



# Off the cliff and back? Credit conditions and international trade during the global financial crisis<sup>☆</sup>

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## ABSTRACT

We study the collapse of international trade flows during the global financial crisis using detailed data on monthly US imports. We show that credit conditions were an important channel through which the crisis affected trade volumes, by exploiting the variation in the cost of capital across countries and over time, as well as the variation in financial vulnerability across sectors. Countries with higher interbank rates and thus tighter credit markets exported less to the US during the peak of the crisis. This effect was especially pronounced in sectors that require extensive external financing, have limited access to trade credit, or have few collateralizable assets. Exports of financially vulnerable industries were thus more sensitive to the cost of external capital than exports of less vulnerable industries, and this sensitivity rose during the financial crisis. The quantitative implications of our estimates for trade volumes highlight the large real effects of financial crises and the potential gains from policy intervention.

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## 1. Introduction and motivation

The global financial crisis has had far-reaching repercussions on cross-border economic activity. After a sharp and sudden collapse in international trade in the last quarter of 2008, world trade flows declined by about 12% in 2009 according to the WTO. This exceeded

the estimated loss of 5.4% in world GDP during the same period.<sup>1</sup> The contraction in exports was especially acute for small open economies, several of whom saw their trade volumes in the second half of 2008 fall by up to 30% year-on-year. This trade decline contributed to the spread of recessionary pressures to countries which had little direct exposure to the US subprime mortgage market where the crisis originated. For example, the popular press has provided anecdotal accounts of how manufacturing plants around the world scaled down production and employment in response to limited export opportunities.<sup>2</sup>

Two aspects of the global financial crisis are believed to be behind this large decline in international trade. On the producer side, the credit crunch at the height of the crisis resulted in a severe reduction in the availability of external finance, thus curtailing firms' production and export capacities. On the consumer side, the gloomy economic outlook led to a slowdown in global demand in general, and for imports in particular. The effects of these forces may very well have

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<sup>1</sup> Authors' own calculations, using GDP in current prices from the IMF's World Economic Outlook Database.

<sup>2</sup> See for example Schwartz (2009a,b) in *The New York Times*.

been amplified by disruptions to global production lines, and by inventory adjustments made by importing firms and distributors.

This paper is one of the first to establish the effect that credit conditions had on international trade during the recent global crisis. We examine the evolution of monthly US imports over the November 2006 to October 2009 period, and compare trade patterns before and during the crisis.<sup>3</sup> We identify the impact of credit conditions by exploiting the variation in the cost of external capital across countries and over time, as well as the variation in financial vulnerability across sectors. We find that during the crisis period, countries with higher interbank rates and thus tighter credit availability exported less to the US, relative to countries where interbank rates were lower as a result of more aggressive monetary easing policies. These effects were especially pronounced in sectors that require extensive external financing, have limited access to buyer–supplier trade credit, or have few collateralizable assets.<sup>4</sup> In other words, exports of financially vulnerable industries were more sensitive to the cost of external capital than exports of less vulnerable industries, and this sensitivity rose during the financial crisis. These results are robust to controlling for cross-country differences in initial income (GDP and GDP per capita) and factor endowments, which themselves could influence trade patterns. Moreover, our findings suggest that credit conditions exerted a disproportionately disruptive effect on trade flows beyond their effect on domestic output, as they continue to hold when we control for countries' industrial production index.

Using our estimates, we infer how US imports would have evolved under two alternative scenarios: (1) credit conditions remained tight, with interbank rates fixed at their September 2008 peak levels throughout the crisis period; and (2) credit conditions eased considerably, with interbank rates dropping immediately after September 2008 to their low levels of August 2009. These projections provide rough upper and lower bounds for the crisis-induced damage to trade flows mediated through the credit channel. We conclude that the 2008–2009 crisis would have reduced US imports by 2.5% more and 5.5% less under these respective scenarios, based on specifications in which the effect of credit conditions is estimated off the within-country variation in interbank rates. Estimates from less restrictive specifications that use the full cross-country variation in the cost of capital indicate that these magnitudes could have been much larger. Moreover, credit conditions contributed to large and systematic differences in export performance across sectors at different levels of financial vulnerability. For example, US imports in the most external finance dependent sector would have dropped 13.4% more and 8.2% less than imports in the least dependent sector, under the respective scenarios. Overall, these estimates highlight the large impact of financial market disturbances on the real economy and the scope for policy intervention through the easing of the credit crunch.

Our findings constitute new evidence on the importance of credit and financing for export activities. Access to outside capital matters for both domestic production and exporting because firms often incur substantial upfront costs that cannot be funded out of internal cash flows or retained earnings. Exporting, however, is more reliant on external finance for three reasons. First, it is associated with additional upfront sunk and fixed outlays specific to international trade. These include learning about the profitability of export opportunities;

<sup>3</sup> Based on the developments in global financial markets described in Section 2, we date the crisis period from September 2008 (when credit conditions started unraveling in earnest) to August 2009 (one year after, when conditions had largely calmed down). We discuss the robustness of our results to alternative crisis period dates later below.

<sup>4</sup> We use the term “trade credit” to refer to transactions between a firm and its buyers or suppliers that involve the transfer of goods or services without an advance or immediate transfer of payment funds. On the other hand, we use the term “trade finance” to refer to formal borrowing by firms from banks or other financial institutions to facilitate international trade activities, such as export letters of credit or trade insurance.

making market-specific investments in capacity, product customization, and regulatory compliance; and setting up and maintaining foreign distribution networks. Some variable trade costs, such as shipping and duties, may also have to be incurred before export revenues are realized. Second, exporters' need for working capital is magnified by the fact that cross-border transactions on average take between 30 and 90 days longer to process than domestic sales.<sup>5</sup> Finally, the added risk that is faced in exporting relative to domestic activities necessitates insurance for many international transactions.

These factors have led to a very active credit market for cross-border activities: Up to 90% of world trade reportedly depends on some form of trade finance or insurance, with the total size of this market estimated at about \$10–12 trillion in 2008 (Auboin, 2009). Given these considerations, firms located in countries with cheaper bank credit should in principle be able to produce and export more. Our finding that economies with lower interbank rates systematically exported more to the US is thus a reflection of the liquidity constraints that exporting firms around the world faced during the height of the crisis.

While credit availability is generally important in all industries, our empirical strategy relies on the observation that some sectors are more dependent on the financial system than others for arguably largely technological reasons beyond the control of individual firms. The growth and finance literature has identified several such measurable dimensions that characterize a sector's financial vulnerability. First, production and exporting in some industries are associated with bigger capital expenditures that cannot be serviced internally, and such industries require more external finance (Rajan and Zingales, 1998). Second, in some sectors, firms routinely receive more buyer–supplier trade credit which gives them an alternative to and thus potentially reduces their dependence on bank financing (Fisman and Love, 2003). Finally, industries with more tangible assets such as plant, property and equipment enjoy easier access to outside capital because firms can pledge more collateral (Braun, 2003; Claessens and Laeven, 2003). This is incidentally consistent with anecdotal evidence that many of the firms reporting big losses in output and employment since September 2008 have been in computers and electronics (Sprint, Nokia, Texas Instruments, Philips, Microsoft, Sony, Ericsson), transportation and machinery (Caterpillar, Harley Davidson), and chemical manufacturing and pharmaceuticals (Pfizer).<sup>6</sup> These sectors feature relatively high dependence on external finance, limited access to trade credit, and/or low levels of tangible assets respectively (see Appendix Table 2).

The central result in our paper is that exports in financially vulnerable sectors became particularly sensitive to the cost of credit at the height of the global crisis. This cannot simply be attributed to countries with cheaper external capital having a comparative advantage in financially dependent industries, since this would not explain the intensification of the effect during the crisis. Instead, we offer two potential explanations. First, the crisis period saw US import demand plummet as American households cut consumption spending and American producers scaled down their purchases of intermediate inputs. This reduced the export revenues and profitability of foreign firms selling to the US, making it more difficult for these exporters to raise the necessary funds for their US sales from lenders in their home country. Second, exporting firms can in practice also access trade financing in the destination market or rely on trade credit raised there by the importing party. The availability of such US-based trade financing would have fallen sharply as the crisis unfolded, potentially hampering export flows to the US. The uneven impact of the crisis across countries and sectors can therefore be attributed to the

<sup>5</sup> See Djankov et al. (2010) and the *Doing Business* dataset. It can take up to 30 days in some countries to secure passage of a shipment from the factory to the export dock, and a further 30 days between arrival at the import dock and delivery at the destination warehouse. This does not include the time in shipping transit.

<sup>6</sup> See Healy (2009) and Rampell (2009) in *The New York Times*.

combined effects of tighter credit at home, sectors' varying degree of financial vulnerability, and depressed demand and/or tighter credit in the US. Using data on retail sales and business loans in the US, we find evidence that the sharp drop in US final demand was more decisive in explaining trade patterns during the crisis period than the decline in US loan supply.

The rest of the paper proceeds as follows. Section 2 reviews the related literature. Section 3 describes the collapse in trade flows during the crisis, while Section 4 discusses the data used in our analysis. Section 5 presents our core results on the cross-country, cross-sector impact of credit conditions during the crisis period, while Section 6 examines their effects at the country level. We interpret the economic significance of our findings via the two hypothetical scenarios in Section 7. The last section concludes.

## 2. Related literature

Our results add to an established literature on the role of financial frictions in international trade. A number of theoretical and empirical papers have shown that, in the presence of credit constraints, countries with more developed financial institutions have a comparative advantage in financially vulnerable sectors.<sup>7</sup> While this literature exploits the same cross-sector variation in financial vulnerability as we do, it typically relies on country-level measures of financial development (such as private credit over GDP, accounting standards, or creditor rights protection) that exhibit little or no time-series variation. By contrast, we explore the response of trade flows to short-term fluctuations in the cost of capital using high frequency (monthly) data. We also focus on export patterns before and during a financial crisis, instead of on conditions in steady state.

The global liquidity squeeze has renewed interest in academic and policy circles alike in the effect of credit constraints on export performance at the firm level. There is now ample evidence from micro data demonstrating that more credit-constrained firms indeed display a lower capacity for exporting.<sup>8</sup> For example, Amiti and Weinstein (2009) show that Japanese banks transmitted financial shocks to exporters during the systemic crisis that plagued Japan in the 1990s. Similarly, Bricongne et al. (2010) find that the exports of French firms in more external finance-dependent sectors were more adversely hit during the recent global crisis.

Our paper also falls within a broader research agenda on the impact of banking and financial crises on economic outcomes such as sectoral growth (Kroszner et al., 2007; Dell'Ariccia et al., 2008) or firms' planned R&D, employment, and capital spending (Campello et al., 2010). With regard specifically to the impact on international trade, Iacovone and Zavacka (2009) find that annual export growth rates were hurt more during banking crises in sectors more dependent on external finance and in sectors with fewer tangible assets, but that these effects were mitigated in countries with stronger levels of financial development. Our results further suggest that movements in the cost of capital can have large real effects on trade in the short run even when broader financial institutions remain unchanged.

Finally, our paper contributes to a fast-growing body of work investigating the trade effects of the 2008–2009 crisis. Freund (2009) and Levchenko et al. (2010) document that the decline in world trade has become increasingly pronounced relative to the decline in GDP in recent downturns, especially during the global financial crisis.<sup>9</sup>

<sup>7</sup> See Kletzer and Bardhan (1987), Beck (2002), Matsuyama (2005), Becker and Greenberg (2007), Do and Levchenko (2007), Chaney (2005), Manova (2008a), and Ju and Wei (2008) for theoretical models, and Beck (2002, 2003), Svaleryd and Vlachos (2005), Hur et al. (2006), Becker and Greenberg (2007), and Manova (2008a,b) for empirical evidence.

<sup>8</sup> See for example Greenaway et al. (2007) based on UK data, Muûls (2008) on Belgium, Manova et al. (2011) on China, and Minetti and Zhu (2011) on Italy.

