durables at the 3-digit NAICS level. Durable sectors include 23X (construction) and 325-339 (chemical, plastics, mineral, metal, machinery, computer/electronic, transportation, and miscellaneous manufacturing). All other 1XX, 2XX, and 3XX NAICS categories are considered non-durable for this exercise.

[21]The peak of both total nominal imports and total nominal exports in the recent crisis is August 2008. An alternative dependent variable would be the percentage drop from the peak to the trough. However, that measure is more noisy because of seasonality. Therefore, we consider a year-on-year reduction, sidestepping seasonal adjustment issues.

variable(s) of interest. This allows us to assess how successful each explanation is at accounting for the cross-sectoral variation.

There is evidence that downstream linkages play a role in the reduction in international trade, especially for imports into the United States. Goods that are used intensely as intermediates ("Average Downstream Use") experienced larger percentage drops in imports and exports. In addition, other proxies such as the number of sectors that use an industry as an intermediate input as well as the Herfindahl index of downstream intermediate use, are significant for imports, though not for exports. The most successful indicator of downstream linkages has a beta coefficient of -0.2, implying that a one standard deviation increase in Average Downstream Use leads to a reduction in trade that is 0.2 standard deviations larger. There is also some evidence that the measure of production sharing based on trade within multinational firms is significantly correlated with a drop in imports, though not exports. In terms of accounting for the variation in the data, the best downstream indicator has a partial R^2 of 0.04, same as the R^2 that can be accounted for by the rest of the controls: sector size, elasticity of substitution, and labor intensity.[22]

Table 6 examines instead the role of upstream vertical linkages, with more mixed results. While some of the measures are significant for either imports or exports, and all have the expected signs, there is no robust pattern of significance. The beta coefficients are lower than the downstream coefficients, and the partial R^2's are on the order of 1% in the best of cases.

4.2 Trade Credit

Table 7 examines the hypothesis that trade credit played a role in the collapse of international trade. In particular, it tests for whether imports and exports experienced greater percentage reductions in industries that use trade credit intensively. As above, Panel *A* reports the results for imports, and Panel *B* for exports. There appears to be no evidence that sectors that either use, or extend, trade credit more intensively exhibited larger changes in trade flows. For imports, the beta coefficients are all less than 5%, and the partial R^2's are virtually zero.

Chor and Manova (2009) use monthly U.S. import data disaggregated by partner country and sector, and a difference-in-differences approach to show that trade from countries that experienced a greater credit contraction fell disproportionately more in sectors that rely on external finance, have fewer tangible assets, or use more trade credit. However, the question remains whether the differential effect of the credit conditions emphasized by those authors translates into greater

[22] Another feature of the vertical linkage hypothesis is that imports and exports will be positively correlated within a sector. To check whether this affects the results, we estimated a Seemingly Unrelated Regression model on the imports and exports equations jointly. The coefficients and the standard errors were very similar to the simple OLS estimates reported in the Tables.

average reductions in trade from countries hit especially hard by the credit crunch. To check whether this is the case, we calculated the trade-weighted increase in the interbank lending rate, Chor and Manova's preferred indicator of the severity of credit contraction, in each sector:

$$TWCC_i^{trade} = \sum_{c=1}^{N} \Delta IBRATE_c \times a_{ic}^{trade}, \tag{5}$$

where $\Delta IBRATE_c$ is the change in the interbank lending rate over the period of the crisis in country c, and a_{ic} is the pre-crisis share of total U.S. trade in sector i captured by country c. In the import equation, a_{ic} is thus the share of total U.S. imports coming from country c in sector i, while in the export equation, a_{ic} is the share of total U.S. exports in sector i going to country c. The variable name $TWCC_i^{trade}$ stands for "trade-weighted credit contraction." In case of imports, its value will be high if in sector i, a greater share of U.S. pre-crisis imports same from countries that experienced a more severe credit crunch. Correspondingly, its value will be relatively low if U.S. imports in that sector are dominated by countries that did not experience a credit crunch during this period. The logic is similar for the export-based measure.[23]

Table 7 reports the results of using these measures. There is no evidence that imports into the U.S. fell by more in sectors dominated by countries that experienced largest credit crunches.[24] Paradoxically, for U.S. exports the coefficient is statistically significant but has the "wrong" sign, implying that U.S. sectors that export predominantly to countries with larger credit contractions grew more (fell by less) than other sectors, all else equal. Our results are not in direct contradiction with those of Chor and Manova (2009), as the bulk of that paper estimates the differential effects of the credit crunch across sectors depending on their characteristics, such as external finance dependence. The difference-in-differences approach adopted by those authors can only answer the question of whether trade changed differentially across sectors depending on their reliance on trade credit or external finance. It does not answer whether trade from countries experiencing greater credit contractions fell by more or not. Thus, it is perfectly plausible that while changing credit conditions affect sectors differentially, the average effect is nil – which is what we find. This point is underscored by the fact that over the period during which trade collapsed – mid-2008 to mid-2009 – the interbank rates used by these authors actually fell in most countries, reflecting aggressive monetary policy easing (see Figure 2 in Chor and Manova 2009). If one believes the credit contraction hypothesis, this should have increased overall trade rather than reduced it, *ceteris*

[23]We are grateful to Davin Chor and Kalina Manova for sharing the interbank lending rate data used in their paper. Their sample of countries does not cover all of the U.S. imports and exports in each sector, but it comes close, with the mean of 95% and medians of 97% for exports and 98% for imports in our sample of 6-digit NAICS sectors.

[24]These results could be sensitive to the timing of the credit contraction. The Table reports the estimates in which $\Delta IBRATE_c$ is taken over the 12 month period from April of 2008 to April 2009 (the end point of the Chor-Manova dataset). The results are unchanged if we instead lag $\Delta IBRATE_c$ by a further 6 or even 12 months.

paribus.

We can also examine the time evolution of trade credit directly. The Compustat database contains information on accounts payable up to and including the first quarter of 2009 for a substantial number of firms. While there are between 7,000 and 8,000 firms per quarter with accounts payable data in the Compustat database over the period 2007-2008, there are 6,250 firms for which this variable is available for 2009q1. While this does represent a drop-off in coverage that may be non-random, it is still informative to look at what happens to trade credit for those firms over time. With this selection caveat in mind, we construct a panel of firms over 2000-2009q1 for which data are available at the end of the period, and trace out the evolution of accounts payable as a share of cost of goods sold. The median value of this variable across firms in each period is plotted in Figure 10(a). The dashed line represents the raw series. There is substantial seasonality in the raw series, so the solid black line reports it after seasonal adjustment. The horizontal line plots the mean value of this variable over the entire period.[25] There is indeed a contraction in trade credit during the recent crisis, but its magnitude is very small. The 2009q1 value of this variable is 55.2%, just 1.3% below the period average of 56.5%, and only 3 percentage points below the most recent peak of 58.1% in 2007q4. We conclude from this that the typical firm in Compustat experienced at most a small contraction in trade credit it receives from other firms.[26]

Figure 10(b) presents the median of the other trade credit indicator, accounts receivable/sales over the period 2004q1-2009q1. The coverage for this variable is not as good: there are very few firms that report it before 2004, and there are only around 6,000 observations per quarter in 2007-2008. In 2009q1, there are 4,967 firms that report this variable, and we use this sample of firms to construct the time series for the median accounts receivable. Once again, the decrease during the recent crisis is very small: the 2009q1 value of 56.3% is only 1 percentage point below the period average of 57.3%, and just 2 percentage points below the 2007q4 peak of 58.5%. Indirectly, accounts receivable may be a better measure of the trade credit conditions faced by the typical firm in the economy, as it measures the credit extended by big Compustat firms to (presumably) smaller counterparts. But the picture that emerges from looking at the two series is quite consistent: there is at most a small reduction in trade credit during the recent downturn.

[25]It is suggestive from examining the raw data that there is no time trend in this variable. We confirm this by regressing it on a time trend: the coefficient on the time trend turns out to be very close to zero, and not statistically significant.

[26]It may be that while the impact on the median firm is small, there is still a large aggregate effect due to an uneven distribution of trade credit across firms. To check for this possibility, we built the aggregate accounts payable/cost of goods sold series, by computing the ratio of total accounts payable for all the firms to the sum of all cost of goods sold for the same firms. The results from using this series are even more stark: it shows an increase during the crisis, and its 2009q1 value actually stands above its long-run average.

4.3 Composition

Finally, Table 8 tackles the issue of composition and durability. There appears to be robust evidence that compositional effects play a role. Both exports and imports tend to collapse more in industries where industrial production contracted more. The beta coefficients are relatively high (0.34 and 0.21 for industrial production, 0.20 and 0.11 for the durable dummy), and the partial R^2's are also high relative to other potential explanatory variables. The coefficient on the durable 0/1 dummy implies that on average imports in durable sectors contracted by 9.2 percentage points more than non-durable ones, and exports in durable sectors contracted by 4.8 percentage points more. These results further support the conclusions of Section 3.1, which shows that accounting explicitly for the durables sector reduces the magnitude of the wedge considerably.

There is an alternative way to examine how much composition may matter. We can compare the data on percentage reductions in exports and imports with data on industrial production at sector level. According to the compositional explanation, imports and exports will drop relative to the level of overall economic activity if international trade flows are systematically biased towards sectors in which domestic absorption fell the most. Composition will account for all of the reduction in imports and exports relative to economic activity if at sector level, reductions in trade perfectly matched reductions in domestic absorption, and all that was different between international trade and economic activity was the shares going to each sector. By contrast, composition will account for none of the reduction in trade relative to output if there are no systematic differences in the trade shares relative to output shares, at least along the volatility dimension. Alternatively, composition will not explain the drop in trade if imports and exports simply experienced larger drops within each sector than did total absorption.

With this logic in mind, we construct a hypothetical reduction in total trade that is implied purely by compositional effects:

$$\tilde{\gamma}^{trade} = \sum_{i=1}^{\mathcal{I}} a_i^{trade} \gamma_i^{IP}.$$

In this expression, $i = 1, ..., \mathcal{I}$ indexes sectors, a_i^{trade} is the initial share of sector i in the total trade flows, and γ_i^{IP} is the percentage change in industrial production over the period of interest. That is, $\tilde{\gamma}^{trade}$ is the percentage reduction in overall trade that would occur if in each sector, trade was reduced by exactly as much as industrial production. Following the rest of the empirical exercises in this section, we compute γ_i^{IP} over the period from 2008q2 to 2009q2, and apply the trade shares a_i^{trade} as they were in 2008q2.

Table 9 reports the results. For both imports and exports, the first column reports the percentage change in nominal trade, the second column the percentage change in real trade, and the third column reports $\tilde{\gamma}^{trade}$, the hypothetical reduction in trade that would occur if in each sector, trade fell by exactly as much as industrial production. Because goods trade data are available for a greater range of sectors than industrial production data, the last column reports the share of total U.S. trade flows that can be matched to industrial production. We can see that we can match 88% of exports and 94% of imports to sectors with IP data. Nonetheless, the fact that this table does not capture all trade flows explains the difference between the values reported there and in Table 2. For ease of comparison, the last line of the table reports the percentage change in the total industrial production. By construction, the actual and implied values are identical.

We can see that industrial production fell by 13.5%, while the matching nominal imports and exports fell by 34.3% and 35.0%, respectively. Comparing the actual changes in nominal trade to the implied ones in column 3, we can see that composition "explains" about half: the implied reduction in exports is 18.1%, and the implied reduction in imports 16.1%. As expected, both of these are larger than the fall in industrial production itself. The real reductions in trade (column 2) are smaller, as we saw above. Thus, $\tilde{\gamma}^{trade}$ is about two-thirds of the real change in exports, and 83% of the change in real imports.

