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ABSTRACT

We survey recent literature on the causes of the collapse in international trade during the 2008-2009 global recession. We argue that the evidence points to the collapse in aggregate expenditure, concentrated on trade-intensive durable goods, as the main driver of the trade collapse. Inventory adjustment likely amplified the impact of these expenditure changes on trade. In addition, shocks to credit supply constrained export supply further exacerbating the decline in trade. Most evidence suggests that changes in trade policy did not play a large role. We conclude that one benefit of the trade collapse is that it has stimulated research in neglected areas at the intersection of trade and macroeconomics.

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During the global recession of 2008-2009, international trade collapsed. From 2008Q1 to 2009Q1, real world trade fell by about 15 percent, exceeding the fall in real world GDP by roughly a factor of 4. This trade collapse echoed the collapse of trade during the Great Depression and triggered fears of a protectionist policy backlash. In the three plus years since its onset, there has been a great deal of research that examines the origins and consequences of the trade collapse. This essay reviews this new literature, focusing our discussion around three major themes.

First, changes in real final expenditure were responsible for most of the collapse of international trade. While early commentators suggested a variety of explanations for the fall in trade relative to GDP, subsequent work has largely confirmed the central role of expenditure.[1] The key to understanding how trade can fall more than GDP lies in understanding how asymmetries in expenditure changes across sectors map to international trade. The global recession saw large declines in spending on final goods (as opposed to services), and specifically durable goods. Because changes in expenditure were largest in the most traded sectors, these changes were transmitted forcefully to the border.

With this intuition as a starting point, we emphasize several technical issues that are important for quantifying the role of expenditure in driving the trade collapse. We first highlight that one must account for input linkages across sectors and countries to estimate the impact of spending changes on imports. We also discuss recent contributions suggesting that inventory adjustment amplifies the response of total imports to changes in final sales of imported goods.

Second, financial shocks that disrupted export supply and impeded international transactions played a secondary role in explaining the decline of trade. We highlight evidence on two separate channels. Financial shocks constrained firms' access to working capital, thus restricting both production and export supply. On top of this general channel, international trade tends to be 'finance intensive' relative to domestic trade, due to long cash cycles and higher payment uncertainty associated with foreign buyers/sellers. Therefore, financial shocks also likely disrupted international trade transactions above and beyond the effect they had on domestic transactions.

Third, changes in trade policy – i.e., protectionism – played essentially no role in explaining the trade collapse, at least in the aggregate. While there were many specific changes in trade policy that affected individual sectors or partners, there was no wholesale increase in either tariff or non-tariff barriers. The fact that protectionism is the "dog that did not bark" during the global recession should be seen as a victory for the political consensus and economic institutions that underpin the global economy.

[1]For contemporary analyses of the trade collapse, see the VoxEU.org volume edited by Baldwin (2009).

The rest of this paper elaborates on these three main themes. We begin in Section 1 by reviewing some basic facts regarding the trade collapse that motivate general interest in the collapse and are a launching point for empirical work on the causes of the collapse. Section 2 presents an organizing framework for the wide range of factors examined in the literature. Sections 3, 4, 5, and 6 review four proposed mechanisms for explaining the collapse: changes in final expenditure, inventory adjustment, financial shocks, and protectionist trade policy. Section 7 concludes.

1 Stylized Facts

This section summarizes several stylized facts about the global trade collapse. These facts serve to motivate and guide the search for explanations for the trade collapse in subsequent sections.

First, the trade collapse stands out relative to post-WWII experience in terms of its abruptness, magnitude, and synchronization across countries. In Figure 1, we plot the ratio of trade to GDP from 1970 to the present for four large countries (China, Germany, Japan, and the United States), a composite rest-of-the-world region, and the world as a whole.[2]

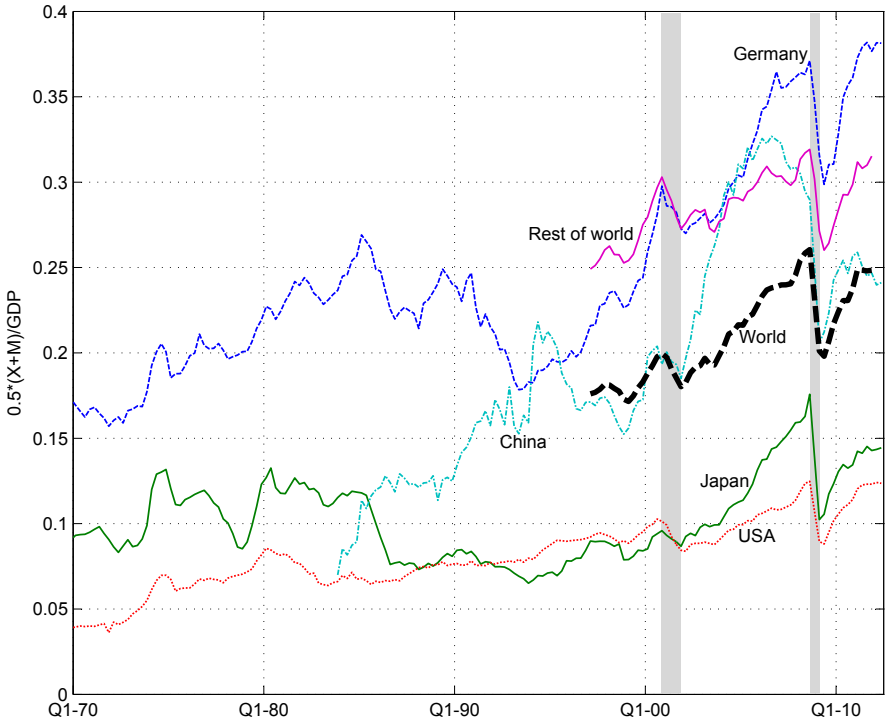
The trade collapse was concentrated in two quarters (Q4-2008 and Q1-2009) and affected all major emerging markets and developing countries simultaneously. The result was an unprecedentedly sharp contraction in world trade. While some countries (e.g., Germany in 1990-1993 or the United States in 1980-1983) had seen declines in trade to GDP of similar size in the past, they had not seen such large declines concentrated in such a short period of time. Further, most past trade contractions were not synchronized across countries to the same extent as the 2008-2009 collapse. The 2000-2001 global recession is the only previous episode in which trade declines were highly synchronized across countries, similar the 2008-2009 collapse though not nearly as large.

Second, the trade collapse was asymmetric across sectors. To start, trade in goods fell substantially more than trade in services. For example, Borchert and Mattoo (2009) report that service trade in the U.S. fell by only a quarter as much as trade in goods. Furthermore, in some service sectors, such as business, professional, and technical services, trade continued to increase throughout the crisis.

Narrowing our focus to goods trade alone, large differences across sectors were also evident. To provide a sense of the magnitude of the differences, Levchenko, Lewis, and Tesar

[2]We measure the ratio of trade to GDP as the simple average of exports and imports divided by GDP. Not all series start in 1970 due to data availability. See Freund (2009) for related evidence on world trade to GDP ratios in previous global recessions.

Figure 1: The Ratio of Trade to GDP: 1970:Q1-2012:Q2



Source: IMF Global Data Source and authors' calculations. Data includes 55 industrial and major emerging markets. Merchandise exports, merchandise imports and GDP measured in current US Dollars. 'World' is defined as sum of all sample countries. 'Rest of the world' is defined as 'World' excluding Germany, USA, Japan and China. Shaded bars indicate periods of peak-to-trough declines in trade during 2000-2001 and 2008-2009 global recessions.

(2010) report that the sharpest drops in U.S. imports occurred in the automotive (-47%) and industrial supplies (-34%) sectors, while consumer goods trade fell by far less (-12%).[3] One way to organize these differences is to note that imports of durables fell substantially more than nondurable imports. For the U.S., Levchenko et al. report that exports of non-automotive consumer durables fell by -24.5% while nondurable exports actually rose. Behrens, Corcos, and Mion (forthcoming) report that in Belgium exports and imports of consumer nondurables changed by -2% and 9%, while consumer durables fell by -36% and -39%.

Third, the trade collapse occurred almost entirely on the intensive margin of trade, whether measured at the sector or firm level. Looking at Harmonized System sector-level data for the U.S., EU, Brazil, and Indonesia, Haddad, Harrison, and Hausman (2010) find that changes in trade on the intensive margin account for 70-95% of the fall in imports. In firm-level data for Belgium, Behrens et al. estimate that close to 100% of the fall in imports and exports took place at the intensive margin. Similarly, Bricongne et al. find that net intensive margin accounted for around 90% of the fall in exports for French exporting firms.

Fourth, the trade collapse was mostly due to changes in the volume of trade, not price changes. While prices did fall in some commodity sectors, they were stable or rose in non-commodity or differentiated goods sectors that make up the bulk of trade. Looking at sector-level data in the U.S., Levchenko et al. report that roughly two-thirds of the decline in values is accounted for by declines in quantities. Gopinath, Itskhoki, and Neiman (2012) extend these findings using transaction level data for the United States from the Bureau of Labor Statistics. They find that the decline in export and import price indexes was entirely due to a decline in prices of non-differentiated goods. Despite the collapse in trade values, export and import prices of differentiated goods remained broadly stable.