<sup>9</sup> See also Berman and Martin (2010) who detail the impact of the crisis on African countries' exporting prospects.

Several papers have sought to explain this large fall in trade relative to output. Eaton et al. (2010) evaluate the relative contributions of changes in demand vs. changes in trade frictions, using a general equilibrium model of production and trade. While they deduce that the fall in demand was more important, trade frictions nevertheless accounted for a significant fraction of the overall decline in the trade to GDP ratio. Behrens et al. (2010) reach a qualitatively similar conclusion, based on an analysis of Belgian firm-level data.<sup>10</sup> Separately, Alessandria et al. (2010) explore the role of inventory adjustments, while Bems et al. (2010) and Levchenko et al. (2010) emphasize the disruption of global production lines and the reduction in trade in intermediate goods. There has also been work examining whether the decline in trade can be attributed to a rise in protectionist policies (Evenett, 2009; Kee et al., 2010). We view these alternative mechanisms as potentially magnifying the role of credit conditions during the crisis, although we do not explicitly test this in the present paper.

## 3. Preview: The crisis-related decline in US imports

Our primary goal is to track how trade flows reacted to the unfolding global crisis. For this reason, we examine trade data on a monthly basis for the US. These data are readily available from the US Census Bureau website, and are regularly released with a lag of about three months.

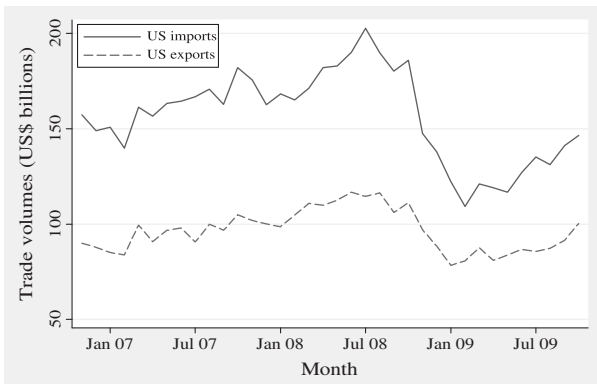
Fig. 1 offers an overview of the main trends in US aggregate trade over the sample period. Trade volumes were recording modest trend growth until mid-2008, when they started contracting severely both in terms of speed and magnitude. US trade flows witnessed a sharp month-on-month decline between October and November 2008, coinciding with the height of the global credit crunch. While nervousness over the exposure of financial institutions to the subprime mortgage market had been building up steadily since the end of 2007, two events in September 2008 – the collapse of Lehman Brothers and the government bailout of AIG – brought credit activity to a virtual standstill.

Several observations regarding the collapse in US trade flows are worth noting. First, the fall in US imports was more precipitous than that in US exports. On a month-on-month basis, US imports contracted 23.1% between October and November 2008, while exports fell 13.6%. This reflects presumably the particularly sharp decline in consumer sentiment and import demand in the US relative to other countries.<sup>11</sup> Second, trade flows in the manufacturing sector (NAICS first digit = 3) mirrored closely this aggregate decline. US manufacturing imports were 19.3% lower in November 2008 compared with the previous month, while the corresponding fall for manufacturing exports was 13.8%.<sup>12</sup> Third, this contraction was very broad-based, as reported in Table 1. Focusing on the import figures, no 3-digit manufacturing industry was spared, with the only difference across industries being one of severity. The worst-hit sector was by far petroleum and coal products where import volumes more than halved during this month. On the other end of the spectrum, food and furniture manufacturing saw the most moderate reductions, but these still registered a more than 5% fall. Finally, although this is not shown in Fig. 1, the drop in trade flows reflects primarily declines in quantities traded as opposed to prices, with one key exception: commodities and related industries (Levchenko

<sup>10</sup> The World Bank has similarly assessed that about 10–15% of the decline in international trade has been driven by the lack of trade financing, with the remaining decline attributable to the collapse in aggregate demand (reported in Auboin, 2009), although these figures appear to be relatively rough estimates. See also McKibbin and Stoeckel (2009) who emphasize the much larger contraction of trade in durables relative to its production during the crisis.

<sup>11</sup> This contrast is even starker when the figures are calculated in year-on-year terms for November 2008: US imports fell 17.5%, while US exports dropped a more moderate 4.9%.

<sup>12</sup> Borchert and Mattoo (2009) document that trade in services was more resilient than trade in manufactured goods during the global financial crisis. They attribute this to the demand for services being less cyclical, and to services production and trade being less dependent on external finance.



Source: US Census Bureau.

Fig. 1. The decline in US trade volumes during the global financial crisis.

et al., 2010; Haddad et al., 2010). Nevertheless, excluding the petroleum and coal sector does not change the overall picture of a sharp drop in trade flows.

This collapse in US exports and imports coincided with a severe contraction in trade financing, a by-product of the overall freeze in lending activity at the height of the crisis. While it is difficult to obtain definitive figures, estimates of the worldwide shortfall in trade finance range from \$25–500 billion for the second half of 2008 (Auboin, 2009; Chauffour and Farole, 2009). Separately, IMF reports have suggested that banks' capacity constraints affected about 6–10% of developing country trade, implying a trade finance gap in the order of \$100–300 billion (IMF-BAFT, 2009).

In terms of the cost of trade financing, all available accounts point to sharply rising interest rates leading up to the last quarter of 2008. For example, an IMF-BAFT (Bankers' Association for Finance and Trade) survey of 44 banks from 23 developed and emerging markets reported a broad-based increase in the price of various trade-related credit instruments between October 2008 and January 2009. While the exact magnitudes vary across countries, there was a near doubling in the spread between banks' cost of funds and the rates on lines of credit or export credit insurance. A similar World Bank survey of firms and banks in 14 developing countries found that the crisis led to a fall in export pre-payments, forcing firms to stretch out their cash flow cycles. While the prices of different credit instruments apparently peaked and started to moderate by the first quarter of 2009, they were still above their pre-crisis levels (Malouche, 2009). These developments prompted many economists and policy-makers to press the case for a coordinated push from country governments to shore up lines of credit (Ellingsen and Vlachos, 2009), as evidenced by the April 2009 G20 Summit commitment to raise \$250 billion for trade finance.

**Table 1**  
The month-on-month fall in US manufacturing imports (Oct–Nov 2008).

A: Industries (NAICS 3-digit) with sharpest declines in imports (top 5)		
324	Petroleum and coal products manufacturing	– 54.0%
315	Apparel manufacturing	– 33.3%
331	Primary metal manufacturing	– 23.7%
316	Leather and allied product manufacturing	– 22.6%
335	Electrical equipment, appliance, and component manufacturing	– 22.3%
B: Industries (NAICS 3-digit) with smallest declines in imports (bottom 5)		
321	Wood product manufacturing	– 12.3%
336	Transportation equipment manufacturing	– 11.8%
326	Plastics and rubber products manufacturing	– 10.1%
311	Food Manufacturing	– 7.3%
337	Furniture and related product manufacturing	– 5.5%

Notes: Calculated from US Census Bureau Data on US imports from the rest of the world.

#### 4. Data description

Since our interest is in understanding how source-country differences in the severity of the credit crunch affected trade performance, we examine US import flows in what follows. We use monthly data for a three-year window, starting in November 2006. It is helpful to have the data start before 2007, as the problems in the US subprime mortgage market were already becoming apparent in the second half of 2007. Our sample ends in October 2009, amid signs of a steady recovery in trade flows (Fig. 1).<sup>13</sup>

We require a measure of credit conditions across countries as our key explanatory variable. In principle, a direct measure of the cost of trade financing, such as the rates charged on export credit lines or insurance, would be ideal. Such data are unfortunately not readily available for a large sample of countries. For example, the IMF and World Bank surveys cited above suffer from limitations in country and time coverage, as well as potential difficulties in the cross-country comparability of the credit instruments for which rates are quoted.

In the absence of systematic information on trade financing costs, we appeal instead to a broader measure of the cost of external finance in the economy. We use the interbank lending rate as a measure of the tightness of prevailing credit conditions in each country over time. These interbank rates are the interest rates that commercial banks charge each other for short-term loans of a pre-set duration (typically: overnight, one month, or three months), which allow banks to adjust their liquidity positions and meet reserve requirements. More generally, the interbank rate has come to be seen as a benchmark for the overall cost of credit in the economy, as other loans such as housing mortgage rates often take their cue from it. During the recent crisis, the interbank rate was a closely-watched indicator that exhibited co-movements with the level of financial stress that the corporate sector was experiencing: Spikes in the interbank rate coincided with a drop in firms' ability to access external capital through the commercial paper market in North America and Europe, while the converse movements were observed as the crisis eased over time (Keogh, 2008; Freilich and McGeev, 2009; Brunnermeier, 2009).<sup>14</sup> To the extent that the interbank rate is a noisy measure of the actual cost of trade financing to exporting firms, it would introduce measurement error and bias our estimation results downwards.

There are two further reasons why we may in fact underestimate the true impact of financial distress on trade flows by using the interbank borrowing rate. First, the lending terms we observe are for contracts that actually took place. Since financial transactions that did not occur would have presumably cleared at higher interest rates, the actual cost of capital for the marginal exporter would likely have been even higher. Second, survey and anecdotal evidence indicate that at the height of the crisis, credit tightening manifested itself in both higher costs of credit and limited availability of external financing, both of which would hamper firms' ability to export. We unfortunately cannot evaluate the impact of credit rationing, given the absence of systematic data on loan quantities across countries and over time. Our results using the interbank rate can thus be seen as providing a lower bound for the combined effect of both margins of credit tightening.

In practice, at any given time, interest rates may differ across individual interbank contracts, depending for example on the perceived credit-worthiness of the borrowing institution. That said,

<sup>13</sup> While the Census Bureau typically posts the trade data within 3 months, it periodically updates past data, presumably as more precise figures become available. Any such revisions are minor, typically not exceeding 1% of the trade value initially reported. We view this as part of the standard noise in our regression models.

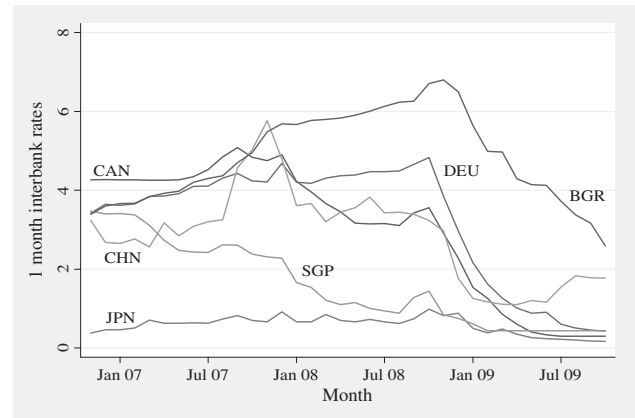
<sup>14</sup> For our purposes, it would naturally be preferable to have a measure of the cost of borrowing such as commercial paper rates that reflects the default risk specific to firms, as opposed to that of banks. Such data are unfortunately not available for a wide set of countries, especially since commercial paper tends to be used as a primary means for firms to raise capital in North America and select European markets.

these rates have historically exhibited a high correlation across lending banks within a country, particularly in developed economies where the banking industry is competitive. In some countries, banking associations and even the central bank will quote a reference rate that reflects prevailing conditions in the interbank market, which then serves as a benchmark for the cost of borrowing in that economy. A well-known example is the London Interbank Offer Rate (LIBOR), which is reported each business day by the British Bankers' Association (BBA). Reflecting this reality, the Thomson Reuters Datastream database which we use can contain more than one interbank rate series for a country, even for loans of the same duration. For each country, we opted first to use a series quoted by the country's central bank. If this was not available, we then turned to rates reported by banking associations or regulatory bodies, such as the BBA, European Banking Federation (EBF), or Financial Markets Association (FMA). In the absence of such sources, we then chose finally to use an interbank rate quoted by a major commercial bank.

