

# Fiscal and Financial Crises\*

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**Abstract:** Interconnections between banking crises and fiscal crises have a long history. We document the long-run evolution from classic banking panics towards modern banking crises where financial guarantees are associated with crisis resolution. Recent crises feature a feedback loop between bank guarantees and bank holdings of local sovereign debt thereby linking financial to fiscal crises. Earlier examples include the crises in Chile (early 1980s), Japan (1990), Sweden and Finland (1991), and the Asian crisis (1997). We discuss the evolution in economic theorizing on crises since the 1950s, and then provide an overview of the long-run evolution of connections between different types of crises. Next we explore the empirics of financial crises. We discuss the methodological issue of crisis measurement encompassing the definition, dating, and incidence of financial crises. Leading data sets differ markedly in terms of their historical frequency of crises leading to *classification uncertainty*. There is a range of estimates of output losses from financial crises in the literature, and these are also dependent upon definitions. We find economically significant output losses from various types of crises using a consistent methodology across time and data sets. Predicting crises also remains a challenge. We survey the *Early Warnings Indicators* literature finding that a broad range of variables are potential predictors. Credit booms have been emphasized recently, but other factors still matter. Finally, we identify a new policy trilemma. Countries can have two of the following three choices: a large financial sector, fiscal bailouts devoted to financial crises, and discretionary fiscal policy aimed at raising demand during the recessions induced by financial crises.

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## 1. Introduction

The recent financial crisis in the Eurozone involved both sovereign debt and the banking system. The circumstances of this crisis were unique as were the country experiences, but the combined incidence of fiscal and financial crises is actually not new. In fact, these connections have changed progressively over the long-run. Recurrent and systemic financial crises emerged as a side effect of the modern process of financial development, globalization, and economic growth which got underway in the early nineteenth century. Over time, economic theory, economic data and changes in the objectives of policy makers have shaped the reactions to crises and their subsequent contours. Interconnections between types of financial crises indeed have a long history.

From the mid-19<sup>th</sup> century, financial crises in the banking sector moved from being the responsibility of markets alone to receiving aid from central banks in a lender of last resort capacity. In the post-World War II period, especially since the 1970s, banking, currency, and debt crises became linked because governments became more willing to guarantee significant fractions of the liabilities of the banking system. The seminal paper by Diaz-Alejandro (1985) generated an enormous literature to explain the Latin American crises of the early 1980s. The Nordic crisis of 1991-1992 and the Japanese Banking Crisis of 1990 involved many of these elements. The Asian crisis of 1997-98 led to new theories which explained “triple crises” based on guarantees and foreign currency denominated debt. Finally the recent Eurozone crisis has led to new work which emphasizes the feedback loop between bank guarantees and banks’ holding of member states’ sovereign debt which links financial to debt crises.

In this paper, we examine the interconnections between financial and fiscal crises based on history, theory, and empirics. Section 2 presents a brief historical overview of financial crises. Banking crises can be traced back hundreds of years. Before the advent of deposit insurance and effective use of the lender of last resort, banking crises were banking panics. In the Depression of the 1930s, governments instituted numerous interventions and guarantees effectively laying a strong precedent for subsequent fiscal resolutions. Since the breakdown of the Bretton Woods system in the 1970s and the advent of liberalized domestic and international financial markets, banking panics have increasingly evolved into fiscally

resolved banking crises. Banking crises have often been global or regional events as countries have been linked together by fixed exchange rates, capital flows, and other sources of contagion. Debt crises—sovereign debt defaults—have also been around for centuries, associated with over-borrowing and have been triggered by international and domestic shocks. Today they occur primarily in emerging countries, but again, several advanced countries in the Eurozone faced a tough test after 2008 (with a sovereign default in Greece). Currency crises—speculative attacks on pegged exchange rates – often accompanied banking crises and sometimes debt crises because of linkages between monetary policy and crisis resolution.

Section 3 surveys theoretical perspectives on financial crises. Banking crises traditionally were analyzed using three approaches: the monetarist approach, the financial fragility approach, and the business cycle approach. Modern perspectives build upon these earlier theories. The key approach is based on the Diamond and Dybvig (1983) notion of the inherent instability of banking because of a maturity mismatch. Also seminal are theories based on asymmetric information. In the recent decade, the financial frictions studied in partial equilibrium models have successfully been added to dynamic general equilibrium models. The pioneering modern work to explain why countries issue sovereign debt and try to avoid debt crises traces back to Eaton and Gersovitz (1981) who emphasize reputation. By contrast Bulow and Rogoff (1989a) focus on the deterrence effect of sanctions. Reinhart and Rogoff (2009) emphasize serial defaults, debt intolerance, and the distinction between domestic and foreign debt. New research in dynamic general equilibrium models also incorporates connections between the fiscal and financial side of the economy.

Section 4 provides empirical perspectives on financial crises. We discuss the methodological issue of crisis measurement which encompasses the definition, dating, and incidence of financial crises. Different approaches to definition and dating which are taken in the literature lead to very different patterns of recorded incidence and hence very different interpretations of the historical record. These classification problems must be acknowledged before any definitive general statements can be made. We also discuss the many and varied causes or determinants of financial crises, including bank credit driven asset booms which have resonance for the recent crisis. A number of approaches have been taken to identify the key determinants of crises and to assess the predictive power of empirical models. This Early Warning Indicators (EWI) literature has made significant advances in the past two

decades. However, our reading of the literature is that it remains very difficult to predict crises with a high level of accuracy both because of Goodhart's law as well as because of the complex economic eco-system represented by the financial sector and the high dimensionality of the potential causes.<sup>1</sup> We then review measures of the output costs of financial crises and provide some measures of these losses using a comparable methodology across datasets. Again, different approaches in the literature and different classification systems lead to significantly different conclusions and hence different perspectives on the economic costs of crises.

