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

Felipe Benguria† Alan M. Taylor‡

March 2020

Abstract

Are financial crises a negative shock to aggregate demand or a negative shock to aggregate supply? This is a 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 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 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 the largest possible crossed dataset of 200+ years of trade flows and almost 200 financial crises in a wide sample of countries. Empirical analysis reveals a clear picture: after a financial crisis event we find the dominant pattern to be that imports contract, exports hold steady or even rise, and the real exchange rate depreciates. On the basis of this macro-level evidence, financial crises are a negative shock to demand.

Keywords: financial crises, deleveraging, imports, exports, local projections.

JEL classification codes: E44, F32, F36, F41, F44, G01, N10, N20.

*This work was kindly supported by a research grant from The Bankard Fund for Political Economy at the University of Virginia. We benefitted from helpful comments from conference participants at the 2017 NBER Summer Institute. We are especially thankful to our discussant Julian di Giovanni. All errors are our own.

†Department of Economics, University of Kentucky (fbe225@uky.edu).

‡Department of Economics and Graduate School of Management, University of California, Davis; NBER; and CEPR (amtaylor@ucdavis.edu).

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

In particular, we ask a novel and very general question: *are financial crises, on average, associated with a negative shock to aggregate demand or to aggregate supply*? This is an important question to answer, because it can help guide better policy responses to future financial crises. Arguably, had we known more in 2008, and known what was to blame for the Great Recession, we might have had more effective policy responses. In real time, clarity was lacking: many sided with a demand shock explanation, but others argued the problem was on the supply side. Yet there were few evidence-based arguments based on similar events in the past. History can shed new light to cut through the intellectual and political fog.

We first develop a simple small open economy model. The home country is subject to deleveraging shocks. The new theoretical contribution is that these shocks can impose binding credit constraints either on households or on firms, or both. We build on Eggertsson and Krugman (2012)—in which households adjust deleveraging shocks—by adding an analogous shock to firms and extending the framework to an open economy setting with a nontradable sector and an endogenous real exchange rate. In the simulations of the model, we treat financial crisis events as household or firm deleveraging shocks, and ask what statistical signatures each kind of event would leave in the empirical time series record.

The answers are clear and divide sharply between each type of shock. Household deleveraging shocks, setting aside second-order equilibrium effects, are pure demand shocks; these 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 tend to contract exports, leave imports largely unchanged, and appreciate the real exchange rate. These clear contrasts in the model predictions help us take the model to the data.

We then present our empirical evidence. The rationale for a long time frame is that 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, 2011a; Schularick and Taylor, 2012). Our analysis therefore centers on a substantial effort to assemble a new large historical dataset. In particular we 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 almost 200 financial crises, and use empirical methods to get a clearer picture of how financial distress typically affects trade.

What does history show? When we look at the long-run trade and price data, match them with established financial crisis timings, and trace out the high frequency responses, do we find that financial crises exhibit the symptoms of demand shocks or supply shocks?

Very clearly, after a financial crisis event we see statistical evidence strongly in favor of the demand-side view: on impact, 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 sample size exceeds 150,000 country pair-year observations for trade flows and real exchange rates. The effects persist out to a five-year horizon.

An important caveat is that to test these claims at the micro-level would need extensive firm and household level data for every country and year going back to the early nineteenth century. Of course, such data do not exist, and are scarce even in advanced economies after WW2. Thus our macro-level diagnostic tests may provide the best answer to the question at this time, given data constraints and the challenges of analyzing historically rare events.

Our results form part of an emerging view that household debt and deleveraging cycles play a highly influential role in economic fluctuations (Jorda, Schularick, and Taylor, 2013; Mian, Sufi, and Verner, 2017), but one novel contribution here is to bring evidence on international adjustment into the debate as an extra tool for validation.

We also dig deeper than just a single aggregate response. In both theory and empirics, we further distinguish between trade in final goods and trade in intermediate inputs. In our model, household deleveraging shocks reduce the demand for imported final goods. In addition, households demand fewer nontraded goods, causing firms to import fewer intermediate inputs. In the case of firm deleveraging shocks, which limit production, imports of intermediate inputs fall, whereas imports of final goods are largely stable. We construct data on trade by product type for the post-WW2 period, and find that financial crises depress imports of both final and intermediate goods: further evidence consistent with our demand-side view of crises.

Our results are stable across developed and developing countries, although the decline in imports is deeper following financial crises in the latter. We also ask whether financial crises in different eras have had different consequences. The answer is no; while we lose some precision in pre-WW2 estimates, in part due to a smaller sample size, qualitatively the response of trade flows and prices is fairly stable across different eras.

In addition, we allow for the possibility that financial crises are endogenous to macroeconomic conditions. We use inverse propensity-score weighting to address the problem of bias arising from selection on observables. Following Jordà, Schularick, and Taylor (2011) we use pre-crisis credit growth as a predictor of financial crises in our first stage. Reassuringly, all of our results remain unchanged. We also acknowledge that economies

are exposed to various types of crises, not just financial ones. Consequently, we extend our dataset with the dates of currency and inflation crises, stock-market crises, and external and domestic sovereign debt crises, relying on the dates from Reinhart and Rogoff (2011a). Our results are robust to jointly controlling for all these other kinds of crises.

Gaps in our knowledge exposed by the crisis have encouraged a return to economic history to evaluate broad questions using a larger universe of data and gain better evidence on how crises affect the macroeconomy. In this paper, we find that clearly, over a long sweep of history, the dominant effects of a financial crisis correspond to the theoretical predictions of a demand shock, not a supply shock, judged by the responses of trade flows and real exchange rates.