This result is echoed for a broader set of countries by Haddad et al., who find that unit value prices (computed for Harmonized System categories) fell overall, but actually increased on average within manufacturing. Similarly, Behrens et al. and Bricongne et al. also attribute the bulk of the trade collapse to quantities looking at Belgian and French firm-level data. The message of these results is that the trade collapse was primarily a collapse in the quantity of goods traded. The sharp fall in commodity prices during the global recession accounts for only a fraction of the collapse in aggregate trade.

[3]Bricongne, Fontagné, Gaulier, Taglioni, and Vicard (2012) find similar patterns for France.

2 Framework

In this section, we lay out an analytical framework to organize the empirical research on the trade collapse. This research has focused on documenting mechanisms that explain deviations of imports from levels predicted by benchmark theoretical or econometric models. We focus our attention on one particular benchmark – CES import demand – that occupies a prominent place in both the macroeconomic and trade literatures. By delineating the channels through which actual imports deviate from this benchmark, we arrive at a framework to categorize alternative empirical stories.

To start, consider a world with two countries (i and j), and suppose that aggregate import demand takes the CES form: $d_{ij} = \left(\frac{\tau_{ij} p_i}{P_j}\right)^{-\sigma} D_j$, where d_{ij} is aggregate real imports by country j from country i, p_i is the price at the factory gate of the good from country i, τ_{ij} is an ad valorem cost of delivering goods from the factory gate in country i to final purchasers in country j, P_j is the aggregate price index for final expenditure in country j; and D_j is real aggregate expenditure (henceforth, expenditure or spending) by country j.[4] Holding trade costs (τ_{ij}) constant, we obtain the standard log-linear import demand equation:

$$\hat{d}_{ij} = -\sigma \left(\hat{p}_i - \hat{P}_j\right) + \hat{D}_j, \tag{1}$$

where the hat notation represents log differences. We will refer to $\hat{d}_{ij}$ as the CES-predicted change in imports.

This CES import demand equation immediately points to two reasons why trade collapsed. The first is that real aggregate expenditure fell precipitously during the global recession ($\hat{D}_j < 0$). During the crisis, however, much attention focused on the decline in trade relative to real expenditure. This points toward a possible second explanation: an increase in the relative price of imports. Increases in the relative factory-gate price of imports (i.e., $\hat{p}_i - \hat{P}_j > 0$) could lead imports to fall more than proportionally with final expenditure (i.e., $\hat{d}_{ij} - \hat{D}_j < 0$).

As noted in the previous section, import prices for the bulk of manufacturing imports did not fall despite the large collapse in aggregate spending. This suggests that there may have been shocks to export supply, for example due to declines in credit supply that hindered production. We can think of these possible supply shocks as operating through this relative price channel, pushing p_i up and exacerbating the decline in imports.

Early research suggested that these simple explanations could not explain the collapse of

[4]To be clear, D_j includes consumption, investment, and government spending. The aggregate price P_j is then the price level associated with this composite expenditure. With balanced trade, D_j would be equal to GDP, but deviates from GDP with unbalanced trade.

trade.[5] This motivated efforts to explain the gap between CES-predicted imports and actual imports. If we define the actual change in imports as $\hat{m}_{ij}$, then the unexplained change in imports is:

$$\omega \equiv \hat{m}_{ij} - \hat{d}_{ij} = \hat{m}_{ij} + \sigma \left(\hat{p}_i - \hat{P}_j \right) - \hat{D}_j. \tag{2}$$

We will call ω the 'trade wedge.' The trade wedge measures the discrepancy between model and data, serving as a model diagnostic in the spirit of Chari, Kehoe, and McGrattan (2007).[6]

The trade wedge captures several economic mechanisms that could explain the large collapse in trade relative to expenditure. To illustrate this idea, suppose that 'true' aggregate import demand is given by: $m_{ij} = f(\tau_{ij}, \frac{p_i}{P_j}, D_j)$, where m_{ij} represents actual imports. Log linear import demand is then:

$$\hat{m}_{ij} = \beta_1 \hat{\tau}_{ij} + \beta_2 \left(\hat{p}_i - \hat{P}_j \right) + \beta_3 \hat{D}_j, \tag{3}$$

where β_1, β_2, and β_3 are the (unrestricted) elasticities of the real imports with respect to trade costs, relative prices, and aggregate expenditure, respectively.[7] Combining Equations (2) and (3), the trade wedge would be given by:

$$\omega = \beta_1 \hat{\tau}_{ij} + (\beta_2 - \sigma) \left(\hat{p}_i - \hat{P}_j \right) + (\beta_3 - 1) \hat{D}_j \tag{4}$$

This expression highlights that the trade wedge captures both trade costs and model mis-specification. The first two terms in this trade wedge are associated with relative prices. Increases in either policy (e.g., tariffs) or non-policy trade costs (e.g., costs of financing international trade) raise the relative price of imported goods, holding factor gate prices constant.[8] Factors that amplify the empirical elasticity of imports to final demand relative to calibrated CES elasticities (e.g., inventory adjustment) also appear in the trade wedge.

The third component of the wedge is associated with mis-specification of the elasticity of real imports to aggregate real expenditure.[9] The aggregate CES import demand system

[5] For example, see Levchenko et al. (2010) who use a trade wedge exercise of the type described here. See also Freund (2009) who reported that the elasticity of trade to world GDP was roughly 3.5 in recent data, well above the unitary elasticity implied by the aggregate CES framework.

[6] See also Levchenko et al. (2010) and Alessandria, Kaboski, and Midrigan (2011, 2012). Jacks, Novy, and Meissner (2009, 2011) and Eaton, Kortum, Neiman, and Romalis (2011) study closely related metrics to assess the magnitude of changes in border frictions.

[7] Note that we allow changes in trade costs to affect true important demand here. This contrasts with the CES benchmark in Equation (1) where we assumed trade costs were constant.

[8] Changes in transport, distribution, and retail margins also can affect the wedge. We do not know of any papers that focus on these, however. Looking at indexes such as the Baltic Shipping Index, transport costs appear to have fallen sharply coincident with the trade collapse.

[9] With a constant trade balance, aggregate real expenditure is related to aggregate real income or value added, so with some abuse of language one can think of this as mis-calibration of the income elasticity of

assumes that real imports respond to aggregate final expenditure $\hat{D}_j$ with an elasticity of one. This need not be the case in a multi-sector model with asymmetric spending changes across sectors, in a model with inventories, or in a model with non-homothetic preferences.

To sum up, we propose mapping explanations for the trade collapse into either (a) relative price changes, or (b) changes in the trade wedge. There are several candidates for explaining changes in the trade wedge, including changes in trade frictions or mechanisms that raise the elasticity of real imports to relative prices or real aggregate expenditure. In subsequent sections, we discuss evidence on these factors in detail. Incorporating them yields a more sophisticated import demand system that fits the data better than the CES benchmark.

3 The Composition of Expenditure Changes

The aggregate CES import demand system, as in Equation (1), embodies the assumption that changes in aggregate expenditure translate one-for-one into changes in aggregate imports. In this section, we examine several channels that lead this result to break down: asymmetries in expenditure changes across sectors, input linkages across sectors, and vertical specialization in trade. These examples highlight challenges researchers face in analyzing the quantitative role of expenditure changes in explaining the trade collapse. We then review evidence from multi-sector models with input-output linkages across sectors and countries.

3.1 Translating Aggregate Expenditure into Imports

We open this section with a basic point: the composition of expenditure changes across sectors interacts with the import intensity of those sectors to drive aggregate real imports. When expenditure changes are largest in import-intensive sectors, imports can easily decline by more than overall aggregate expenditure. While this mechanism is general, quantifying the importance of these expenditure asymmetries is complicated by the fact that imports consist of both final and intermediate goods. We illustrate two complications that arise due to input linkages across sectors and vertical specialization in trade.

3.1.1 Asymmetries in Expenditure Changes Across Sectors

Let us begin with a two-sector extension of the benchmark framework in which final demand takes the nested CES form. Within each sector $s \in \{1, 2\}$ of country j, domestic and foreign goods, $d_{jj}(s)$ and $d_{ij}(s)$, are aggregated to form a composite sector level good, denoted $d_j(s)$.

imports or the elasticity of imports to GDP.

These sector level goods are then aggregated to form a composite final good, denoted D_j.[10] To isolate composition effects, we assume that aggregation of home and foreign goods within sectors is Leontief, so that: $\hat{d}_{ij}(s) = \hat{d}_j(s)$.

To make the analysis more concrete, let us label the two sectors so that $s = 1$ represents services and $s = 2$ represents goods. And let us make the stark assumption that services are not traded, reflecting the general idea that goods are more tradable than services. With this set-up, changes in aggregate real imports are given by:

$$\hat{m}_{ij} = \left[\frac{\hat{d}_j(2)}{\hat{D}_j}\right] \hat{D}_j, \tag{5}$$

where we used the Leontief assumption that $\hat{d}_{ij}(2) = \hat{d}_j(2)$.