For our baseline results, we use the one-month (or thirty-day) interbank rate, to be consistent with the typical duration needed to complete an international trade shipment. Our results are extremely similar when we instead use the three-month (or ninety-day) rate, as the various rates are highly correlated. We average the interbank rate quoted across business days to obtain a monthly measure of the cost of credit in each country. In all, Datastream provides information on interbank rates for a sample of 31 economies. While this may not be a particularly large number of countries, it nevertheless covers most of the US' key trading partners and up to 72% of total US manufacturing imports in 2007.<sup>15</sup> The sample also contains a broad spectrum of countries in terms of levels of economic and financial development, including most of the OECD, several key emerging markets (Romania, Hungary) and some small open economies (Singapore, Hong Kong). We do not view the lack of coverage of developing countries as a major problem, as the interbank rate is likely a poorer indicator of the cost of credit in countries where the banking sector and interbank market are generally less developed.

Fig. 2 and Appendix Table 1 illustrate the evolution of the one-month interbank rate during our sample period. Borrowing rates typically peaked in mid to late 2008 in most major economies. This reflects the rising cost of private credit as banks became extremely averse to lending and preferred instead to shore up their capital positions. Lending rates spiked in September 2008, when Lehman Brothers collapsed and AIG failed. Credit conditions only began easing in November 2008, in response to the broad range of extraordinary monetary policy moves deployed by central banks around the world to bolster liquidity. These successfully lowered the interbank cost of borrowing from a median in our sample of 4.66% (September 2008) to 0.44% (October 2009).

Beneath this broad trend, there are important differences in the time paths of the interbank rate across countries. This reflects differences in the severity and timing of the credit crunch, as well as the extent to which policy interventions were successful at easing credit conditions. In countries such as Germany and Bulgaria, the interbank rate was on a steady upward trend before an abrupt reversal in October and November 2008. In contrast, interbank rates were declining from a much earlier date in Canada and Singapore, where central bankers intervened earlier to cope with the impending downturn. In China, there was a spike in the cost of credit in the latter half of 2007, well before the height of the crisis in the US and Europe. As for Japan, although interbank rates there also crept up during the financial crisis and fell back again as monetary easing commenced in the last quarter of 2008, they were always very low and never climbed above the 1% level. This cross-country variation in the (policy-induced) declines in the cost of credit will be crucial to our empirical



Source: Thomson Datastream.

Fig. 2. Interbank rates during the global financial crisis.

strategy for estimating the importance of credit conditions for international trade.

Our empirical strategy further exploits differences in the sensitivity to credit availability across sectors. We follow closely the prior literature in constructing three such variables of industry financial vulnerability. External finance dependence (*EXTFIN*) is measured as the fraction of total capital expenditure not financed by internal cash flows from operations, and reflects firms' requirements for outside capital (Rajan and Zingales, 1998). Access to (buyer-supplier) trade credit (*TCRED*) is calculated as the ratio of the change in accounts payable over the change in total assets, and indicates how much credit firms receive *in lieu* of having to make upfront or spot payments (Fisman and Love, 2003). In principle, the availability of such trade credit provides a potential substitute to formal trade financing. Note that while *EXTFIN* proxies for firms' long-term needs for external finance, *TCRED* relates to their short-term working capital requirements. Finally, asset tangibility (*TANG*) is constructed as the share of net plant, property and equipment in total book-value assets. This captures firms' ability to pledge collateral in securing external finance (Braun, 2003; Claessens and Laeven, 2003).

To construct each of these variables, we use data on all publicly-traded firms in Compustat North America. We first calculate financial vulnerability at the firm level as an average measure over the 1996–2005 period. This pre-dates the crisis, so that its impact on firm behavior does not contaminate the measures. We then use the median value across firms in each NAICS 3-digit category as the sector measure of *EXTFIN*, *TCRED* and *TANG*, respectively. Appendix Table 2 lists these values and provides some summary statistics for the 21 industries in our data.

These three variables are widely viewed as technologically-determined characteristics of a sector which are innate to the manufacturing process and exogenous from the perspective of an individual firm. This is corroborated by the relative stability of these measures over time and their much greater variation across industries than among firms within a given industry. The value of these sector characteristics may in principle differ across countries, but we construct them using US data. This is motivated by three considerations. First, similar firm-level data are not systematically available for a broad range of countries. Second, the US has one of the most advanced financial systems, recent developments notwithstanding, and the behavior of US firms thus likely reflects an optimal choice over external financing and asset structure. Finally, our empirical strategy requires only that the relative rank ordering of the industries remain stable across countries, even if the precise magnitudes may vary.

As is standard in the literature on trade and finance, the sector measures we use are based on firms' overall financing decisions and asset composition. While they are not available specifically for

<sup>15</sup> The three largest US trade partners by import value that are missing from our sample are Mexico, Israel, and Korea.

activities related to international trade, we argue that they are nevertheless appropriate proxies for three reasons, which we illustrate for the case of external finance dependence. First, firms need to incur the same production costs in manufacturing for the foreign market as in manufacturing for the home country, and these production costs often constitute a large share of the total cost of exporting. Second, products which entail a lot of R&D, marketing research and distribution fixed costs at home plausibly also require similarly large fixed costs for product customization, marketing and distribution in foreign markets. Both of these factors imply that whatever forces a firm in a particular industry to fund its domestic operations with outside finance will also force it to use external capital for its sales abroad. Finally, the empirical measure is based on data for all publicly listed companies in the US. Since these companies are typically large exporters, *EXTFIN* measures their total requirement for external finance, and not just that for their domestic activities. Similar arguments can be made for the sector measures of trade credit intensity and asset tangibility. Ultimately, what is important for identifying the effects of credit conditions on trade flows is the relative rank ordering of sectors in terms of financial vulnerability. As long as this rank ordering is similar for domestic sales and exporting, the sector indicators we use will reflect it.

Appendix A describes all other control variables used in the empirical analysis.

## 5. Effects of credit conditions across countries and sectors

We examine how credit conditions affected trade flows during the global financial crisis in three steps. We first show that countries with higher interbank rates exported relatively less in financially vulnerable sectors, and that this effect intensified during the peak crisis months. Exploiting the variation across countries and sectors in this way allows us to isolate the effect of credit conditions from that of other potential confounding factors. Next, we document that at the country level, a higher interbank rate was indeed associated with lower exports to the US during the crisis period, but not in the months before or after it. Together, these two steps allow us to gauge the magnitude of the effect that credit conditions had on the level and sectoral composition of trade flows.

In this section, we undertake the first of these steps, and study the differential effect of the crisis across exporting countries with varying levels of credit tightness and across sectors with varying levels of financial vulnerability. We explore the three sector characteristics that reflect firms' sensitivity to the cost of external capital: dependence on external finance (*EXTFIN*), access to trade credit (*TCHED*), and endowment of tangible assets (*TANG*). Focusing on one sector measure at a time, for example *EXTFIN*, we estimate the following specification:

$$\ln Y_{ikt} = \beta_1 \text{IBrate}_{it} \times \text{EXTFIN}_k + \beta_2 D_{\text{crisis}} \times \text{IBrate}_{it} \times \text{EXTFIN}_k + D_{it} + D_{kt} + D_{ik} + \epsilon_{ikt} \quad (1)$$

where  $Y_{ikt}$  is the value of US imports from country  $i$  in sector  $k$ , and  $\text{IBrate}_{it}$  is the interbank rate in that exporting country during month  $t$ . We report standard errors clustered by country, to allow for correlated idiosyncratic shocks at the exporter level. Similar results obtain under clustering at the country-industry level instead (available on request).

We define  $D_{\text{crisis}}$  as a binary variable equal to 1 from September 2008 to August 2009, which we refer to as the crisis period. We date the start of this crisis period to a key month (September 2008) marked by several major financial institution failures and bailouts, including Lehman Brothers and AIG, that triggered a sharp escalation in the global credit crunch. On the other hand, trade flows were on a steady recovery path by the second half of 2009. We thus designate August 2009 as the last month for the crisis dummy, one year after its onset. That said, our intention is not to provide a canonical dating for the end

of the crisis; our results are similar if we allow the crisis dummy to stretch to the last month in our sample (October 2009).

The main variables of interest are the double and triple interaction terms. The coefficient on  $\text{IBrate}_{it} \times \text{EXTFIN}_k$  estimates the effect of fluctuations in countries' cost of capital over time on the sectoral composition of their exports. We expect that countries may export relatively less in financially dependent sectors when they experience higher interbank rates, namely  $\beta_1 < 0$ . Given the extensive set of fixed effects used in the regression (see the discussion below),  $\beta_1$  is identified from the variation in financial dependence across industries within a given country-month, the variation in the cost of credit across exporting countries in a given industry-month, and the variation in the cost of credit over time within a given country-sector.

The triple interaction term ( $D_{\text{crisis}} \times \text{IBrate}_{it} \times \text{EXTFIN}_k$ ) in turn tests whether the sensitivity of financially vulnerable sectors to the cost of capital intensified during the crisis period. Equivalently,  $\beta_2$  establishes whether any negative effect of the crisis on exports was not only stronger in countries with tighter credit markets, but also concentrated on the most financially dependent sectors in those countries. We thus anticipate that  $\beta_2 < 0$ . Conceptually,  $\beta_2$  reports the difference between the crisis-driven change in exports of a country with tight credit markets in a financially dependent sector vs. a financially less dependent sector, and compares that to the same difference for a country with lower interbank rates.

Importantly, we condition on an extensive set of fixed effects to guard against omitted variables bias. First, we include industry-month pair fixed effects,  $D_{kt}$ . Among other things, these control for fluctuations in sector-specific import demand in the US, for any time-series variation in the availability of trade financing in the US, and for monthly seasonality in the trade data. Note also that these fixed effects subsume the average effect of the crisis on US bilateral imports (the main effect of  $D_{\text{crisis}}$ ), and any differential effect that the crisis had on sectors at different levels of financial dependence ( $D_{\text{crisis}} \times \text{EXTFIN}_k$ ).<sup>16</sup>

We further control for country-month fixed effects,  $D_{it}$ . These take into account the impact of shocks to aggregate production and credit conditions in each exporting country over time, as well as bilateral exchange rate fluctuations. They also accommodate the possibility that the financial crisis affected exports differentially across countries with varying degrees of credit tightness, which would have entered as  $D_{\text{crisis}} \times \text{IBrate}_{it}$  had country-month fixed effects been excluded.

Finally, we incorporate country-industry fixed effects,  $D_{ik}$ . These account for time-invariant sources of comparative advantage that affect the average pattern of country exports across sectors. In particular, they control for the comparative advantage that countries with lower interbank rates might have in financially dependent sectors *on average*.

It should be emphasized that this estimation approach provides a very stringent test. The set of fixed effects included is exhaustive in that only explanatory variables that simultaneously vary by country, industry and month can be estimated. This significantly allays concerns regarding omitted variables and alternative explanations. Consider, for instance, the possibility that the interbank rate might capture the effect of some other unobserved country characteristic which was the actual driving force behind the impact of the crisis on trade flows. This could rationalize why countries with higher interbank rates may have seen their export levels decline during the crisis (an effect implicitly controlled for with the country-month fixed effects). It could not, however, easily explain why the crisis exerted a

<sup>16</sup> If consumers also need to borrow, sectors' dependence on external capital on the consumption side may in principle be correlated with sectors' dependence on external capital on the production side. The  $D_{kt}$ 's, however, control for US consumer demand by sector and month, including consumers' ability to finance such demand. The triple interaction thus isolates the trade effect of credit conditions on the production side, in the exporting country.

disproportionately large effect on financially vulnerable industries in such countries.