Contribution to the Literature Our focus on trade takes off from an emerging literature following the 2008 financial crisis. A wave of studies attests to the interest in the study of the repercussion of financial crises for exports and imports in an open economy. Most of this work seeks to establish the reasons behind the observed collapse of international trade. 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, Mishra, and Topalova, 2014).[1]

Another idea is that trade in inputs is subject to greater fixed costs of shipments; fixed costs induce periodic ordering, but wait-and-see can postpone trades when a supply shock hits the input importer (Alessandria, Kaboski, and Midrigan, 2010). Also, some of the trade collapse could be a composition effect, since trade is dominated by durable goods and intermediate inputs, which are much more cyclical than GDP itself (Levchenko, Lewis, and Tesar, 2010; Eaton, Kortum, Neiman, and Romalis, 2016; Behrens, Corcos, and Mion, 2013; Bussière, Callegari, Ghironi, Sestieri, and Yamano, 2013). Finally, increases in uncertainty, often associated with financial crisis events, may trigger a disproportionate decline in imports relative to domestic 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, Forthcoming).[2]

[1]Two papers examine the response of trade flows to crises over recent decades. Iacovone and Zavacka (2009) study the response of exports to credit conditions in 23 crises episodes during 1980–2006. Abiad, Mishra, and Topalova (2014) study the impact of both financial and sovereign debt crises during 1970–2009 on imports and exports, finding that crises primarily depress imports. Our approach builds on but differs substantially from this work. The main difference is our goal. Our findings and our model work together to answer the key question in our paper: are financial crises demand or supply shocks? We also expand the time horizon fivefold: as noted, we study only large financial crises which are rare events. In addition, we focus not only on international trade flows but also on prices to distinguish the demand versus supply shock explanations.

[2]These and other explanations are gathered in Baldwin (2009). Further empirical work includes Freund

These and other explanations may not be mutually exclusive. Our contribution is to develop a simple model that admits both demand and supply shocks, with clear, distinct predictions for the responses of international trade flows and prices under each type of shock. We depart from standard trade models by adapting recent intertemporal models of deleveraging shocks to an open economy setting. Our model's predictions can be told apart very cleanly upon examining the data. Our interest is not the economic response to a single crisis episode but in the average response to nearly 200 episodes over two centuries.

We also contribute to a literature documenting the causes and consequences of financial crises (Reinhart, 2010; Reinhart and Rogoff, 2011a; Schularick and Taylor, 2012; Jordà, Schularick, and Taylor, 2011). In the same spirit we look to the past record from many crisis episodes over decades or centuries. Past works examined the impact of crises on several macroeconomic outcomes, such as GDP and unemployment, but not on international trade and prices as we do. Much of this literature focuses on documenting the consequences, not causes, of financial crises. Work that does ask for causes (such as Schularick and Taylor, 2012) points to the role of credit, but does not seek to answer whether these events should be understood as demand or supply shocks.

Finally, our work meshes with a growing literature on the recent Great Recession. In particular, Mian, Rao, and Sufi (2013) find a large contraction in household spending in the U.S. as a consequence of declining housing net worth; Mian and Sufi (2014) establish that this led in turn to a large decline in employment; Mian, Sufi, and Verner (2017) provide global evidence of the same character. These and other findings from recent data echo the demand-side view that our long-run historical evidence strongly supports.

I. 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).[3] 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 a sticky-wage economy populated by patient and impatient households. These households derive utility from the consumption of an import good and

(2009) who examines the response of trade to global downturns; and Bems, Johnson, and Yi (2011) who study the role of vertical linkages in amplifying the trade collapse.

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

a nontraded good. Firms in the economy produce a nontraded good sold locally and an export good sold abroad. They produce using labor and imported inputs and must borrow to finance a share of their production cost in advance. Both impatient households and firms face exogenous, binding borrowing limits, and we study the impact on the economy of sudden declines in the amount that households or firms can borrow.[4]

A. Households

We assume that households maximize lifetime utility

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

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 nontraded good, respectively. The household budget constraint supposes that they receive income as a wage for labor supplied to local firms in the nontraded 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 nontraded 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

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

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

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

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

[4] An additional mechanisms through which financial crises could impact trade flows is through a tightening in trade finance. Amiti and Weinstein (2011) and Paravisini, Rappoport, Schnabl, and Wolfenzon (2014) find evidence of falling exports due to a decline in trade finance during a crisis.

[5] We assume patient households receive profits for simplicity, as in Martinez and Philippon (2014).

B. Production

We assume that in both the export and the nontraded sectors there is a continuum of firms of measure one that produce output using labor and imported inputs. 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 nontraded sector sell their good domestically at a price P_N determined in equilibrium. Inputs are traded at the exogenous world price P_I.

In each sector, 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 in each sector $S \epsilon \{N, X\}$ the firms' budget constraint is given by

$$\widehat{\pi}_{S\,t} + \delta_{S\,t} = \delta_{S\,t-1} \cdot (1 + r_{t-1}) + \pi_{S\,t}\,,$$

where $\delta_{S\,t}$ is the amount borrowed in period t, $\pi_{S\,t}$ denotes profits paid to households, and $\widehat{\pi}_{S\,t}$ denotes profits excluding the financing cost (revenue minus production cost). When simulating a firm deleveraging shock, we impose a binding limit $\overline{\delta}_S$ on the amount firms can borrow and that will be tightened suddenly by the shock.

