After the Panic: Are Financial Crises Demand or Supply Shocks? Evidence from International Trade*

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PRELIMINARY: COMMENTS WELCOME

Abstract

Are financial crises a negative shock to demand or a negative shock to supply? This is a huge and fundamental question for both macroeconomics researchers and those involved in real-time policymaking, and in both cases the question has become much more urgent in the aftermath of the recent financial crisis. Arguments for monetary and fiscal stimulus responses usually interpret such events as demand-side shortfalls. Conversely, arguments for tax cuts and structural reform often proceed from supply-side frictions. Resolving the question requires models capable of admitting both mechanisms, and empirical tests that can tell them apart. We develop a simple small open economy model, where a country is subject to deleveraging shocks that impose binding credit constraints on households and/or firms. These financial crisis events leave distinct statistical signatures in the empirical time series record, and they divide sharply between each type of shock. Household deleveraging shocks are mainly demand shocks, contract imports, leave exports largely unchanged, and depreciate the real exchange rate. Firm deleveraging shocks are mainly supply shocks, contract exports, leave imports largely unchanged, and appreciate the real exchange rate. To test these predictions, we compile a crossed dataset of 200+ years of trade data and dates of 100+ financial crises in a large sample of countries. Empirical analysis gives a clearer picture of how financial distress affects trade and relative prices: after a financial crisis event we find that imports contract, exports hold steady or even rise, and the real exchange rate depreciates. History shows that, on average, financial crises are very clearly a negative shock to demand.

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1. Introduction

What is the link between financial crises and trade collapses, and what can macroeconomists learn from it? In the paper we look to the past, and explore evidence from up to 200 years of international trade and price data to answer this question. Our historical long-run approach is unique, differs from existing studies, and could open up new avenues of research.

In particular, we want to ask a very general question: are financial crises, on average, associated with a negative shock to demand or a negative shock to supply? This is an important question to answer, because it can help guide better policy responses to future financial crises. And arguably, had we known more back in 2008, it might have made for a clearer answer as to what was to blame for the Great Recession, and, thus, helped in the search for the most effective policy response. In real time, that clarity was sadly lacking: many economists and policymakers sided with a demand shock explanations, but a sizable number also argued the problem was on the supply side. Yet few, on either side, seemed able to adduce reasons based on what the historical record had to say about similar events in the past. But with two viewpoints in strong contradiction, having some evidence-based arguments to hand might have been useful to cut through the intellectual and political fogs in the depths of the crisis.

Our focus on trade takes off from an emerging literature since 2008. A wave of studies since the crisis attests to the interest in the study of macroeconomic crises, and their repercussions for exports and imports in an open economy. Some have focused on direct financial effects on certain sectors or firms (Chor and Manova (2012); Amiti and Weinstein

(2011); Iacovone and Zavacka (2009); Abiad *et al.* (2014)).[1] Another suggestion is that international trade in inputs is subject to greater fixed costs of shipments; fixed costs induce periodic ordering, but wait-and-see might postpone trades when a supply shock hits the input importer (Alessandria *et al.* (2010)). Part of the trade collapse could be a composition effect, since international trade is dominated so much by durable goods and intermediate inputs, and these are much more cyclical than GDP itself (Levchenko *et al.* (2010); Eaton *et al.* (2011); Behrens *et al.* (2013)), yet even here much of the mystery remains unexplained, and these and other explanations may or may not be shown to be mutually exclusive in the end. Finally, increases in uncertainty, often associated with financial crisis events, may trigger a disproportionate decline in imports relative to domestic nontraded activity due to the interplay between the fixed costs of trade and the option value of waiting to place an order for shipment (Novy and Taylor (2014)).[2]

Gaps in our knowledge exposed by the recent crisis should encourage a return to economic history to evaluate the broader questions using a larger universe of data, and a larger sample of financial crises. In this way, we can accumulate better evidence about how crises affect the macroeconomy. This is the rationale for expanding the time frame of the analysis. Financial crises are relatively rare events. To say anything meaningful from a statistical standpoint, we must expand our data across countries, and back in time, as recent research has shown (Reinhart and Rogoff (2009, 2011); and Schularick and Taylor

[1] Using data from 1970-2009 Abiad *et al.* (2014) find that financial crises in importers, much more than in exporters, depress bilateral trade. We build on this work by treating financial crises as exogenous, expanding the sample time horizon fivefold to include many more crisis episodes (particularly the 2008-2009 financial crisis and the Great Depression), examining the consequences of crises on the bilateral real exchange rate, and rationalizing these findings with a model of household and firm deleveraging shocks.

[2] These and other explanations are gathered in Baldwin (2009). Further empirical work on crises and trade includes Freund (2009) who examines the response of trade to global downturns; and Bems *et al.* (2011) who study the role of vertical linkages in amplifying the trade collapse.

(2012)).

The first part of our paper introduces some stylized facts and then turns to theory. We develop a simple small open economy model, where the home country is subject to deleveraging shocks that impose binding credit constraints on households and/or firms, following Eggertsson and Krugman (2012). In simulations, we regard financial crisis events as deleveraging shocks, and ask what kind of statistical signature such events would leave in the empirical time series record.

The answers are very clear, and divide sharply between each type of shock. Household deleveraging shocks, setting aside second order equilibrium effects, are pure demand shocks; these will tend to contract imports, leave exports largely unchanged, and depreciate the real exchange rate. Firm deleveraging shocks, setting aside second order equilibrium effects, are pure supply shocks; these will tend to contract exports, leave imports largely unchanged, and appreciate the real exchange rate. Though the model is a stripped down and purely real model of one country, we argue that the central insights will prevail in more general frameworks, such as with sticky prices or with a two-country setup.

These clear contrasts in the model predictions help us take the theory to the data. What does history show? When we look at the long-run trade and price data, and match them with established crisis timings, do we find that financial crises exhibit the symptoms of demand shocks or supply shocks? The answer will turn out to be strikingly unambiguous.

It is in the second part of our paper that we present the empirical evidence. Our analysis centers on a substantial effort to assemble a new large data historical set. In particular we propose to extend and then match two types of datasets, historical bilateral data on trade flows, and country specific data on macroeconomic aggregates and financial crisis

dates. With that done, we can look over a universe of roughly 100 financial crises, and use empirical methods to get a clearer picture of how financial distress affects trade. Very clearly, after a financial crisis event we see, on impact, that imports contract, exports hold steady or even rise, and the real exchange rate depreciates. All effects are statistically significant, and especially so in the bilateral data where the contemporaneous sample size exceeds 180,000 pair-year observations for trade flows and 100,000 for real exchange rates. The effects persist out to a five year horizon.

Clearly, over the long sweep of history, the dominant effects of a financial crisis event have corresponded to the theoretical predictions of a demand shock, not a supply shock, as judged by the evidence left in the time series data for trade flows and real exchange rates.

2. Data: Trade and Financial Crises.

The dataset used in this paper includes 70 developed and developing countries and we focus on the period 1816–2014. We combine bilateral trade flows between all country pairs with data on financial crises, GDP, and bilateral real exchange rates. We have also included in the dataset information on bilateral trade barriers as used in typical gravity models of trade. Our dataset is assembled gathering several data sources which we describe below.

2.1. Financial Crisis Dates

We rely on data on the dates of financial crises compiled by Reinhart and Rogoff (2011). While this source dates various types of economic crises, our focus is on banking (i.e., financial) crises. During the period 1816–2014, the median country faces 3 crisis episodes. At the extremes, the country at the 10th percentile faces a single financial crisis episode,

while the country at the 90th percentile faces 8 crises over these two centuries. In the full sample of countries, we observe 245 such episodes. Reinhart and Rogoff (2011) mark financial crisis dates using dummy variables at an annual frequency. We identify the first year of a crisis as the relevant shock event. Reinhart and Rogoff (2011) define as banking crises episodes where bank runs lead to the public sector assuming control of financial institutions, and/or episodes of large-scale financial assistance from the govermnment to financial institutions.

2.2. Bilateral Trade Flows and Frictions

Bilateral trade data were obtained mainly from the CEPII TRADHIST database for the pre-WW2 period and entirely from the IMF's *Direction of Trade Statistics* for the post-WW2 period.[3] Trade figures are reported in nominal U.S. dollars, which we deflate using the U.S. GDP deflator. While we record positive trade flows for more than 90 percent of exporter-importer pair cells in recent years, the share of non-zero falls to 50 percent of cells when we go back to 1960, and to about 20 percent of cells in the 1930s.