5.1. Core results

The results from estimating Eq. (1) are presented in Table 2. As anticipated, we find that countries with higher interbank rates tend to export relatively less in sectors with a greater requirement for external finance ( $\beta_1 < 0$ ), although this is not precisely estimated (Column 1). Of note, this effect intensified significantly during the crisis period ( $\beta_2 < 0$ , Column 2, significant at the 10% level).

We obtain similar results when considering the variation in sectors' access to trade credit (TCRED). On the one hand, trade credit that is extended by upstream suppliers or downstream buyers in lieu of cash in advance or spot payments can offer firms a substitute for formal bank loans. If one's business partners are willing and able to continue extending trade credit despite developments in the financial sector, this would suggest that industries with greater routine access to trade credit would be more resilient in the face of high costs of trade financing. On the other hand, it is possible that the willingness to extend trade credit may have dried up as a result of the general liquidity crunch. If so, trade credit may have diminished during the crisis period, with a more severe export contraction witnessed in countries with higher interbank rates, where both formal and informal credits would presumably have been hit harder.

The results in Columns 4 and 5 point strongly to the former interpretation. Countries with high interbank rates exported relatively more in sectors with greater access to trade credit, and this effect became more pronounced during the crisis period ( $\beta_2 > 0$ , significant at the 1% level). This result is not inconsistent with the anecdotal evidence of a collapse in overall financing during the crisis for two reasons. First, our measure of TCRED is based on firms' use of trade credit in 1996–2005, before the crisis began. Second, and more importantly, our identification relies on the technologically-determined variation in this measure across sectors. Fisman and Love (2003) have shown that the relative ranking of sectors is similar when TCRED is computed using firm-level data from different decades. This suggests that the ranking of sectors by TCRED would likely remain stable even when the level of total trade credit available, and presumably that available in each sector, drops.

Finally, we consider sectors' endowment of tangible assets (TANG) as an inverse proxy for financial vulnerability. Since industries characterized with more hard assets can in principle offer greater collateral to secure a loan, such sectors should be less sensitive to adverse credit conditions. We thus expect the signs of the coefficients to be reversed compared to the results obtained with EXTFIN. Indeed,

we find that countries with higher interbank rates posted a better export performance in sectors intensive in tangible assets (Column 7). Moreover, this comparative advantage was markedly stronger during the financial crisis (Column 8,  $\beta_2 > 0$ , significant at the 1% level).

Note that our results are consistent with Levchenko et al. (2010), who find weaker evidence for the role of trade credit in explaining sector-level trade flows during the crisis. Their analysis focuses on the cross-industry variation in access to trade credit. By contrast, we exploit both this cross-industry variation, as well as the cross-country variation in the cost of formal bank financing to uncover the role of TCRED. In addition, while they examine the annual change in trade between the second quarter of 2008 and the second quarter of 2009, we analyze the substantial movements in export patterns and credit conditions at the monthly frequency. Our findings thus suggest that the differential response of trade flows across countries and sectors, as well as the rapid unfolding of the crisis, are important factors for identifying the effects of credit conditions on cross-border activity.

5.2. Sensitivity analysis

While the extensive set of fixed effects in Eq. (1) go a long way towards mitigating concerns about omitted variables, we nevertheless perform a series of robustness tests.

We first confirm that our results are not driven by cross-country differences in factor endowments which may affect the pattern of export specialization. Specifically, we interact countries' initial physical and human capital per worker ( $\log(K/L)_i$  and  $\log(H/L)_i$ ) respectively with measures of industry factor intensities ( $\log(k/l)_k$  and  $\log(h/l)_k$ ), as well as with the crisis dummy. This is in the spirit of Romalis (2004), who finds that skill-abundant countries tend to export more in skill-intensive industries (likewise with physical capital). The only difference here is that we allow the strength of such factor-endowment motives for trade to change during the crisis. Since the double interaction terms between country endowments and industry factor intensities are subsumed by the country-industry fixed effects, we control only for the triple interaction terms,  $D_{crisis} \times \log(K/L)_i \times \log(k/l)_k$  and  $D_{crisis} \times \log(H/L)_i \times \log(h/l)_k$ .

We also allow for the possibility that our measure of the cost of capital, *IBrate*, may be correlated with and thus picking up the effect of country size or overall level of development. To do so, we include the triple interactions of an initial measure of country GDP with  $D_{crisis}$  and a full set of industry fixed effects. We also condition on a similar set of triple interactions based on initial country GDP per capita. (Once again, the double interactions of initial GDP and GDP per capita with industry fixed effects are subsumed by the  $D_{ik}$ 's.)

Table 2  
Effects of the crisis on trade across countries and sectors.

Crisis = 1: Sep 08 to Aug 09 Fin vulnerability measure:	Dependent variable: log (industry exports to the US)								
	EXTFIN			TCRED			TANG		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>IBrate</i> × Fin Vuln	−0.006 [0.005]	−0.001 [0.003]	0.000 [0.003]	0.565* [0.293]	0.281 [0.275]	0.288 [0.311]	0.152* [0.081]	0.120 [0.092]	0.137 [0.109]
<i>Crisis</i> × <i>IBrate</i> × Fin Vuln		−0.007* [0.004]	−0.009** [0.004]		0.495*** [0.109]	0.587*** [0.174]		0.057*** [0.017]	0.057 [0.041]
Factor endowment controls	No	No	Yes	No	No	Yes	No	No	Yes
Initial size and income controls	No	No	Yes	No	No	Yes	No	No	Yes
Cty-Ind, Cty-Mth, Ind-Mth fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	22,901	22,901	20,208	22,901	22,901	20,208	22,901	22,901	20,208
R-squared	0.964	0.964	0.965	0.964	0.964	0.965	0.964	0.964	0.965

Notes: Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. The dependent variable is log monthly exports to the US in 3-digit NAICS manufacturing industries, covering Nov 06 to Oct 09. All specifications include country-industry, country-month, and industry-month fixed effects. The Crisis variable is an indicator equal to 1 from Sep 08 to Aug 09. The financial vulnerability measure in Columns (1)–(3) is EXTFIN, that in Columns (4)–(6) is TCRED, and that in Columns (7)–(9) is TANG. For each financial vulnerability measure, the first two columns are lean specifications containing no auxiliary controls. The third column includes factor endowment controls ( $Crisis \times \log(K/L) \times \log(k/l)$  and  $Crisis \times \log(H/L) \times \log(h/l)$ ), as well as country size and income controls ( $Crisis \times \log(GDP) \times$  industry fixed effects and  $Crisis \times \log(GDPpc) \times$  industry fixed effects).

**Table 3**  
Robustness I: country sample.

Crisis = 1: Sep 08 to Aug 09 Fin vulnerability measure:	Dependent variable: log (industry exports to the US)								
	EXTFIN			TCRED			TANG		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	EU cluster	Less TUR	Less JPN	EU cluster	Less TUR	Less JPN	EU cluster	Less TUR	Less JPN
<i>I</i> Brate × Fin Vuln	0.000 [0.003]	0.004 [0.003]	−0.000 [0.003]	0.288 [0.314]	0.300 [0.527]	0.472 [0.339]	0.137 [0.109]	0.048 [0.148]	0.142 [0.118]
<i>Crisis</i> × <i>I</i> Brate × Fin Vuln	<b>−0.009**</b> [0.004]	<b>−0.014*</b> [0.007]	<b>−0.009**</b> [0.004]	<b>0.587***</b> [0.138]	<b>0.675**</b> [0.260]	<b>0.541***</b> [0.161]	<b>0.057</b> [0.037]	<b>0.132**</b> [0.050]	<b>0.059</b> [0.041]
Factor endowment controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Initial size and income controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cty-Ind, Cty-Mth, Ind-Mth fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,208	19,461	19,452	20,208	19,461	19,452	20,208	19,461	19,452
R-squared	0.965	0.966	0.964	0.965	0.966	0.964	0.965	0.966	0.964

Notes: See notes to Table 2. Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. For each financial vulnerability measure, the first column treats the Euro zone countries as a group when clustering the standard errors, while the second and third columns drop Turkey and Japan respectively. All columns include the factor endowment controls, as well as the country size and income controls.

Even with these controls for the role of country endowments, size and income, our main findings on the importance of credit conditions continue to hold. The triple interaction coefficients for *EXTFIN* and *TCRED* remain highly significant in Columns 3 and 6 (Table 2). While that for *TANG* is no longer statistically significant in Column 9, its point estimate retains the same sign and magnitude. In the tables that follow, we will report specifications that include this extended set of factor endowment, country size and income controls; the results are similar if these auxiliary controls are taken out.

Our findings are also robust to accounting for a number of particularities of our country sample, as shown in Table 3. Columns 1, 4 and 7 report results treating the Euro-zone member countries as one cluster when computing the robust standard errors, for each of the three sector measures of financial vulnerability respectively. This helps to address the concern that interbank rates in the Euro zone track each other very closely because of the common monetary policy regime, so that the interbank rate observations from individual Euro-zone countries cannot be regarded as strictly independent. Reassuringly, our findings are unaffected by this correction. Columns 2, 5 and 8 confirm the stability of our results to removing the country with the highest interbank rates in the sample (Turkey). Columns 3, 6 and 9 likewise show that there is no substantial change when we exclude the economy with the lowest interbank rates (Japan), which also exhibits the smallest movements in *I*Brate over the sample period. In unreported regressions, we have further found that our conclusions hold when we drop the petroleum and coal products industry, this being the key sector for which price changes contributed more to the decline in US imports than quantity adjustments.

Our results also obtain under different assumptions about the timing of the crisis period and with alternative interbank rate measures (Table 4). Under each financial vulnerability measure, the first column dates the start of the crisis to March 2008, the month of the Bear Stearns collapse, instead of September 2008. The second column lags the interbank rate by one month to account for the possibility that firms need to borrow in advance of the export delivery date. Finally, the third column uses the three-month instead of the one-month interbank rate. Our findings hold in all of these specifications with estimates of comparable magnitudes and levels of statistical significance, with the exception of the coefficients for *TANG* which are less precisely estimated.

To summarize, countries with higher interbank rates and hence worse credit conditions recorded lower exports in financially vulnerable sectors, and this effect was more pronounced at the height of the crisis. Recall that over the course of the crisis period, interbank rates were generally decreasing as policies to ease the credit crunch took effect. Our findings thus highlight the contrast in cross-sector export performance that arose from the variation in the extent to which policies succeeded in lowering interbank rates in different countries. Note also that our results are particularly strong for *TCRED* in both quantitative and qualitative terms. This suggests that at the short-run monthly frequency, firms' access to trade credit matters more for the sensitivity of their exports to credit conditions relative to firms' long-term external capital requirements and their availability of collateral. This is corroborated by Appendix Table 3, which reports joint tests including interactions with all three sector measures of financial vulnerability in the same regression. The signs and magnitudes of the point estimates obtained are similar to those in Table 2. However, while the coefficients for *TCRED*

**Table 4**  
Robustness II: crisis date and interbank rate measures.

Crisis = 1: Sep 08 to Aug 09 Fin vulnerability measure:	Dependent variable: log (industry exports to the US)								
	EXTFIN			TCRED			TANG		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Mar 08	Lag <i>I</i> Brate	3 month <i>I</i> Brate	Mar 08	Lag <i>I</i> Brate	3 month <i>I</i> Brate	Mar 08	Lag <i>I</i> Brate	3 month <i>I</i> Brate
<i>I</i> Brate × Fin Vuln	0.000 [0.005]	−0.002 [0.004]	0.001 [0.003]	0.258 [0.279]	0.328 [0.331]	0.336 [0.310]	0.138 [0.097]	0.148 [0.104]	0.149 [0.103]
<i>Crisis</i> × <i>I</i> Brate × Fin Vuln	<b>−0.009**</b> [0.004]	<b>−0.009**</b> [0.004]	<b>−0.009**</b> [0.004]	<b>0.471*</b> [0.254]	<b>0.517***</b> [0.158]	<b>0.599***</b> [0.168]	<b>0.036</b> [0.047]	<b>0.040</b> [0.039]	<b>0.058</b> [0.040]
Factor endowment controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Initial size and income controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cty-Ind, Cty-Mth, Ind-Mth fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,208	20,208	20,208	20,208	20,208	20,208	20,208	20,208	20,208
R-squared	0.965	0.965	0.965	0.965	0.965	0.965	0.965	0.965	0.965

Notes: See notes to Table 2. Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. For each financial vulnerability measure, the first column dates the start of the crisis to March 2008, the second column uses the lag of the one-month *I*Brate, and the third column uses the three-month *I*Brate. All columns include the factor endowment controls, as well as the country size and income controls.



remain statistically significant, those for *EXTFIN* and *TANG* report larger standard errors. This likely reflects the fact that the coefficients are identified from the variation in three sector characteristics across a relatively small number of 21 industries.