Firms have the following generalized CES production function:

$$q_{S\,t} = \left(\theta \cdot l_{S\,t}^{\rho} + (1-\theta) \cdot i_{S\,t}^{\rho}\right)^{\frac{\epsilon}{\rho}}\,,$$

with $\epsilon < 1$, which implies decreasing returns to scale.[6] Firms' production cost is then given by $C_{S\,t}(q_{S\,t}, w_t, P_I) = (\theta^{\sigma} \cdot w_t^{1-\sigma} + (1-\theta)^{\sigma} \cdot P_I^{1-\sigma})^{\frac{1}{1-\sigma}} \cdot q_{S\,t}^{1/\epsilon}$, with $\sigma = \frac{1}{(1-\rho)}$.

In the absence of a binding borrowing constraint, firms—which are price takers—will optimally produce at an output level

$$q_{S\,t} = \left(\epsilon \cdot p_{S\,t} / \left(\theta^{\sigma} \cdot w_t^{1-\sigma} + (1-\theta)^{\sigma} \cdot P_I^{1-\sigma}\right)^{\frac{1}{1-\sigma}}\right)^{\epsilon/1-\epsilon}\,,$$

while borrowing as necessary. However, at times when the borrowing constraint is present and binding the firms will be restricted in the amount that they can produce. Firms then borrow $\lambda \cdot C_{S\,t} = \overline{\delta}_S$ each period. This, in turn, implies that firms can only produce

$$q_{S\,t} = \left(\overline{\delta}_S / \left(\lambda \cdot \left(\theta^{\sigma} \cdot w_t^{1-\sigma} + (1-\theta)^{\sigma} \cdot P_I^{1-\sigma}\right)^{\frac{1}{1-\sigma}}\right)\right)^{\epsilon}\,.$$

[6] Imposing decreasing returns to scale in the production function will allow both quantities and prices to respond to shocks.

C. Equilibrium

In equilibrium the nontraded goods market clears, determining its price P_N, where the condition for demand equals supply is:

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

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

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

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. Under sticky wages, shocks can lead to an excess supply of labor (unemployment) in which the equilibrium is demand-determined. Following Martinez and Philippon (2014) we ration the labor market uniformly between the patient and impatient households.

D. Simulations

The aim of the model is to simulate the responses of the economy to deleveraging shocks to households and firms. The calibration of the model, extensions, and robustness are discussed in Appendix A.

Demand shock We interpret a decline in the borrowing limit for impatient households as a *demand shock*.[7] All else equal, such households consume less, given a reduced ability to borrow. On impact, they reduce 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 imported final good and the nontraded good, leading to lower aggregate demand. In response, the price of the nontraded good falls. Firms in the nontraded sector adjust production, lowering their demand for the intermediate input. Lower demand for both the imported final good and the intermediate input leads to lower imports. Exports vary only due to general equilibrium effects, as world demand is unchanged.

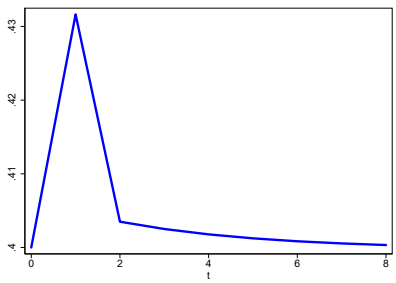
We simulate the response to two types of shocks to impatient households' borrowing limit. Figure 1 graphs the adjustment of exports, imports of the final good, the intermediate input, and total imports, the trade balance, and the price of the nontraded good in response

[7] When simulating this household deleveraging shock, we allow firms to borrow freely.

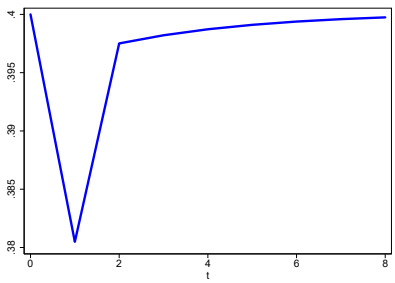
Figure 1: *Adjustment in Response to a Household Deleveraging Shock.*

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

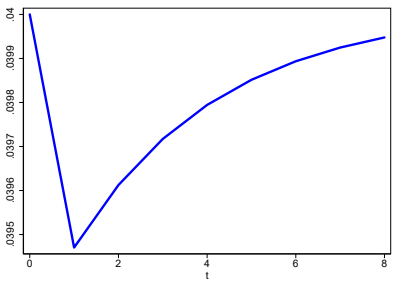
(a) *Exports / GDP*



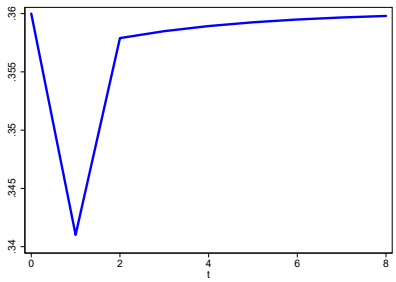
(b) *Imports / GDP*



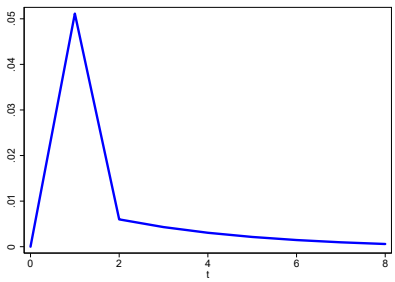
(c) *Imports of Inputs / GDP*



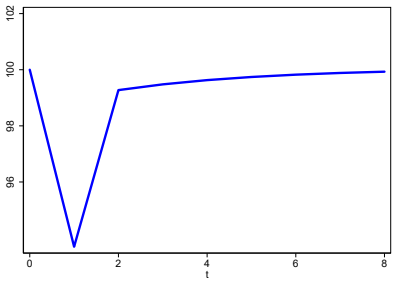
(d) *Imports of Final Goods / GDP*



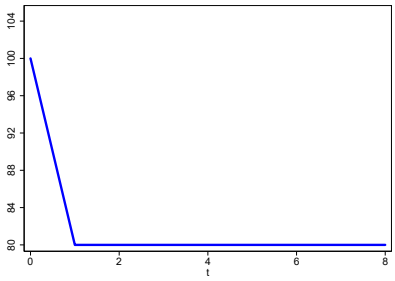
(e) *Trade Balance / GDP*



(f) *Price of Nontraded Good*



(g) *Households' Borrowing Limit*



to each of these shocks. The first shock, 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. Imports of both the final good and the intermediate input fall. The trade balance rises in response to the decline in imports. The price of the nontraded good falls.