We also assemble a secondary dataset on country-level aggregate exports, imports, GDP and crises over the same period and sample of countries to provide more aggregate evidence on the trajectory of trade following crises.

2.3. GDP and Real Exchange Rates

Our historical GDP series are assembled from various sources. Whenever possible we obtain real GDP series from Glick and Taylor (2010) and from Maddison (1995, 2001). In

[3]For details on the construction of see CEPII TRADHIST database see Fouquin *et al.* (2016).

recent years, we use the World Bank's *World Development Indicators* database. To fill in gaps in the early years in our sample we also use Barro and Ursúa (2008) and Mitchell (1992, 1993, 1995).

We also construct measures of bilateral real exchange rates. We obtain nominal exchange rates from the IMF's *International Financial Statistics* for the post-1950 period and from Global Financial Data for the pre-WW2 period. We obtain series on price levels from Jordà and Taylor (2011) for most of our sample, and from the IMF's *World Economic Outlook* for very recent years.

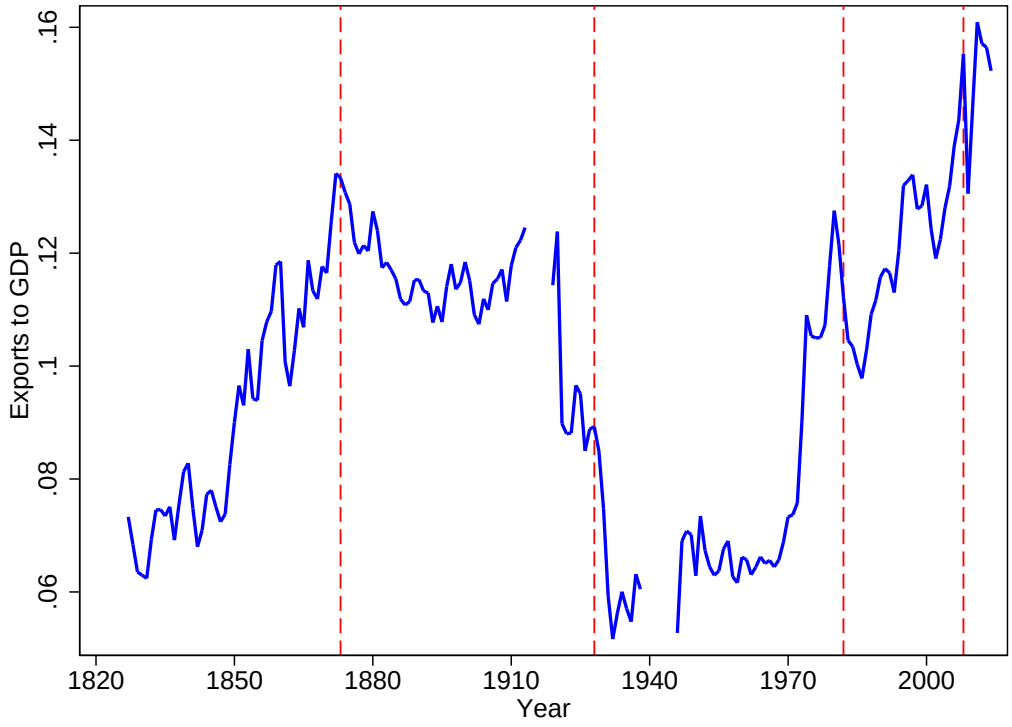
2.4. World Trade and Major Crises

To motivate our analysis, we note that what was witnessed after the global financial crisis in 2008 was nothing new, especially not the so-called Great Trade Collapse, meaning the fall in trade volumes relative to GDP. Figure 1 shows the trajectory of world exports/GDP after the major global financial crises between 1827 and the present. We aggregate total exports and GDP over this period for a constant set of countries. This limits our world-trade figure to 10 countries with continuously available trade and GDP data over the 1827–2014 period. We exclude years of world wars in which trade or GDP data are missing for many countries.

From this graph, the trade collapse following the recent 2008–2009 financial crisis is unsurprising. Our figure also shows, with vertical dashed lines, the starting dates of the Panic of 1873 episode, the 1930s Great Depression episode, the 1980s LDC Sovereign-Financial Crises episode, and the 2008 Great Recession episode. Similar declines in world trade can be seen to have occurred after each of these episodes. Two years following the start of the Great Recession in 2008, world exports to GDP in our data had fallen by 0.93

Figure 1: *World Trade and Major Crises.*

This figure is constructed aggregating exports and GDP for a constant sample of the following 10 countries: Australia, Chile, Denmark, Spain, France, United Kingdom, Netherlands, Portugal, Sweden, and the United States. Vertical dashed lines indicate the starting year of four major world financial crises: the Panic of 1873 episode, the 1930s Great Depression episode, the 1980s LDC Sovereign-Financial Crises episode, and the 2008 Great Recession episode.



percentage points. This is a similar decline to that in the early 1980s, when the trade to GDP fell ratio fell by 0.86 percentage points. The impact of the Great Depression, however, was almost twice as large, with a 1.45 percentage point fall in world trade to GDP.

However, the recovery of trade after the recent "trade collapse" was faster — compared to output — than that seen in previous episodes. Five years following the start of the Great Recession the exports-to-GDP ratio was 0.1 percentage points higher than in the year prior to the start of the crisis, while in the 1980s debt crisis and the Panic of 1873 it was still one percentage point lower. The Great Depression stands out in this regard. Due perhaps to

rising protectionist measures adopted by the U.S. and other countries during this period (and other rising frictions, such as the collapse of the gold standard) exports-to-GDP were still more than 3 percentage points lower than in the year prior to the start of the crisis.

This figure nicely motivates our study by revealing an enduring link between crisis events and trade outcomes. What is obscured in this figure, however, is the uneven impact of financial crises on imports and exports, and the correlation between those shocks and the location of the underlying financial crisis events. The remainder of this paper focuses on those issues with a combination of parsimonious theory and granular empirics.

3. A Crisis-Deleveraging Model: Demand, Supply, and Trade Shocks

We study a small open economy and introduce borrowing limits into both the firm and household side of the economy. This is guided by our desire to understand whether the macroeconomic effects of financial crises can be best understood as demand or supply shocks. In the case of households, this apparatus exactly mirrors the approach of Eggertsson and Krugman (2012).[4] We add the same apparatus to the firm side of the model to make our modeling of the two shocks conceptually as simple and symmetric as possible.

Formally, we will describe an economy populated by patient and impatient households. These households derive utility from the consumption of an import good and a non-traded good. Firms in the economy produce a non-traded good sold locally and an export good sold abroad. They produce using labor and must borrow from the world to finance a share of their production cost in advance. Both impatient households and firms face exogenous,

[4] In related work Benigno and Romei (2014) study how debt deleveraging in one country spreads to the rest of theworld economy.

binding borrowing limits, and we study the impact on the economy of sudden declines in the amount that households or firms can borrow.

3.1. Households

We assume that households maximize lifetime utility

$$U = E_0 \sum_{t=0}^{\infty} (\beta^i)^t \cdot \left(log(C^i_{Mt}) + log(C^i_{Nt}) - \frac{{N^i_t}^{1+\phi}}{1+\phi} \right),$$

subject to a budget constraint discussed below, with $i \epsilon \{B, S\}$ indexing borrowers and savers and time preference parameters such that $\beta^s > \beta^b$. We denote by C^i_M and C^i_N a household's consumption of the import good and the non-traded good, respectively. The household budget constraint supposes that they receive income as a wage for labor supplied to local firms in the non-traded and export sectors. In addition, patient households (only) own and receive firm profits.[5] The economy faces an exogenous world price of the import good, P_M, and an endogenously determined price of the non-traded good, P_N. Households borrow from, or lend to, the rest of the world at an exogenous real interest rate r, subject to limits.