We note that asymmetric changes in sector-level expenditure show up in the trade wedge because they drive the elasticity of imports with respect to aggregate expenditure away from one. Using the notation of Equation (4), $\beta_3 = \frac{\hat{d}_j(2)}{\hat{D}_j}$. If spending changes are identical across sectors, so that $\hat{d}_j(1) = \hat{d}_j(2)$, then it follows that $\hat{d}_j(2) = \hat{D}_j$.[11] This implies that the elasticity of imports to aggregate expenditure is equal to one (i.e., $\beta_3 = 1$). Outside this special case, changes in imports can either be larger or smaller than aggregate expenditure, giving rise to a non-zero trade wedge.

The sign of the trade wedge depends on how changes in expenditure are correlated with sectoral openness. If final spending on tradable goods ($s = 2$) falls more than spending on non-traded services ($s = 1$), then the elasticity of imports with respect to aggregate expenditure is greater than one and the trade wedge will be negative $\hat{\omega} < 0$. This intuition generalizes in a straightforward way to an economy with many tradable sectors. In that case, $\hat{m}_{ij} = \sum_s \alpha_j^m(s)\hat{d}_{ij}(s) = \sum_s \alpha_j^m(s)\hat{d}_j(s)$, where $\alpha_j^m(s)$ is the share of each sector in imports. Rewriting:

$$\hat{m}_{ij} = \left[\sum_s \alpha_j^m(s) \left(\frac{\hat{d}_j(s)}{\hat{D}_j}\right)\right] \hat{D}_j. \tag{6}$$

Thus, if sectors with relatively large expenditure changes ($\frac{\hat{d}_j(s)}{\hat{D}_j} > 1$) have relatively large import shares $\alpha_j^m(s)$, then the elasticity of imports to aggregate expenditure will be greater than one and the trade wedge will be positive.

The intuition derived from this simple example is clear, but needs to be extended before it can be taken to data. One important shortcut in the example is that we treated imports as if

[10] In developing results in this section, we assume that we have data on sector-level expenditure changes. We focus on the response of trade to these expenditure changes, but do not model the sources of these changes directly. Therefore, we do not need to specify how the top level of aggregation works here.

[11] This uses the fact that $\hat{D}_j = \sum_s \alpha_j^d(s)\hat{d}_j(s)$, where $\alpha_j^d(s)$ is the share of each sector in total expenditure.

they are directly sold to final users. This is unrealistic since roughly two-thirds of imports are used as intermediate inputs in most countries. The heavy use of imported intermediates has two important implications. First, final expenditure need not be directly linked to imports on a sector-by-sector basis. For example, goods may be used as inputs to the production of services, so imports may depend on spending on services even if services are non-traded. Second, imports are often used to produce exports. Therefore, imports depends not only on domestic final expenditure, but also demand for exports. We take up these extensions in the next two sections.

3.1.2 Input Linkages Across Sectors

To explain the issues that arise due to imported input linkages across sectors, we consider an empirically motivated extension of the multi-sector model. We continue to analyze a two sector economy (goods and services) and maintain the assumption that only goods are traded. However, now we recognize that some goods are used as intermediate inputs in production.

Specifically, let us assume that the services sector uses imported goods as intermediate inputs in production. We denote these intermediate goods imports by country j as $x_{ij}(2,1)$, where the index $(2,1)$ indicates that goods $(s=2)$ are used by service sector $(s=1)$. Further, assume that the production function for services is Leontief, so that changes in imported inputs are proportional to changes in gross output of services. Denoting the change in gross output as $\hat{q}_j(1)$, then $\hat{x}_{ij}(2,1) = \hat{q}_j(1)$. Because services are non-traded, $\hat{q}_j(1) = \hat{d}_j(1)$, so demand for imported inputs is proportional to final spending on services: $\hat{x}_{ij}(2,1) = \hat{d}_j(1)$. Finally, we continue to assume that the country imports goods for direct consumption $(d_{ij}(1))$ and combines these with domestically produced goods $(d_{jj}(1))$ via a Leontief aggregator.

Given these assumptions, the change in aggregate imports can be expressed as:

$$\begin{aligned} \hat{m}_{ij} &= \alpha_j^{md}\hat{d}_{ij}(2) + \alpha_j^{mx}\hat{x}_{ij}(2,1) \\ &= \alpha_j^{md}\hat{d}_j(2) + \alpha_j^{mx}\hat{d}_j(1) \end{aligned} \tag{7}$$

where α_j^{md} and α_j^{mx} are the shares of final goods and intermediate inputs in aggregate imports. The important point to note here is that aggregate imports of goods in country j depend not only on final spending on goods, but also on final spending on services.

We proceed to compute the change in real imports in this example:

$$\hat{m}_{ij} = \left[\frac{\alpha_j^{mx}\hat{d}_j(1) + \alpha_j^{md}\hat{d}_j(2)}{\hat{D}_j}\right]\hat{D}_j. \tag{8}$$

The effect of imported intermediates on the trade wedge can be deduced from this expression.

If there are no imported intermediates ($\alpha_j^{mx} = 0$), then this expression collapses to the multi-sector model of the previous section. In this case, the elasticity of imports to aggregate expenditure is greater than one and the trade wedge is positive if expenditure falls by more in the goods sector than overall aggregate expenditure. On the other hand, if $\alpha_j^{mx} > 0$ and the fall in expenditure is larger for goods than services (assuming both fall), the elasticity of imports to aggregate expenditure gets pushed back towards one. That is, imported inputs actually tend to decrease the magnitude of the trade wedge. The reason is that imports depend on spending on both goods and services due to the cross-sector input linkage, and this makes the response of imports more similar to overall expenditure. Because spending on goods fell by more than spending on services in most countries, this insight directly carries over to the trade collapse episode. The conclusion is that one needs to be careful to account for input linkages across sectors when examining how changes in expenditure translate into changes in imports.

3.1.3 Vertical Specialization in Trade

Input linkages that tie imports to demand for exports are also important in explaining how imports respond to expenditure changes. Unlike previous examples where the size of expenditure changes across sectors within countries was important in explaining import responses, we now emphasize that the size of expenditure changes across countries can be important as well.

To illustrate this issue, we work with a different modification of the two-country example.[12] As in previous examples, goods are tradable and services are non-traded in both countries. However, suppose now that country j only imports intermediate inputs ($d_{ij}(2) = 0$), while country i imports only final goods ($d_{ji}(2) > 0$). Unlike the previous example, assume that imported inputs in country j are used to produce goods, not services. Assuming that the goods production technology is Leontief, then $\hat{x}_{ij}(2,2) = \hat{q}_j(2)$, where the notation is the same as in previous sections. Finally, to emphasize the role of cross-country differences in expenditure changes, we assume that expenditure changes are symmetric within countries, so $\hat{d}_{ij}(s) = \hat{D}_j$.

With this set-up, changes in aggregate real imports for country j are: $\hat{m}_{ij} = \hat{x}_{ij}(2,2) = \hat{q}_j(2)$. Changes in gross output are themselves given by: $\hat{q}_j(2) = \alpha_{jj}^q(2)\hat{d}_{jj}(2) + \alpha_{ji}^q(2)\hat{d}_{ji}(2)$, where $\alpha_{jj}^q(2) = \frac{d_{jj}(2)}{q_j(2)}$ and $\alpha_{jj}^q(2) + \alpha_{ji}^q(2) = 1$. Since $\hat{d}_{ij}(s) = \hat{D}_j$, then we can write imports

[12] To be consistent with previous sections, we describe the economy as if it has two sectors here. As will be obvious, the basic point we want to make holds for a one sector economy as well.

as:

$$\begin{aligned}\hat{m}_{ij} &= \alpha^q_{jj}(2)\hat{D}_j + \alpha^q_{ji}(2)\hat{D}_i \\ &= \left[\alpha^q_{jj}(2) + \alpha^q_{ji}(2)\frac{\hat{D}_i}{\hat{D}_j}\right]\hat{D}_j\end{aligned} \tag{9}$$

Because imported inputs are used to produce exports, imports in country j depend on final expenditure both at home and abroad. Further, the elasticity of imports with respect to domestic expenditure depends on the ratio of domestic to foreign expenditure changes. In previous examples, the distribution of expenditure changes across sectors pushes the elasticity of imports to aggregate expenditure away from one. Here the distribution of expenditure changes across countries does the same: heterogeneity in global expenditure influences the size of the changes in trade.

Another point to note is that vertical specialization can make changes in imports more synchronized across countries than changes in final expenditure. For example, suppose that expenditure in country j is constant, while expenditure in country i falls (i.e., expenditure changes are not synchronized). Then, imports fall in country i due to the change in final expenditure directly, and imports fall in country j because country j needs fewer imported intermediate inputs to produce exported final goods.