Supply shock In turn, we interpret a decline in the borrowing limit for firms as a *supply shock*. All else equal, firms must produce less output from less input, given a reduced ability to borrow. The immediate impact is to reduce the production of both the export good and the nontraded good, as firms in both sectors face a tighter borrowing constraint. Exports fall directly due to the shock. Further, the price of the nontraded good rises due to a decline in supply. A lower amount of credit to produce leads to a lower demand for the imported input by both the export and the nontraded sectors. 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. The ratio of imports of final goods to GDP rises as the fall in GDP is larger than the fall in imports. Total imports to GDP rise, as the rise in final goods to GDP dominates the decline in imported inputs to GDP.

Figure 2 illustrates the economy's adjustment in response to this type of shock, where, as before, we simulate an unanticipated permanent decline in firms' borrowing limit.

II. Data: Trade and Financial Crises over Two Centuries

The dataset used in this paper includes 69 developed and developing countries and covers the period 1816–2014. We combine bilateral trade flows between all country pairs with data on financial crises, GDP, and bilateral real exchange rates. Further details on these data are provided in Appendix B.

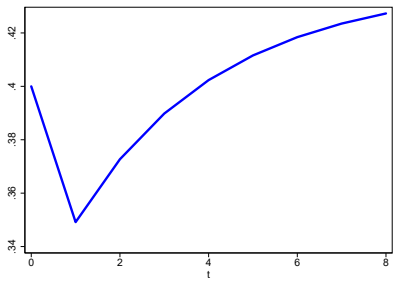
Financial Crises Dates We rely on data on the dates of financial (i.e., banking) crises compiled by Reinhart and Rogoff (2011a). They define banking crises as episodes where bank runs lead to the public sector assuming control of financial institutions, and/or episodes of large-scale financial assistance from the government to financial institutions. These data are available for 70 countries.[8,9] Reinhart and Rogoff (2011a) mark financial crisis dates using dummy variables at an annual frequency. We identify the first year of

[8]We exclude Taiwan from our sample due to a lack of recent trade and GDP data.
[9]Table A.2 reports the list of countries and the financial crises start dates.

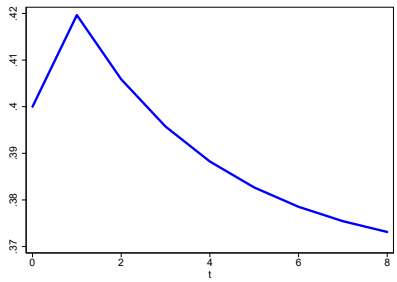
Figure 2: *Adjustment in Response to a Firm Deleveraging Shock.*

This figure describes the adjustment of the trade balance, exports, imports, and the price of the nontraded good to a 20 percent permanent reduction in firms' borrowing limit $\overline{\delta}$. The shock occurs in period $t = 1$.

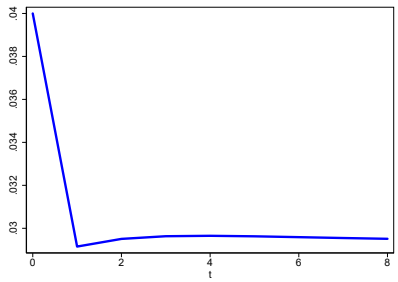
(a) *Exports / GDP*



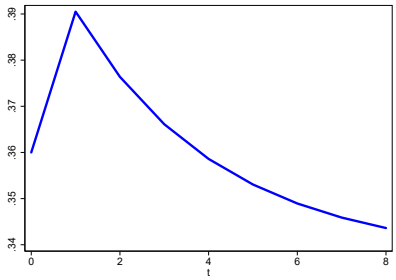
(b) *Imports / GDP*



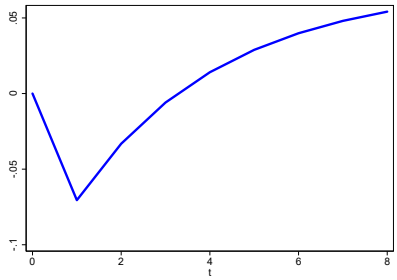
(c) *Imports of Inputs / GDP*



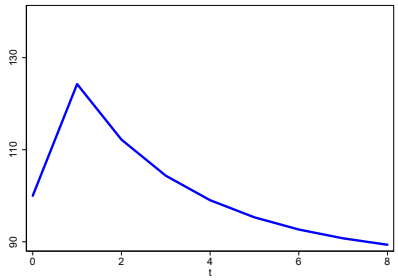
(d) *Imports of Final Goods / GDP*



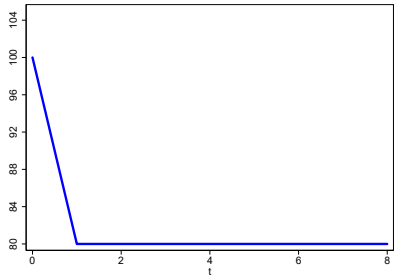
(e) *Trade Balance / GDP*



(f) *Price of Nontraded Good*



(g) *Firms' Borrowing Limit*



a crisis as the relevant shock event. We exclude crises adjacent to major world wars, or around which we lack trade data. We thus can analyze a maximum of 195 crisis episodes in our historical window. In this sample, 77 crises take place in advanced countries and 118 in developing economies; 108 crises occur in the post-WW2 period and 87 in the pre-WW2 era.[10] The distribution of the number of crisis episodes by country is such that the median country faces 3 crisis episodes during the full sample window 1816–2014. At the extremes, the country at the 10th percentile faces a single financial crisis episode, while the country at the 90th percentile faces 6 crises over the two centuries.