We conclude from this exercise that the actual pattern of trade is consistent with the presence of compositional effects: it does appear that international trade is systematically biased towards sectors with larger domestic output reductions. The simple assumption that trade in each sector fell by the same amount as industrial production can "account" for between 50% and almost 85% of the actual drop in trade flows. Several caveats are of course in order to interpret the results. First and foremost, this is an accounting exercise rather than an economic explanation. We do not know why trade flows are systematically biased towards sectors with larger falls in domestic output, nor do we have a good sense of why some sectors had larger output reductions than others.[27] It also does not explain why the trade collapse during this recession is so different from most previous recessions. Second, it is far from clear that trade falling by the same proportion as output is an accurate description of what happened. Indeed, as evidenced by columns 1 and 3 of Table 8, the percentage change in IP as a dependent variable explains only 11% of the variation in imports, and 4.4% of the variation in exports.[28] Finally, industrial production may not be an entirely appropriate benchmark, since it captures domestic output, while a more conceptually correct measure would be domestic absorption. Nonetheless, our exercise does provide suggestive evidence of compositional

[27]Indeed, benchmarking the trade drop to the drop in industrial production leaves open the question of why the reduction in industrial production itself is so much larger than in GDP: while total GDP contracted by 3.8% in the recent episode, industrial production fell by 13.5%.

[28]While the table reports the standardized beta coefficient, the simple OLS coefficient on the change in industrial production is about 0.58, implying that a given change in IP is associated with a change in trade of just over half the magnitude. While this coefficient may be biased due to measurement error in IP data, taken at face value it implies a less than one-for-one relationship between IP and trade changes.

effects.

To combine the above results together, Table 10 reports specifications in which all the distinct explanations are included together. The first column presents results for all sectors and the baseline set of control variables. The second column reports the results for manufacturing sectors only, which allows us to include additional controls such as capital and skill intensity. The bottom line is essentially unchanged: both downstream linkages and compositional effects are robustly significant for imports, while upstream linkages and trade credit are not.[29] When it comes to magnitudes, it appears that the downstream linkage variable and the durable indicator are roughly of the same magnitude, on both on the order of 0.2-0.3. All together, the regressors of interest – downstream and upstream linkages, trade credit, and composition – explain about 9% of the cross-sectoral variation in the full sample, and 12% in the manufacturing sample. For exports, there is also suggestive evidence that downstream linkages and compositional effects continue to matter, but the results are less robust.

In the subsample of the manufacturing sectors in columns 2 and 4, we also control for inventories. We use monthly inventory data for 3-digit NAICS sectors from the BEA. Unfortunately, this coarse level of aggregation implies that we only have 20 distinct sectors for which we can record inventory levels. The particular variable we use is the ratio of inventories to imports (resp., exports) at the beginning of the period, 2008q2.[30] The initial level of inventories is not significant, and its inclusion leaves the rest of the results unchanged. In addition, it appears to have the "wrong" sign: sectors with larger initial inventories had *smaller* reductions in imports, all else equal. These estimates are not supportive of the hypothesis that imports collapsed in part because agents decided to deplete inventories as a substitute to buying more from abroad.[31]

4.4 Aggregation

How much of the aggregate reduction in trade can be accounted for by the leading explanations evaluated above? The magnitude and significance of the coefficients of interest are informative

[29] Indeed, in the manufacturing-only sample, the trade credit variable is significant but with the "wrong" sign for both imports and exports: it implies that trade in credit-intensive industries fell by *less*.

[30] Alternatively, we used the average level of inventories to imports (resp., exports) over the longer period, 2001-2007, and the results were unchanged. We also used the percentage change in inventories that happened contemporaneously with the reduction in trade, and the coefficient was insignificant: it appears that there is no relationship between changes in inventories and changes in trade flows over this period.

[31] Alessandria et al. (2010) argue for the importance of inventory adjustment as an explanation for why trade fell by more than output. The quantitative exercise in that paper focuses on the auto sector. As evident from Table 2, while the auto sector experienced large reductions in cross-border trade, it is far from the only sector that did so. In addition, at the outset of the crisis the automotive vehicles, engines, and parts sector accounted for 9% of U.S. exports and 11% of U.S. imports. At a purely mechanical level, the auto sector accounted for at most one-sixth of the total reduction in either imports and exports, and thus it is important to consider other sectors in quantitative assessments of the inventory hypothesis.

about how successful they are in explaining the cross-sectoral variation. However, it is not clear whether these explanations have an appreciable impact on changes in the aggregate trade. For instance, it may be that goods with greatest downstream linkages – that fell systematically more, as indicated by our estimates – are also responsible for a tiny share of the overall imports. In this case, downstream linkages, though statistically significant, would not account for much of the aggregate reduction in trade.

To shed light on these issues, we perform an aggregation exercise in the spirit of di Giovanni and Levchenko (2009, 2010). The aggregate reduction in total trade flow (imports or exports), γ^A, can be written as:

$$\begin{aligned}\gamma^A &= \sum_{i=1}^{\mathcal{I}} a_i \gamma_i \\ &= \sum_{i=1}^{\mathcal{I}} a_i \left(\widehat{\gamma}_i + \epsilon_i\right)\end{aligned}$$

where, once again, i indexes sectors, a_i is the share of sector i in the aggregate trade flow, and γ_i is the actual percentage reduction in trade in sector i. The second line writes the actual reduction in trade in sector i as the sum of the predicted reduction $\widehat{\gamma}_i$ and the residual – an equality that holds by construction. Since the predicted change in trade in sector i can be expressed in terms of the actual values of the right-hand side variables and the estimated coefficients, the actual change in aggregate trade can be decomposed as:

$$\begin{aligned}\gamma^A = &\underbrace{\sum_{i=1}^{\mathcal{I}} a_i \widehat{\beta}_{DUR} * \text{Durable}_i}_{\text{Composition Effect}} + \underbrace{\sum_{i=1}^{\mathcal{I}} a_i \widehat{\beta}_{DS} * \text{Downstream}_i}_{\text{Downstream Effect}} + \\ &\underbrace{\sum_{i=1}^{\mathcal{I}} a_i \widehat{\beta}_{US} * \text{Upstream}_i}_{\text{Upstream Effect}} + \underbrace{\sum_{i=1}^{\mathcal{I}} a_i \widehat{\beta}_{TC} * \text{TradeCredit}_i}_{\text{Trade Credit Effect}} + \\ &\underbrace{\sum_{i=1}^{\mathcal{I}} a_i \widehat{\boldsymbol{\gamma}}_C * \mathbf{X}_i}_{\text{Controls}} + \underbrace{\widehat{\alpha}}_{\text{Constant}} + \underbrace{\sum_{i=1}^{\mathcal{I}} a_i \epsilon_i}_{\text{Residuals}} .\end{aligned} \tag{6}$$

Note that the last term, Residuals, equals zero by construction. In order to perform this decomposition, we use the coefficient estimates in columns 1 and 3 of Table 10, in which all of the explanations are included together in the full sample of sectors. The point estimates and the standard errors are reported in Table 11. For imports, the Composition Effect can account for a 6.9% reduction in trade, out of a total 29.9% drop.[32] The Downstream Effect accounts for a

[32] Once again, the total reductions in imports and exports reported in this table are different from what appears

further 4% reduction. By contrast, the Trade Credit Effect goes the "wrong" way, showing a 5.9% increase in trade, though of course it is not statistically significant. The remaining controls together imply a 10.2% reduction. Surprisingly, the Upstream Effect is the largest, showing a 13.4% drop in trade. However, as evident from the regression table, the coefficient on the Upstream variable is not robustly statistically significant. For exports, both the Composition and the Downstream Effects are smaller, at 3.4 and 2.2%, respectively. Controls account for more than half of the observed reduction, 18.5%.

We conclude from this exercise that the two robustly statistically significant explanations – composition and downstream linkages – are also relevant quantitatively, together accounting for some 40% of the observed reduction in imports, and nearly 20% of exports.

4.5 Is the 2008-2009 Crisis Different?

We can use our estimation approach to examine the changes in international trade during previous economic downturns. To that end, we assembled monthly data on imports and exports, as well as the data on sectoral characteristics, for the two previous recessions, 1991 and 2001. Since the NAICS classification did not exist in 1991, all of the data are recorded in the SIC classification for that episode. For the 1991 recession, the indicators of intermediate input linkages (both downstream and upstream) were re-calculated based on the 1987 Benchmark Input-Output Table, and trade credit variables were computed from the pre-1990 data in Compustat. Similarly, measures of factor intensity were calculated based on the I-O Table and the NBER Productivity Database for the pre-1990 period. Finally, we also collected data for inventories and industrial production for the 1980s and early 1990s.[33] For the 2001 recession, we continue to use the intermediate input indicators based on the 2002 Benchmark Input-Output Tables that were used in the main analysis, as it is unlikely that the I-O structure would have experienced noticeable changes between 2001 and 2002. The other variables – trade credit intensity, export and import shares, factor intensity, and inventories – were re-computed using pre-2001 data.

To keep the approach consistent with the main analysis above, we average monthly trade data at the quarterly frequency, and take the year-on-year changes to avoid seasonality issues. For the 1991 recession, there is no dramatic change in trade. Thus, we take the difference between 1991q4 and 1990q4 as our left-hand side variable. For the 2001 recession, the peak in both imports and exports is December 2000, also coinciding with the peak of the business cycle. Thus, we take the

in the summary statistics, as the regression specification underlying this table does not cover all sectors due to the unavailability of some regressors of interest.

[33]The historical IP data are no longer publicly available in the SIC classification. We are very grateful to Charlie Gilbert at the Federal Reserve Board for providing these data.

2000q4 to 2001q4 change as the dependent variable.[34]

Appendix Table A2 reports the results. The first main conclusion is that the sectoral characteristics have much less explanatory power in accounting for the sectoral cross-section of trade changes. While the overall R^2 that we could achieve for the 2008-09 crisis could be as high 13.5% for all sectors and 20% for manufacturing, the best we can do for 1991 and 2001 is about 3 to 7% for all sectors and 10% for manufacturing. This is not surprising: while the average changes in cross-border trade flows were much smaller in these two episodes, their standard deviations were quite similar across the three recessions. Thus, idiosyncratic sectoral shocks – essentially the error term in our regressions – were relatively more important in 1991 and 2001. Paradoxically, while in the current recession the aggregate trade changes are much more of a puzzle as evidenced by Section 3, we have a much better handle on the cross-sectoral variation.

Second, the only consistently robust explanatory variable in 1991 and 2001 is the Durable indicator. It is significant for all but the 2001 exports. The magnitudes of the beta coefficients are smaller, but roughly in line, with what we found for the 2008-09 recession. There is some evidence that vertical linkages mattered for some trade flows, but it is not robust across episodes and flows.

5 Conclusion

This paper uses highly disaggregated data on U.S. imports and exports to examine the anatomy of the recent collapse in international trade. We show that this collapse is exceptional in two ways: it is far larger relative to economic activity than what has been observed in previous U.S. downturns; and it is far larger than what would be predicted by the evolution of domestic absorption and prices over the same period. Cross-sectional patterns of declines are consistent with vertical specialization and compositional effects as (at least partial) explanations for the collapse. By contrast, we do not detect any impact of trade credit on the reduction in international trade.

An important next step in this research agenda is to develop a theoretical framework that can be quantitatively successful at replicating this collapse in trade. Doing so will enable us to use this episode as a laboratory to distinguish between the different models of international transmission. Our hope is that the empirical results in this paper can offer some guidance as to which channels are likely to be most promising. In particular, our findings on compositional effects and vertical linkages point to the crucial importance of developing quantitative models featuring a realistic sectoral production structure and trade patterns. This will allow the researcher to model both input-output linkages and systematic differences in the sectoral composition of production and trade patterns. Recent advances in the closed economy (Carvalho 2008), and open economy settings

[34]We experimented with various start dates for both recessions, and the results were not materially affected.

(Boileau 1999, Erceg et al. 2008, Engel and Wang 2009, Imbs and Mejean 2009, Jin 2009) appear promising in this regard. By contrast, we do not find much of a role for financial variables in the collapse of trade. This of course does not imply that the financial crisis did not have macroeconomic consequences. Rather, financial shocks appear to have affected trade insofar as they had an impact on overall economic activity, rather than through a direct finance-trade channel.