In results available in a previous working paper version, we have also found that higher pre-crisis levels of financial development mitigated the adverse effects of the crisis. In particular, the exports of countries with stronger initial financial institutions (as measured by private credit as a share of GDP) were more resilient to the crisis in financially vulnerable sectors. It thus appears that both long-term institutional features of the financial system, as well as short-term fluctuations in the cost of capital, did influence the trade impact of the financial crisis.

5.3. An illustration of the short-run effects of credit conditions

Our main estimating Eq. (1) assumes that the crisis resulted in a one-time stepwise change in trade patterns. To illustrate how the effect of credit conditions on trade flows evolved as the financial crisis unfolded, we next relax this assumption and employ a more flexible regression specification:

$$\ln Y_{ikt} = \sum_{m=1}^M \beta_m D_m \times \text{IBrate}_{it} \times \text{EXTFIN}_k + D_{it} + D_{kt} + D_{ik} + \epsilon_{ikt}. \quad (2)$$

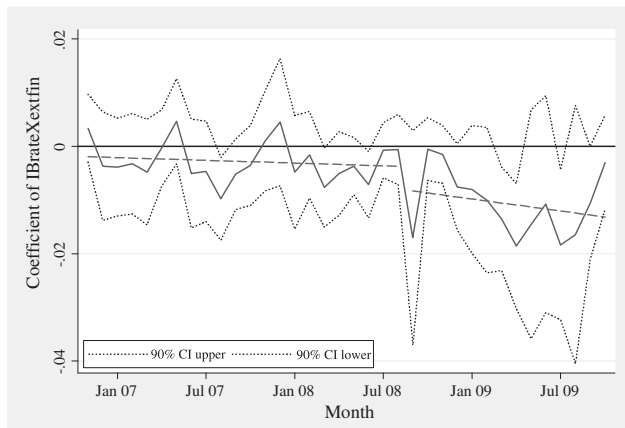
This allows the effect of credit conditions on the composition of exports to vary non-linearly over time, by using a full set of month dummies,  $D_m$  (equal to 1 in month  $m$ ) instead of the crisis indicator, and interacting each  $D_m$  with the product of the interbank rate in country  $i$  in month  $t$  and the external finance dependence of industry  $k$ . The  $D_{it}$ ,  $D_{kt}$  and  $D_{ik}$  are country-month, industry-month, and country-industry fixed effects as before.

We plot the  $\beta_m$  coefficients estimated from Eq. (2) against time in Fig. 3A. Fig. 3B and C present similar graphs from using *TCRED* and *TANG* respectively. In each figure, the dotted lines indicate the 90% confidence intervals of each  $\beta_m$  coefficient. Two linear regression trend lines for the  $\beta_m$ 's are also shown, for the pre- and post-September 2008 periods.

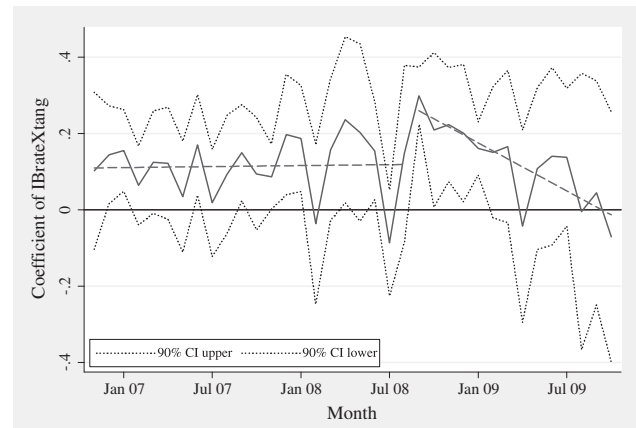
Two patterns stand out. First, despite some month-to-month volatility, the coefficients on the interactions with *EXTFIN* are almost always negative, while those with *TCRED* and *TANG* are almost always positive. This reinforces our earlier conclusion that countries with higher interbank rates export systematically less in financially vulnerable sectors that require more external finance, enjoy less access to trade credit, or have few collateralizable assets.

Second, all three figures clearly indicate that the importance of credit conditions for the composition of exports increased dramatically as the crisis deepened. There is a pronounced break right around September 2008, the month we use as the start date for  $D_{crisis}$  in our

A *IBrate* X *EXTFIN*



C *IBrate* X *TANG*



B *IBrate* X *TCREDIT*

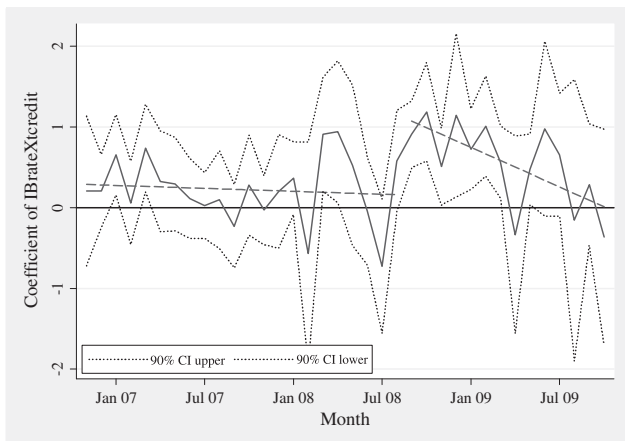


Fig. 3. The Importance of credit channels of comparative advantage over time.

Notes: The month-varying  $\beta_m$  coefficients of *IBrate* × *Fin Vuln* are obtained by estimating Eq. (2), as described in Section 5.3. The *Fin Vuln* measure in Panel A is *EXTFIN*, while that used in Panels B and C is *TCREDIT* and *TANG* respectively. In each panel, the dotted lines indicate the bounds of the 90% confidence interval of each  $\beta_m$  coefficient. Two linear trend lines for the  $\beta_m$ 's are plotted, one for pre-September 2008 and a second for September 2008 and after. A horizontal line at 0 is included.

**Table 5**  
Components of the cost of capital.

Crisis = 1: Sep 08 to Aug 09 Fin vulnerability measure:	Dependent variable: log (industry exports to the US)					
	<i>EXTFIN</i>		<i>TCRED</i>		<i>TANG</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
Cost of capital measure:	TBill rate	IB spread	TBill rate	IB spread	TBill rate	IB spread
IB component × Fin Vuln	0.003 [0.004]	0.008 [0.007]	0.036 [0.100]	0.068 [0.145]	0.038 [0.408]	1.176 [0.819]
<i>Crisis</i> × IB component × Fin Vuln	<b>−0.016*</b> [0.008]	<b>−0.010</b> [0.009]	<b>0.161**</b> [0.066]	<b>0.124</b> [0.143]	<b>0.919***</b> [0.305]	<b>0.527</b> [1.250]
Factor endowment controls	Yes	Yes	Yes	Yes	Yes	Yes
Initial size and income controls	Yes	Yes	Yes	Yes	Yes	Yes
Cty-Ind, Cty-Mth, Ind-Mth fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,649	13,649	13,649	13,649	13,649	13,649
R-squared	0.970	0.970	0.971	0.970	0.971	0.970

Notes: See notes to Table 2. Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. For each financial vulnerability measure, the first column uses the 3-month local treasury bill rate as the cost of capital measure, while the second column uses the local IB spread (*IBrate* less the 3-month local treasury bill rate). All columns include the factor endowment controls, as well as the country size and income controls.

earlier analysis. This is consistent with the core results from the more parsimonious specification in Eq. (1).

Fig. 3 naturally raises the question whether the severe and rapid crisis of 2008–2009 will have long-lasting consequences for trade patterns. Put simply, will the global economy transition to a new steady state in which trade finance becomes a more important determinant of export patterns? Or will the relevance of credit conditions for trade ease off once this crisis is decisively behind us? Fig. 3 suggests that *EXTFIN* became progressively more important for the sectoral composition of trade as the crisis unfolded, but also that *TCRED* and *TANG* became less salient over time. Based on this, we cannot conclusively determine whether the crisis has permanently raised the importance of credit channels of comparative advantage, and a complete verdict will have to await the availability of more data.

#### 5.4. Decomposing the interbank rate

While we have so far been using the interbank rate as a proxy for the cost of capital, this can in turn be written as the sum of two components: (i) a baseline short-term lending rate, such as the rate on three-month treasury bills; and (ii) the spread between the interbank rate and this baseline rate. Conceptually, the former reflects the baseline risk of systemic default in the financial system. On the other hand, the spread captures the premium required to additionally compensate lenders for the risk of default that is specific to interbank loans, and by extension to the commercial banking system. The finance literature has often measured credit conditions with this interbank spread, as it has historically widened when the perceived risk of bank default increased during periods of adverse credit or banking conditions.

In our benchmark analysis, we have used the interbank rate rather than the spread as the former in principle captures the total cost of capital that exporting firms have to incur. Moreover, to the extent that the countries in our sample are well-integrated financially, creditors around the world would presumably have access to the same baseline sovereign debt instrument, namely US treasuries. The spread would then be equal to the local interbank rate less that paid on three-month US treasury bills, otherwise known as the TED spread.<sup>17</sup> But since the US treasury bill rate does not differ across exporting countries, its effect would already be fully absorbed in the estimation of Eq. (1) by the industry-month dummies. Given these fixed effects, we would in fact not be able to empirically disentangle the role of the interbank rate from that of the spread.

<sup>17</sup> A commonly quoted TED spread is the London interbank offer rate (LIBOR) less the rate on three-month US treasuries.

Notwithstanding these considerations, if borrowers in some countries lack ready access to US sovereign debt instruments, then the relevant spread measure should arguably be calculated using a local treasury bill rate. In this case, we can check which component of the overall cost of capital, namely the baseline treasury rate or the interbank spread, drives our baseline results. To this end, we use data on local three-month treasury bill rates from the IMF's International Financial Statistics, supplemented with information for missing countries from Global Financial Data.<sup>18</sup> In all, data on local treasury rates are available for 21 out of the 31 countries in our sample. This incomplete country coverage is an important caveat to consider when interpreting our results here, as it may reduce the precision of our estimates.

Table 5 presents the results from re-estimating Eq. (1) using either local treasury bill rates or the spread between countries' interbank and treasury bill rates in place of our key *IBrate* explanatory variable. For each sector measure of financial vulnerability, we consistently find statistically significant effects that enter with the right predicted sign when using the baseline treasury bill rate (Columns 1, 3, 5). By contrast, the coefficients for the interbank spread are always imprecisely estimated (Columns 2, 4, 6). Together, these results indicate that changes in the baseline risk of systemic default were more important for the decline in trade flows than risks captured specifically by the interbank spread.

These findings are not surprising upon closer inspection of the time series correlation between the interbank rate, the local three-month treasury rate and the interbank spread. The raw correlation between the interbank rate and the local treasury bill rate in the panel is 0.98, while that between *IBrate* and the spread is a much smaller 0.18. For the mean country in our sample, the former correlation is 0.93 in the time series, with a tight standard deviation of 0.07 across countries. By contrast, the time-series correlation between the interbank rate and the spread is 0.24 for the average economy, and varies from  $-0.26$  to  $0.62$ .<sup>19</sup> The much tighter correlation between *IBrate* and the treasury rate indicates that the overall cost of capital was driven more by the baseline risk of default during this recent crisis. Our analysis would have missed out an important component of the cost of credit had we focused instead on the spread as a proxy for credit conditions.