Trade Flows Bilateral trade data were obtained from the newly available CEPII TRADHIST database (Fouquin and Hugot, 2016) for the pre-WW2 period and entirely from the IMF's *Direction of Trade Statistics* for the post-WW2 period. Trade figures are reported in nominal U.S. dollars, which we deflate using the U.S. GDP deflator. We also assemble a second dataset on country-level total exports, total imports, GDP, and financial crises over the same period and sample of countries to provide more aggregate evidence on the response of trade following crises. Finally, we also assemble a dataset of bilateral trade flows by product type spanning the period 1962–2014. These data are restricted to the post-WW2 period as product-level data are not systematically available for earlier decades.

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 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 Ursua (2008) and Mitchell (1992, 1993, 1995). Finally, 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 Reinhart and Rogoff (2011a) for most of our sample, and from the IMF's *World Economic Outlook* for very recent years.

III. 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. Reinhart and Rogoff (2009), Jorda, Schularick, and Taylor (2013), and others, have documented the deep impact of

[10] We consider the following set of 14 countries to be advanced economies: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States.

crisis episodes on various outcomes such as output, unemployment, government debt, and the pace of recovery. With the same historical perspective, we will focus on international trade.

Formally, let $\ln T_{it}$ denote a trade flow, which will be either total exports (X_{it}) or total imports (M_{it}) for country i in year t, measured in real constant dollars. In the same units we also measure GDP, denoted Y_{it}. Imposing a benchmark unit trade elasticity (i.e., homotheticity, as in standard gravity models) with respect to country GDP, we study the size-normalized trade flow $\ln\left[\frac{T_{i,t}}{Y_{i,t}}\right]$. We are interested in the dynamic response of this object, in the aftermath of a financial crisis event in country i. Thus, we denote by $Crisis_{it}$ the dummy variable which indicates the start of a financial crisis event. 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 regressions for each horizon h

$$\ln\left[\frac{T_{i,t+h}}{Y_{i,t+h}}\right] - \ln\left[\frac{T_{i,t}}{Y_{i,t}}\right] = \alpha_i^h + \beta_t^h + \gamma^h Crisis_{it} + e_{it}\,, \tag{1}$$

where α_i^h are country fixed effects and β_t^h are year fixed effects. The coefficient of interest is γ^h which denotes the response at horizon h to a financial crisis. These coefficients show how, controlling for pure GDP scaling effects, the financial crisis shock affects trade volumes. The estimation is by OLS with standard errors clustered by country and year, and all time-invariant country characteristics (e.g., certain geographical factors) are absorbed in the fixed effects.

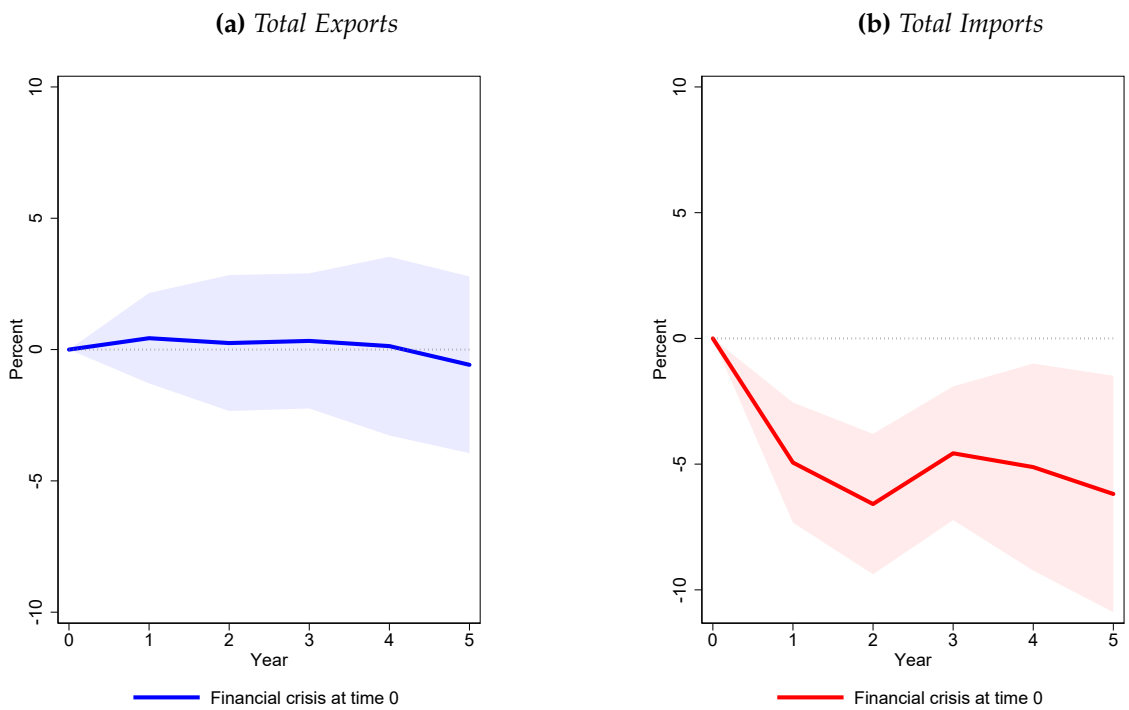
Figure 3 and Appendix Table A.3 show our estimates for the full sample. We find that on impact a financial crisis is associated with a *decrease* in GDP-normalized imports (-4.9% change).[11] But we find that on impact a financial crisis is associated with a (not statistically significant) *increase* in normalized exports. The effects on imports remain of a similar magnitude and statistically significant even out to the horizon $h = 5$ years (-6.2% change), while the effect on exports remain not statistically different from zero.