We assume that the impatient households' budget constraint is given by

$$P_{Mt} \cdot C^b_{Mt} + P_{N\,t} \cdot C^b_{N\,t} - D^b_t = w_t \cdot N^b_t - (1 + r_{t-1}) \cdot D^b_{t-1},$$

and the binding borrowing constraint we impose on the impatient households is

$$(1 + r_t) \cdot D^b_t \leq \overline{D}.$$

[5]This assumption is for analytical simplicity. It follows Martinez and Philippon (2014), who show that it may be consequential quantitatively, but not qualitatively.

Similarly, we assume that the patient households' budget constraint is given by

$$P_{Mt} \cdot C^s_{Mt} + P_{N\,t} \cdot C^s_{N\,t} - D^s_t = w_t \cdot N^s_t + \frac{\pi_{Xt}}{\chi} + \frac{\pi_{N\,t}}{\chi} - (1 + r_{t-1}) \cdot D^s_{t-1}\,,$$

where χ and $1 - \chi$ denote the fraction of patient and impatient households in the economy.

Aggregate consumption of each good is the sum of consumption across households:

$$C_{Mt} = \chi \cdot C^s_{Mt} + (1 - \chi) \cdot C^b_{Mt}\,,$$
$$C_{Nt} = \chi \cdot C^s_{Nt} + (1 - \chi) \cdot C^b_{Nt}\,.$$

Finally, aggregate hours supplied are given by:

$$N_t = \chi \cdot N^s_t + (1 - \chi) \cdot N^b_t\,.$$

3.2. Production

We assume that in both the export and the non-traded sectors there is a continuum of firms of measure one that produce output using only labor. Firms in the export sector sell their goods to the rest of the world at the exogenous world price P_X, while firms in the non-traded sector sell their good domestically at a price P_N determined in equilibrium.

In both sectors, firms must borrow a fraction λ of their cost to finance production. Firms borrow from the rest of the world at an exogenous real interest rate r, subject to limits.

We assume that the firms' budget constraint is given by

$$\hat{\pi}_t + \delta_t = \delta_{t-1} \cdot (1 + r_{t-1}) + \pi_t \,,$$

where δ_t is the amount borrowed in period t, π denotes profits paid to households, and $\hat{\pi}$ denotes profits excluding the financing cost (revenue minus production cost). We impose a binding limit $\overline{\delta}$ on the amount firms can borrow.

Firms' production function is

$$q_t = l_t \,,$$

and their cost is $C_t(q_t, w_t) = w_t \cdot q_t$. The borrowing limit restricts the amount firms can produce. Firms borrow each period $\lambda \cdot C_t = \overline{\delta}$, which implies firms produce $q_t = \overline{\delta}/\lambda \cdot w_t$.

3.3. Equilibrium

In equilibrium the non-traded good's market clears, determining its price P_N, where the condition for demand equals supply is given by

$$\chi \cdot c^s_{N\,t} + (1 - \chi) \cdot c^b_{N\,t} = q_{N\,t} \,.$$

Finally, we assume wages evolve according to the following Phillips curve:

$$w_t = w_{t-1} \cdot (1 + \kappa \cdot (N_{t-1} - N_{ss})) \,.$$

This assumption follows Martinez and Philippon (2014). We denote by N_{ss} the steady state

level of aggregate hours. The parameter κ regulates the speed of adjustment of wages, which is proportional to the deviation of aggregate hours from steady state. Wages are sticky, but in the limit $\kappa \to \infty$ the economy converges to one with flexible wages. The reason we adopt this formulation is that slow adjustment in wages prevents changes in firm borrowing limits from being absorbed immediately into wages, which would impacts on quantities, including trade, running counter to the empirical evidence, as we see below.

3.4. Calibration

A first set of parameters is chosen directly based on the literature. Following Eggertsson and Krugman (2012) and Martin and Philippon (2014) we assume half the households are constrained ($\chi = 0.5$). We assign a value 0.02 to the real interest rate, and set the discount factor of patient households such that $\beta^s = 1/(1+r)$. Based on Martinez and Philippon (2014) we set the slope of the Phillips curve $\kappa = 0.1$ and the inverse elasticity of labor supply ϕ is set to 1 as in Monacelli (2009).

The remaining parameters are the price of the export good (P_X), the price of the import good (P_M), the borrowing limit for impatient households ($\overline{D}$), the borrowing limit for firms ($\overline{\delta}$), and the fraction of firms' cost that must be financed before production takes place (λ). These parameters are set to target the following conditions. First, we target the trade balance equal to zero. Second, we target the ratio of exports (or imports) to GDP equal to the post-1990 sample mean (31%). Third, we target the terms of trade equal to one, such that the price of the import good is equal to the price of the export good. Fourth, we target the debt to income ratio of impatient households equal to one, and assumption which follows Eggertsson and Krugman (2012). Finally, we target the ratio of debt to revenue for

firms to equal 0.1.

3.5. Simulations

The goal of the model is to permit us to simulate the responses of the economy to deleveraging shocks to households and firms.

Demand shock We interpret a decline in the borrowing limit for impatient households as a *demand shock*. All else equal,such households are forced to spend less on consumption, given their reduced ability to borrow. On impact, they reduce their consumption as they borrow a now lower amount but still repay a higher amount borrowed in the previous period. This reduces demand for both the import and the non-traded good, leading to lower aggregate demand. In response, the price of the non-traded good falls. Lower demand for the import good leads to lower imports, while exports do not vary as they depend only on the borrowing limit to firms. We simulate the response to two types of shocks to impatient households' borrowing limit.

Figure 2 graphs the adjustment of exports, imports, the trade balance, and the price and consumption of the non-traded good in response to each of these shocks. The first shock, shown in panel A, is an unanticipated permanent decline in the borrowing limit. Given the fall in GDP, the ratio of exports to GDP rises while imports to GDP fall, as imports fall further than GDP. The trade balance rises in response to the decline in imports. The price of the non-traded good falls.

The second shock, in panel B of figure 2, is an unanticipated gradual decline and subsequent recovery in the borrowing limit, representing a more realistic multi-year finan-

cial crisis. This generates initially similar paths for exports, imports and the price of the non-traded good. All these series, however, recover and "overshoot" beyond the initial level as the borrowing limit returns to the original. The reason is that as the borrowing limit falls, constrained households are paying higher level of past debt than they can borrow, which reduces their consumption. As the borrowing limit increases, the opposite happens, leading to an increase in their consumption.

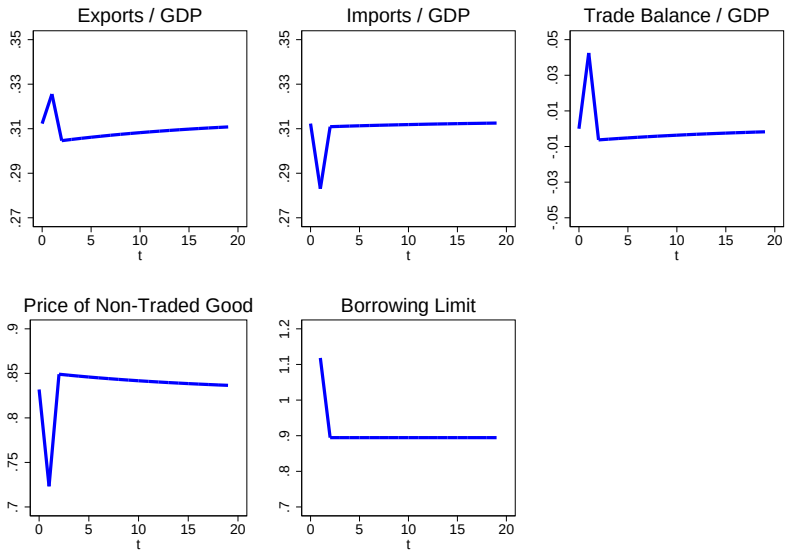
Supply shock In turn, we interpret a decline in the borrowing limit for firms as a *supply shock*. All else equal, every firm is forced to produce less output from less input, given their reduced ability to borrow.

The immediate impact is to reduce the production of both the export good and the non-traded good, as firms in both sectors face a tighter borrowing constraint. Exports fall directly due to the shock. Further, the price of the non-traded good rises due to a decline in supply. The shock also lowers wages and firm profits in both sectors. This leads to lower income to both patient and impatient households. Patient households are able to smooth the impact of the shock over time, with a minor decline in demand, but impatient households cannot borrow and translate their lower income fully into lower consumption.