A final point to note is that the presence of vertical specialization by itself does not amplify the response of global trade to expenditure. If expenditure changes are identical across countries ($\hat{D}_i = \hat{D}_j$), then the change in world trade is proportional to the change in global demand.[13] However, if expenditure changes are heterogeneous across sectors such that expenditure declines more in vertically specialized sectors, then global trade can decline more than global expenditure.[14]

3.2 Evidence on the Role of Expenditure Changes

There are two main messages from Section 3.1. First, asymmetric expenditure changes across sectors interact with differences in sectoral import intensity to determine changes in imports. Second, input linkages across sectors and countries mediate the relationship between expenditure changes and changes in trade. Therefore, one needs to simultaneously account for both asymmetric expenditure changes and input linkages to quantify the role of expenditure in explaining the trade collapse.

[13] To be clear, if $\hat{D}$ is the change in global expenditure, then by construction $\hat{D}_i = \hat{D}_j = \hat{D}$. Further, $\hat{m}_{ij} = \hat{m}_{ji} = \hat{D}$, and global trade is a weighted average of $\hat{m}_{ij}$ and $\hat{m}_{ji}$.

[14] See Bems, Johnson, and Yi (2011) for formalization of this argument.

Several recent papers by Bems, Johnson, and Yi (2010, 2011), Eaton, Kortum, Neiman, and Romalis (2011), and Bussière, Callegari, Ghironi, Sestieri, and Yamano (forthcoming) do exactly that.[15] Though these papers employ different underlying frameworks, they share two main features. First, they feature multiple sectors and input linkages across sectors and countries, as described in the previous section. Second, they take changes in expenditure as given, and explore the consequences of those changes for international trade.

Bems et al. work with a global input-output framework that describes bilateral final and intermediate goods linkages across countries. They feed observed sectoral expenditure changes into that framework to generate predictions for trade flows during the crisis. In this exercise, Bems et al. abstract from changes in trade due to relative price changes.[16] This is an advantage in the sense that it isolates the role of expenditure changes in a clean way. It is a disadvantage in that it is silent about what explains residual changes not attributable to expenditure.

Eaton et al. instead use a multi-sector, many-country Ricardian model with input linkages across sectors and countries in which trade endogenously responds to price changes. Using the model, Eaton et al. perform an accounting exercise that splits the trade collapse into components due to changes in final expenditure, changes in productivity, changes in border trade frictions, and changes in trade deficits.[17] Of course, because the model is used as a measurement device, interpretation of these components is model-dependent.

Bussière et al. take a less model-based, and more econometric approach. Bussière et al. use input-output tables to construct a measure of the level of import demand that takes input linkages into account. They start by using the input-output tables to measure the import-intensity of consumption, investment, government spending, and exports. They then combine these import intensities with the actual time series changes in each spending component to construct a time series measure of the level of import demand. They then use this import demand measure along with coefficients from import regressions estimated off historical data to assess the contribution of expenditure changes in explaining import collapses for 18 OECD countries.

[15] Though we focus on aggregate evidence here, Behrens et al., Bricogne et al., and Haddad et al. (among others) also conclude that expenditure changes are the most important explanation for the trade collapse by examining firm and sector-level data.

[16] Bems et al. assume that production functions and preferences are Leontief to shut down the response of quantities to price changes. Formally, their approach is equivalent to assuming that prices are constant in an alternative framework with CES production functions and preferences, described in Bems and Johnson (2012).

[17] Eaton et al. do not explicitly model non-manufacturing sectors, and so focus on changes in manufacturing trade only in this exercise. In addition to the parameterized model, Eaton et al. use data on sector-level changes in production, expenditure, trade balances, and prices (including imputed factor price changes and producer price indexes) to separate these components.

Despite differences in approach, these papers all find that changes in expenditure were the most important explanation for declines in trade during the global recession. All three present baseline estimates that expenditure changes accounted for 65-80% of the trade collapse. These results imply an elasticity of world trade to GDP on the order of three, well in excess of the unitary elasticity that would be implied by the benchmark aggregate CES framework in Section 2.

Further, all three papers emphasize that the composition of expenditure changes was key to explaining the collapse.[18] Spending on durables fell by roughly 30 percent during the global recession, while spending on services was almost unchanged. Given that durables tend to be both heavily traded and highly vertically specialized, this collapse was strongly transmitted to trade. To put a number on this, Eaton et al. find that roughly 2/3 of the decline in world trade to GDP is accounted for by the change in durables expenditure alone.[19]

Consistent with the discussion in Section 3.1.3, changes in expenditure abroad significantly affected not only exports, but also imports for many countries. Bussière et al. argue that the collapse in exports was the main contributor to the fall in imports for Japan, France, Italy, and Spain. Bems et al. estimate that the realized 4.4% fall in expenditure in the U.S. (holding final expenditure in the rest of the world constant) decreased imports in Canada and Mexico by 3.9% and in Emerging Asia by 1.7%. Similarly, the fall in expenditure in EU15 took a large toll on imports in Emerging Europe. These results all point to vertical specialization as playing an important role of synchronizing the collapse of trade across countries.

Shifting attention to the role of cross-sector input linkages as described in Section 3.1.2, Bems et al. estimate that imports of intermediate inputs contracted by considerably less than imports of final goods. For the world as a whole, final goods trade was roughly twice as sensitive to the decline in global spending as intermediate goods trade: the elasticity of final goods trade to total world expenditure was above 4, while the elasticity of intermediate goods trade was 2. These results are consistent with the idea that ignoring intermediate linkages and simply assuming that imports track changes in final expenditure would lead one to over predict the elasticity of trade to expenditure.

Overall, there is a consensus that the composition of expenditure changes was the main

[18]Bems et al. and Eaton et al. focus on splitting goods into durables versus nondurables. Bussière et al. split expenditure by national accounts expenditure categories, so instead emphasize the collapse in investment spending.

[19]Focusing instead on the elasticity of world trade to GDP, Bems et al. show that the elasticity of world trade to GDP is roughly one if they assume expenditure changes are symmetric across sectors within each country, rises to two if expenditure changes are allowed to be asymmetric across goods and services, and rises to roughly 3 if expenditure changes are allowed to be asymmetric within goods across durables and nondurables as well.

contributor to the abrupt fall in trade relative to aggregate expenditure and GDP. That said, the estimates indicate changes in expenditure are responsible for perhaps 65-80% of the collapse, so there is a substantial residual that remains to be accounted for. Therefore we turn to additional mechanisms to fill this gap.

4 Amplification via Inventory Adjustments

In the previous section, we demonstrated that the composition of changes in final expenditure across sectors and countries can lead imports to respond more than proportionally to changes in aggregate final expenditure. In this section, we describe how inventory adjustments serve as an additional mechanism that amplifies changes imports relative to final expenditure.

As Alessandria, Kaboski, and Midrigan (2010b) point out, economies of scale in transportation and delivery lags for international shipments tend to imply that agents should hold large inventories of imported goods. When a negative demand shock arrives, imports may fall both because demand is lower and because lower levels of demand imply that agents should reduce inventory levels. This amplification mechanism has the potential to explain both the large short run elasticity of imports to demand shocks and movements in the trade wedge.

To illustrate the effects of inventory adjustment, we turn again to the benchmark framework and now assume that agents hold inventories of imported goods.[20] Specifically, let imports in each period include both imports to satisfy final demand and imports to be held in inventory. As an accounting identity, imports are then given by: $m_{ijt} = d_{ijt} + I_{ijt} - I_{ijt-1}$, where $I_{ijt} - I_{ijt-1}$ is the change in inventories of imported goods from period $t-1$ to period t. Final sales of imported goods d_{ijt} are equal to final expenditure on imports less changes in private inventories.[21]

For simplicity, assume that there is a behavioral inventory rule where inventories are a constant ratio of final sales of imported goods: $\frac{I_{ijt}}{d_{ijt}} = \frac{I}{d} \; \forall \; t$. This implies that imports are given by: $m_{ijt} = d_{ijt} + \frac{I}{d}\left[d_{ijt} - d_{ijt-1}\right]$. With this set-up, we want to compute the elasticity

[20] The basic story here holds if agents may hold inventories of domestic goods as well. The key assumption needed to generate a larger response for imports relative to domestically supplied goods is that inventory-to-sales ratios are higher for imported than domestic goods.

[21] In previous sections, we did not take a stand on whether d_{ijt} represented final expenditure (inclusive of inventory investment) or final sales. Here this distinction becomes important. In both Bems et al. and Eaton et al., changes in final expenditure are measured inclusive of inventory investment, yet these papers do not capture the amplifying role of inventories. In Bems et al. and Eaton et al., changes in final expenditure lower demand for both domestic and imports proportionally at the sector level. The inventory adjustment mechanism described here suggests that changes in expenditure should be associated with a larger than proportional response of imports. A general model could clearly encompass both this inventory channel along with the demand asymmetries and input-output linkages above.

of imports with respect to changes in final sales of imported goods. Starting from an initial steady state with constant inventories, so that $m_{ij} = d_{ij}$ initially, this elasticity is given by:

$$\hat{m}_{ij} = \left[1 + \frac{I}{d}\right] \hat{d}_{ij} \tag{10}$$

Inventory adjustment causes imports rise/fall more than proportionally with final sales of imported goods.[22] Combining this result with the benchmark CES demand for imports in Equation (1), we get:

$$\hat{m}_{ij} = -\left[1 + \frac{I}{d}\right] \sigma \left(\hat{p}_i - \hat{P}_j\right) + \left[1 + \frac{I}{d}\right] \hat{D}_j. \tag{11}$$

Inventory adjustment amplifies the sensitivity of imports to both changes in relative prices and real final sales. In the language of Equation (3), the price elasticity is $\beta_2 = -\left[1 + \frac{I}{d}\right] \sigma$ and expenditure elasticity is $\beta_3 = 1 + \frac{I}{d}$. Correspondingly, the trade wedge in this case is given by: $\hat{\omega} = \frac{I}{d}\sigma \left(\hat{p}_i - \hat{P}_j\right) + \frac{I}{d}\hat{D}_j$. Thus, as emphasized by Alessandria et al. (2011, forthcoming), inventory adjustment ultimately gets picked up in the trade wedge.