Studies of the "trade collapse" during the recent Great Recession document similar patterns and are motivated by the very large fall in trade in comparison to output. Because the 2008 event was a *global* crisis hitting many countries simultaneously, and because a country's exports are other countries' imports, it is difficult to tell apart in this recent episode whether the crisis depressed imports, exports, or both. Our empirical strategy *can* make this distinction, and the results show clearly that crises lower imports. A second message that emerges is that large declines in imports relative to GDP are the norm

[11] Strictly, the units of the estimated coefficients are log points, but for simplicity we refer to them using the % sign from here onwards as this is a close approximation.

Figure 3: *Local projections: response of total trade in goods to financial crisis*

This figure shows the response of the level of total GDP-normalized exports ($\ln X_i - \ln Y_i$) and imports ($\ln M_i - \ln Y_i$) to financial crisis in country i. See text.



Notes: Shaded regions indicate 95% confidence intervals.

historically. Finally, the historical record indicates that financial crises disrupt trade flows for many years. In Appendix C.2 we extend these results considering various subsamples.

These results appear inconsistent with the supply-side view of financial crises, but more consistent with the demand-side view. However, up to now our examination of total trade flows does not take into account events in countries' trading partners. In the next section we extend this approach to consider bilateral trade flows, sharpening our identification.

IV. 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 also 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.[12]

In new notation for this setting, we now denote by T_{eit} the trade flow from exporter country e to importer country i in year t, and we denote by Y_{et} and Y_{it} the GDP level in each country, all measured in real constant dollars. We construct the size-normalized trade flow given by $\ln(T_{eit}/[Y_{et}Y_{it}])$, imposing a unit trade elasticity (homotheticity) with respect to exporter and importer GDP (again, as in standard gravity models).

We are interested in studying the response of this normalized trade flow following a financial crisis event in either country e or country i, or both. We denote by $Crisis_{et}$ and $Crisis_{it}$ the dummy variables indicating the start of a financial crisis event in countries e and i. We estimate the response of the normalized trade flow from time t to time $t+h$ across all episodes.

As before, we use the local projection method of Jordà (2005), where now we are estimating the series of regressions for each horizon h

$$\ln\left[\frac{T_{ei,t+h}}{Y_{e,t+h}Y_{i,t+h}}\right] - \ln\left[\frac{T_{eit}}{Y_{et}Y_{it}}\right] = \alpha_{ei}^h + \beta_t^h + \gamma_e^h Crisis_{et} + \gamma_i^h Crisis_{it} + \Xi^h \boldsymbol{X}_{eit} + e_{eit}\,, \qquad (2)$$

where α_{ei}^h are country-pair fixed effects and β_t^h are year fixed effects. We also allow for additional controls $\boldsymbol{X}_{eit}$.

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 GDP scaling effects, the financial crisis shock impacts trade flows between country pairs. We once again estimate these series of equations by OLS with standard errors clustered by exporter-year and importer-year using multiway clustering. Time-invariant pair characteristics (e.g., distance or other geographical factors) are absorbed in the fixed effects.

The full sample estimates are shown in panel (a) of Figure 4 and in Appendix Table A.6. In our preferred specification we include as additional controls $\boldsymbol{X}_{eit}$ two lags of the dependent variable and the change between $t+h$ and t in the bilateral real exchange rate ($\ln RER_{ei,t+h} - \ln RER_{ei,t}$). In the Appendix (see Table A.20 and panel (a) of Figure A.21 we show that very similar results are obtained when we ignore these additional controls.

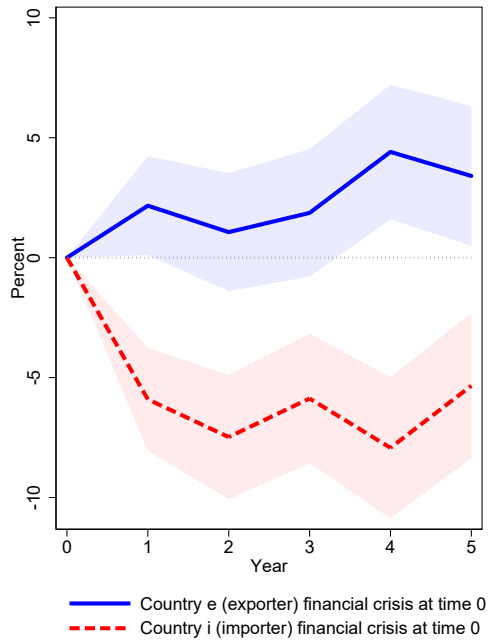
With about 200,000 observations we can obtain fairly good precision in the estimates. We find that on impact a financial crisis is associated with an *increase* in the normalized trade

[12]Note that our empirical strategy in this section, comparing bilateral trade flows and real exchange rates across country pairs, minimizes the possibility that the results are driven by contagion of crises across countries (either through trade or through other mechanisms). Later, when addressing reverse causality, we further limit this concern.