Figure 3 illustrates the adjustment in response to this shock. As before, we simulate the economy's adjustment to both an unanticipated permanent decline in the firms' borrowing limit (in panel A) and an unanticipated gradual decline and subsequent recovery in the borrowing limit (in panel B). As with the shock to households, the gradual firm deleveraging shock in panel B generates a slight "overshooting" in all outcomes.

Figure 2: *Adjustment in Response to a Household Deleveraging Shock.*

Panel A: This figure describes the adjustment of the trade balance, exports, imports, and the price of the non-traded good to a 20 percent permanent reduction in impatient households' borrowing limit $\overline{D}$. The shock occurs in period t = 1.



Panel B: This figure describes the adjustment of the trade balance, exports, imports, and the price of the non-traded good to a gradual 20 percent reduction and subsequent recovery in impatient households' borrowing limit $\overline{D}$. The shock starts in period t = 1, with a 5 percent decline in the borrowing limit in the first four periods and a 5 percent increase in the following four periods.

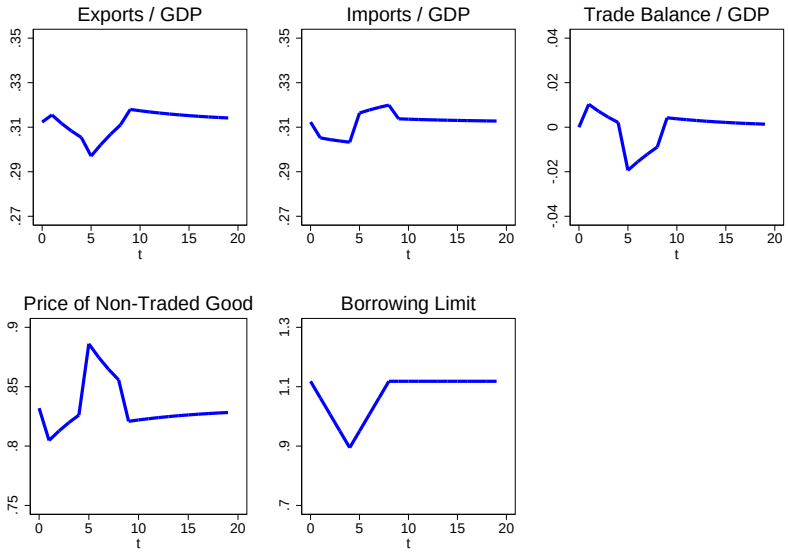
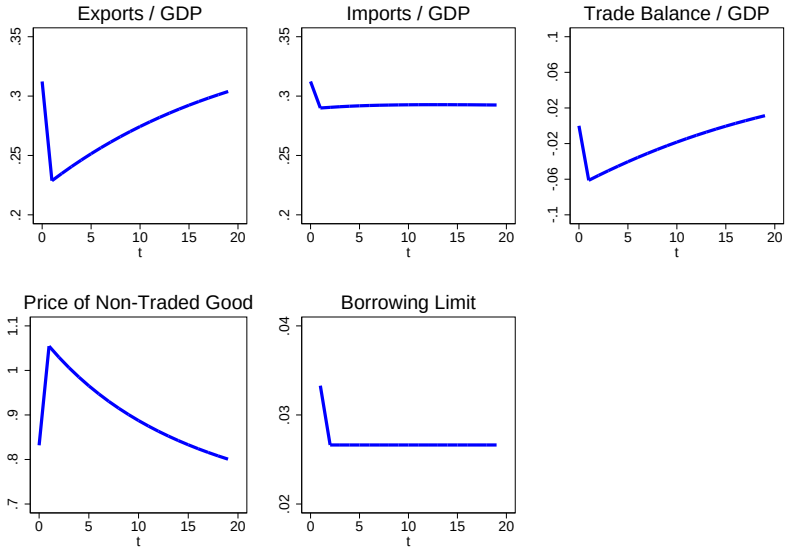
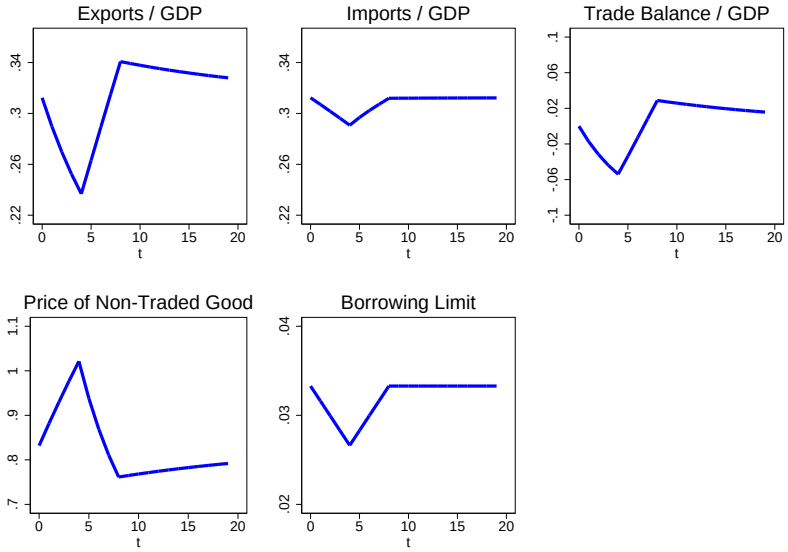


Figure 3: *Adjustment in Response to a Firm Deleveraging Shock.*

Panel A: This figure describes the adjustment of the trade balance, exports, imports, and the price of the non-traded good to a 20 percent reduction in in firms' borrowing limit $\bar{\delta}$. The shock occurs in period t = 1.



Panel B: This figure describes the adjustment of the trade balance, exports, imports, and the price of the non-traded good to a gradual 20 percent reduction and subsequent recovery in firms' borrowing limit $\bar{\delta}$. The shock starts in period t = 1, with a 5 percent decline in the borrowing limit in the first four periods and a 5 percent increase in the following four periods.



4. Response of Total Trade Flows to Financial Crises

Our first empirical exercise examines the evolution of countries' aggregate exports and imports following financial crises in our historical 1816–2014 panel. We count 172 such crisis episodes, a third of which occur in the developed countries in our sample. Reinhart and Rogoff (2009) and others have documented the deep impact of crisis episodes on various outcomes such as output, unemployment, and government debt, and the pace of recovery. With the same historical perspective, we will focus on international trade.

We graph the growth rates of real exports, imports and GDP in the years immediately before and following banking crises. We compute unweighted means across all episodes for the 70 countries in our sample. We identify the beginning of a crisis in year t and graph the growth rates of these outcomes in a pre-crisis period, in period t, and in the following three years. The series are normalized to zero in the pre-crisis baseline period. In each set of results, we graph real exports (in blue) and GDP (in red) on the left panel and real imports and GDP on the right. Figure 4(a) illustrates the results for the full set of countries.

Studies of the "trade collapse" during the recent Great Recession document and are motivated by the very large fall in trade in comparison to output. The first message that emerges from these figures is that historically this has been the normal behavior of trade following crises. Both exports and imports fall well beyond GDP. The second message—key to our main argument in this paper—is that the decline in imports is substantially larger than the fall in exports. In 4(a), which includes the entire 1816-2014 period and is based on 172 crisis episodes, the growth rate in real imports one year after a crisis starts (period $t+1$ in the figure) is 11 percentage points lower than in the pre-crisis period, while the

$t+1$ growth rate in exports is only 4 percentage points lower than in the pre-crisis period. A third finding from these figures is that the recovery is fairly fast. Growth rates of both exports and imports are back to normal in the second year after the start of a crisis.