Appendix A Wedges Derivation

We begin with the simplest 2-good IRBC model of Backus et al. (1995). There are two countries, Home and Foreign, and two intermediate goods, one produced in Home, the other in Foreign. There is one final good, used for both consumption and investment. The resource constraint of the Home country in each period is given by:

$$C_t + I_t = \left[\omega^{\frac{1}{\varepsilon}} \left(y_t^h\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} \left(y_t^f\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{A.1}$$

where C_t is Home consumption, I_t is Home investment, y_t^h is the output of the Home intermediate good that is used in Home production, and y_t^f is the amount of the Foreign intermediate used in Home production. In this standard formulation, consumption and investment are perfect substitutes, and Home and Foreign goods are aggregated in a CES production function. The parameter ω allows for a home bias in preferences.

The household (or, equivalently, a perfectly competitive final goods producer), chooses the mix of Home and Foreign intermediates optimally:

$$\begin{aligned}
&\min_{y_t^h, y_t^f} \left\{p_t^h y_t^h + p_t^f y_t^f\right\} \\
&s.t. \\
&C_t + I_t \leq \left[\omega^{\frac{1}{\varepsilon}} \left(y_t^h\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} \left(y_t^f\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}
\end{aligned}$$

where p_t^h is the price of the domestically-produced good and p_t^f is the price of the imported good, both expressed in the home country's currency. This yields the standard demand equations:

$$\begin{aligned}
y_t^h &= \omega \left(\frac{P_t}{p_t^h}\right)^{\varepsilon} (C_t + I_t) \\
y_t^f &= (1-\omega) \left(\frac{P_t}{p_t^f}\right)^{\varepsilon} (C_t + I_t),
\end{aligned} \tag{A.2}$$

where $P_t = \left[\omega \left(p_t^h\right)^{1-\varepsilon} + (1-\omega) \left(p_t^f\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$ is the standard CES price level.

Log-linearizing these, we obtain the import demand relationship in log changes given in equation (1).

The derivation is essentially the same for subcomponents of final demand. In particular, suppose that durable goods consumption in the Home country, D_t, is an aggregate of Home and Foreign durable varieties:

$$D_t = \left[\omega^{\frac{1}{\varepsilon}} {d_t^h}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} {d_t^f}^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{A.3}$$

where d_t^h is the domestic durable variety consumed in Home, and d_t^f is the Foreign durable variety consumed in Home. In other words, a "final durable goods" producer aggregates domestically-produced durable intermediates with foreign-produced durable intermediates to create a durable good that can be used either as purchases of new durable consumption goods or capital investment.[35] Cost minimization then produces the expression for the durable wedge in equation (2).

Similarly, suppose that investment and consumption goods are different, but both are produced from domestic and foreign varieties

$$C_t = \left[\omega^{\frac{1}{\varepsilon}} \left(c_t^d\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} \left(c_t^f\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}},$$

$$I_t = \left[\zeta^{\frac{1}{\sigma}} \left(i_t^d\right)^{\frac{\sigma-1}{\sigma}} + (1-\zeta)^{\frac{1}{\sigma}} \left(i_t^f\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}.$$

In this formulation, domestic consumption goods c_t^d are different from domestic investment goods i_t^d, and the same holds for the foreign consumption and investment goods. These production functions then lead to the consumption and investment wedges in equations (3) and (4).

[35] This formulation may appear to sidestep the special feature of durable goods, namely that it is the stock of durables that enters utility. In our formulation, equation (A.3) defines the flow of new durable goods, rather than the stock. Our assumption is then that the flow of new durable goods is a CES aggregate of the *flows* of foreign and domestic durable purchases, d_t^h and d_t^f. We can then define the stock of durables by its evolution $\mathcal{D}_t = (1-\delta)\mathcal{D}_{t-1} + D_t$, with the stock $\mathcal{D}_t$ entering the utility function. An alternative assumption would be that foreign and domestic durables have separate *stocks*, and consumer utility depends on a CES aggregate of domestic and foreign durable stocks (this is the assumption adopted by Engel and Wang 2009). A priori, we find no economic reason to favor one set of assumptions over the other, while our formulation is much more amenable to analyzing prices and quantities jointly. This is because statistical agencies record quantities and prices of purchases, which are flows.

References

Alessandria, George, Joseph P. Kaboski, and Virgiliu Midrigan, "The Great Trade Collapse of 2008-09: An Inventory Adjustment?," January 2010. mimeo, Federal Reserve Bank Philadelphia, Ohio State University and New York University.

Amiti, Mary and David E. Weinstein, "Exports and Financial Shocks," September 2009. mimeo, Federal Reserve Bank of New York and Columbia University.

Anderson, James and Eric van Wincoop, "Trade Costs," *Journal of Economic Literature*, 2004, *42* (3), 691–751.

Auboin, Marc, "Restoring Trade Finance: What the G20 Can Do," in Richard Baldwin and Simon Evenett, eds., *The Collapse of Global Trade, Murky Protectionism, and the Crisis: Recommendations for the G20*, London: CEPR, 2009, chapter 15, pp. 75–80.

Backus, David K., Patrick J. Kehoe, and Finn E. Kydland, "International Business Cycles: Theory and Evidence," in Thomas Cooley, ed., *Frontiers of business cycle research*, Princeton: Princeton University Press, 1995, pp. 331–356.

Baldwin, Richard and Simon Evenett, "Introduction and Recommendations for the G20," in Richard Baldwin and Simon Evenett, eds., *The Collapse of Global Trade, Murky Protectionism, and the Crisis: Recommendations for the G20*, London: CEPR, 2009, chapter 1, pp. 1–9.

Behrens, Kristian, Gregory Corcos, and Giordano Mion, "Trade Crisis? What Trade Crisis?," February 2010. mimeo, UQAM, NHH, and LSE.

Bems, Rudolfs, Robert C. Johnson, and Kei-Mu Yi, "The Role of Vertical Linkages in the Propagation of the Global Downturn of 2008," January 2010. mimeo, International Monetary Fund, Dartmouth College, and Federal Reserve Bank of Philadelphia.

Blanchard, Olivier and Michael Kremer, "Disorganization," *Quarterly Journal of Economics*, 1997, *112*, 1091–1126.

——, Hamid Faruqee, and Mitali Das, "The initial impact of the crisis on emerging market countries," March 2010. mimeo, International Monetary Fund.

Boileau, Martin, "Trade in capital goods and the volatility of net exports and the terms of trade," *Journal of International Economics*, August 1999, *48* (2), 347–365.

Bricongne, Jean-Charles, Lionel Fontagné, Guillaume Gaulier, Daria Taglioni, and Vincent Vicard, "Firms and the global crisis: French exports in the turmoil," December 2009. Bank of France Working Paper 265.

Broda, Christian and David Weinstein, "Globalization and the Gains from Variety," *Quarterly Journal of Economics*, May 2006, *121* (2), 541–85.

Burstein, Ariel, Christopher Kurz, and Linda L. Tesar, "Trade, Production Sharing, and the International Transmission of Business Cycles," *Journal of Monetary Economics*, 2008, *55*, 775–795.

Carvalho, Vasco, "Aggregate Fluctuations and the Network Structure of Intersectoral Trade," June 2008. Mimeo, CREI-Universitat Pompeu Fabra.

Chari, V.V., Patrick J. Kehoe, and Ellen R. McGrattan, "Business Cycle Accounting," *Econometrica*, May 2007, *75* (3), 781–836.

Chinn, Menzie, "What Does the Collapse of US Imports and Exports Signify?," June 23 2009.

Chor, Davin and Kalina Manova, "Off the Cliff and Back? Credit Conditions and International Trade during the Global Financial Crisis," October 2009. mimeo, Singapore Management University and Stanford University.

Cole, Harold and Lee Ohanian, "The U.S. and U.K. Great Depressions through the Lens of Neoclassical Growth Theory," *American Economic Review, P&P*, May 2002, *92* (2), 28–32.

Cowan, Kevin and Alejandro Neut, "Intermediate Goods, Institutions, and Output Per Worker," 2007. Central Bank of Chile Working Paper No. 420.

di Giovanni, Julian and Andrei A. Levchenko, "Trade Openness and Volatility," *Review of Economics and Statistics*, August 2009, *91* (3), 558–585.

di Giovanni, Julian and Andrei A. Levchenko, "Putting the Parts Together: Trade, Vertical Linkages, and Business Cycle Comovement," *American Economic Journal: Macroeconomics*, April 2010, *2* (2), 95–124.

Eaton, Jonathan, Sam Kortum, Brent Neiman, and John Romalis, "Trade and the Global Recession," February 2010. mimeo, Penn State University and University of Chicago.

Economist, "Shipping in the Downturn: Sea of Troubles," June 30 2009.

Engel, Charles and Jian Wang, "International Trade in Durable Goods: Understanding Volatility, Cyclicality, and Elasticities," July 2009. mimeo, University of Wisconsin and Federal Reserve Bank of Dallas.

Erceg, Christopher J., Luca Guerrieri, and Christopher Gust, "Trade adjustment and the composition of trade," *Journal of Economic Dynamics and Control*, August 2008, *32* (8), 2622–2650.

Freund, Caroline, "The Trade Response to the Global Downturn: Historical Evidence," August 2009. World Bank Policy Research Working Paper 5015.

Hummels, David, Jun Ishii, and Kei-Mu Yi, "The Nature and Growth of Vertical Specialization in World Trade," *Journal of International Economics*, June 2001, *54*, 75–96.

Iacovone, Leonardo and Veronika Zavacka, "Banking Crises and Exports: Lessons from the Past," May 2009. World Bank Policy Research Working Paper 5016.

Imbs, Jean, "The First Global Recession in Decades," December 2009. mimeo, HEC Lausanne.

____ and Isabelle Mejean, "Elasticity Optimism," January 2009. mimeo, HEC Lausanne and Ecole Polytechnique.

IMF, "Survey of Private Sector Trade Credit Developments," February 2009. memorandum.

Jacks, David S., Christopher M. Meissner, and Dennis Novy, "The role of trade costs in the great trade collapse," in Richard Baldwin, ed., *The great trade collapse: Causes, Consequences and Prospects*, VoxEU.org Ebook, 2009, chapter 18.

Jin, Keyu, "International Business Cycles with Heterogenous Sectors," October 2009. mimeo, LSE.

Kremer, Michael, "The O-Ring Theory of Economic Development," *Quarterly Journal of Economics*, August 1993, *108* (3), 551–75.

Lane, Philip and Gian Maria Milesi-Ferretti, "The Cross-Country Incidence of the Global Crisis," January 2010. mimeo, Trinity College Dublin and International Monetary Fund.

Levchenko, Andrei A., "Institutional Quality and International Trade," *Review of Economic Studies*, 2007, *74* (3), 791–819.

Love, Inessa, Lorenzo A. Preve, and Virginia Sarria-Allende, "Trade Credit and Bank Credit: Evidene from Recent Financial Crises," *Journal of Financial Economics*, 2007, *83*, 453–469.

Raddatz, Claudio, "Credit Chains and Sectoral Comovement: Does the Use of Trade Credit Amplify Sectoral Shocks?," 2009. Forthcoming, *Review of Economics and Statistics*.

WTO, "World Trade Report," July 2009.

Yi, Kei-Mu, "Can Vertical Specialization Explain the Growth of World Trade?," *Journal of Political Economy*, February 2003, *111* (1), 52–102.