Alessandria, Kaboski, and Midrigan (2010a, 2011) examine the role of inventory adjustment in explaining the trade collapse. Direct evidence on this channel is difficult to come by, as information on inventories and sales for imported goods is not available for most industries, or even in the aggregate. Data is available for the U.S. auto industry, however, so Alessandria et al. use this industry as a case study. Consistent with the basic story above, imports fell about two-and-a-half times more than sales of imported autos during the trade collapse. Further, they show that the decline in sales was matched by a sharp rise in the inventory-to-sales ratio for imported autos. The inventory-to-sales ratio then fell back to its initial level over time as retailers filled orders out of inventory rather than imports. Once the inventory-to-sales ratio returned to its 'normal' level, retailers started importing again to meet consumer demand, and imports of autos rebounded.

To generalize from this example to economy-wide adjustment, Alessandria et al. turn to a model. In Alessandria et al. (2010a), they extend the partial equilibrium sS inventory model in Alessandria et al. (2010b) to a two-country setting, and calibrate it using import and inventory behavior for the U.S. They then simulate model responses to shocks to the cost of labor and a shock to the carrying cost of inventory (in the form of an interest rate shock), and evaluate the performance of the model against a benchmark model without inventory frictions. The model generates the stylized fact that imports respond more than final sales, as observed in the data. It also generates sharp v-shaped declines in imports and

[22] If $\hat{d}_{ij} = \hat{d}_{jj}$, then this result holds for total final sales, as well.

hump-shaped inventory-to-sales ratios, as in the time series data for autos during the trade collapse.

These results suggest that inventory dynamics may play an important role in amplifying the transmission of changes in final demand to imports. From a quantitative perspective, Alessandria et al. (2011) argue that inventory adjustment could account for as much as one-third of the trade wedge during the 2008-2009 episode for the United States, implying that it could account for up to 20% of the decline in US imports.[23]

These results come with the caveat that there is little direct evidence for the inventory adjustment channel outside autos in the United States.[24] While the preponderance of evidence from the calibrated models and autos case study point toward the importance of inventory adjustment, more work is needed to corroborate the importance of this mechanism in other contexts. Further, whereas Alessandria et al. focus on a case study for inventories of a final good, Altomonte, Di Mauro, Ottaviano, Rungi, and Vicard (2012) suggest that inventories of inputs in global supply chains may have played an important role in the crisis. Empirical work aimed at supply chain inventories would also be worthwhile.

5 Financial Shocks and Exports

The two previous sections focused on the implications of changes in expenditure for trade, presumably arising from demand-side shocks. This section turns to the supply side. We focus on an active literature that investigates the effects of the financial crisis and ensuing credit crunch on trade. We separate this literature into two broad bins.

First, the financial crisis impeded production and hence exports, because firms depend on external credit to finance production. In the benchmark framework, we can interpret these effects as an export supply shock that increases the factory gate price and hence depresses imports, for a given level of aggregate expenditure. Further, the credit crunch is likely to have more severe effects for countries, sectors, and firms that are more financially vulnerable. Identifying the effects of the credit crunch rests on linking measures of financial vulnerability to cross-country, cross-sector, and cross-firm changes in trade.

Second, the financial crisis disrupted the financing of international transactions. Due to long cash flow cycles and payment uncertainty, international trade tends to be 'finance

[23]To generate this estimate, Alessandria et al. make assumptions about steady-state inventory to sales ratios, which are not directly observed for US imports, and the elasticity of substitution between home and foreign goods in preferences. With more conservative assumptions, the estimate shrinks.

[24]For example, Behrens et al. find that the ratio of inventories to sales at the firm level is not an important determinant of changes in imports for Belgian firms during the crisis, though they cannot measure inventories of domestic versus imported goods directly.

intensive' relative to domestic trade.[25] Therefore, financing disruptions may have hit international trade harder than domestic trade, which in our simple framework would look like an increase in the trade wedge. That is, we think of international trade finance disruptions as increasing the cost of delivering goods to foreign consumers, holding the factory gate price of producing those goods constant.[26] Disruptions to trade finance are hard to measure directly due to lack of comprehensive data, but we review what indirect evidence exists below.

5.1 Export Supply Shocks

The launching point for analysis of the impact of financial shocks on export supply is the observation that firms require working capital to produce. Therefore, disruptions to the supply of working capital constrain their ability to supply goods to both domestic and foreign markets. Following Paravisini, Rappoport, Schnabl, and Wolfenzon (2012), we think of production or exports as a function of demand for output and the level of credit used by the firm. And the amount of credit used is itself a function of the supply of credit to the firm and the firm's demand for credit, which itself depends on the demand for output. This two-step formulation highlights several important challenges in examining how financial disruptions influence exports.

First, data on credit use is not typically available at the firm or industry level, particularly in a form that can be matched to contemporaneous information on production. Therefore, most papers rely on proxies for credit use, usually constructed from firms' financial reports or balance sheet information. For example, measures used include the share of capital expenditure not financed by internal cash flows ('external financial dependence'), the tangibility of assets, share of short-term debt, the incidence of defaults on creditors, and so on. These capture how vulnerable particular firms or industries are to financial shocks. The expectation is that the financial crisis affected exports of firms/sectors with high vulnerability more than firms/sectors with low vulnerability, controlling for other confounding factors.

Second, even if credit data is available, the use of credit is clearly endogenous to production decisions. To estimate the causal effect of credit disruptions on production, one

[25] As discussed in Feenstra, Li, and Yu (2011), firms engaged in international trade may also face tighter credit constraints in obtaining working capital loans (as opposed to loans that specifically finance export transactions) than domestically oriented firms due to their longer cash cycles. Moreover, exporting firms incur higher fixed costs as they enter foreign markets, which also need to be financed. These factors make exporting firms relatively more sensitive to financial shocks than domestic firms, in addition to the pure 'trade finance' channels that we emphasize below. Direct evidence on how important these additional factors were during the trade collapse is sparse.

[26] This is helpful as an analytical construct, but not necessarily a guide to looking for the effects of trade finance disruptions using actual price data. Whether trade finance disruptions show up in factory gate, export prices at the border, import prices at the border, or consumer prices is an open question.

ideally needs instruments that pick up shocks to credit supply. For example, Amiti and Weinstein (2011) and Paravisini et al. both match firms to the banks that supply them with credit, and then use the health of those banks as an instrument for credit use. In all other papers, instruments are not available. These papers instead measure the financial vulnerability of firms/sectors using pre-crisis data, and then examine whether pre-existing financial vulnerability explains differences across firms/sectors during the financial crisis.

Third, changes in demand for output may be correlated with credit disruptions at the firm or sector level. Failing to control for these demand changes would undermine the identification of the causal effect of financial shocks on exports, because demand influences both the level of exports conditional on credit and demand for credit itself. Most papers therefore attempt to control for demand, for example by including proxies for export demand or time-varying fixed effects for sectors, firms, products, or destinations (and interactions thereof). The particular specifications used differ across papers depending on what data is available, and these differences should be kept in mind when comparing results across papers.

With these concerns in mind, we turn to the empirical evidence, grouping the evidence into two broad categories. The first group consists of evidence based on proxies for financial vulnerability. We further subdivide this area into firm-level versus sector-level evidence. The second group consists of evidence using data on individual firms matched to the banks that supply them with credit.

Using firm-level data, Behrens et al., Bricongne et al., and Coulibaly, Sapriza, and Zlate (2011) all find that financial constraints explain some of the decline in production and exports during the trade collapse. Using data on Belgian firms, Behrens et al. find that firms with shorter debt maturities and larger shares of financial debt in total liabilities tended to see larger declines in exports. Bricogne et al. find that French firms subject to tighter credit constraints due to past defaults on creditors experienced larger declines in exports, and that these effects are most pronounced in sectors that are highly dependent on external finance. Examining data on publicly traded firms for six emerging markets in Asia, Coulibaly find that firms with higher working capital requirements, larger amounts of short-term debt, greater external finance dependence, and lower retained earnings experienced larger declines in total sales during the crisis.