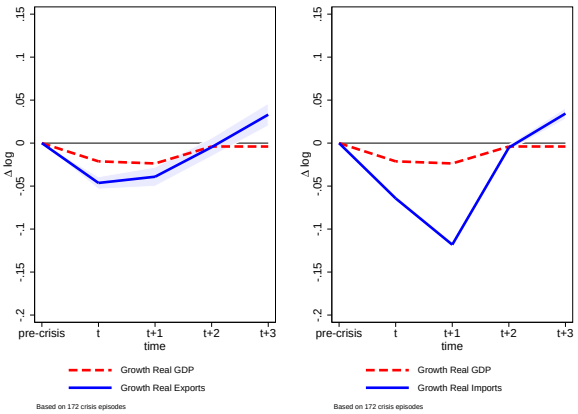
If we exclude the Great Recession, as shown in Figure 4(b), the results are very similar, with a slightly smaller drop in imports. In the post-WW2 sample shown in 4(c) the fall in imports is even larger than in the full sample with an average growth rate 14 percentage points lower than in the pre-crisis period. On the other hand, the fall in export growth rates in this period is somewhat softer than in the full sample. In the pre-WW2 sample where our data is less dense, we see drops in imports of similar magnitude compared to the full sample, but recoveries with much higher growth rates. In the case of exports, the decline is larger than in the post-WW2 years, and again differently than in this period, growth rates are above pre-crisis averages after the initial plunge.

We also examine the response of exports and imports in developed and developing countries separately, as shown in Figures 5 and 6 respectively. We count 14 countries in our sample as developed and the remaining 56 as developing. While largely our main messages remain valid for both samples, there are some differences. In the developed-country sample, during the post-WW2 period, differences in the decline in exports and imports following a crisis—while still there— are not as marked as in the developing country sample. Second, a feature of the developing country sample is the magnitude of the impact on imports, which, in the full sample is almost 50 percent larger. Finally, the results for the pre-WW2 period in developing countries (in 6(d)) are the only ones for which we don't observe the larger post-crisis drop in imports than in exports, although the precision of our estimates for this limited subsample is considerably lower.

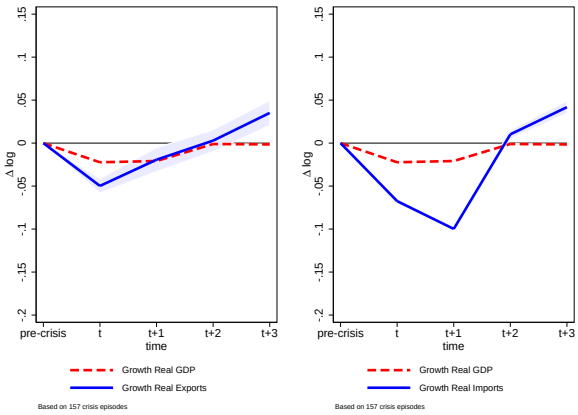
Figure 4: *Impulse Response: Full Sample.*

The red dashed line represents the growth rate of GDP and the blue solid line, the growth rate of exports (left) or imports (right). Shaded regions indicate 90% confidence intervals.

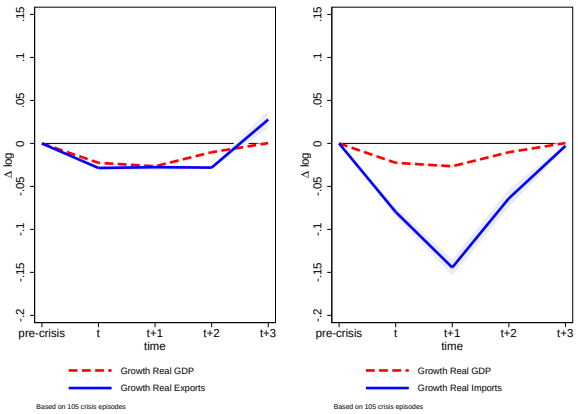
(a) *Entire Period*



(b) *Excluding Great Recession*



(c) *Post-WW2*



(d) *Pre-WW2*

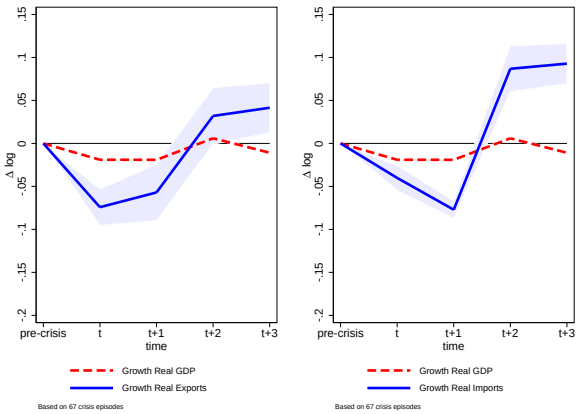
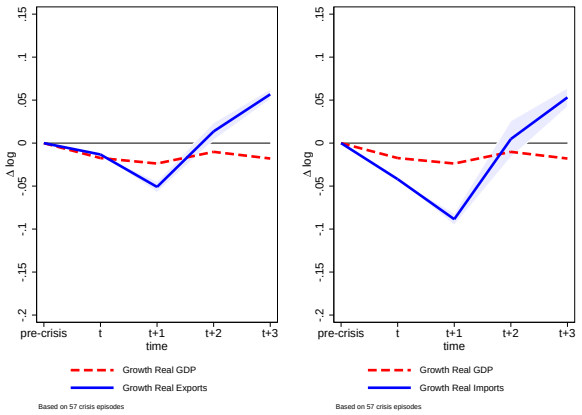


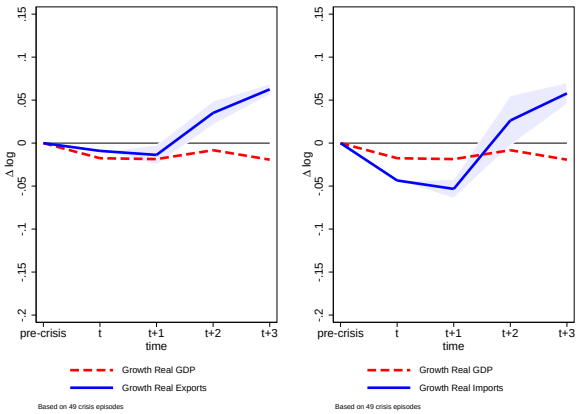
Figure 5: *Impulse Response: Developed Countries.*

The red dashed line represents the growth rate of GDP and the blue solid line, the growth rate of exports (left) or imports (right). Shaded regions indicate 90% confidence intervals.

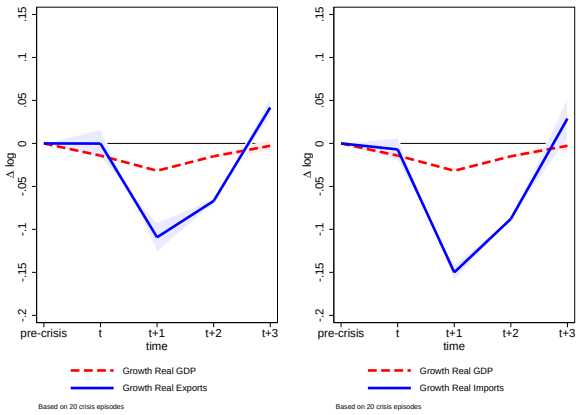
(a) *Entire Period*



(b) *Excluding Great Recession*



(c) *Post-WW2*



(d) *Pre-WW2*

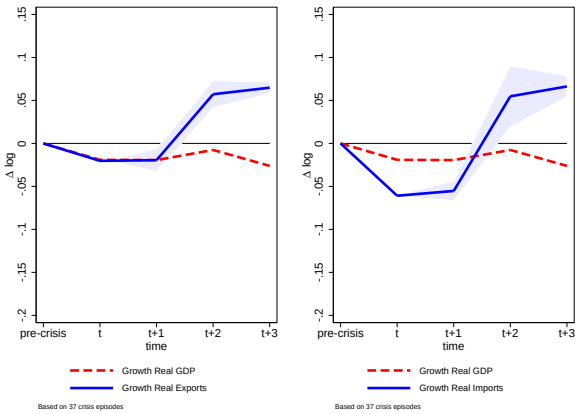
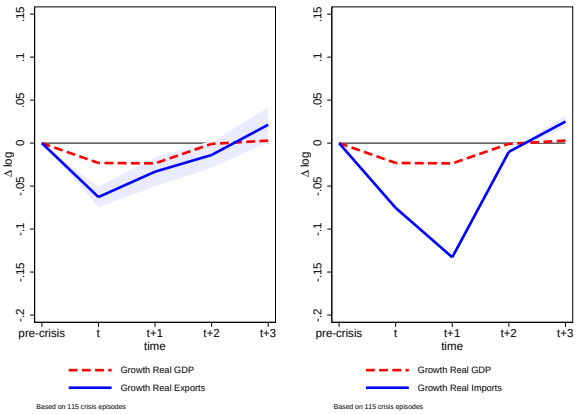


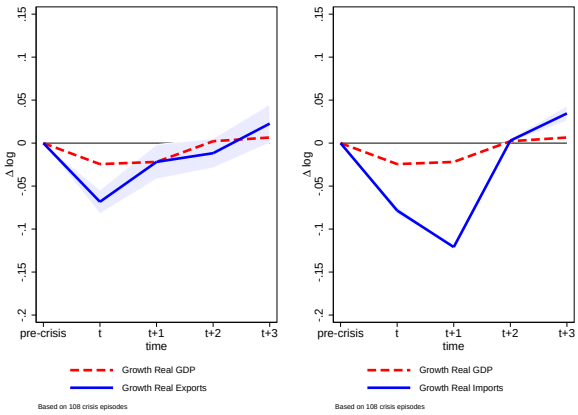
Figure 6: *Impulse Response: Developing Countries.*

The red dashed line represents the growth rate of GDP and the blue solid line, the growth rate of exports (left) or imports (right). Shaded regions indicate 90% confidence intervals.