Table 1. Changes in Exports/GDP and Imports/GDP during Recessions

	2008	
	Recession	From Peak
Exports/GDP	-14.6%	-19.7%
Imports/GDP	-24.9%	-29.5%
Non-Oil Imports/GDP	-21.5%	-23.3%
	2001	
	Recession	From Peak
Exports/GDP	-14.2%	-17.1%
Imports/GDP	-13.5%	-16.0%
Non-Oil Imports/GDP	-11.5%	-14.5%
	Average 1950s-1990s	
	Recession	
Exports/GDP	-0.9%	
Imports/GDP	-0.3%	

Notes: This table reports the percent reductions in Exports/GDP and Imports/GDP during the 2008 and 2001 recessions and the average for all the downturns from 1950 to 2000. Column "Recession" reports the change in the trade variables during the official NBER recession (2007-2009 recession to 2009q2). Column "From Peak" reports the change from the peak of the trade ratios to the trough (for 2001), and to the current trough (2009q2). Source: National Income and Product Accounts.

Table 2. Disaggregated Trade Flows, Nominal

	Exports			**Imports**		
	Share of Total	Absolute Change	Percent Change	Share of Total	Absolute Change	Percent Change
Total	1.00	-348.1	-26%	1.00	-765.7	-34%
Total, excluding petroleum				0.78	-495.8	-29%
Panel A: By Sector						
Foods, feeds, and beverages	0.09	-21.5	-19%	0.04	-8.2	-9%
Industrial supplies and materials	0.30	-134.9	-34%	0.15	-155	-47%
Durable goods	0.10	-50.3	-36%	0.08	-84.2	-50%
Nondurable goods	0.20	-84.6	-33%	0.07	-70.8	-44%
Petroleum and products				0.22	-269.9	-54%
Capital goods, except automotive	0.35	-94.6	-20%	0.21	-123.7	-26%
Civilian aircraft, engines, and parts	0.06	-3.7	-5%	0.02	-6.7	-18%
Computers, peripherals, and parts	0.04	-11.0	-24%	0.05	-23.7	-22%
Other	0.26	-79.9	-23%	0.15	-93.3	-29%
Automotive vehicles, engines, and parts	0.09	-58.1	-47%	0.11	-121.4	-49%
Consumer goods, except automotive	0.12	-19.5	-12%	0.22	-75.5	-15%
Durable goods	0.07	-23.0	-24%	0.12	-50.2	-18%
Nondurable goods	0.05	3.6	5%	0.10	-25.2	-11%
Other	0.04	-19.6	-35%	0.04	-11.8	-12%
Panel B: By Destination						
Canada	0.19	-80.6	-33%	0.17	-157.7	-43%
Asia	0.25	-80.2	-26%	0.34	-170.2	-24%
China	0.06	-10.5	-15%	0.15	-51.4	-16%
India	0.01	-2.3	-13%	0.01	-5.1	-21%
Japan	0.05	-20.3	-31%	0.07	-61.2	-42%
Taiwan	0.02	-10.9	-42%	0.02	-10.0	-28%
EU25	0.22	-68.0	-25%	0.18	-120.1	-31%
Germany	0.04	-16.2	-30%	0.05	-40.5	-39%
United Kingdom	0.04	-13.8	-25%	0.03	-17.1	-28%
Eastern Europe	0.01	-4.8	-49%	0.01	-3.8	-31%
Latin America	0.21	-76.8	-29%	0.18	-132.6	-33%
Brazil	0.02	-7.8	-28%	0.01	-13.9	-43%
Mexico	0.11	-37.6	-28%	0.11	-67.3	-29%
OPEC	0.04	-9.9	-18%	0.10	-146.5	-60%
Australia	0.02	-5.5	-26%	0.00	-4.0	-35%

Notes: This table reports the percentage decrease in nominal U.S. exports and imports over the period 2008q2 to 2009q2, disaggregated by sector (Panel A) and by destination (Panel B). Source: National Income and Product Accounts and U.S. International Trade Commission.

Table 3. Nominal Trade Flows, Real Trade Flows, and Prices

	Exports			**Imports**		
	Nominal	Real	Price	Nominal	Real	Price
Total	-26.2%	-18.9%	-9.0%	-34.4%	-21.4%	-16.5%
Total, excluding petroleum				-28.7%	-24.5%	-5.6%
Foods, feeds, and beverages	-18.5%	-6.7%	-12.7%	-9.1%	-4.7%	-4.8%
Industrial supplies and materials	-33.9%	-13.8%	-23.3%	-47.1%	-30.3%	-24.0%
Durable goods	-36.4%	-20.2%	-20.3%	-50.2%	-35.0%	-23.4%
Nondurable goods	-32.6%	-10.3%	-24.9%	-43.8%	-25.6%	-24.5%
Petroleum and products				-54.2%	-7.1%	-50.7%
Capital goods, except automotive	-20.2%	-19.0%	-1.5%	-26.3%	-25.3%	-1.4%
Civilian aircraft, engines, and parts	-4.8%	-9.4%	5.0%	-17.6%	-21.7%	5.3%
Computers, peripherals, and parts	-23.7%	-16.8%	-8.2%	-21.9%	-16.3%	-6.7%
Other	-23.2%	-21.6%	-2.0%	-28.8%	-28.6%	-0.4%
Automotive vehicles, engines, and parts	-46.6%	-46.8%	0.6%	-48.9%	-49.1%	0.3%
Consumer goods, except automotive	-11.9%	-11.4%	-0.6%	-15.2%	-14.6%	-0.7%
Durable goods	-24.5%	-25.0%	0.6%	-18.4%	-17.2%	-1.5%
Nondurable goods	5.2%	7.5%	-2.2%	-11.3%	-11.5%	0.2%
Other	-34.7%	-28.5%	-8.8%	-12.4%	-11.3%	-1.2%

Notes: This table reports the percentage decrease in nominal U.S. exports and imports over the period 2008q2 to 2009q2, the percentage change in real U.S. exports and imports, and the percentage change in the price of exports and imports, by sector. Source: National Income and Product Accounts.

Table 4. Trade Wedges

ε	(1) Overall	(2) Overall, Non-Oil	(3) Durable	(4) Consumption	(5) Investment
1.5	-0.401	-0.278	-0.205	-0.064	-0.105
6	-1.190	-0.648	-0.342	0.072	-0.203

Notes: This table reports the wedges calculated for 2009q2 with respect to 2008q2 (year-on-year). Source: National Income and Product Accounts and authors' calculations.

Table 5. Trade Changes and Downstream Production Linkages

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: Percentage Change in Imports				*Panel B: Percentage Change in Exports*			
Average Downstream Use	-0.200***				-0.094**			
	(0.043)				(0.042)			
Number of Downstream Industries		-0.145***				-0.061		
		(0.041)				(0.042)		
Downstream Herfindahl			0.134***				-0.018	
			(0.046)				(0.048)	
Production Sharing				-0.087**				-0.01
				(0.043)				(0.051)
Share in Total	-0.077**	-0.091***	-0.123***	-0.096***	-0.206***	-0.220***	-0.229***	-0.229***
	(0.032)	(0.028)	(0.028)	(0.028)	(0.063)	(0.060)	(0.056)	(0.055)
Elasticity of Substitution	-0.071	-0.079	-0.075	-0.036	-0.045	-0.047	-0.037	-0.036
	(0.057)	(0.058)	(0.059)	(0.058)	(0.081)	(0.082)	(0.081)	(0.080)
Labor Intensity	-0.162***	-0.151***	-0.161***	-0.141**	-0.173***	-0.168***	-0.179***	-0.176***
	(0.055)	(0.055)	(0.056)	(0.055)	(0.047)	(0.047)	(0.048)	(0.047)
Observations	437	437	437	443	437	437	437	443
R^2	0.080	0.061	0.059	0.042	0.094	0.089	0.086	0.088
Partial R^2	0.041	0.021	0.018	0.007	0.009	0.004	0.000	0.000

Notes: Standardized beta coefficients reported throughout. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the percentage reduction in U.S. Imports (Panel A) and the percentage reduction in exports (Panel B) in a 6-digit NAICS category from 2008q2 to 2009q2 (year-to-year). *Average Downstream Use* is the average usage output in a sector as an intermediate input in other sectors; *Number of Downstream Industries* is the number of industries that use a sector as an intermediate; *Downstream Herfindahl* is the Herfindahl index of the usage of a sector as an intermediate in other sectors. These three indicators are computed based on the U.S. 2002 Benchmark Input-Output Table. *Production Sharing* is the share of intra-firm imports in total U.S. imports (Panel A), or the share of intra-firm exports in total U.S. exports (Panel B), computed from the BEA multinationals data, and averaged over the period 2002-2006. *Share in Total* is the share of a sector in total U.S. imports (Panel A), or exports (Panel B). *Elasticity of Substitution* between varieties in a sector is sourced from Broda and Weinstein (2006). *Labor Intensity* is the compensation of employees as a share of value added, from the U.S. 2002 Benchmark Input-Output Table.

Table 6. Trade Changes and Upstream Production Linkages

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Percentage Change in Imports			*Panel B: Percentage Change in Exports*		
Intermediate Use Intensity	-0.116*			-0.025		
	(0.063)			(0.055)		
Number of Intermediates Used		-0.120**			-0.128***	
		(0.047)			(0.047)	
Herfindahl of Intermediate Use			-0.032			0.009
			(0.045)			(0.052)
Share in Total	-0.097***	-0.089***	-0.104***	-0.229***	-0.195***	-0.233***
	(0.028)	(0.027)	(0.027)	(0.057)	(0.060)	(0.057)
Elasticity of Substitution	-0.045	-0.045	-0.039	-0.038	-0.045	-0.036
	(0.058)	(0.058)	(0.058)	(0.079)	(0.079)	(0.080)
Labor Intensity	-0.116*	-0.120**	-0.165***	-0.168***	-0.136***	-0.176***
	(0.061)	(0.056)	(0.055)	(0.053)	(0.049)	(0.047)
Observations	443	443	443	443	443	443
R^2	0.047	0.048	0.036	0.088	0.101	0.088
Partial R^2	0.012	0.013	0.001	0.001	0.015	0.000

Notes: Standardized beta coefficients reported throughout. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the percentage reduction in U.S. Imports (Panel A) and the percentage reduction in exports (Panel B) in a 6-digit NAICS category from 2008q2 to 2009q2 (year-to-year). *Intermediate Use Intensity* is spending on intermediate inputs per dollar of final sales; *Number of Intermediates Used* is the number intermediates a sector uses in production; *Herfindahl of Intermediate Use* is the Herfindahl index of the intermediate good usage in a sector. These three indicators are computed based on the U.S. 2002 Benchmark Input-Output Table. *Share in Total* is the share of a sector in total U.S. imports (Panel A), or exports (Panel B). *Elasticity of Substitution* between varieties in a sector is sourced from Broda and Weinstein (2006). *Labor Intensity* is the compensation of employees as a share of value added, from the U.S. 2002 Benchmark Input-Output Table.

Table 7. Trade Changes and Trade Credit Intensity

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Percentage Change in Imports			*Panel B: Percentage Change in Exports*		
Accounts Payable/Cost of Goods Sold	0.017			-0.016		
	(0.069)			(0.058)		
Accounts Receivable/Sales		-0.031			0.05	
		(0.065)			(0.057)	
TWCC			-0.071			0.138**
			(0.068)			(0.063)
Share in Total	-0.124***	-0.116***	-0.106***	-0.233***	-0.240***	-0.239***
	(0.036)	(0.027)	(0.027)	(0.060)	(0.058)	(0.055)
Elasticity of Substitution	-0.035	-0.038	-0.047	-0.035	-0.03	-0.039
	(0.059)	(0.059)	(0.059)	(0.085)	(0.081)	(0.076)
Labor Intensity	-0.175***	-0.176***	-0.163***	-0.165***	-0.164***	-0.159***
	(0.055)	(0.057)	(0.052)	(0.048)	(0.047)	(0.046)
Observations	419	419	441	419	419	443
R^2	0.041	0.042	0.046	0.082	0.084	0.106
Partial R^2	0.000	0.001	0.005	0.000	0.003	0.020

Notes: Standardized beta coefficients reported throughout. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the percentage reduction in U.S. Imports (Panel A) and the percentage reduction in exports (Panel B) in a 6-digit NAICS category from 2008q2 to 2009q2 (year-to-year). *Accounts Payable/Cost of Goods Sold* and *Accounts Receivable/Sales* are measures of trade credit used and extended, respectively, computed using firm-level information from the Compustat database. *TWCC* is the measure of trade-weighted credit contraction, computed from country-specific changes in the interbank interest rates and U.S. bilateral trade shares according to equation (5). *Share in Total* is the share of a sector in total U.S. imports (Panel A), or exports (Panel B). *Elasticity of Substitution* between varieties in a sector is sourced from Broda and Weinstein (2006). *Labor Intensity* is the compensation of employees as a share of value added, from the U.S. 2002 Benchmark Input-Output Table.