<sup>18</sup> We took care to exclude countries in the IMF International Financial Statistics for which the reported treasury rates were not explicitly for a three-month maturity. For the Global Financial Data, we took the average of daily closing rates to calculate a monthly measure.

<sup>19</sup> The correlation between the three-month treasury rate and the interbank spread was even lower, varying from  $-0.78$  to  $0.26$  and averaging  $-0.05$  across the countries.

**Table 6**  
Effects on trade vs. production.

Crisis = 1: Sep 08 to Aug 09 Fin vulnerability measure:	Dependent variable: log (industry exports to the US)					
	<i>EXTFIN</i>		<i>TCRED</i>		<i>TANG</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>IBrate</i> × Fin Vuln	−0.002 [0.003]	−0.001 [0.003]	−0.105 [0.288]	−0.149 [0.286]	0.069 [0.104]	0.080 [0.122]
<i>Crisis</i> × <i>IBrate</i> × Fin Vuln	<b>−0.007</b> [0.004]	<b>−0.006</b> [0.005]	<b>0.557***</b> [0.173]	<b>0.706**</b> [0.288]	<b>0.064**</b> [0.029]	<b>0.059</b> [0.049]
Factor endowment controls	No	Yes	No	Yes	No	Yes
Initial size and income controls	No	Yes	No	Yes	No	Yes
IPI controls	Yes	Yes	Yes	Yes	Yes	Yes
Cty-Ind, Cty-Mth, Ind-Mth fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,695	15,758	17,695	15,758	17,695	15,758
R-squared	0.963	0.965	0.963	0.965	0.963	0.965

Notes: See notes to Table 2. Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. For each financial vulnerability measure, the first column contains no auxiliary controls, whereas the second column includes the factor endowment controls, and the country size and income controls. All columns control for log(Industrial Production Index) × industry FEs and *Crisis* × log(Industrial Production Index) × industry FEs.

### 5.5. Effects on trade vs. production

Our primary interest has been in the effect of the financial crisis on trade flows via the credit channel. It is nevertheless useful to ask whether this effect holds over and above that on domestic output. To the extent that both domestic producers and exporters incur the same costs in developing and manufacturing a product, they may be equally hurt by credit conditions. But exporters may be affected more because of the additional costs they bear that are specific to production for and shipping to foreign markets.

To explore this issue, we would ideally like to control on the right-hand side of Eq. (1) for each exporting country's sector-level industrial production at the monthly frequency. Such data are unfortunately not available for a large number of economies. Instead, we control for the monthly log industrial production index (IPI) in each sending country interacted with a full set of industry fixed effects. We also include the corresponding triple interactions with the crisis dummy. In this way, we account as best we can for the overall effect of aggregate production on trade flows, while allowing the strength of this effect to vary freely across sectors, as well as during the crisis period. There are however two limitations to this approach: First, output fluctuations across different industries need not be proportional to those in aggregate production. Second, the IPI is not available for all the countries in our sample, so we face the potential problem of a loss of precision once again.

Bearing in mind these caveats, Table 6 does suggest that credit conditions had more severe repercussions for international trade than for domestic output. While the point estimates for *EXTFIN* and *TANG* remain largely unchanged, they are now less precisely estimated. The findings for *TCRED*, on the other hand, remain statistically and economically significant. This suggests that rising costs of capital had a larger effect on the pattern of trade than on the pattern of production, a conclusion which dovetails with the larger decline in trade flows relative to GDP reported in Freund (2009) and Levchenko et al. (2010). It is also consistent with the firm-level evidence in Amity and Weinstein (2009) and Bricongne et al. (2010) that financial crises distort cross-border activity more than domestic transactions. In the same spirit but using country-level data for economies in steady state, Manova (2008b) finds that financial development allows countries to export relatively more in financially dependent sectors even controlling for domestic output by sector.

### 5.6. Teasing out the mechanisms

What might explain the intensification of credit channels of comparative advantage during the crisis period? Recall from Fig. 2 that the time path of interbank rates exhibits a fair amount of variation across countries, so that *IBrate* is not collinear with the crisis dummy,

$D_{crisis}$ . Our results therefore cannot be attributed simply to a non-linear effect of the cost of capital on export performance. We consider instead two potential explanations why countries with higher interbank rates may have experienced larger falls in their exports during the crisis, especially in financially vulnerable sectors.

First, the crisis period was marked by a sharp decline in the demand for imported final goods as households took a hit in their real estate and financial asset values. The prospect of job insecurity also dampened consumer sentiment. Producers in turn scaled down their output plans, prompting a reduction in the demand for imported intermediate inputs. While non-durable goods and services may have been more resilient, demand for imported manufactures as a whole collapsed. The anticipated decline in US market sales would have made it more difficult for foreign firms to raise trade financing to cover their fixed upfront costs, given that these firms would require sufficiently large export revenues to guarantee lenders a high enough expected return. Faced with tighter credit conditions, both the number of firms exporting from each country to the US, as well as the value of each firm's exports would contract in response to a sharp decline in US demand. This contraction would be amplified in countries with high interbank rates, and felt most acutely in financially vulnerable sectors.<sup>20</sup>

An alternative explanation recognizes that exporting firms may access trade financing not only in their home country, but also in their destination market. Exporters may directly obtain bank loans in the destination country, or receive trade credit that its import partner firm raises in its local market. It is thus possible that US imports fell because exporters found it more difficult to secure financing in the US during the crisis period. If exporters indeed depend on US credit markets, then adverse credit conditions in the US would be particularly burdensome on firms based in countries where external credit is limited, especially those firms engaged in financially vulnerable sectors. This interpretation raises the possibility that financial turmoil in one country can amplify the effect of credit tightening in its trade partners.<sup>21</sup>

To explore these two explanations, we re-estimate Eq. (1) using proxies for US final goods demand and US credit supply conditions in place of the crisis dummy,  $D_{crisis}$ . We use monthly data on log retail sales in the US from the US Census Bureau to measure movements in final goods demand. As an indicator of the availability of external finance in the US, we take the log value of US business and commercial loans extended by financial institutions in each month, from Federal Reserve releases. Since we expect higher demand or credit supply

<sup>20</sup> This logic can be formalized using a model with credit constraints and firm heterogeneity, as in Manova (2008a).

<sup>21</sup> This is consistent with the theory and evidence in Manova (2008a), Antràs et al. (2009) and Manova et al. (2011) that foreign portfolio flows and foreign direct investment can compensate for underdeveloped domestic financial markets.

**Table 7**  
Final goods demand vs. credit supply conditions in the destination market.

Crisis = 1: Sep 08 to Aug 09 Fin vulnerability measure:	Dependent variable: log (industry exports to the US)								
	EXTFIN			TCRED			TANG		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crisis measure:	US retail	US loans	Joint test	US retail	US loans	Joint test	US retail	US loans	Joint test
<i>IBrate</i> × Fin Vuln	−1.439** [0.683]	0.143* [0.072]	−1.203 [0.791]	73.515* [41.351]	−1.098 [1.733]	53.442 [62.033]	−1.258 [7.548]	−9.577 [12.211]	−4.802 [7.898]
Log (US retail) × <i>IBrate</i> × Fin Vuln	0.073** [0.035]		0.066* [0.038]	−3.726* [2.102]		−3.081 [2.652]	0.073 [0.383]		0.182 [0.376]
Log (US loans) × <i>IBrate</i> × Fin Vuln		−0.020** [0.010]	−0.012 [0.010]		0.173 [0.236]	1.024 [1.879]		1.392 [1.692]	0.192 [0.240]
Factor endowment controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Initial size and income controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cty-Ind, Cty-Mth, Ind-Mth fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,208	20,208	20,208	20,208	20,208	20,208	20,208	20,208	20,208
R-squared	0.965	0.965	0.965	0.965	0.965	0.965	0.965	0.965	0.965

Notes: See notes to Table 2. Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. For each financial vulnerability measure, the table explores how final demand proxied by Log (US retail sales) or credit supply proxied by Log (US business loans) interact with credit conditions in the exporting country and financial vulnerability of the industry in explaining exports to the US. All columns include the factor endowment controls, as well as the country size and income controls.

levels in the US to mitigate the effects of adverse credit conditions in exporting countries, we anticipate the triple interactions with these variables to both enter with the opposite sign to those with  $D_{crisis}$ . Finding significant coefficients for the interactions with retail sales or business loans would then provide support for one or both of the above explanations. However, to the extent that these variables are imperfect measures, we may not be able to entirely reject a mechanism based on insignificant coefficients.

The evidence in Table 7 suggests that the sharp drop in US demand was more decisive than tighter US loan supply in explaining why exports to the US became particularly sensitive to credit conditions at the height of the crisis. While countries with higher interbank rates on average exported less in sectors more reliant on external finance, this distortion was alleviated during months of stronger demand in the US (Column 1). On the other hand, reductions in US loan supply did not seem to intensify the impact of credit conditions in the sending country (Column 2). These conclusions are further confirmed by the horse-race in Column 3: When we include interactions with both US demand and US credit supply in the same regression, the former continues to play a statistically significant role, while the latter no longer does. Qualitatively similar patterns obtain when we instead consider the variation across sectors with different access to trade credit, although the results are weaker with our final financial vulnerability variable, *TANG*.<sup>22</sup>

In our working paper version, we also pursued an alternative approach to evaluate the role of credit availability in the destination country. Instead of examining US imports, we considered US exports by destination country and sector as the outcome variable. We regressed it on the interactions of the interbank rate in the importing market with sectors' financial dependence and the crisis dummy. The largely insignificant effects we found offer further suggestive evidence that the cost of capital at the export dock is substantially more important for trade activity than that in the importing country.

## 6. Level effects of credit conditions on trade flows

The econometric approach in Section 5 exploits the variation in financial vulnerability across sectors, and permits the inclusion of a

<sup>22</sup> We have also run specifications in which the triple interaction with the US final demand and/or credit supply proxies enter together with the triple interaction with the crisis dummy (available on request). The crisis dummy term generally tends to be more robustly significant than the US retail sales and/or business loans interactions, with the latter two often losing statistical significance. In particular, this means either that our US final demand proxies are relatively noisy variables or that the US final demand story does not fully explain the intensification during the crisis period.

demanding set of fixed effects. This alleviates concerns regarding omitted variables, and allows us to isolate a plausibly causal effect of credit conditions on trade flows during the financial crisis. However, it precludes an evaluation of the level effect of credit conditions. We now examine this level effect, so that we can later quantify the impact of credit conditions during the crisis on overall trade volumes.

### 6.1. Cross-country estimation

We first study the impact of the crisis on trade flows across exporting countries with varying levels of the cost of capital. In particular, we estimate the following:

$$\ln Y_{ikt} = \gamma_1 IBrate_{it} + \gamma_2 D_{crisis} \times IBrate_{it} + D_{kt} + \varepsilon_{ikt}. \quad (3)$$

As before,  $Y_{ikt}$  and  $IBrate_{it}$  are respectively the value of US imports from country  $i$  in industry  $k$  and the interbank rate in that country during month  $t$ .  $D_{crisis}$  is again a binary variable equal to 1 between September 2008 and August 2009. We include industry-month fixed effects which subsume the average effect of the crisis on US sectoral imports. These also control for fluctuations in sector-specific US import demand, as well as for monthly seasonality in the data. We further condition on the log monthly-averaged nominal bilateral exchange rate with the US dollar ( $\log EXCH_{it}$ ) and its interaction with the crisis dummy ( $D_{crisis} \times \log EXCH_{it}$ ), to account for any effects that exchange rate movements may have had on trade flows. These can now be identified because we do not include country-month fixed effects in the regression.<sup>23</sup> We report standard errors clustered by country, but the results are similar when clustering by country-industry.