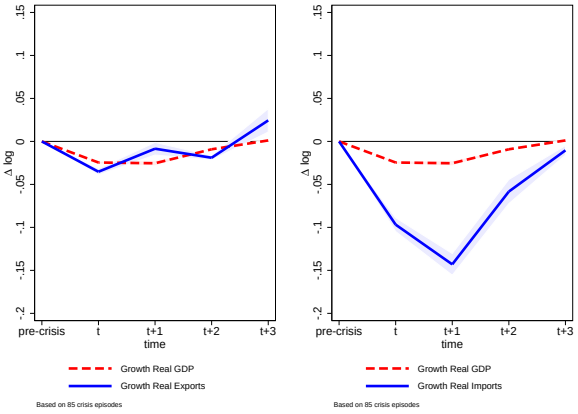
(a) *Entire Period*



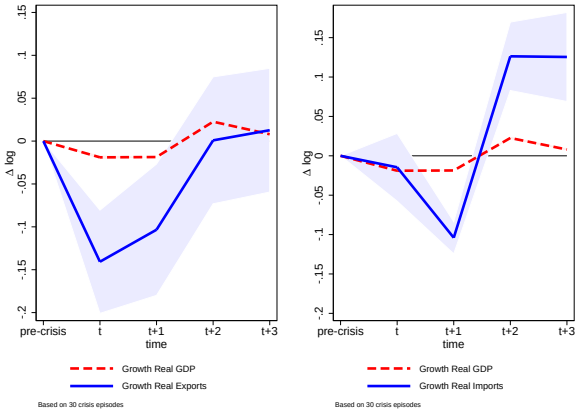
(b) *Excluding Great Recession*



(c) *Post-WW2*



(d) *Pre-WW2*



5. Response of Bilateral Trade Flows to Financial Crises

In this section we take our empirical work to the most granular level possible. We now consider all country pairs, in all years, and look at the post-crisis response of exports, imports, and the real exchange rate for every given pair-year observation. Not only will this greatly expand the number of observations, it will also allow us to more exactly control for the incidence of financial crises potentially affecting one or both trading partners in any given observation. As a starting point, we treat crises as exogenous events. Later we will address reverse causality, that is, the concern that financial crisis episodes might be a "nonrandom treatment" which is endogenous to macroeconomic conditions.

Formally, let $\ln T_{ijt}$ be the trade export flow from exporter country i to importer country j in year t, measured in real constant dollars. In the same units we also measure GDP levels in the two countries, denoted Y_{it} and Y_{jt}. As is standard gravity models of trade, and imposing a benchmark unit trade elasticity (homotheticity) with respect to country GDP size, we examine the size-normalized trade flow given by $\ln(T_{ijt}/[Y_{it}Y_{jt}])$. We are interested in the dynamic response of this object, in the aftermath of a financial crisis event in either country i or country j, or both. Thus, we denote by $Crisis_{it}$ the dummy variable which indicates the start of a financial crisis event in country i. We then trace out the response of the normalized trade flow from time t to time $t+h$ across all episodes, using the local projection method of Jordà (2005) and estimating the series of regression for each horizon h

$$\ln(T_{ij,t+h}/[Y_{i,t+h}Y_{j,t+h}]) - \ln(T_{ijt}/[Y_{it}Y_{jt}]) = \alpha_{ij}^h + \beta_t^h + \gamma_e^h Crisis_{it} + \gamma_i^h Crisis_{jt} + e_{ijt}\,,$$

where α_{ij}^h are country pair fixed effects and β_t^h are year fixed effects. Here, the coefficients of interest γ_e^h and γ_i^h denote the responses at horizon h to a financial crisis in the exporter and importer country, respectively. These coefficients will show how, controlling for pure GDP scaling effects, the financial crisis shock affects trade volumes between each country pair. The estimation is by OLS with standard errors clustered by pair and year, and all time-invariant pair characteristics (e.g., distance or other geographical factors) are absorbed in the fixed effects.

The full sample estimates are shown in Table 1 and in panel (a) of Figure 7. With about 200,000 observations we can obtain fairly good precision in the estimates. We find that on impact a financial crisis is associated with a *increase* in the normalized trade flow, +3.0% change, when the financial crisis event takes place in the exporter country. But we find that on impact a financial crisis is associated with a *decrease* in the normalized trade flow, -6.7% change, when the financial crisis event takes place in the importer country. The effects remain of a similar magnitude and statistically significant even out to the horizon h = 5 years, where the effects are +5.2% and -6.0%.

These patterns are clearly inconsistent with the supply-side view of financial crises, but quite consistent with the demand-side view of financial crises.

Next we turn to our model's predictions for the response of the real exchange rate. We are now estimating the series of regression for each horizon h

$$\ln RER_{ij,t+h} - \ln RER_{ij,t} = \alpha_{ij}^h + \beta_t^h + \gamma_e^h Crisis_{it} + \gamma_i^h Crisis_{jt} + e_{ijt}\,,$$

where again α_{ij}^h are country pair fixed effects, β_t^h are year fixed effects. The coefficients of

Table 1: *Local projections: response of bilateral trade to financial crisis in exporter or importer*

This table shows the response of the level of bilateral GDP-normalized trade $\ln T_{ij} - \ln Y_i - \ln Y_j$ to financial crisis in either exporter country i or importer country j. This measures deviations in trade relative to the scaled economic size of home and foreign, as in the gravity model. See text.

Financial crisis in exporter (year 0)	3.0*	2.4	3.5*	5.7**	5.2**
	(1.3)	(1.6)	(1.7)	(1.7)	(1.7)
Financial crisis in importer (year 0)	-6.7**	-10.6**	-8.2**	-6.0**	-6.0**
	(1.4)	(1.6)	(1.7)	(1.7)	(1.7)
N	198173	193950	189755	185592	181434

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$.

Table 2: *Local projections: response of bilateral RER to financial crisis in exporter or importer*

This table shows the response of the level of the bilateral real exchange rate $\ln E_{ij} + \ln P_j - \ln P_i$ to financial crisis in either exporter country i or importer country j. In the standard convention, this is the exporter side RER, so an increase is an exporter depreciation, a decrease is an importer depreciation. See text.