Table 8. Trade Changes and Compositional Effects

	(1)	(2)	(3)	(4)
	Panel A: Percentage Change in Imports		*Panel B: Percentage Change in Exports*	
Percentage Change in Industrial Production	0.338***		0.211***	
	(0.045)		(0.052)	
Durable dummy		-0.200***		-0.106**
		(0.047)		(0.049)
Share in Total	-0.101**	-0.091***	-0.233***	-0.210***
	(0.045)	(0.031)	(0.065)	(0.056)
Elasticity of Substitution	-0.009	-0.047	-0.011	-0.042
	(0.069)	(0.061)	(0.089)	(0.081)
Labor Intensity	-0.078	-0.103*	-0.083*	-0.148***
	(0.055)	(0.054)	(0.048)	(0.049)
Observations	401	443	402	443
R^2	0.144	0.072	0.116	0.097
Partial R^2	0.109	0.038	0.044	0.011

Notes: Standardized beta coefficients reported throughout. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the percentage reduction in U.S. Imports (Panel A) and the percentage reduction in exports (Panel B) in a 6-digit NAICS category from 2008q2 to 2009q2 (year-to-year). *Percentage Change in Industrial Production* is the decline in the index of industrial production in a sector; *Share in Total* is the share of a sector in total U.S. imports (Panel A), or exports (Panel B). *Elasticity of Substitution* between varieties in a sector is sourced from Broda and Weinstein (2006). *Labor Intensity* is the compensation of employees as a share of value added, from the U.S. 2002 Benchmark Input-Output Table.

Table 9. Compositional Effects: Change in Trade Flows as Implied by Industrial Production.

	(1) Nominal Change	(2) Real Change	(3) Implied by IP change $\left(\tilde{\gamma}^{trade}\right)$	(4) Share of Trade Corresponding to IP
Exports	-34.3%	-25.0%	-18.1%	0.88
Imports	-35.0%	-19.4%	-16.1%	0.94
IP		-13.5%	-13.5%	1.00

Notes: Changes in nominal and real exports over 2008q2 to 2009q2 for NAICS sectors where industrial production (IP) data are available. Weights calculated from share of nominal trade and used to generate the third column. The fourth column indicates the fraction of overall nominal trade that can be matched to IP data.

Table 10. Trade Changes and and All Explanatory Variables Together

	(1)	(2)	(3)	(4)
	Panel A: Percentage Change in Imports		*Panel B: Percentage Change in Exports*	
Average Downstream Use	-0.171***	-0.205***	-0.094**	-0.053
	(0.043)	(0.052)	(0.044)	(0.048)
Intermediate Use Intensity	-0.119*	-0.063	-0.019	-0.03
	(0.066)	(0.112)	(0.063)	(0.086)
Accounts Payable/Cost of Goods Sold	0.065	0.180**	0.010	0.191***
	(0.084)	(0.069)	(0.067)	(0.062)
Durable Dummy	-0.229***	-0.302***	-0.098	-0.244***
	(0.062)	(0.060)	(0.062)	(0.065)
Share in Total	-0.077	0.014	-0.189***	-0.242***
	(0.050)	(0.063)	(0.068)	(0.067)
Elasticity of Substitution	-0.083	-0.076	-0.05	-0.02
	(0.061)	(0.078)	(0.086)	(0.065)
Labor Intensity	-0.069	0.048	-0.128**	-0.062
	(0.063)	(0.117)	(0.064)	(0.117)
Capital Intensity		0.181		0.127
		(0.137)		(0.131)
Skill Intensity		-0.105		0.012
		(0.097)		(0.076)
Inventories		0.095		0.041
		(0.062)		(0.059)
Observations	415	350	415	351
R^2	0.135	0.212	0.097	0.178
Partial R^2	0.092	0.120	0.018	0.053

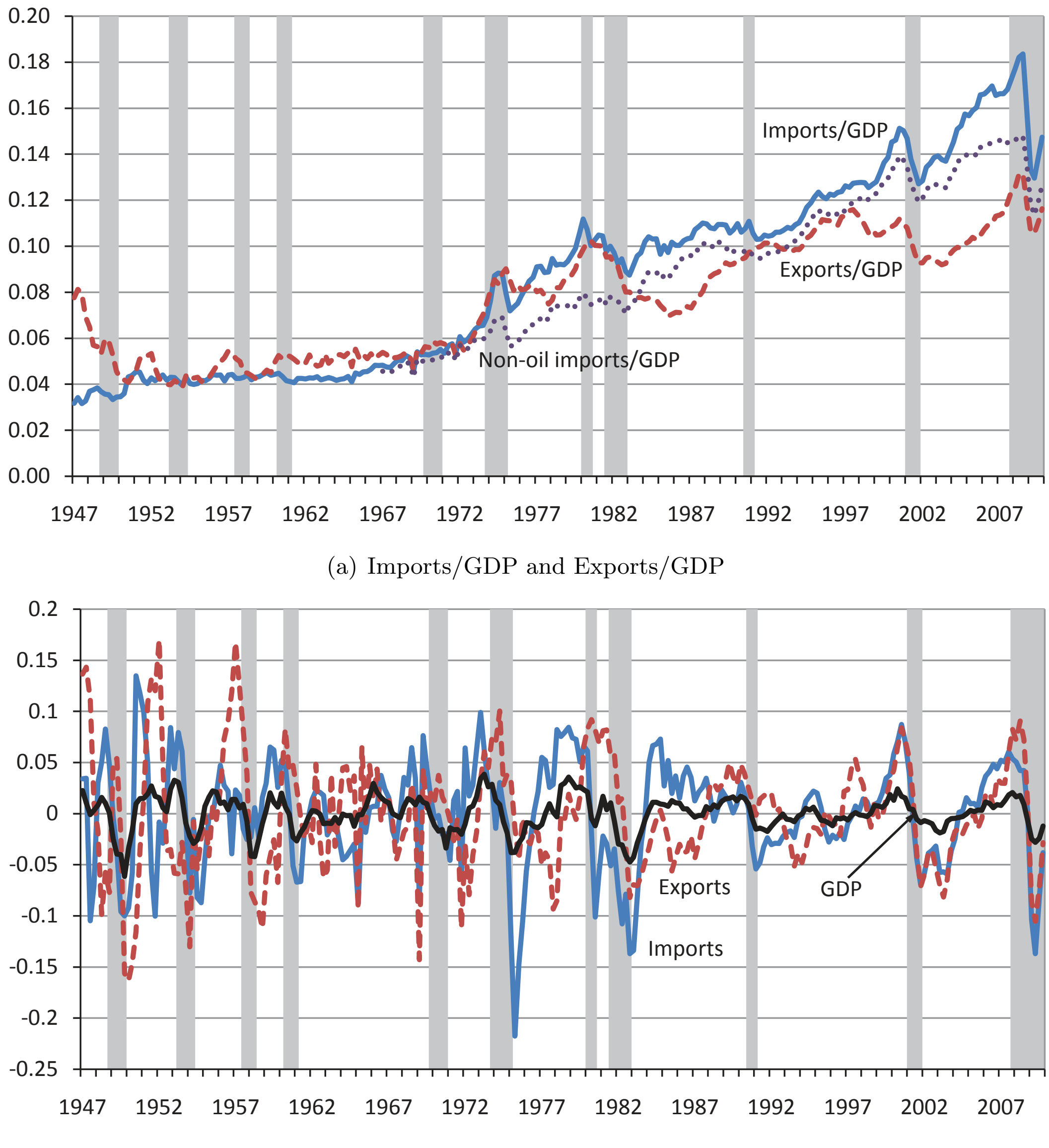
Notes: Standardized beta coefficients reported throughout. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the percentage reduction in U.S. Imports (Panel A) and the percentage reduction in exports (Panel B) in a 6-digit NAICS category from 2008q2 to 2009q2 (year-to-year). *Average Downstream Use* is the average usage output in a sector as an intermediate input in other sectors; *Intermediate Use Intensity* is spending on intermediate inputs per dollar of final sales; *Accounts Payable/Cost of Goods Sold* is a measure of trade credit; *Share in Total* is the share of a sector in total U.S. imports (Panel A), or exports (Panel B). *Elasticity of Substitution* between varieties in a sector is sourced from Broda and Weinstein (2006). *Labor Intensity* is the compensation of employees as a share of value added, from the U.S. 2002 Benchmark Input-Output Table. *Capital Intensity* =1-(total compensation)/(value added); *Skill Intensity*=[(nonproduction workers)/(total employment)]*(1-capital intensity). These two indicators are computed using the NBER Productivity Database. *Inventories* is the beginning-of-period level of inventories relative to imports (resp., exports).

Table 11. Decomposition of the Aggregate Reduction in Trade

(1) Total (γ^A)	(2) Composition Effect	(3) Downstream Effect	(4) Upstream Effect	(5) Trade Credit Effect	(6) Controls	(7) Constant
			Imports			
-0.299	-0.069	-0.040	-0.134	0.059	-0.102	-0.014
	(0.019)	(0.010)	(0.075)	(0.076)	(0.045)	(0.084)
			Exports			
-0.304	-0.034	-0.022	-0.021	0.007	-0.185	-0.050
	(0.021)	(0.010)	(0.069)	(0.048)	(0.052)	(0.075)

Notes: This table presents a decomposition of the actual aggregate change in trade into components given in equation (6). Standard errors are reported in parentheses.

Figure 1. Historical Trends in Aggregate Trade, 1947-2009.

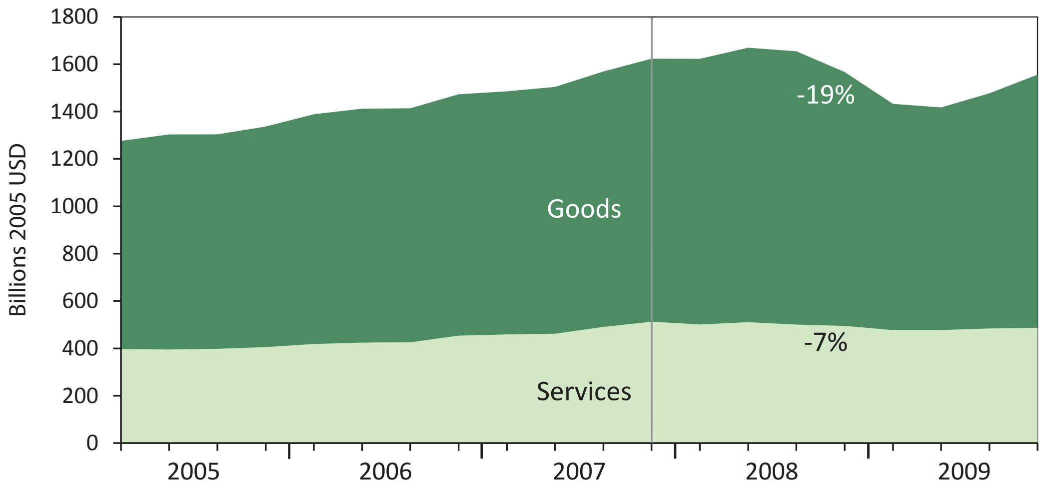


(a) Imports/GDP and Exports/GDP

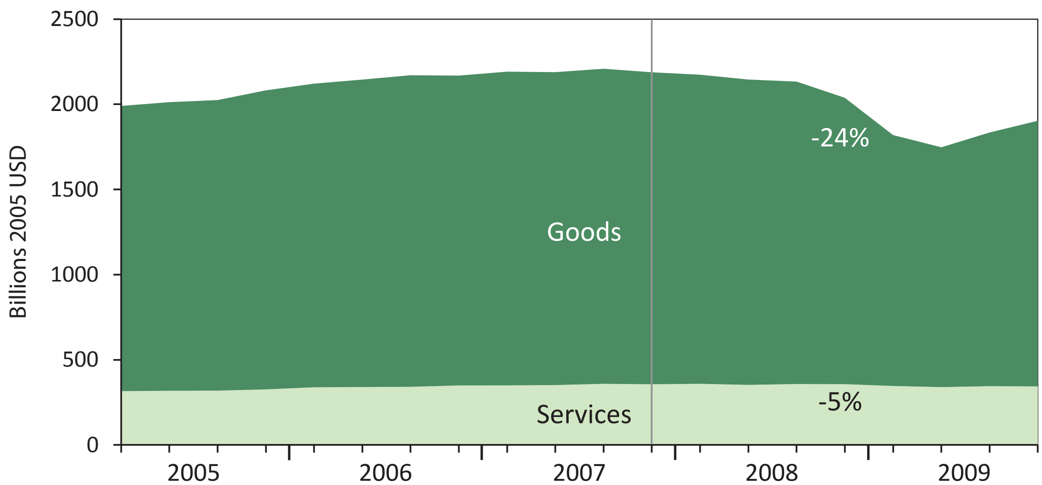
(b) Imports, Exports, and GDP in Deviations from Trend