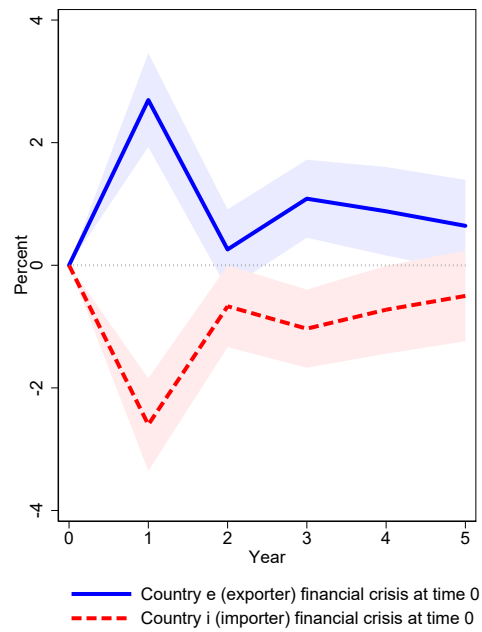
Figure 4: *Local projections: response of bilateral trade and RER to financial crisis in exporter or importer*

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

(a) *Bilateral Trade (exports from e sold as imports to i)*



(b) *Bilateral RER (importer i CPI / exporter e CPI)*



Notes: Shaded regions indicate 95% confidence intervals.

flow, +2.2% 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, −5.9% change, when the financial crisis event takes place in the importer country. The effects remain of a similar magnitude and are statistically significant even out to the horizon $h = 5$ years, where the effects are +3.4% and −5.3%.

Like our previous results, 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 regressions for each horizon h

$$\ln RER_{ei,t+h} - \ln RER_{ei,t} = \alpha_{ei}^h + \beta_t^h + \gamma_e^h Crisis_{et} + \gamma_i^h Crisis_{it} + \Xi^h \boldsymbol{X}_{eit} + e_{eit}\,, \qquad (3)$$

where again α_{ei}^h are country pair fixed effects and β_t^h are year fixed effects. The coefficients of 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 exporter-year and importer-year.

The full sample estimates are shown in panel (b) of Figure 4 and in Appendix Table A.7. In our preferred specification we include two lags of the dependent variable but omitting these controls results in similar results as we show in the Appendix (see Table A.21 and panel (b) of Figure A.21).

On impact a financial crisis is associated with an *appreciation* in the real exchange rate, +2.7% change, when the financial crisis event takes place in the exporter country. But on impact a financial crisis is associated with a *depreciation* in the real exchange rate, -2.6% change, when the financial crisis event takes place in the importer country. Even at horizon $h = 4$ years, the effects are +0.9% and -0.7% and statistically significant.

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

In Appendix D.2 we show that our results are fundamentally similar in different time periods within our long historical sample We also find similar results across developing and developed countries, with a larger drop in normalized imports following a crisis among the latter.

Trade in Final Goods versus Trade in Intermediate Inputs. Our model predicts sharply different responses for both trade in final goods and trade in intermediate inputs depending on whether a financial crisis is a deleveraging shock to households or firms. Recall our model predicts a decline in imports of final goods to GDP and imports of intermediate goods to GDP following a household deleveraging shock. In contrast, a firm deleveraging shock induces an increase in imports of final goods to GDP and a fall in imports of intermediate inputs to GDP.

We have assembled data on bilateral trade flows by product type for the post-1962 period, which is described in Section II. We estimate equation 2 using each component of bilateral trade flows as the dependent variable. The results are shown in Appendix Figures A.22 and A.23 and Appendix Table A.24 . Both trade in final goods and trade in intermediate inputs fall in response to a crisis in the importing country, and rise following a crisis in the exporter.

These patterns are consistent with the model's predictions for a demand shock, and inconsistent with the predictions for a supply shock.

Robustness. Finally, we show in Appendices D and E our results are robust to i) controlling for other types of crises and sudden stops, ii) accounting for the endogeneity of financial crises using inverse probability weighting, iii) controlling for changes in TFP, iv)

controlling for changes in multilateral resistance terms and v) different clustering of standard errors. In addition we explore and rule out the existence of confounding pre-existing trends.

V. Conclusions

We develop a simple model of a country subject to "financial crisis" deleveraging shocks that impose tighter borrowing limits on households and/or firms. These shocks leave distinct statistical signatures in the time series record for 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. These patterns will hold in a variety of models with households and/or firms subject to financial frictions of this kind, so the lesson is more general.

Taking the model to the data, we compiled a crossed dataset of 200+ years of trade flows and financial crises in a large sample of countries. We use empirical methods to see how financial distress affects trade and relative prices. Very clearly, after a financial crisis event, imports contract, exports hold steady or rise, and the real exchange rate depreciates. The effects are statistically significant: this pattern is the rule, not the exception.

Based on both price and quantity evidence a robust interpretation emerges: on average financial crises are not, for the most part, a supply shock, but rather a negative shock to demand.

VI. References

Abiad, Abdul, Prachi Mishra, and Petia Topalova. 2014. How Does Trade Evolve in the Aftermath of Financial Crises? *IMF Economic Review* 62(2): 213–247.

Alessandria, George, Joseph P. Kaboski, and Virgiliu Midrigan. 2010. The Great Trade Collapse of 2008–09: An Inventory Adjustment? *IMF Economic Review* 58(2): 254–294.

Amiti, Mary, and David E. Weinstein. 2011. Exports and Financial Shocks. *Quarterly Journal of Economics* 126(4): 1841–1877.

Baldwin, Richard E., editor. 2009. *The Great Trade Collapse: Causes, Consequences and Prospects*. London: Centre for Economic Policy Research.

Barro, Robert J., and Jose F. Ursua. 2008. Macroeconomic Crises Since 1870. *Brookings Papers on Economic Activity* 39(1 (Spring)): 255–350.