Financial crisis in exporter (year 0)	3.8**	0.8*	1.0*	0.9*	1.1*
	(0.5)	(0.4)	(0.4)	(0.4)	(0.4)
Financial crisis in importer (year 0)	-4.0**	-1.3**	-1.5**	-1.5**	-1.4**
	(0.5)	(0.4)	(0.4)	(0.4)	(0.4)
N	157279	152732	148455	144202	139983

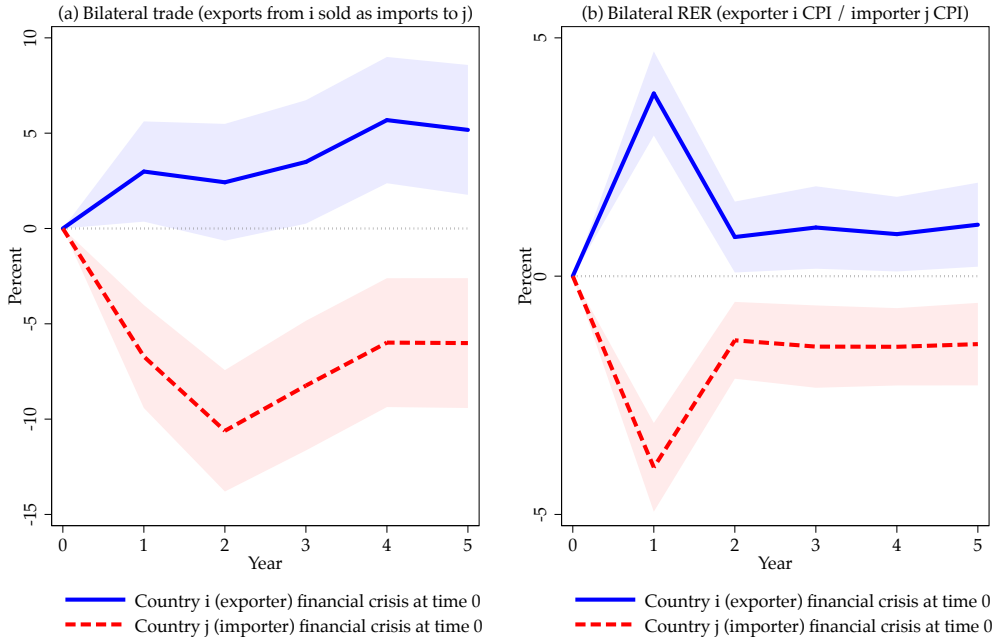
Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$.

interest γ_e^h and γ_i^h now show the post-crisis response of the real exchange rate between each country pair, where RER is defined as the importer's price level relative to the exporter's, both measured in a common currency. The estimation is again by OLS with standard errors clustered by pair and year.

The full sample estimates are shown in Table 2 and in panel (b) of Figure 7. We have now just 150,000 observations in Year 1, so precision is still quite good. On impact a financial

Figure 7: *Local projections: response of bilateral trade and RER to financial crisis in exporter or importer*

This figure shows the response of the level of bilateral GDP-normalized trade $\ln T_{ij} - \ln Y_i - \ln Y_j$ and the level of the bilateral real exchange rate $\ln E_{ij} + \ln P_j - \ln P_i$ to financial crisis in either exporter country i or importer country j. See text.



Notes: Shaded regions indicate 90% confidence intervals.

crisis is associated with an *appreciation* in the real exchange rate, +3.8% change, when the financial crisis event takes place in the exporter country. But we find that on impact a financial crisis is associated with a *depreciation* in the real exchange rate, -4.0% change, when the financial crisis event takes place in the importer country. Even at horizon $h = 5$ years, the effects are +1.1% and -1.4% and statistically significant.

Again, the patterns are clearly inconsistent with the supply-side view, but quite consistent with the demand-side view of financial crises.

6. Crisis Endogeneity and Inverse Probability Weighting

We address the concern that financial crisis episodes might be endogenous to macroeconomic conditions using the method of inverse probability weighting. This procedure assigns more influence in our bilateral trade and RER regressions to observations that are relatively unpredictable by prior macroeconomic conditions. This method has been discussed in a time series context by Angrist *et al.* (2017) and applied to the study of financial crises (Jordà *et al.* (2011) ; Jordà *et al.* (2016)) and to the study of fiscal policy (Jordà and Taylor (2016)).

To start, we construct a first-stage estimator of the probability that country c has a financial crisis at time t. As a predictor of crises, we use credit growth over the five-year period leading to each crisis (between years $t-6$ and $t-1$). This choice follows Schularick and Taylor (2012) who show that credit growth is a powerful predictor of financial crises.[6] We fit logit models for the probability of experiencing a financial crisis including either country or country and year fixed effects.

A successful predictor of our binary outcome (to experience or not a financial crisis) will maximize the rate of true positives and minimize the rate of false positives. An "ROC" curve reflects the trade-off between these two goals. The "area under the ROC curve" statistic summarizes the predictor's quality in this regard.[7] This statistic ranges from 0.5 (for a predictor not different than a random guess) to 1 (for a perfect predictor), and is independent of the cutoff value used to predict an outcome.

We report the first-stage results in table 3. Column 1 corresponds to the benchmark case

[6] Credit is measured as domestic credit to GDP and obtained from the World Bank's World Development Indicators. Credit data is only available for our wide sample of developed and developing countries for the post-WWII period.

[7] See Jordà and Taylor (2011) for a detailed explanation of these concepts.

Table 3: *First Stage: Financial Crisis Prediction*

This table shows the results of the logit model of the probability of a financial crisis at time t on credit growth between $t-6$ and $t-1$. See text.

	(1)	(2)	(3)
Credit Growth		0.0230**	0.0222**
		(0.0056)	(0.0061)
Country Fixed Effects	Y	Y	Y
Year Fixed Effects	N	N	Y
N	3575	2879	1878
AUC	0.622	0.666	0.728
	(0.0272)	(0.0288)	(0.0223)

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$.

with only country fixed effects, against which we assess the usefulness of credit growth as a crisis predictor. In column 2 we add credit growth, and in column 3 we add year fixed effects. As shown by Schularick and Taylor (2012), positive credit growth has a statistically significant impact on the probability of experiencing a financial crisis. Further, the AUC statistic in columns 2 and 3 is higher - and statistically different - than in our benchmark case in column 1, showing the contribution for credit growth as a financial crisis predictor.

We label $\hat{p}_{ct}$ the predicted probability that country c experiences a crisis at time t, and $1-\hat{p}_{ct}$ the probability it does not. We construct weights for our bilateral trade and RER regressions based on these predicted probabilities as follows. We weight observations in which both the exporter i and the importer j experience a financial crisis by $\frac{1}{\hat{p}_{it}\cdot\hat{p}_{jt}}$. In cases where both exporter and importer do not face a crisis, we assign weights $\frac{1}{(1-\hat{p}_{it})\cdot(1-\hat{p}_{jt})}$. Finally, we assign weights $\frac{1}{\hat{p}_{it}\cdot(1-\hat{p}_{jt})}$ for cases with a crisis in the exporter only, and $\frac{1}{(1-\hat{p}_{it})\cdot\hat{p}_{jt}}$ for cases with a crisis in the importer only. Note that the construction of these weights assumes that the probability of facing a crisis is independent across countries.

We then re-estimate our bilateral trade regression using these weghts. As shown in table 4, the results are largely unchanged and our main message subsists. We find (in panel (b)) a similar decrease by -6.9% in the normalized trade flow when the financial crisis event takes place in the importer country, while we had found a -6.7% change in the initial, unweighted results. As before, this impact is highly persistent.

Finally, we also repeat the estimation of the bilateral RER equation using IPW in table 5, also finding results similar to the baseline ones. The weighted results – a 3.8% increase when the financial crisis event takes place in the exporter country and a 4.0% decrease when it hits the importer country, are very similar, although somewhat more persistent, to the new weighted results in panel (b) of table 5 (a 2.8% increase on impact follwoing crises in the exporter and a 2.5% decrease following crises on the importer).

7. Conclusions

We have developed a simple small open economy model, where a country is subject to "financial crisis" deleveraging shocks that impose tighter borrowing limits on households and/or firms. These shocks leave distinct statistical signatures in the empirical time series record, and they divide sharply between each type of shock. Household deleveraging shocks are mainly demand shocks, contract imports, leave exports largely unchanged, and depreciates the real exchange rate. Firm deleveraging shocks are mainly supply shocks, contract exports, leave imports largely unchanged, and appreciate the real exchange rate.

Taking this model to the data, we compiled a crossed dataset of 200+ years of trade data and dates of 100+ financial crises in a large sample of countries. We use empirical methods to get a clearer picture of how financial distress affects trade and relative prices.

Table 4: *Local projections: response of bilateral trade to financial crisis in exporter or importer*

This table shows the response of the level of bilateral GDP-normalized trade $\ln T_{ij} - \ln Y_i - \ln Y_j$ to financial crisis in either exporter country i or importer country j. This measures deviations in trade relative to the scaled economic size of home and foreign, as in the gravity model. Regressions are weighted using IPW. See text.

Panel A: IPW with country fixed-effects.