Notes: The top panel plots the ratios of imports/GDP and exports/GDP for the U.S., along with the NBER recession bars. The bottom panel plots total imports, exports, and GDP in deviations from HP trend with parameter 1600. Source: National Income and Product Accounts.

Figure 2. Goods and Services Trade



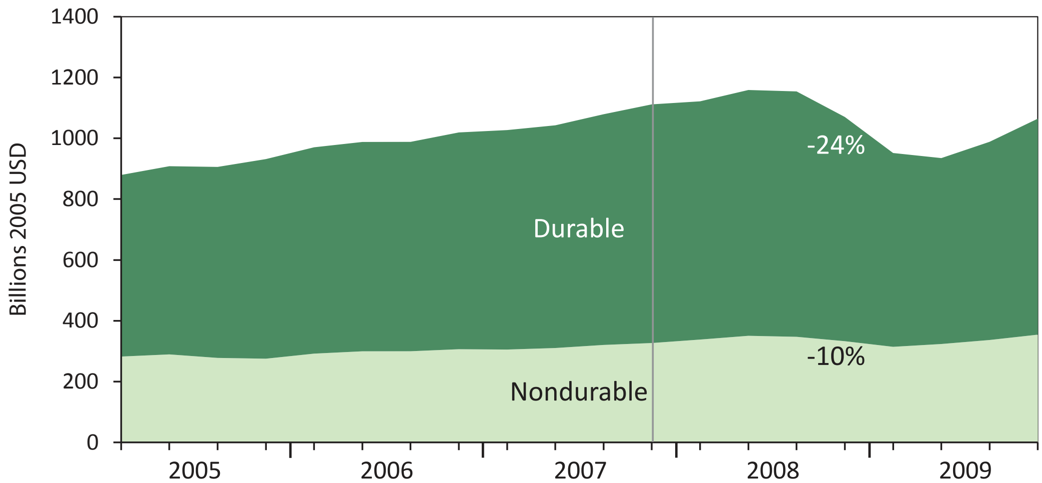
(a) Exports



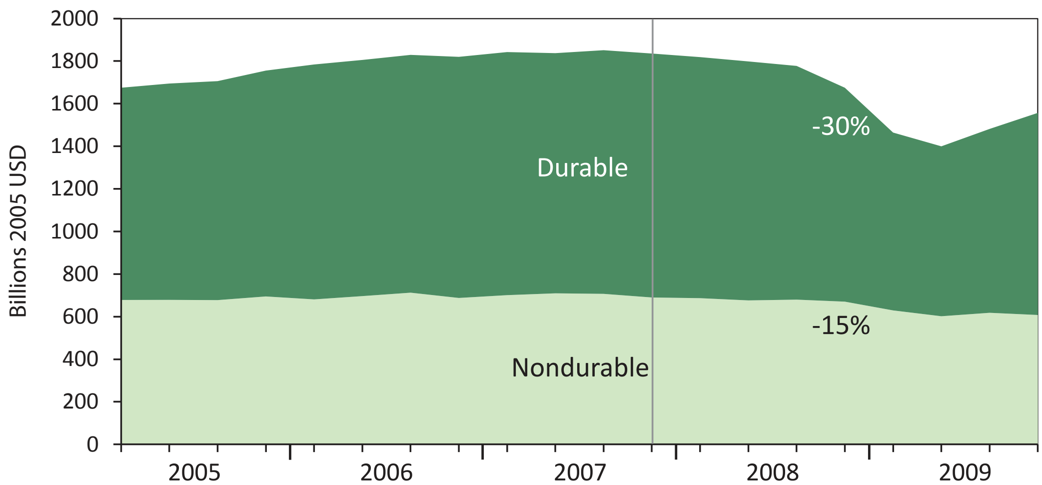
(b) Imports

Notes: This Figure reports the total real exports (top panel) and real imports (bottom panel), of both goods and services. Source: National Income and Product Accounts.

Figure 3. Durables and Non-Durables Trade



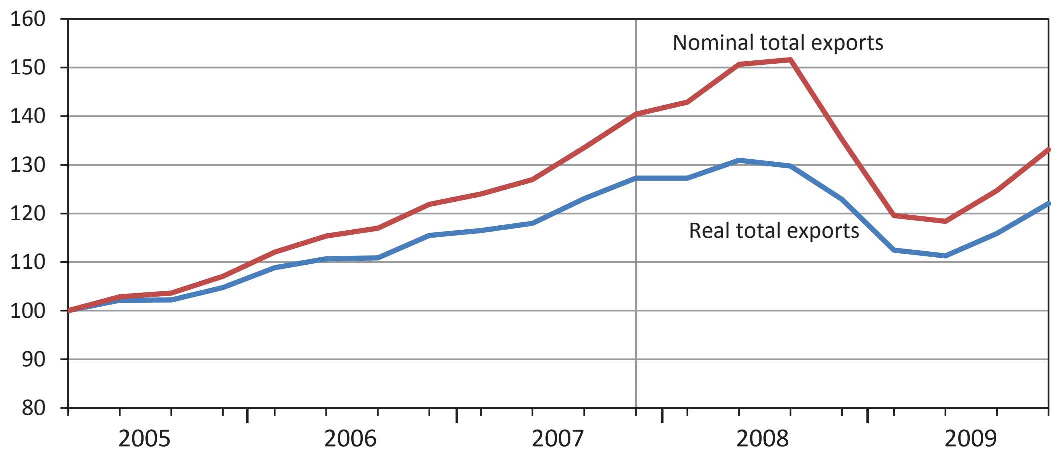
(a) Exports



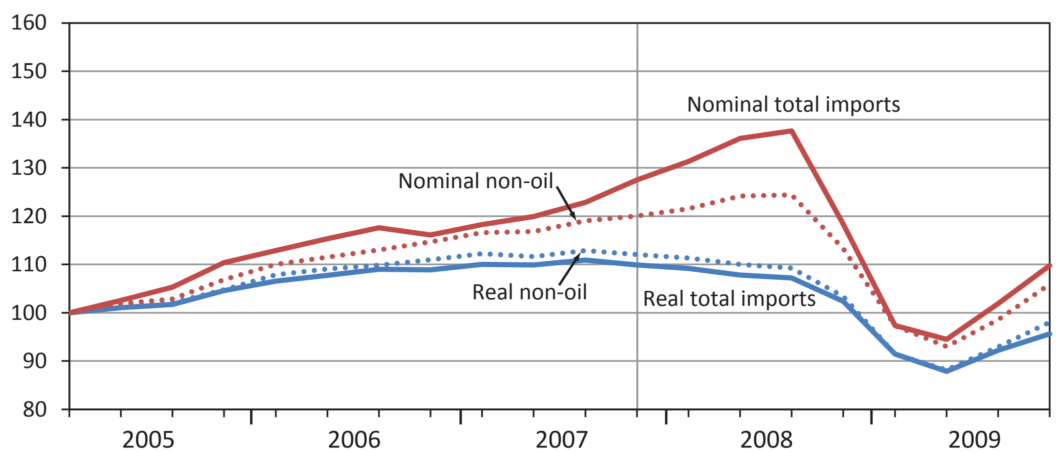
(b) Imports

Notes: This Figure reports the total real exports (top panel) and real imports (bottom panel), of both durable and non-durable goods. Source: National Income and Product Accounts.

Figure 4. Real and Nominal Trade



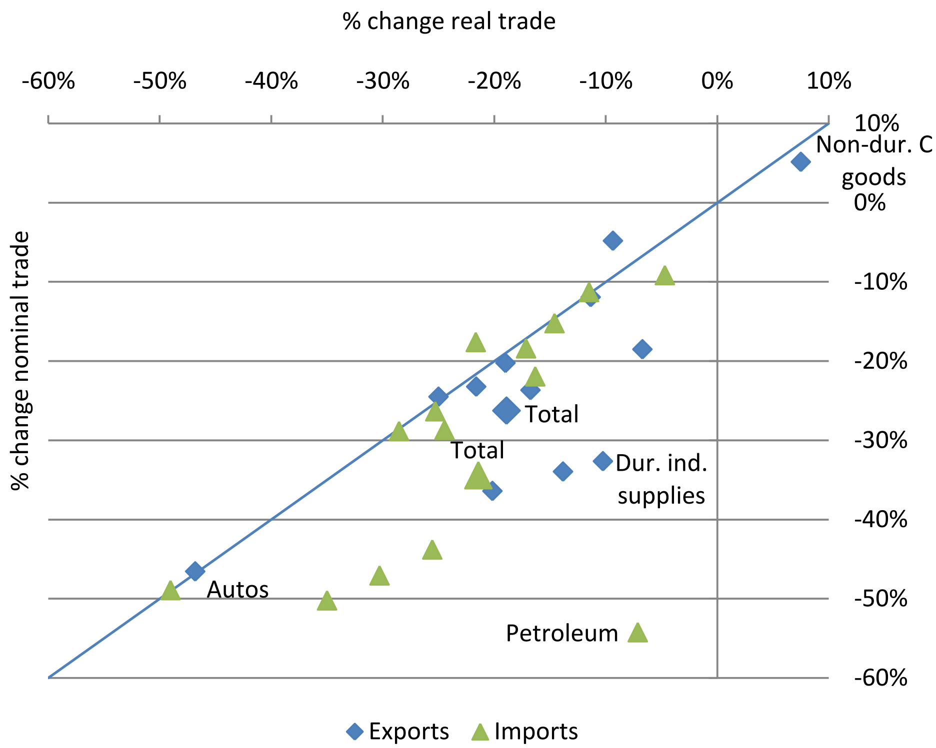
(a) Exports



(b) Imports

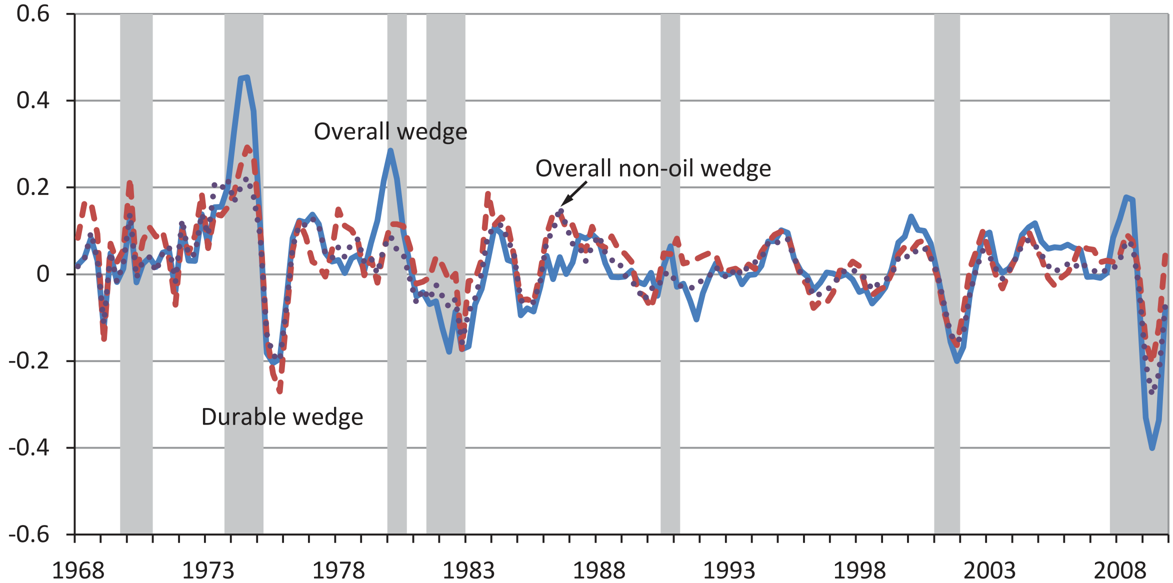
Notes: This Figure reports the evolution of nominal and real exports (top panel) and imports (bottom panel). Both the nominal and real series are normalized to 2005. Source: National Income and Product Accounts.