Using sector-level data, Chor and Manova (2012) examine how the sector-composition of exports to the United States varies across countries depending on the cost of finance in those source countries.[27] They document that tight financial conditions (i.e., higher interbank

[27]Iacovone and Zavacka (2009) present related results using data from 23 banking crises during the 1980's and 1990's. They find that sectors with high external finance dependence or low asset tangibility tend to see exports fall more than the average sector during a banking crisis.

interest rates) led exports to fall more during the 2008-2009 crisis in sectors with high external finance dependence or low asset tangibility. They further show that countries with tight financial conditions exported less to the United States than countries where financial conditions were looser.

Turning to matched firm-bank data, Paravisini et al. present evidence for exports from Peru during 2008-2009 crisis. They match Peruvian customs records, with information on detailed Harmonized System products exported by individual firms to each destination market, to data on credit obtained by each firm from individual Peruvian banks. They then measure the exposure of each bank to the sudden stop of capital flows to Peru that accompanied the crisis, assuming that banks with a large share of foreign liabilities on their balance sheet were hurt more by the sudden stop. Using this data, they regress firm-product-destination exports on firm-level credit, instrumenting firm-level credit using the health of the banks that lend to each firm.[28] They find that the elasticity of exports to credit is 0.23 for firm-product-destination pairs that are active both before and after the crisis, and that individual firms are less likely to continue exporting during the crisis when credit dries up.[29]

Amiti and Weinstein use matched firm-bank data for Japan during 1987-1999 period and the 2008-2009 crisis. They obtain export data from corporate reports of firms listed on the Japanese stock exchange. They then match these firms with banks, where each firm is linked to the single bank that clears most transactions for the firm (i.e., the firm's 'reference bank'). To measure the health of these banks, Amiti and Weinstein use market-to-book values. In their main specifications, Amiti and Weinstein regress exports of each firm on the market-to-book value of its reference bank.[30] The resulting elasticity suggests that a 10% drop in the reference bank's book-to-market value induces a 1% drop in exports.[31]

We interpret all these results as picking up the effects of the financial crisis that manifest themselves as a supply shock at the firm or sector level. Seen through this lens, we expect to

[28]This specification identifies the elasticity of exports to total credit separately from the elasticity of credit to proxies for bank health. Further, they control for changes in demand using destination-product-time fixed effects, and control for non-random matching between firms and banks using firm-product-destination fixed effects.

[29]In contrast to some of the previous evidence, Paravisini et al. do not find that sectors with high external finance dependence are more sensitive to credit disruptions.

[30]Their main specification uses data from 1987-1999 only, and they report similar but less exhaustive results for 2008-2009. In this regression, they control for industry-time and bank fixed effects. These fixed effects can be interpreted as controls for non-random matching between exports and bank, as well as industry-specific demand changes. These controls are similar to the Paravisini et al. specification, but do not control for destination-based matching between firms and banks or product-destination specific changes in demand as in the Paravisini et al. specification.

[31]Amiti and Weinstein argue that exports decline due to contractions in trade finance provided by the reference bank, not necessarily due to a general supply constraint induced by decreased credit availability. We discuss this point further below.

see declines in *both* production and exports for firms or sectors that face credit constraints. One prominent topic of debate concerns whether the financial crisis caused exports to fall more than production at the firm/sector level.[32] Larger declines in exports than production, controlling for differences in demand at home and abroad, would suggest that exporters faced special problems as a result of the crisis. For example, many pointed to disruptions to international trade finance during the crisis. We therefore turn to examine trade finance in greater detail.

5.2 International Trade Finance

During the financial crisis, research interest in trade finance increased substantially. We therefore open this section by defining terms and reviewing some background material. Broadly, "trade finance" refers to payment arrangements between buyers and sellers of goods. Of course, we focus on the international dimensions of trade finance here, i.e., financing arrangements for cross-border transactions.

There are two main categories of international trade finance.[33] The first category is bank-intermediated trade finance, in which banks facilitate transactions between buyers and sellers.[34] For example, with a letter of credit, banks serve two main functions: the importer's bank guarantees payment and the exporter's bank provides working capital, taking the payment guarantee as collateral. The second category is non-bank trade finance, in which buyers and sellers extend credit to each other. For example, if payments terms are specified as cash-in-advance, then the importer effectively provides finance to the exporter and bears the risk of nonperformance by the exporter.[35] Alternatively, with open account payment terms (which show up as 'trade credit' on the seller's balance sheet), the exporter effectively provides finance to the importer and bears the risk of nonpayment by the importer.

In practice, both bank-intermediated and non-bank trade finance are important. Though data is sparse, the best estimates suggest that 20-40% of international trade is financed via

[32] Aggregate data does not shed much light on this question, because aggregate exports can fall relative to aggregate production for compositional reasons. Even at the firm level, differential changes in demand across markets or compositional effects within multi-product firms could also induce changes in the ratio of exports to production.

[33] See Antrás and Foley (2011) and Schmidt-Eisenlohr (2012) for models that analyze determinants of financing choice. Both papers emphasize that differences in contract enforcement across countries provide incentives to select payment terms that result in enforcement taking place in high enforcement jurisdictions. Letters of credit via banks are attractive when contract enforcement is weak in both the importing and exporting countries.

[34] Olsen (2010) and Ahn (2011) provide models describing the role of banks and letters of credit in international trade finance.

[35] Leibovici and Waugh (2012) propose a macroeconomic model of import demand in which imports must be paid for up front and then are delivered in a subsequent period, which can be though of as cash-in-advance financing.

banks, with the remainder financed via non-bank methods.[36]

With this background, we see two main channels via which the financial crisis impaired trade finance. First, the financial crises severely hobbled the banking system in most countries, which in turn led bank-intermediated trade finance to become more expensive or unavailable all together.[37] Second, the general distress in financial markets and drying up of credit availability, may have led firms to hoard liquidity. In that case, open account or cash-in-advance financing of trade becomes more costly and/or harder to obtain as well. Direct evidence regarding the extent to which these contributed to the trade collapse is sparse. We first review here what direct survey and case study evidence exists on how trade finance difficulties contributed to the trade collapse and then turn to several types of indirect evidence.

Surveys of firms and financial institutions provide the most comprehensive source of data on changes in availability and terms of trade finance during the trade collapse. Drawing on IMF-BAFT surveys of 40 major banks during 2008-2010, Asmundson, Dorsey, Khachatryan, Niculcea, and Saito (2011, p.93) report that "bank-intermediated trade finance largely held up during the crisis." They found that the cost of procuring trade finance rose (relative to bank's cost of capital) and the quantity of trade finance fell.[38] This decline in quantity mostly reflected the decline in trade volumes. In fact, the share of trade supported by bank-intermediated trade finance actually rose during the crisis as exporters shifted from open account to bank-intermediated financing to obtain insurance against nonpayment risk. Moreover, Korinek, Le Cocguic, and Sourdin (2010) report that bank-intermediated trade finance generally declined by less than overall short-term finance during the financial crisis, consistent with the idea that banks view trade finance as safe relative to other forms of short-term lending.

Malouche (2011) reports similar evidence of trade finance stresses from World Bank surveys for firms and banks in 14 developing countries. In those surveys, the primary concern of exporting firms appears to be lack of demand, with trade finance problems playing a

[36]Appendix III in Asmundson et al. (2011a) puts the share of bank-intermediated trade finance at 35-40% based on IMF staff estimates and available surveys of financial institutions. Antràs and Foley (2011) report that 84% of transactions by the U.S. exporter for which they have data are financed on open account or cash-in-advance terms. They also discuss the results of FCIB surveys (`http://fcibglobal.com`) that suggest roughly 75% of trade is financed via non-bank methods. Senechal (2012) puts the share of open-account financing at 80%.

[37]Olsen (2010) emphasizes that small changes in the probability of bank survival can lead to big changes in the ability of banks to guarantee transactions and Ahn (2011) argues that the premium paid for trade finance over regular finance should be counter-cyclical. Both these models then can help explain disruptions in bank-intermediated trade finance during the trade crisis.

[38]Bank surveys by the International Chamber of Commerce from 2010-2012 echo these findings on the decreased quantity and increased prices of bank-intermediated trade finance during the crisis. They also show a rebound in trade finance following the crisis.

secondary role in explaining the drop in exports. Moreover, small and medium sized firms appeared to suffer the most from tightening trade finance conditions, though they also cited lack of export demand as their main concern and did not view trade finance as the binding constraint on exporting.[39]

Overall, these surveys indicate stresses in bank-intermediated trade finance, but markets continued to function. The decline in the overall value of bank-intermediated trade finance outstanding appears to be mostly due to the decline in trade itself, rather than vice-versa. An important caveat to this conclusion is that there were substantial policy measures taken by the G20, multilateral development banks, and national export credit agencies during the crisis to support bank-intermediated trade finance.[40] Further, interest rate cuts by central banks offset some of the increase in margins on trade finance lending. The decline in bank-intermediated trade finance likely would have been more severe in the absence of these measures.