	Year 1	Year 2	Year 3	Year 4	Year 5
Financial crisis in exporter (year 0)	1.4	-0.1	1.8	4.3	3.8
	(1.8)	(2.5)	(2.7)	(2.6)	(2.7)
Financial crisis in importer (year 0)	-4.4*	-11.1**	-10.3**	-10.5**	-9.8**
	(1.7)	(2.4)	(2.6)	(2.5)	(2.6)
N	129391	125928	122469	119030	115601

Panel B: IPW with country and year fixed-effects.

	Year 1	Year 2	Year 3	Year 4	Year 5
Financial crisis in exporter (year 0)	2.0	0.9	2.6	4.9*	4.5
	(1.8)	(2.3)	(2.5)	(2.5)	(2.5)
Financial crisis in importer (year 0)	-6.9**	-13.5**	-12.0**	-11.3**	-9.9**
	(1.7)	(2.2)	(2.4)	(2.3)	(2.4)
N	90911	90689	90461	90326	90174

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$.

Table 5: *Local projections: response of bilateral RER to financial crisis in exporter or importer*

This table shows the response of the level of the bilateral real exchange rate $\ln E_{ij} + \ln P_j - \ln P_i$ to financial crisis in either exporter country i or importer country j. In the standard convention, this is the exporter side RER, so an increase is an exporter depreciation, a decrease is an importer depreciation. Regressions are weighted using IPW. See text.

Panel A: IPW with country fixed-effects.

	Year 1	Year 2	Year 3	Year 4	Year 5
Financial crisis in exporter (year 0)	3.7**	0.2	-0.9	1.1	1.0
	(0.9)	(0.6)	(0.6)	(0.8)	(0.8)
Financial crisis in importer (year 0)	-2.9**	0.7	0.5	-0.2	-0.7
	(0.9)	(0.6)	(0.6)	(0.8)	(0.9)
N	112661	108947	105373	101760	98167

Panel B: IPW with country and year fixed-effects.

	Year 1	Year 2	Year 3	Year 4	Year 5
Financial crisis in exporter (year 0)	2.8**	0.6	-0.5	1.3*	0.7
	(0.7)	(0.5)	(0.6)	(0.7)	(0.7)
Financial crisis in importer (year 0)	-2.5**	0.3	0.3	-0.7	-0.4
	(0.7)	(0.5)	(0.6)	(0.7)	(0.7)
N	81100	79879	78559	77248	75906

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$.

Very clearly, after a financial crisis event we see, on impact, that imports contract, exports hold steady or even rise, and the real exchange rate depreciate, with effects persisting for five years.

Based on both price and quantity evidence from the very long run, a robust interpretation emerges. History shows that on average financial crises are not, for the most part, a supply shock. Rather, they are very clearly a negative shock to demand.

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Appendices

Table A.1: *List of financial crises.*

This table lists all financial crisis episodes in our dataset. See text.

Country	Crisis years
Algeria	1990
Angola	1992
Argentina	1890, 1914, 1931, 1980, 1989, 1995, 2001
Australia	1828, 1843, 1893, 1931, 1989
Austria	1873, 1924, 1929, 2008
Belgium	1838, 1848, 1870, 1914, 1925, 1931, 1939, 2008
Bolivia	1986, 1994
Brazil	1890, 1897, 1914, 1923, 1963, 1985, 1990, 1994
Canada	1837, 1866, 1873, 1906, 1912, 1923, 1983
Central African Republic	1976, 1988
Chile	1890, 1899, 1907, 1915, 1926, 1976, 1982
China	1863, 1873, 1883, 1897, 1910, 1923, 1931, 1992
Colombia	1982, 1998
Costa Rica	1987, 1994
Cote d'Ivoire	1988
Denmark	1857, 1877, 1885, 1902, 1907, 1921, 1931, 1987, 2008
Dominican Republic	1996, 2003
Ecuador	1981, 1998
Egypt	1907, 1981, 1990
El Salvador	1989
Finland	1921, 1931, 1939, 1991
France	1881, 1889, 1907, 1914, 1930, 1939, 1994, 2008
Ghana	1982, 1997
Greece	1931, 1991, 2008
Guatemala	1990, 2001, 2006
Honduras	1999
Hungary	1931, 1991, 2008
Iceland	1985, 1993, 2007
India	1863, 1908, 1913, 1921, 1929, 1947, 1993
Indonesia	1992
Ireland	1836, 1856, 2007
Italy	1866, 1887, 1891, 1907, 1914, 1921, 1930, 1935, 1990
Japan	1901, 1907, 1914, 1923, 1927, 1992
Kenya	1985
Malaysia	1985, 1997

Notes: The data on financial crisis dates are obtained from Reinhart and Rogoff (2011).

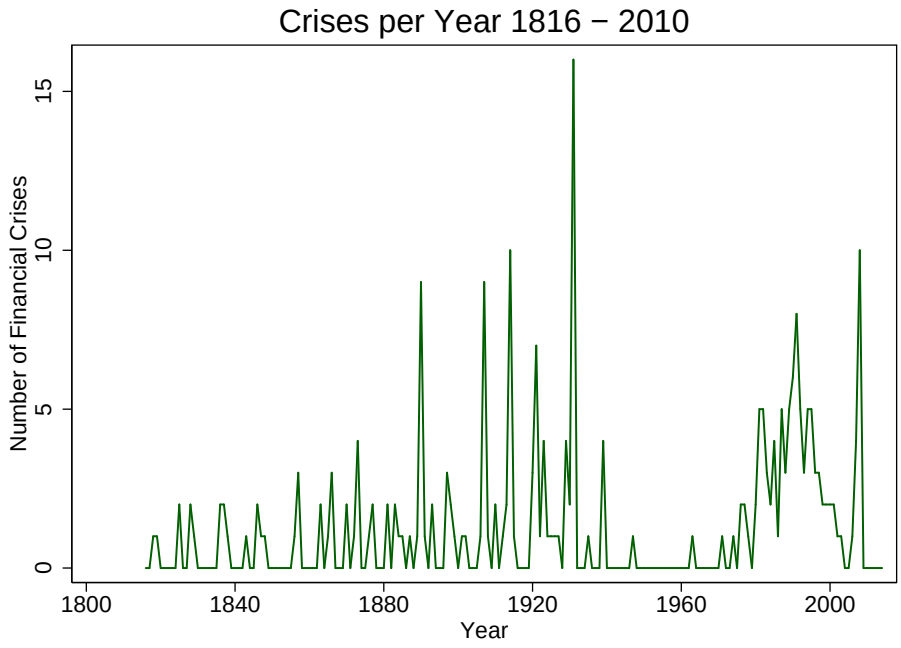
Table A.2: *List of financial crises, CONTINUED.*

Country	Crisis years
Mexico	1883, 1907, 1913, 1920, 1929, 1981, 1994
Morocco	1983
Myanmar	1996
Netherlands	1819, 1897, 1914, 1921, 1939, 2008
New Zealand	1890, 1987
Nicaragua	1987, 2000
Nigeria	1992
Norway	1898, 1914, 1921, 1931, 1987
Panama	1988
Paraguay	1890, 1995
Peru	1872, 1983, 1999
Philippines	1981, 1997
Poland	1931, 1991
Portugal	1828, 1846, 1890, 1920, 1931, 2008
Romania	1931, 1990
Singapore	1982
South Africa	1865, 1877, 1881, 1890, 1977, 1989
Spain	1829, 1846, 1920, 1931, 1977, 2008
Sri Lanka	1989
Sweden	1876, 1907, 1922, 1931, 1991
Switzerland	1870, 1910, 1921, 1931, 2008
Thailand	1980, 1996
Tunisia	1991
Turkey	1931, 1982, 1991, 2000
United Kingdom	1825, 1837, 1847, 1857, 1866, 1890, 1914, 1974, 1984, 1991, 1995, 2007
United States	1818, 1825, 1836, 1857, 1873, 1884, 1890, 1907, 1914, 1929, 1984, 2007
Uruguay	1893, 1898, 1971, 1981, 2002
Venezuela	1978, 1993
Zambia	1995
Zimbabwe	1995

Notes: The data on financial crisis dates are obtained from Reinhart and Rogoff (2011).

Figure A.1: *Frequency of financial crises*

This figure shows the number of financial crises per year. See text.



Notes: The data on financial crisis dates are obtained from Reinhart and Rogoff (2011).