Figure 5. Real and Nominal Changes in Trade, by Sector



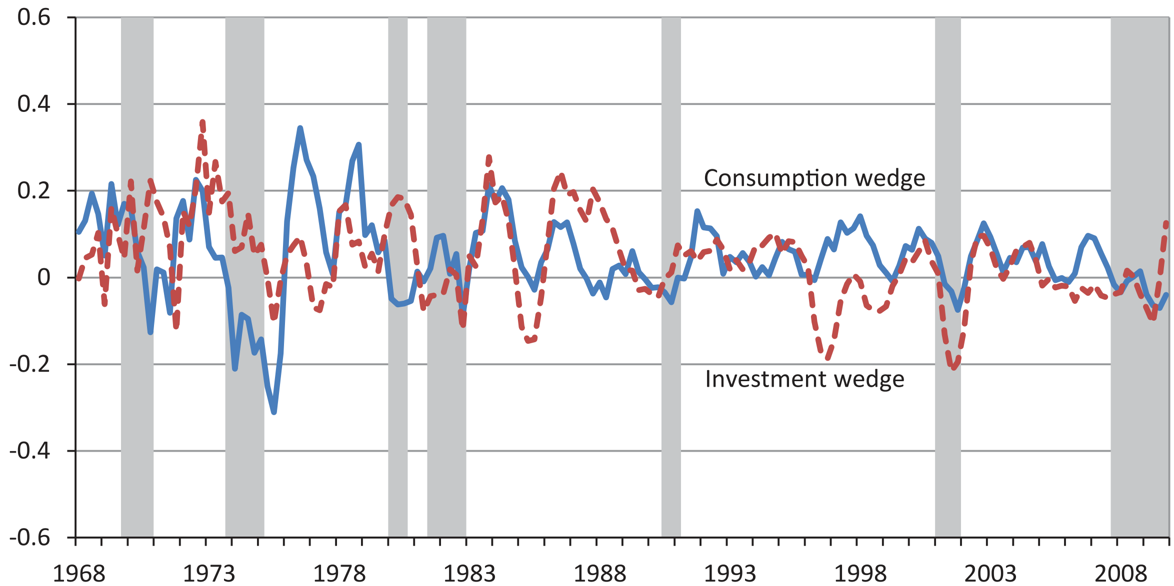
Notes: This figure plots the percentage changes in real imports and exports against the percentage changes in nominal imports and exports, by EndUse sector, along with a 45-degree line. Source: National Income and Product Accounts.

Figure 6. Overall and Durable Wedges



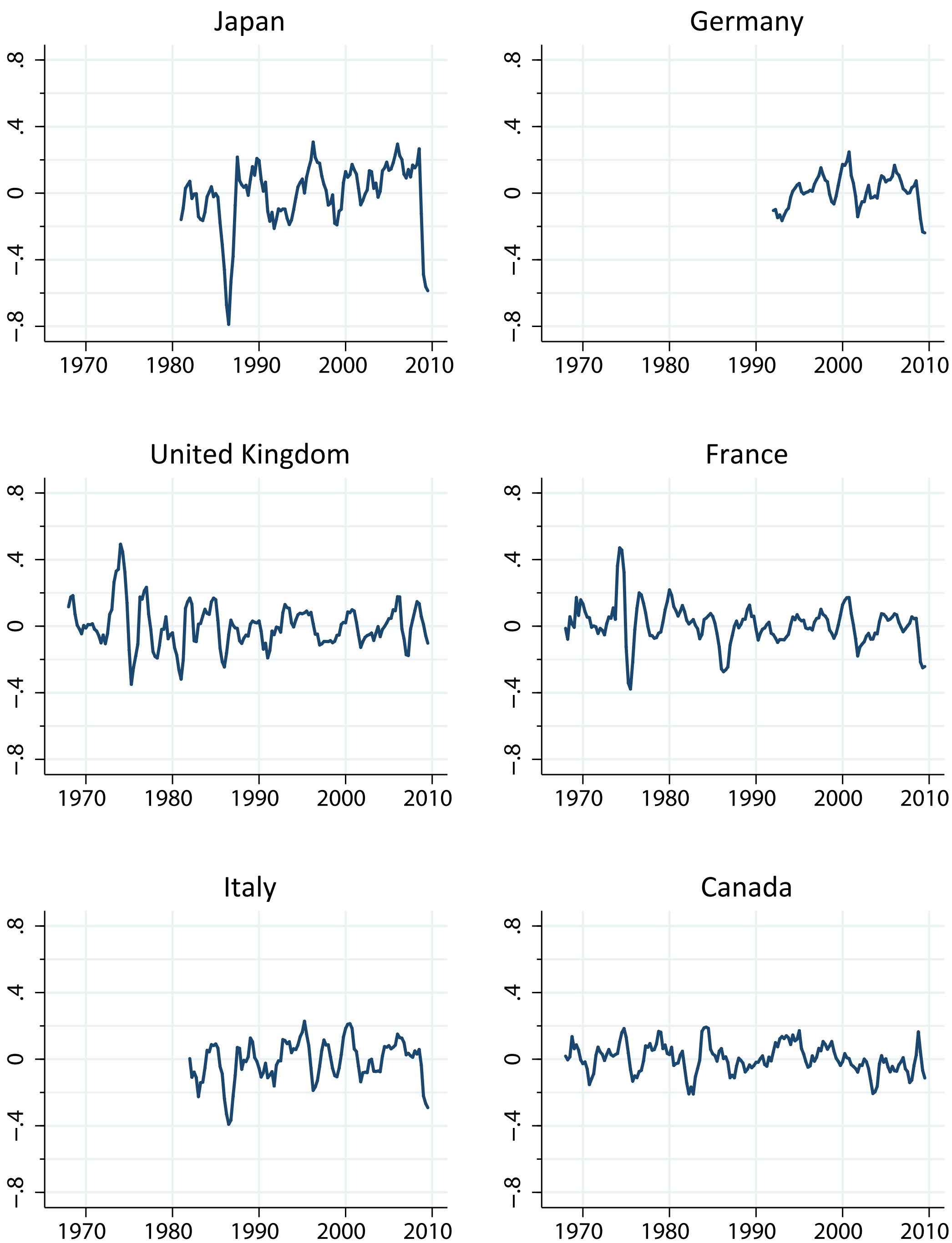
Notes: This figure plots the wedges for total imports and the durable imports. Source: National Income and Product Accounts and authors' calculations.

Figure 7. Consumption and Investment Wedges



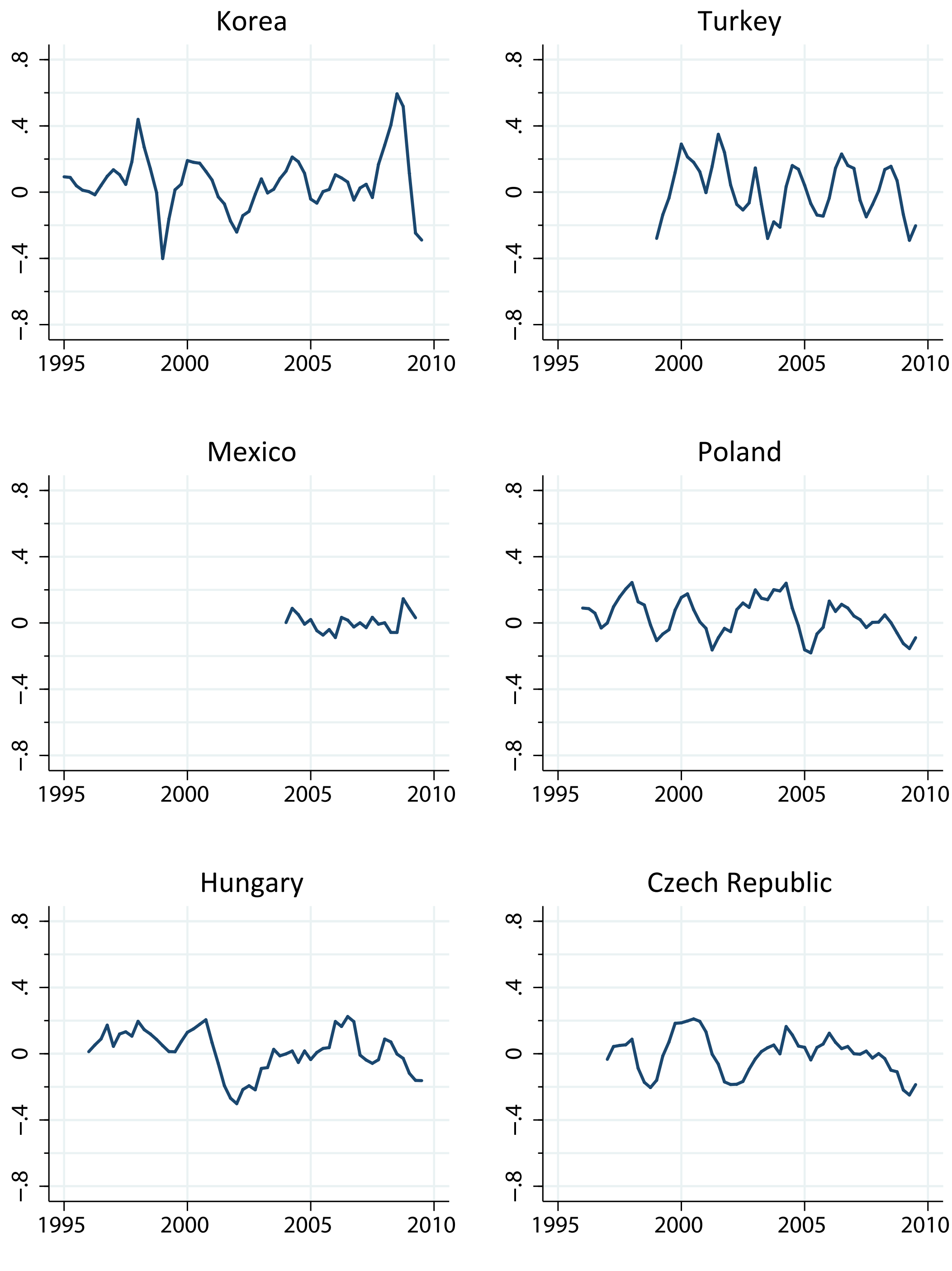
Notes: This figure plots the wedges for consumption imports and investment imports. Source: National Income and Product Accounts and authors' calculations.