Turning from survey evidence to a case study, Antràs and Foley (2011) have unique data on trade and non-bank financing relationships for a large US exporter of frozen and refrigerated food products that includes the 2008-2009 crisis period. They found that importers who traded on cash-in-advance terms prior to the crisis decreased their imports by more than those that traded on open account terms, consistent with the idea that buyers were liquidity constrained. Further, new importers during the crisis were more likely to trade on cash-in-advance terms than in periods outside the financial crisis, indicating that the exporting firm was concerned about payment defaults. This evidence suggests that trade finance may be important for understanding heterogeneity in responses to the financial crisis across firms or countries.[41]

Pursuing this idea that payment arrangements matter, Coulibaly et al. examine the extent to which open account financing (trade credit) substituted for bank credit during the financial crisis in Asian emerging markets. They point out that trade credit declined by less for financially vulnerable firms (with more short-term debt) during the crisis and that firms that were able to substitute towards trade credit (away from financial credit) experienced smaller declines in sales. These observations both suggest that trade credit may substitute

[39]The access of smaller firms to bank-intermediated finance seems to have been crowded out by larger firms that turned from using international to domestic banks during the crisis. Moreover, even for firms using non-bank finance, they suffered from delayed payments by buyers and shorter payment cycles with suppliers.

[40]See descriptions of policy measures in Asmundson et al., Auboin (2009), or various chapters in Chauffour and Malouche (2011).

[41]For example, cash-in-advance terms are more often adopted for destinations with weak contract enforcement, so these underlying institutional differences across importers may play a role in explaining differential declines in trade across destinations.

for financial credit, at least in part. They also argue that exporters generally are less able to substitute trade credit for financial credit, and that this lower ability to use trade credit is one reason why their sales fell more than comparable domestically oriented firms. This inability to substitute across modes of trade finance could thus partly explain why exporters were hit harder by the financial crisis.[42]

These results all point to trade finance disruptions as part of the explanation for declines in trade. There are also several types of indirect evidence that have used to assess the importance of trade finance. There is some disagreement between various studies regarding whether this indirect evidence supports the view that trade finance disruptions were significant.

The first piece of evidence concerns whether exports fell more than domestic sales (equivalently, more than total production or sales) at the firm level.[43] Amiti and Weinstein show that exports did fall more than domestic sales for Japanese firms served by unhealthy reference banks during the 1990's financial crises in Japan. In contrast, Behrens et al. find that the ratio of exports to total sales or production is stable during the crisis in their sample of Belgian firms.

The second piece of evidence concerns whether exports fell by more to destinations with longer cash cycles or higher risk of nonpayment. For example, exporting to more distant markets or exporting via sea rather than air shipment both lengthen delivery times and hence the length of the cash cycle. Further, exporting to countries with less developed financial markets might increase the risk of default. Consistent with these ideas, Amiti and Weinstein find that shocks to bank health have a larger effect on exports for firms that ship by sea. Further, Berman, De Sousa, Martin, and Mayer (2012) find that exports tend to fall by more to destinations with longer shipping times following banking crises in the destination country (which proxy for increased payment default risk).[44] In contrast, Paravisini et al. do not find that the sensitivity of exports to credit differs across destinations as a function of distance in their Peruvian data. Bricogne et al. also find that the effect of tighter credit constraints on exports does not vary across destinations with distance or financial development of the

[42]Chor and Manova (2011) find that exports in sectors that use trade credit extensively were more resilient to the crisis. These results could indicate that high pre-crisis use of trade credit offered opportunities to substitute trade credit for bank credit during the crisis. They could also be explained by the fact that high use of trade credit is associated with low use of cash-in-advance terms, which Antràs and Foley found to predict declines in trade. Further investigation of these mechanics regarding trade credit is warranted.

[43]Sector level or aggregate evidence is generally not very informative regarding whether trade finance is important, since aggregate changes may be driven by composition effects.

[44]Ahn, Amiti, and Weinstein (2011) and Berman et al. both examine export unit values as well, looking for evidence that firms respond to export supply restrictions or increased risk of nonpayment by raising prices. Both papers find evidence that prices are in fact higher to destinations served by sea (Ahn et al.) or with longer shipping times (Berman et al.).

destination.

5.3 Quantitative Magnitudes

The preponderance of evidence above suggests that financial shocks impaired the ability of firms to export. An important follow-up question is: how much of the overall export decline can be attributed to financial shocks? Based on a variety of estimates, we see a rough consensus emerging that perhaps 15-20% of the fall in trade can be attributed to the financial shock.

Amiti and Weinstein and Paravisini et al. provide the clearest statements on this point. Amiti and Weinstein attribute 20% of the decline in Japanese trade during 2008-2009 to shocks to bank health, while Paravisini et al. put the figure at 15% for Peru.[45] This comfortingly narrow range of 15-20% is prima facie consistent with the previous discussion regarding the role demand in explaining the bulk of the trade collapse.

These figures are broadly consistent with studies that use balance sheet information to infer financial constraints. Behrens et al. argue that about one-third of the decline in Belgian exports is due to the financial shock. Bricogne et al. find that financially constrained firms lowered exports by 20% in response to the financial shock, but that these responses did not affect aggregate French exports. Finally, Chor and Manova examine several counterfactual scenarios for interest rates during the 2008-2009 crisis to gauge the impact of financial constraints. They conservatively estimate that US imports in a typical country and sector would have fallen about 10% more than they actually did if interest rates had remained at their September 2008 peaks throughout the crisis, and about 25% less if interest rates had fallen immediately to their August 2009 levels.[46]

6 Trade Policy

During the early stages of the trade collapse, many worried that the macroeconomic crisis would provoke a repeat of the destructive spiral of protectionism that broke out during the Great Depression. With this backdrop in mind, we review evidence on changes in protection during the crisis in this section. By and large, there was not a significant shift toward

[45] Amiti and Weinstein find that the importance of financial constraints was somewhat larger during the financial crises of the 1990's, accounting for between 20-40% of the decline in exports during that time.

[46] To be clear, we construct this estimate from their finding that US imports would have been 2.5% lower than they actually were if interest rates had stayed high during the crisis and 5.5% less if interest rates had fallen immediately, combined with the fact that U.S. imports contracted by about 23% during October-November 2008. This is clearly a back-of-the-envelope calculation.

protectionism during the trade collapse. We close this section describing several explanations regarding why protectionism may have been muted.

To assess the extent of protectionism, one needs to examine changes in several types of trade policy instruments. First, tariffs are the most prominent trade policy instrument. Though changes in tariffs are restricted by both the World Trade Organization (WTO) and regional trade agreements, many countries have substantial discretion to raise tariffs since their WTO bound rates exceed their applied rates.[47] Second, non-tariff measures – including WTO-legal temporary trade barriers, such as antidumping, safeguards, and countervailing duties – also introduce substantial discretion in trade policy. On top of these well-documented measures, many other measures fall into the category of 'murky protectionism,' defined by Baldwin and Evenett (2009) as "abuses of legitimately-created discretion which are used to discriminate against foreign goods, companies, workers and investors." Examples of murky protectionism include countries using health and safety regulations to keep foreign goods out of the domestic market, bailouts of domestic firms, or 'Buy America' style provisions in government procurement that bias spending toward domestic goods. These types of protectionism are particularly difficult to quantify.

On the tariff front, there is little evidence that applied tariffs systematically increased during the crisis. Kee, Neagu, and Nicita (forthcoming) examine applied most-favored-nation and bilateral tariff schedules for 135 countries during 2008 and 2009, and find that average tariff rates were unchanged or actually fell for 125 of the 135 countries in their sample. Gawande, Hoekman, and Cui (2011) find very few increases in average bilateral tariffs for seven major emerging markets against their major trading partners.

In contrast to tariffs, increases in non-tariff barriers are more prevalent in the data.[48] Using the World Bank's Temporary Trade Barriers Database, Bown (2011) reports that G20 countries increased the number of product lines subject to temporary trade barriers by 25% during 2008-2009. Emerging markets were the most active users of these measures, increasing the number of product lines covered by 40%.

These raw numbers of new temporary trade barriers overstate the extent of protectionism induced by the crisis for at least two reasons. First, these barriers are applied to a relatively small number of categories that account for small shares of total trade. For example, they cover about 5% of HS 6-digit categories and 3% of total imports for the US and 2.5% of HS 6-digit categories and 2.5% of total imports for the EU during 2008-2009. This limited

[47] In the colloquial language of trade policy, this policy space is referred to as 'water in the tariff.' See Foletti, Fugazza, Nicita, and Olarreaga (2011) for summary measures of the extent of tariff policy discretion.

[48] During the crisis, The Global Trade Alert project was established to provide a real time catalog of measures impeding trade. See `http://www.globaltradealert.org/`. See also the World Bank and CEPR volume on temporary trade barriers edited by Chad Bown.

application necessarily limits the aggregate importance of these measures, though they may of course have large effects on particular industries or partners. Second, Bown (2011) emphasizes that the increase in temporary trade barriers in emerging markets during the crisis is largely explained by pre-existing trends. That is, emerging markets were increasing their use of temporary trade barriers prior to the crisis, and they continued to do so during the crisis. This suggests that these measures were not introduced due to the crisis, but rather reflect an underlying shift in the structure of protection over time.