The coefficients of interest,  $\gamma_1$  and  $\gamma_2$ , are now identified from the variation in the cost of capital across exporting countries in a given month and sector. The main effect of  $IBrate_{it}$  thus establishes the extent to which countries with cheaper credit are able to export more to the US. The interaction term in turn identifies the impact of credit tightness on trade flows at the height of the crisis.

<sup>23</sup> Our results are not particularly sensitive to this control as exchange rates moved relatively little during this period compared to the interbank rates and trade volumes. The effect of  $\log EXCH_{it}$  itself shows up as expected, with a stronger exporter exchange rate associated with lower exports to the US (results available on request).

As Table 8 documents, countries with lower interbank rates systematically exported more to the US (Column 1). This effect is statistically significant at the 10% level, with the point estimate implying that a one percentage point rise in the cost of bank financing would be associated with approximately a 16% drop in that country's exports to the US market. This result is consistent with the broader body of evidence in the prior literature demonstrating that financial frictions constrain firms' export levels, or even prevent firms from exporting altogether.

We also find that tight credit conditions became particularly damaging to a country's exports during the crisis. While the point estimate of  $\gamma_2$  is negative but not significant in Column 2, this finding strengthens considerably when we further control for cross-country differences in per worker factor endowments, GDP and GDP per capita, along with their respective interactions with the crisis dummy (Columns 3 and 4;  $\gamma_2$  now significant at the 5% level). Column 5 explores the extent to which credit conditions during the crisis were disproportionately damaging for trade flows relative to overall production. We control here for countries' log industrial production index, as well as its interaction with the crisis dummy. In contrast to our earlier findings in Section 5.4, we now find weaker evidence that financial frictions restricted the overall volume of cross-border activity over and above total output.

## 6.2. Within-country estimation

To what extent were these level effects of the interbank rate also manifest in the within-country experience? To this end, we consider a more stringent specification that includes country–industry fixed effects ( $D_{ik}$ ). We estimate the following fully saturated model:

$$\ln Y_{ikt} = \gamma_1 IBrate_{it} + D_{kt} + D_{ik} + \varepsilon_{ikt}. \quad (4)$$

The  $D_{ik}$ 's now control for time-invariant determinants of comparative advantage that affect the average pattern of country exports across sectors, including the average effect that high interbank rates might have on financially vulnerable sectors. These also control for all other country characteristics that are relatively stable over time. The coefficient of interest,  $\gamma_1$ , is thus identified purely from the variation in the cost of capital within countries over time, and abstracts from the variation in the (average) interbank rate in the cross-section of

countries. In practice, we estimate Eq. (4) for different subperiods in our sample, to explore whether the level effect of the interbank rate varied over time. This is similar in spirit to Eq. (3), but slightly more flexible in that it does not impose a stepwise change during the crisis period.

We report results for the full sample period in the top panel of Table 9. In contrast to our findings in Table 8 which were based on the cross-country variation in  $IBrate$ , we now document a positive but smaller within-country association between exporting countries' interbank rates and sales to the US (Column 1, significant at the 5% level). This result is not driven by movements in the bilateral exchange rates against the US dollar (Column 2). However, it is not robust to controlling for exporters' industrial production index (Column 3). It also does not survive a number of other sensitivity checks, including treating Europe as a cluster, dropping the petroleum and coal products industry, or lagging the interbank rate (available on request).<sup>24</sup>

We next break the sample into three subperiods that correspond to the months before the crisis unfolded in earnest (November 2006 to August 2008), the most acute stage of the crisis (September 2008 to December 2008), and the remainder of the sample period (January 2009 to October 2009). As the rest of Table 9 shows, this breakdown allows us to uncover a strong and very robust negative relationship between a country's interbank rate and export performance at the very peak of the financial crisis. On the other hand, no systematic pattern emerges for the periods before or after this peak. (We have experimented with extending the most acute phase of the crisis, either with an earlier start or a later end month. The correlation between  $IBrate$  and log exports tends to become successively less negative as we expand this period, before eventually turning positive and insignificant.)

How should we interpret these results? The prevailing cost of credit in an economy reflects the equilibrium between the demand for external capital and the supply of such financing. During normal economic times, interbank rates tend to be higher during business cycle peaks, reflecting firms' increased demand for bank financing in order to service attractive investment and export opportunities. By contrast, during a period of unusual financial turmoil as was the case during the recent crisis, higher interbank rates likely capture instead the limited availability of capital. Our results suggest that the latter effect dominated during the height of the crisis. Since the September through December 2008 months were generally marked by falling interbank rates as monetary policies were eased, our results imply that countries where the cost of capital did not fall as much had a worse overall trade performance than countries where interbank rates fell more substantially.

It is important to emphasize that these findings do not contradict our earlier results in Table 8. In particular, the sector–month fixed effects in Eq. (3) control for changes in US import demand that affect all exporting countries equally. The effects of the interbank rate are thus identified primarily from cross-country differences on the supply side, namely credit availability, and it may indeed be the case that credit availability was generally higher and export performance stronger in countries with lower average interbank rates. On the other hand, the additional country–industry fixed effects in Eq. (4) ensure that the effect of the interbank rate in Table 9 is identified from time-series fluctuations in both supply and demand within each exporting country. Our results in Tables 8 and 9 are also consistent with our findings on the differential effect of the crisis across sectors in Section 5. Regardless of whether a high interbank rate is due to strong demand for capital or a shortage of credit supply, firms in financially vulnerable sectors would be constrained in their ability to expand due to their higher sensitivity to the cost of credit.

**Table 8**  
Credit conditions and trade volumes across countries.

Crisis = 1: Sep 08 to Aug 09	Dependent variable: log (industry exports to the US)				
	(1)	(2)	(3)	(4)	(5)
<i>IBrate</i>	−0.162* [0.079]	−0.143* [0.082]	−0.199* [0.101]	−0.037 [0.064]	0.019 [0.067]
<i>Crisis</i> × <i>IBrate</i>		−0.036 [0.167]	−0.069** [0.030]	−0.059** [0.026]	−0.060 [0.037]
Factor endowment controls	No	No	Yes	Yes	Yes
Initial size and income controls	No	No	No	Yes	Yes
IPI controls	No	No	No	No	Yes
Ind–Mth fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	22,145	22,145	20,208	20,208	15,758
R-squared	0.283	0.284	0.336	0.577	0.603

Notes: Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. The dependent variable is log monthly exports to the US in 3-digit NAICS manufacturing industries, covering Nov 06 to Oct 09. All specifications include industry–month fixed effects. The *Crisis* variable equals 1 from Sep 08 to Aug 09. All columns control for the log bilateral exchange rate (*EXCH*) and *Crisis* × log(*EXCH*). Columns (3)–(5) control for log(*K/L*), *Crisis* × log(*K/L*), log(*H/L*), and *Crisis* × log(*H/L*). Columns (4)–(5) control for log(*GDP*), *Crisis* × log(*GDP*), log(*GDPpc*), and *Crisis* × log(*GDPpc*). Column (5) further includes log(Industrial Production Index) and *Crisis* × log(Industrial Production Index).

<sup>24</sup> When we include  $D_{crisis} \times IBrate_{it}$  in this regression for the full sample period, the results are similar to the top panel in Table 9.  $D_{crisis} \times IBrate_{it}$  typically yields a positive though frequently insignificant coefficient (available on request).

**Table 9**  
Credit conditions and trade volumes within countries.

	Dependent variable: log (industry exports to the US)		
	(1)	(2)	(3)
<i>Nov 06 to Oct 09:</i>			
<i>lBrate</i>	0.016** [0.008]	0.016* [0.008]	0.008 [0.006]
Observations	22,901	22,145	17,695
R-squared	0.961	0.961	0.960
<i>Nov 06 to Aug 08:</i>			
<i>lBrate</i>	0.028* [0.016]	0.023 [0.015]	0.003 [0.014]
Observations	14,121	13,659	10,937
R-squared	0.966	0.966	0.964
<i>Sep 08 to Dec 08:</i>			
<i>lBrate</i>	<b>-0.025**</b> [0.010]	<b>-0.022**</b> [0.009]	<b>-0.033***</b> [0.009]
Observations	2,566	2,482	1,988
R-squared	0.981	0.982	0.980
<i>Jan 09 to Oct 09:</i>			
<i>lBrate</i>	0.016 [0.021]	0.009 [0.021]	0.012 [0.025]
Observations	6,214	6,004	4,770
R-squared	0.968	0.969	0.969
Log (Exchange Rate)	No	Yes	Yes
Log (IPI)	No	No	Yes
Cty-Ind, Ind-Mth fixed effects	Yes	Yes	Yes

Notes: Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. The dependent variable is log monthly exports to the US in 3-digit NAICS manufacturing industries. All specifications include country-industry and industry-month fixed effects. Regressions are performed in each panel for the months stated. Columns (2)–(3) control for  $\log(EXCH)$ , while Column (3) also controls for  $\log(\text{Industrial Production Index})$ .

## 7. Interpreting the magnitudes

Sections 5 and 6 provide strong evidence that credit conditions were an important determinant of aggregate trade flows and their sectoral composition during the height of the global financial crisis. These results reflect the importance of the cost of securing short-term financing, as proxied by the interbank rate, for exporting activity. In this section, we perform some exercises to gauge the contribution of changing credit conditions to the overall trade collapse witnessed during the crisis.

To do so, we use our regression estimates to infer how US imports would have evolved under two alternative scenarios. First, we evaluate the hypothetical impact on trade had interbank rates remained at their peak levels of September 2008 throughout the crisis period. We then consider the opposite extreme, assuming that interbank rates had dropped immediately after September 2008 to their low levels of August 2009. These two calculations provide rough upper and lower bounds respectively for the damage that the crisis could have inflicted on trade flows specifically through the credit channel.

It is tempting to interpret the first scenario as one in which the policy response by monetary authorities to ease credit conditions was not effective, resulting in persistently high interbank rates. Conversely, the latter scenario might be viewed as one of exceptionally aggressive policy interventions to lower interbank rates. We would however caution that our analysis is not a precise policy evaluation. Given the reduced-form nature of our empirical approach, our point estimates are not strictly adequate for projecting the general equilibrium effects of policies. We instead view this exercise as providing a ballpark estimate to make sense of how much credit conditions affected international trade flows.

### 7.1. Case 1: Persistently high cost of credit

We first examine the scenario where the interbank rate in each country remains fixed at its peak September 2008 level through August 2009. To proceed, we use our regression point estimates and the actual interbank rates to obtain the predicted US imports from each country and sector. We then compare these against the predicted trade flows under the counterfactual path of interest rates.

To infer the additional decline in overall trade volumes that would have resulted, we first consider the estimates from Eq. (3). Recall that in this specification, the level effect of credit conditions is estimated primarily from the cross-country variation in the cost of capital. Based on Column 2 of Table 8, we find that the US would have imported 35.2% less from the average country and sector between September 2008 and August 2009, had interbank rates remained at their elevated September 2008 levels.

These figures of course rely on a less-restrictive specification. A more conservative estimate of the trade impact of the crisis can be obtained using Eq. (4), which was estimated purely from the within-country movements in the cost of capital over time. Based on Column 2 of the “Sep 08 to Dec 08” panel in Table 9, we find that the crisis would have lowered US imports by an additional 2.5% over this period had interest rates remained at their peak levels. While this impact is considerably less severe, it is nevertheless quite sizable when considered against the overall 12% drop in world trade flows for the whole of 2009. This magnitude is also in line with recent estimates on the firm-level impact of the crisis: Using French micro data, Bricongne et al. (2010) find that firms which had defaulted on a payment in the preceding 12 months, and hence presumably had limited access to finance during the crisis, subsequently saw a 2% worse export performance relative to firms that did not experience such a payments incident.