Figure 8. Overall Wedges, Large Industrial Countries



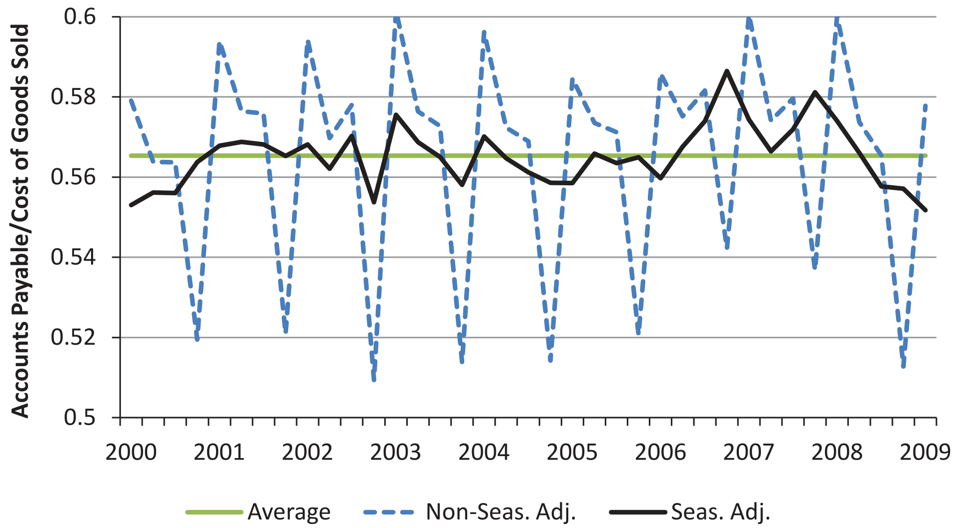
Notes: This figure plots the wedges for total imports for a selected set of countries. Source: OECD and authors' calculations.

Figure 9. Overall Wedges, Selected Emerging Markets

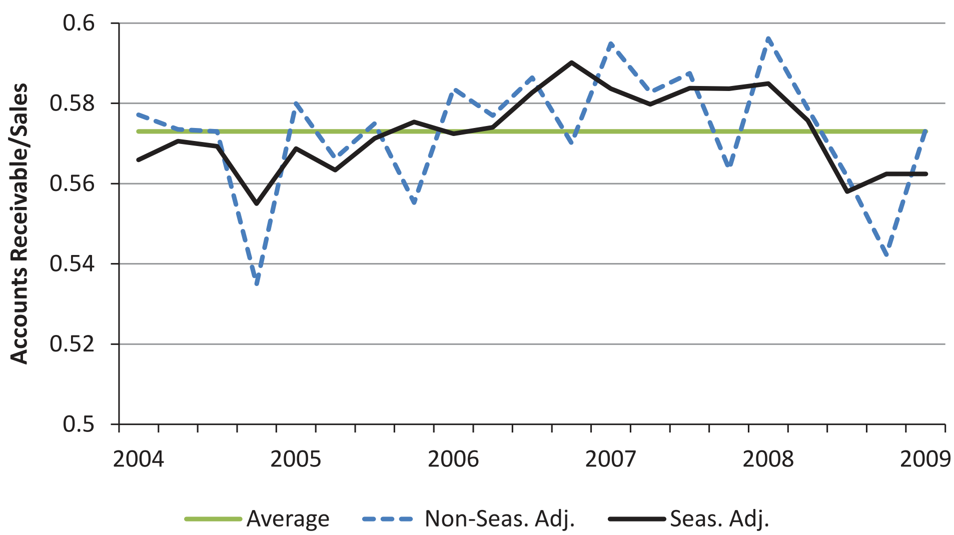


Notes: This figure plots the wedges for total imports for a selected set of countries. Source: OECD and authors' calculations.

Figure 10. The Evolution of Trade Credit



(a) Accounts Payable/Cost of Goods Sold



(b) Accounts Receivable/Sales

Notes: The top panel of this figure displays the median value of accounts payable/cost of goods sold across firms in each period. The bottom panel reports the median value of accounts receivable/sales across firms in each period. Source: Compustat.

Table A1. Summary Statistics

	Mean	Std. Dev.	Min	Max
Independent Variables				
Percentage Change in Imports	-0.253	0.227	-1.000	0.861
Percentage Change in Exports	-0.209	0.214	-0.969	0.744
Downstream Indicators				
Average Downstream Use	0.001	0.002	0.000	0.013
Number of Downstream Industries	102	111	1	419
Downstream Herfindahl	0.220	0.223	0.009	1.000
Production Sharing (exports)	0.196	0.133	0.005	0.612
Production Sharing (imports)	0.150	0.139	0.000	0.577
Upstream Indicators				
Intermediate Use Intensity	0.631	0.122	0.254	0.949
Number of Intermediates Used	113	26	46	218
Herfindahl of Intermediate Use	0.094	0.066	0.028	0.532
Credit Indicators				
Accounts Payable/Cost of Goods Sold	0.469	0.141	0.194	1.733
Accounts Receivable/Sales	0.532	0.131	0.156	0.817
TWCC (imports)	-2.691	0.493	-5.594	-1.178
TWCC (exports)	-2.721	0.392	-4.190	-0.411
Compositional Indicators				
Percentage Change in Industrial Production	-0.179	0.121	-0.757	0.036
Durable dummy	0.588	0.493	0	1
Control Variables				
Share in Total Imports	0.002	0.007	0.000	0.088
Share in Total Exports	0.002	0.005	0.000	0.045
Elasticity of Substitution	6.8	10.7	1.2	103
Labor Intensity	0.633	0.229	0.049	0.998

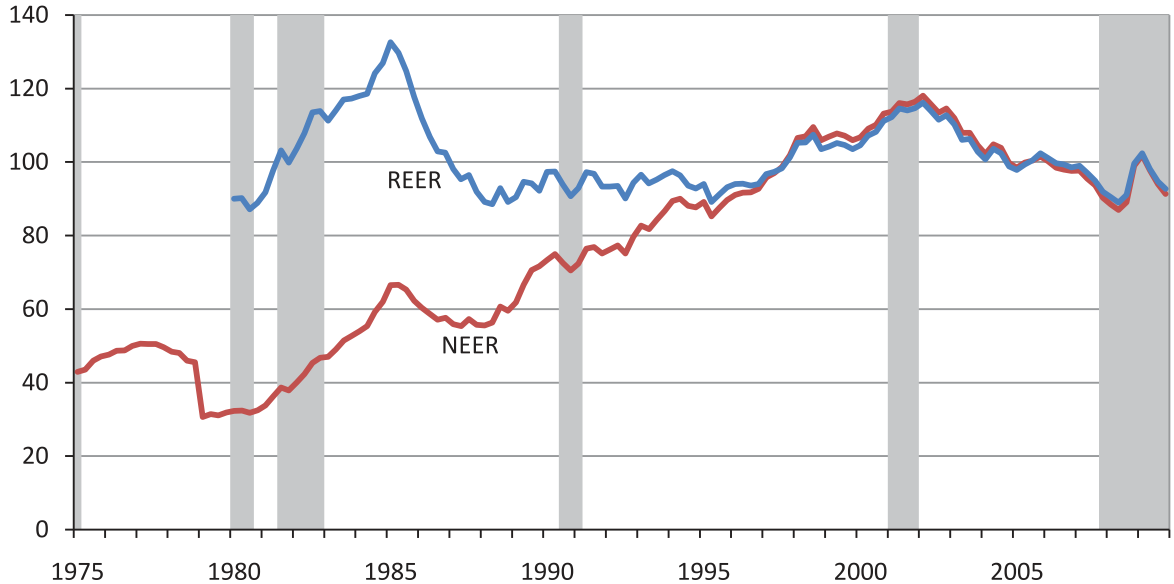
Notes: This table presents the summary statistics for the variables used in the estimation for the 2008-2009 episode. Variable definitions and sources are described in detail in the text.

Table A2. Trade in the 1991 and 2001 Recessions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1991 Recession				**2001 Recession**			
	Panel A: Percentage Change in Imports		*Panel B: Percentage Change in Exports*		*Panel C: Percentage Change in Imports*		*Panel D: Percentage Change in Exports*	
Average Downstream Use	0.065	0.074	-0.114***	-0.101**	-0.049	-0.08	-0.073	-0.048
	(0.048)	(0.048)	(0.041)	(0.042)	(0.043)	(0.051)	(0.050)	(0.057)
Intermediate Use Intensity	-0.118*	0.038	-0.035	0.082	0.059	-0.068	0.131**	0.04
	(0.067)	(0.073)	(0.065)	(0.105)	(0.064)	(0.084)	(0.056)	(0.089)
Accounts Payable	-0.114**	0.045	-0.105	0.115**	-0.079	0.052	-0.042	-0.023
	(0.045)	(0.048)	(0.100)	(0.050)	(0.056)	(0.069)	(0.060)	(0.078)
Durable Dummy	-0.069	-0.146**	-0.131**	-0.193***	-0.104**	-0.134**	-0.005	-0.031
	(0.057)	(0.065)	(0.061)	(0.071)	(0.053)	(0.062)	(0.052)	(0.066)
Share in Total	0.024	0.051*	0.026	0.016	-0.108*	-0.049	-0.052	-0.071
	(0.028)	(0.029)	(0.062)	(0.071)	(0.060)	(0.055)	(0.040)	(0.049)
Elasticity of Substitution	-0.118**	-0.058	-0.155**	-0.112	-0.014	-0.028	0.015	0.006
	(0.049)	(0.056)	(0.064)	(0.070)	(0.068)	(0.088)	(0.064)	(0.078)
Labor Intensity	-0.018	0.249***	-0.073	0.094	-0.189***	-0.032	-0.150**	-0.117
	(0.020)	(0.083)	(0.061)	(0.106)	(0.065)	(0.119)	(0.061)	(0.118)
Capital Intensity		0.416***		0.180		-0.021		-0.030
		(0.103)		(0.128)		(0.118)		(0.131)
Skill Intensity		-0.190***		-0.039		-0.084		0.032
		(0.069)		(0.082)		(0.095)		(0.110)
Inventories		-0.071		0.107		0.213***		-0.016
		(0.044)		(0.066)		(0.053)		(0.070)
Observations	400	383	398	380	408	350	414	351
R^2	0.037	0.107	0.063	0.095	0.074	0.115	0.032	0.021
Partial R^2	0.022	0.021	0.044	0.043	0.028	0.023	0.019	0.005

Notes: Standardized beta coefficients reported throughout. Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the percentage reduction in U.S. Imports (Panels A and C) and the percentage reduction in exports (Panels B and D) in a 4-digit SIC category from 1990q4 to 1991q4 (1991 Recession) or 6-digit NAICS category from 2000q4 to 2001q4 (2001 Recession). *Average Downstream Use* is the average usage output in a sector as an intermediate input in other sectors; *Intermediate Use Intensity* is spending on intermediate inputs per dollar of final sales; *Accounts Payable/Cost of Goods Sold* is a measure of trade credit; *Share in Total* is the share of a sector in total U.S. imports (Panel A), or exports (Panel B). *Elasticity of Substitution* between varieties in a sector is sourced from Broda and Weinstein (2006). *Labor Intensity* is the compensation of employees as a share of value added, from the U.S. 1987 Benchmark Input-Output Table (1991 Recession), or U.S. 2002 Benchmark Input-Output Table (2001 Recession). *Capital Intensity* =1-(total compensation)/(value added); *Skill Intensity*=[(nonproduction workers)/(total employment)]*(1-capital intensity). These two indicators are computed using the NBER Productivity Database. *Inventories* is the beginning-of-period level of inventories relative to imports (resp., exports).

Figure A1. Nominal and Real Effective Exchange Rates for the U.S..



Notes: This figure displays the Nominal Effective Exchange Rate and the Real Effective Exchange Rate for the United States. Source: International Monetary Fund.