To quantify the importance of changes in trade barriers in explaining the trade collapse, Kee et al. combine data on tariff changes and antidumping duties to compute indexes of aggregate trade restrictiveness for 135 countries during 2008-2009. Consistent with their findings on average tariffs, they find most countries actually continued to liberalize during the crisis even after taking antidumping duties into account. There are some notable exceptions where protection rose, including for some major emerging markets like Brazil and China. But even there, changes typically only amounted to an aggregate tariff-equivalent increase of a few percentage points. Kee et al. conclude that tariff changes and anti-dumping duties accounted for perhaps 2% of the decline in world trade. Given this estimate and the observations regarding other forms of protectionism above, it is difficult to see trade policy as a central protagonist in explaining the trade collapse.

The resilience of the open trading system was a victory for both the political consensus and institutions that underpin the global economy. The fact that there was no strong protectionist response to the crisis begs the question: why was protectionism contained? There are several lines of work that suggest answers, though more work is certainly needed to answer this question.

First, the institutional architecture of international trade – including the WTO and regional preferential agreements – may have served to manage protectionist pressures. For example, the ability of countries to adopt WTO-legal temporary trade barriers may placate the most injured or politically powerful industries, alleviating pressure to adopt more comprehensive or permanent barriers. Moreover, though WTO tariff bindings exceed applied tariffs in many cases, preferential agreements shrink the genuine discretion that countries have in adjusting tariffs after a crisis.[49] More generally, the role of the WTO as a forum for monitoring trade policy and exerting moral suasion in discouraging protectionism is also likely important, though extremely difficult to quantify.

Second, some have argued that the political economy of trade policy has changed with the rise of cross-border foreign direct investment and supply chain fragmentation. For example,

[49]Foletti et al. argue that around 7% of the difference between applied and bound rates is effectively eliminated once one takes preferential agreements into account.

use of imported inputs likely induces firms to lobby for freer trade, offsetting traditional lobbying for import-substituting protection. Gawande et al. present suggestive evidence that vertical specialization in production at the sector level is negatively correlated with the level of tariffs across sectors and changes in tariffs during the 2008-2009 crisis in some important emerging markets (e.g., China).

Third, one way in which the 2008-2009 crisis differed from the Great Depression was that most countries had flexible exchange rates, and hence the ability to respond to the crisis using macroeconomic policy rather than trade policy. Looking at the Depression episode, Eichengreen and Irwin (2010) point out that countries that stayed on the Gold Standard were significantly more protectionist than countries that floated their exchange rates. They argue that countries that stayed on gold resorted to trade policy as a second-best form macro-policy, rather than due to protectionist pressures per se.

Bown and Crowley (2012) provide some evidence that exchange rate flexibility played a role in explaining the muted protectionist response during the 2008-2009 episode.[50] Using pre-crisis data on temporary trade barriers for the US and EU, they show that higher unemployment tends to raise protectionism, while exchange rate depreciations tend to alleviate protectionist pressure. Given these results, we should have seen large increases in protectionism during the crisis, since unemployment rose and the U.S. dollar appreciated sharply in late 2008 and early 2009. However, protectionist policy did not materialize. Bown and Crowley suggest that one reason for this is that currency appreciation was short lived. In fact, the dollar and euro depreciated from mid-2009 onward, relieving protectionist pressures before they could turn into new trade barriers.

7 Conclusion

Our review indicates that there were three main proximate causes and/or propagation mechanisms that account for the collapse of international trade during the 2008-2009 global recession. Compositional effects associated with changes in final expenditure explain most of the magnitude and sectoral pattern of the trade collapse. In addition, shocks to credit supply – affecting both firms' ability to secure working capital and trade finance – played an important secondary role. Inventory adjustments were an amplification mechanism that led imports to decline more than proportionally with respect to final sales. Finally, our reading

[50] They also argue that a switch in the typical behavior of the US and EU in imposing temporary trade barriers was important in explaining the absence of protectionism. Historically, the US and EU tended to impose barriers against slow growing partners. During the global recession, they switched to imposing protection against relatively fast growing countries, and this clearly limited the number of potential targets for protection.

is that trade policy played virtually no role in explaining changes in aggregate trade.

No study has integrated all four explanations into a single coherent framework that would allow one to assign weights to each. This remains an important topic for future work. We can, however, summarize the quantitative results from the research we have reviewed. The research finds that 65-80% percent of the trade collapse can be attributed to compositional effects associated with changes in expenditure. Credit shocks can account for about 15-20% percent of the collapse, and inventory adjustments may responsible for as much as 20% of the collapse. These estimates are obtained from independent papers, each focusing on a particular channel, so they do not necessarily sum to 100%. Nonetheless, the central estimates from each set of papers do in fact come close to adding up to 100%.

One benefit of the trade collapse is that it stimulated work on neglected areas at the intersection of international trade and macroeconomics. Narrowly, one can read individual contributions as focused on understanding the role of particular mechanisms in explaining the collapse. More broadly, the entire literature points the way toward a better understanding of the determinants of import demand and the role of finance in production and exporting. We believe that much has been learned, but this research is still in its early stages and there is ample scope to develop these new insights further. With that in mind, we conclude by highlighting four areas that we believe deserve more work.

First, though existing research examines the role of expenditure changes in the trade collapse, this research takes those changes as given and is silent regarding the underlying sources of those changes. More work explaining the nature of the shocks that drove changes in expenditure would be worthwhile. For example, conventional models imply that spending in one country is linked to spending in all other countries, in that home income depends on foreign spending on imports. Incorporating these demand spillovers would permit one to quantify how shocks were propagated across countries (e.g., from the U.S. to the rest of the world) during the recession. Pushing further, one might also incorporate credit constraints into such a model to examine how financial shocks shaped expenditure changes during the recession, and hence were propagated across countries via real channels.[51]

Second, contemporary commentators on the trade collapse often pointed to 'vertical specialization' or 'global supply chains' as an explanation for the severity of the collapse. Yet, we have not extensively discussed their role in our review. There are two reasons for this. The first reason is that several possible roles for vertical specialization are sub-sets of explanations discussed above. For example, Bems et al. (2011) point out that vertical

[51]Credit constraints may be partly responsible for the large fall in durables expenditure relative to non-durable expenditure. Further, credit constraints also likely contributed to the collapse of investment, which has a high import content.

linkages mechanically amplified the trade collapse because expenditure changes tended to be largest in vertically specialized sectors.[52] Similarly, Kim and Shin (2011) examine the role global supply chains in propagating financial shocks, while Altomonte et al. suggest that inventory adjustment along the supply chain also amplified the collapse.[53] These can all be read as extensions of existing stories, reinterpreted to emphasize the role of global supply chains. The second reason is that there is (as of yet) not enough direct evidence regarding how global supply chains responded to the shock to confidently assign guilt or innocence to them. More empirical work is needed in this area.[54]

Third, we can learn more about the importance of each explanation by carefully studying the trade increase following the trade collapse. As Figure 1 shows, trade rebounded almost as rapidly as it fell. This fact, and a deeper pursuit of related facts, may help discriminate between alternative explanations for the collapse. For example, consider explanations that rely heavily on weakening of vertical specialization, in which foreign suppliers are replaced by domestic suppliers. Because these vertical links take time to break and to re-create, the rapidity of the trade decline and rebound suggests that vertical specialization stories are not that important. Similarly, this evidence may provide further support for our interpretation that changes in trade policies have not played an important role, because policy changes also take time. These thoughts are all speculative, but they do point to the value of studying the rebound data.

Fourth, while recent work highlights the important role of financial frictions in shaping the response of trade to shocks, there is ample room for further work in this area. Given the concerns about trade finance disruptions expressed by policymakers during the trade collapse, one is struck by the paucity of available data on trade finance. Efforts to improve data collection in this area would likely have large benefits. In addition, more effort is needed to study trade financing decisions in the context of more general firm financing decisions. Whereas existing papers focus on one class of financial decisions at a time, we see benefits from analyzing multiple decisions simultaneously. For example, we would like to better understand how firms substitute working capital loans for trade finance (e.g., trade credit)

[52]Consistent with this argument, Johnson and Noguera (2012) find that gross trade fell by more than trade measured in value added terms between 2008 and 2009.

[53]Kim and Shin (2012) suggest that financial shocks are likely to disrupt global supply chains because they require large amounts of credit to finance inventory holdings across stages and delays between initial production stages and eventual payment.

[54]In one relevant study, Alfaro and Chen (2012) highlight a channel via which global supply chains may have attenuated, rather than exacerbated, the collapse. They show that affiliate firms in industries that are upstream from their foreign multinational parents (i.e., vertically linked) fared better than comparable firms with no vertical linkages to multinational parents during the 2008-2009 crisis. They argue this is evidence that input demand on the part of the parent sustains firms in the face of idiosyncratically bad shocks in their home markets.

during crisis, or how firms substitute between bank-intermediated and non-bank forms of trade finance. Recent models of trade finance by Olsen (2010), Ahn (2011), Antrás and Foley (2011), and Schmidt-Eisenlohr (2012) provide a good starting point for this analysis. Better data combined with better models could contribute to better policymaking during the next financial crisis.

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