Behrens, Kristian, Gregory Corcos, and Giordano Mion. 2013. Trade Crisis? What Trade Crisis? *Review of Economics and Statistics* 95(2): 702–709.

Bems, Rudolfs, Robert C. Johnson, and Kei-Mu Yi. 2011. Vertical Linkages and the Collapse of Global Trade. *American Economic Review* 101(3): 308–317.

Benigno, Pierpaolo, and Federica Romei. 2014. Debt Deleveraging and the Exchange Rate. *Journal of International Economics* 93(1): 1–16.

Bussière, Matthieu, Giovanni Callegari, Fabio Ghironi, Giulia Sestieri, and Norihiko Yamano. 2013. Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008-2009. *American Economic Journal: Macroeconomics* 5(3): 118–51.

Chor, Davin, and Kalina Manova. 2012. Off the Cliff and Back? Credit Conditions and International Trade during the Global Financial Crisis. *Journal of International Economics* 87(1): 117–133.

Eaton, Jonathan, Samuel Kortum, Brent Neiman, and John Romalis. 2016. Trade and the Global Recession. *American Economic Review* 106(11): 3401–38.

Eggertsson, Gauti B., and Paul Krugman. 2012. Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo Approach. *Quarterly Journal of Economics* 127(3): 1469–1513.

Fouquin, Michel, and Jules Hugot. 2016. Two Centuries of Bilateral Trade and Gravity Data: 1827-2014: Dataset. CEPII Working Paper 2016-14. http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=32.

Freund, Caroline L. 2009. The Trade Response to Global Downturns: Historical Evidence. World Bank Policy Research Working Paper Series 5015.

Glick, Reuven, and Alan M. Taylor. 2010. Collateral Damage: Trade Disruption and the Economic Impact of War: Dataset. *Review of Economics and Statistics* 92(1): 102–127. https://doi.org/10.1162/rest.2009.12023.

Global Financial Data. 2016. Exchange Rates Database. https://www.globalfinancialdata.com (accessed January 2016).

Iacovone, Leonardo, and Veronika Zavacka. 2009. Banking Crises and Exports: Lessons from the Past. In *The Great Trade Collapse: Causes, Consequences and Prospects*, edited by Baldwin, Richard E. Centre for Economic Policy Research.

International Monetary Fund. 2016a. Direction of Trade Statistics. https://data.imf.org (accessed January 2016).

International Monetary Fund. 2016b. International Financial Statistics. https://data.imf.org (accessed January 2016).

Jordà, Òscar. 2005. Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review* 95(1): 161–182.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2011. Financial Crises, Credit Booms, and External Imbalances: 140 Years of Lessons. *IMF Economic Review* 59(2): 340–378.

Jorda, Oscar, Moritz Schularick, and Alan M. Taylor. 2013. When Credit Bites Back. *Journal of Money, Credit and Banking* 45(s2): 3–28.

Levchenko, Andrei A., Logan T. Lewis, and Linda L. Tesar. 2010. The Collapse of International Trade During the 2008–09 Crisis: In Search of the Smoking Gun. *IMF Economic review* 58(2): 214–253.

Maddison, Angus. 1995. *Monitoring the World Economy, 1820-1992*. Paris: OECD.

Maddison, Angus. 2001. *The World Economy: A Millenial Perspective, Development Centre of the Organization for Economic Cooperation and Development*. Paris: OECD.

Martinez, Joseba, and Thomas Philippon. 2014. Does a Currency Union Need a Capital Market Union? Unpublished.

Measuring Worth. 2016. U.S. GDP Deflator. https://www.measuringworth.com (accessed January 2016).

Mian, Atif, Kamalesh Rao, and Amir Sufi. 2013. Household Balance Sheets, Consumption, and the Economic Slump. *Quarterly Journal of Economics* 128(4): 1687–1726.

Mian, Atif, and Amir Sufi. 2014. What Explains the 2007–2009 Drop in Employment? *Econometrica* 82(6): 2197–2223.

Mian, Atif, Amir Sufi, and Emil Verner. 2017. Household Debt and Business Cycles Worldwide. *The Quarterly Journal of Economics* 132(4): 1755–1817.

Mitchell, Brian. 1992. *International Historical Statistics: Europe, 1750–1988*. New York: Stockton Press.

Mitchell, Brian. 1993. *International History Statistics: The Americas, 1750–1988*. New York: Stockton Press.

Mitchell, Brian. 1995. *International Historical Statistics: Africa, Asia, and Oceania, 1750–1988*. New York: Stockton Press.

Novy, Dennis, and Alan M. Taylor. Forthcoming. Trade and Uncertainty. *Review of Economics and Statistics* .

Paravisini, Daniel, Veronica Rappoport, Philipp Schnabl, and Daniel Wolfenzon. 2014. Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data. *The Review of Economic Studies* 82(1): 333–359.

Reinhart, Carmen M. 2010. This Time is Different Chartbook: Country Histories on Debt, Default, and Financial Crises. NBER Working Paper 15815.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2009. The Aftermath of Financial Crises. *American Economic Review* 99(2): 466–72.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2011a. From Financial Crash to Debt Crisis. *American Economic Review* 101(5): 1676–1706.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2011b. Replication data for: From Financial Crash to Debt Crisis. *American Economic Association* [publisher], Inter-university Consortium for Political and Social Research [distributor] https://doi.org/10.3886/E112444V1.

Schularick, Moritz, and Alan M. Taylor. 2012. Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008. *American Economic Review* 102(2): 1029–1061.

The Correlates of War Project. 2016. National Material Capabilities Database. https://correlatesofwar.org (accessed January 2016).

World Bank. 2016. World Development Indicators. https://datacatalog.worldbank.org/dataset/world-development-indicators (accessed January 2016).