Our results naturally point to a more severe impact on trade flows in financially vulnerable sectors. To quantify the size of these cross-sector effects, we use the estimates from the triple interaction regression in Eq. (1), specifically the estimates from Columns 2, 5 and 8 in Table 2. If all countries' interbank rates had stayed at their September 2008 levels until the end of August 2009, US imports would have been 13.4% lower in the most external finance-dependent sector (chemical manufacturing) relative to the least dependent sector (leather and allied products). Similarly, countries would have exported 16.9% less on average in the sector with the least availability of trade credit (textiles) relative to the sector with the greatest access (petroleum and coal products). Finally, trade would have been 17% weaker in the industry with the lowest share of tangible assets (leather and allied manufacturing) relative to the industry with the hardest assets (petroleum and coal products).

### 7.2. Case 2: Instantaneous drop in the cost of credit

We next consider the converse scenario, under which the interbank rate in each country drops to its low August 2009 level immediately after September 2008. To gauge how much higher trade flows would have been, we once again use our point estimates from the respective regressions described in the previous subsection. This time, we compare the predicted trade flows under the actual interbank rates to those under the assumption of permanently low rates after September 2008.

We conservatively conclude that the 2008–2009 crisis would have hurt overall US imports by 5.5% less under this scenario (based on the Table 9 specification). Our estimates from the less restrictive specification that uses the full cross-country variation in credit conditions indicate that this magnitude may be as high as a 30.5% improvement (based on the Table 8 specification). Once again, trade flows in financially vulnerable sectors would have benefited disproportionately more from the increased availability of cheaper external

credit. The difference in export performance between the most and least external capital-dependent industries would have been 8.2%. The corresponding difference when considering industries' access to trade credit or endowment of tangible assets would have been a 9.7% gap (coincidentally equal for both sector measures).

These hypothetical scenarios provide a sense of the large impact of financial market disturbances on the real economy. They also indirectly suggest that policy interventions that lowered the cost of capital were quite important in averting a substantially more severe collapse in trade flows. At the same time, the effect of the crisis would have been significantly milder had credit conditions improved faster.

## 8. Conclusion

This paper is one of the first to establish and quantify the effect that credit conditions had on international trade during the 2008–2009 global financial crisis. Using monthly data on US imports, we find that countries with higher interbank rates and thus tighter credit conditions exported less to the US during the crisis period. These effects were especially pronounced in sectors that require extensive external financing, have limited access to buyer–supplier trade credit, or have few collateralizable assets. In other words, exports of financially vulnerable industries were more sensitive to the cost of external capital than exports of less vulnerable industries, and this sensitivity rose during the financial crisis. This impact of credit conditions on trade flows holds even after controlling as best we can for domestic production, so that the financial market disruptions mattered for international trade over and above their effect on output per se.

Our findings imply that adverse credit conditions played an important role in the transmission of the effects of the crisis to international trade flows. They also suggest that policy interventions that contributed towards relaxing the high cost of capital substantially dampened the detrimental impact on cross-border trade. For example, our most conservative estimates indicate that US imports would have fallen by about 2.5% more had interest rates persisted at their peak September 2008 levels.

In sum, our paper provides further evidence of the effect of credit conditions on trade, particularly during a severe shock to the banking and financial sector. It highlights the potential gains from interventions targeting access to external finance, and sheds light on the role of such policies in mitigating the uneven impact of the crisis on trade flows across countries and sectors.

## Appendix A

### A. Trade flows

US trade flows: From the US Census Bureau Foreign Trade Statistics. Monthly data at the 3-digit NAICS level is used.

### B. Industry characteristics

External capital dependence (*EXTFIN*): Constructed following Rajan and Zingales (1998). See Section 3.

Trade credit (*TCRED*): Constructed following Fisman and Love (2003). See Section 3.

Asset tangibility (*TANG*): Constructed following Braun (2003). See Section 3.

Factor intensities ( $\log(k/l)$ ,  $\log(h/l)$ ): From the NBER-CES database. These are constructed first for SIC 4-digit industries: (i) Physical capital intensity as the log of the ratio of real capital stock to total employment; and (ii) Skill intensity as the log of the ratio of non-production workers to total employment. These are calculated using 1996 data, the most recent year available. We map SIC 4-digit to

NAICS 3-digit industries using concordance weights between the two classification systems constructed from US import volumes from 1989–2006, obtained from the Feenstra et al. (2002) database. The factor intensity of each NAICS 3-digit industry is the concordance-weighted average of the factor intensities of its constituent SIC 4-digit industries.

### C. Country variables

Interbank rates (*IBrate*): See Section 3.

Factor abundance ( $\log(K/L)$ ,  $\log(H/L)$ ): Based on Caselli (2005) and the Penn World Tables, Version 6.2 (Heston et al., 2006). Physical capital stock is calculated using the perpetual inventory method, namely:  $K_t = I_t + \delta K_{t-1}$ , where  $I_t$  is investment and  $\delta = 0.06$  is the assumed depreciation rate. The investment flow and labor force data are from the latest version of the Penn World Tables. Human capital per worker is taken from Caselli (2005). Following Hall and Jones (1999),  $H/L$  is calculated as a Mincerian return-weighted average years of schooling, namely  $H/L = \exp(\phi(s))$ , where  $s$  is the average years of schooling in the population over 25 years of age, and  $\phi(\cdot)$  is a piece-wise linear function with a slope of 0.13 for  $s < 4$ , 0.10 for  $4 < s < 8$ , and 0.07 for  $s > 8$ . We use the average value of  $K/L$  and  $H/L$  over 1996–2005 as our measures of initial factor endowments.

Exchange rates: From Thomson Datastream, in units of foreign currency per US dollar. A monthly average of daily rates is used.

Treasury Bill rate: Three-month rate. From the IMF International Financial Statistics; countries for which the reported treasury bill rate was not explicitly documented to be for a three-month maturity were dropped. Supplemented for some additional countries by information from the Global Financial Data; a monthly average of daily closing rates was used.

Industrial Production Index: From the IMF International Financial Statistics.

GDP and GDP per capita: From the World Development Indicators (WDI), in PPP units. Averaged over 1996–2005.

US retail sales: Seasonally adjusted. From the US Census Bureau.

US business loans: Total commercial and industrial loans at all US commercial banks, seasonally adjusted. From the Board of Governors of the Federal Reserve System H.8 release.

### Appendix Table 1A

List of countries with interbank rate data.

Australia (AUS); Belgium (BEL); Bulgaria (BGR); Canada (CAN); China (CHN); Czech Republic (CZE); Germany (DEU); Denmark (DNK); Spain (ESP); Finland (FIN); France (FRA); Great Britain (GBR); Greece (GRC); Hong Kong (HKG); Hungary (HUN); Ireland (IRL); Italy (ITA); Japan (JPN); Malaysia (MYS); Netherlands (NLD); Norway (NOR); New Zealand (NZL); Poland (POL); Portugal (PRT); Romania (ROM); Singapore (SGP); Slovakia (SVK); Sweden (SWE); Thailand (THA); Turkey (TUR); Taiwan (TWN)

Notes: Sample consists of 31 countries for which one-month interbank rate data was available from Thomson Datastream.

### Appendix Table 1B

Summary statistics for country one-month interbank rates.

	Min	5 pct	Median	95th pct	Max	Mean	Std dev
Nov 06	0.38	1.67	3.47	8.76	19.26	4.52	3.23
Mar 08	0.85	1.22	4.31	10.27	16.35	4.97	2.92
Sep 08	0.74	1.28	4.66	12.99	18.12	5.32	3.30
Jan 09	0.25	0.50	2.16	14.59	15.14	3.52	3.61
Oct 09	0.12	0.15	0.44	7.38	10.33	1.77	2.47

Appendix Table 2

Industry characteristics: summary statistics.

NAICS industry	External Finance Dep (EXTFIN)	Asset Tangibility (TANG)	Trade and Credit (TCRED)	Phy Cap Intensity (log(k/l))	Human Cap Intensity (log(h/l))	
311	Food manufacturing	-0.558	0.332	0.078	4.854	-1.424
312	Beverage and tobacco product manufacturing	-0.452	0.321	0.044	5.132	-0.918
313	Textile mills	-0.154	0.371	0.063	4.198	-1.893
314	Textile product mills	-0.335	0.264	0.024	3.313	-1.671
315	Apparel manufacturing	-0.646	0.131	0.066	2.617	-1.943
316	Leather and allied product manufacturing	-1.857	0.115	0.083	3.254	-1.853
321	Wood product manufacturing	-0.372	0.428	0.037	3.816	-1.820
322	Paper manufacturing	-0.366	0.535	0.063	5.783	-1.459
323	Printing and related support activities	-0.487	0.296	0.084	3.587	-0.628
324	Petroleum and coal products manufacturing	-0.175	0.551	0.123	6.857	-1.040
325	Chemical manufacturing	5.472	0.138	0.032	5.606	-0.848
326	Plastics and rubber products manufacturing	-0.278	0.355	0.081	4.280	-1.571
327	Nonmetallic mineral product manufacturing	-0.394	0.417	0.050	4.403	-1.562
331	Primary metal manufacturing	-0.364	0.406	0.084	5.584	-1.407
332	Fabricated metal product manufacturing	-0.781	0.279	0.093	4.097	-1.391
333	Machinery manufacturing	-0.237	0.182	0.070	4.380	-1.001
334	Computer and electronic product manufacturing	0.435	0.116	0.054	4.686	-0.726
335	Electrical equipment, appliance, and component manufacturing	-0.288	0.197	0.080	3.973	-1.297
336	Transportation equipment manufacturing	-0.386	0.250	0.120	4.957	-1.643
337	Furniture and related product manufacturing	-1.040	0.289	0.081	2.952	-1.387
339	Miscellaneous manufacturing	0.549	0.135	0.042	3.597	-1.227

Notes: EXTFIN, TANG and TCRED are calculated from 1996 to 2005 Compustat data. Log(k/l) and log(h/l) are calculated from 1996 NBER-CES data for US manufacturing. For more details, please see Appendix A.

Appendix Table 3

Effects of the crisis on trade across countries and sectors: joint tests.

Crisis = 1: Sep 08 to Aug 09	Dependent variable: log (industry exports to the US)		
	(1)	(2)	(3)
<i>IBrate</i> × <i>EXTFIN</i>	0.003 [0.006]	0.006 [0.008]	-0.001 [0.007]
<i>Crisis</i> × <i>IBrate</i> × <i>EXTFIN</i>	<b>-0.003</b> [0.005]	<b>-0.004</b> [0.005]	<b>0.001</b> [0.007]
<i>IBrate</i> × <i>TCRED</i>	0.261 [0.346]	0.305 [0.388]	-0.244 [0.327]
<i>Crisis</i> × <i>IBrate</i> × <i>TCRED</i>	<b>0.394**</b> [0.180]	<b>0.464*</b> [0.243]	<b>0.692*</b> [0.367]
<i>IBrate</i> × <i>TANG</i>	0.122 [0.098]	0.146 [0.116]	0.083 [0.131]
<i>Crisis</i> × <i>IBrate</i> × <i>TANG</i>	<b>0.035*</b> [0.017]	<b>0.026</b> [0.046]	<b>0.039</b> [0.052]
Factor endowment controls	No	Yes	Yes
Initial size and income controls	No	Yes	Yes
IPI controls	No	No	Yes
Cty-Ind, Cty-Mth, Ind-Mth fixed effects	Yes	Yes	Yes
Observations	22,901	20,208	15,758
R-squared	0.964	0.965	0.965

Notes: See notes to Table 2. Standard errors are clustered by country, with \*\*\*, \*\*, and \* denoting significance at the 1%, 5%, and 10% levels respectively. Column (1) is a lean specification containing no auxiliary controls. Column (2) includes the factor endowment controls, and the country size and income controls. Column (3) additionally controls for log(Industrial Production Index) × industry FEs and *Crisis* × log(Industrial Production Index) × industry FEs.

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