Section 5 contains a preliminary examination of the empirical connection between financial and fiscal crises and identifies a potential new policy "trilemma". In the future, countries will be able to have two of the following three: a large financial sector, fiscal bailouts devoted to the inevitable crises that accompany leverage and financial deepening, and discretionary fiscal policy aimed at raising demand in the recessions occasioned by financial crises. This story is different from the older argument in the literature that fiscal policy is pro-cyclical in less-developed countries. Moreover, as the recent crisis suggests, this trilemma may become more binding at higher initial levels of debt-to-GDP.

Section 6 concludes. Here we discuss the strengths and weaknesses of the literature and we consider some issues for further research.

## **2. Historical Overview**

Financial crises can be traced back hundreds of years (Kindleberger 1987). Historical narratives identify separate banking, currency, and debt crises and combinations of them (Bordo and Eichengreen, 1999; Bordo and Meissner, 2006; Reinhart and Rogoff, 2009). While financial crises cum fiscal crises are certainly not a new phenomenon, it would be incorrect to say that the recent global financial crisis and the subsequent Eurozone crisis were no different than all of those that have come before. The nature and origins of fiscal

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<sup>1</sup> Goodhart's Law proposed that "any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes". So for instance if policy makers were to regulate financial variables previously associated with crises previous relationships will break down but crises will still occur. See Arnold, Borio, Ellis, and Moshirian (2012) on macroprudential policy and financial stability.

crises and their relationship to financial crises has in fact changed dramatically over the long-run in important ways.

Banking crises before the advent of deposit insurance (and other components of the financial sector safety net) were banking panics--attempts by the public to convert their deposits into currency *en masse*. Unless resolved by lender of last resort actions, banking panics could seriously impact the real economy by reducing the money supply (Friedman and Schwartz, 1963) and by reducing financial intermediation (Bernanke, 1983). Banking panics would propagate through asset markets as banks under threat dumped assets in fire sales. They could also propagate via interbank connections and other institutional arrangements to create a systemic collapse (Mitchener and Richardson, 2014).

Banking panics could also be caused by shocks leading to the failure of important financial firms outside the traditional banking sector like shadow banks (Rockoff, 2014). They could occur as a consequence of a bank credit driven asset price boom-bust cycle. Schularick and Taylor (2012), Brunnermeir and Oehmke (2013), and many others recently have argued that systemic banking crises are very likely to follow bank credit driven asset price booms.

Finally banking crises can also have an international dimension as for example during the Baring Crisis of 1890-91, the global instability of 1907, the Credit Anstalt Crisis of 1931, the Asian Financial Crisis of 1997-98, and the subprime mortgage crisis of 2007-2009. Bordo and Landon-Lane (2012) identify five global financial crises (1890-91, 1914, 1929-30, 1980-81, 2007-08) where the incidence of banking crises affected banks in multiple countries and in several continents in the same year. In all of these cases of “contagion”, cross-border claims and faltering foreign banks or counterparties led to insolvency or liquidity problems at home. In addition, interest rate shocks emanating from leading financial centers (e.g., by the Bank of England in 1890, the Federal Reserve in 1929 and in 1980-81) could contribute directly or indirectly to starting or exacerbating financial stress especially in emerging countries (Kaminsky and Vega-Garcia, 2016).

The incidence of banking panics was high in many advanced countries in the nineteenth century before monetary authorities learned to act as lenders of last resort. In the UK the last depositor-led banking panic was in 1866. In France it was in 1882, and in Germany it was in 1873. In the U.S. it took until 1933 and the advent of deposit insurance before banking panics ceased (Schwartz, 1987).

With the advent of deposit insurance and other forms of government guarantees during the Great Depression, and progressively in some countries even earlier, the nature of banking crises changed from panics to crises which were increasingly resolved by a fiscal rescue.<sup>2</sup> This created a direct link between the banking system and the government's balance sheet. Once this precedent was set, a costly bailout now had the potential to create significant fiscal imbalance and even lead to a default. Moreover, guarantees could lead to moral hazard (i.e., protected banks would increase their balance sheets and take on more risk knowing that they would be bailed out).<sup>3</sup> This would in turn increase the cost of bailouts ex post and increase the strain on the government's finances. In turn, if the deficits were money financed with an expansion in the monetary base, this would increase the likelihood of inflation, currency crisis, or a sovereign default.

Before the 1930s, sovereign defaults had long been a fact of life reflecting the precarious nature of borrowing (often in foreign currencies) to finance wars, cover revenue gaps, or build infrastructure none of which had immediate growth or revenue payoffs leaving a maturity mismatch. Sudden stops of capital flows often led to sovereign defaults for this reason (Bordo, 2006; Bordo, Cavallo and Meissner, 2010). Banking crises, even in the absence of guarantees, could lead to fiscal distress by reducing real income and government revenue.

A wave of sovereign defaults tied to international capital flows occurred in the 1820s in many Latin American Republics as over-optimistic investors from Europe lent these fledgling republics more than their weak public finances could handle. It took four decades before these countries paid into arrears and could access international capital markets again. In the next two centuries, Latin America had three more waves of default (Marichal, 1989).<sup>4</sup> Most countries, with the principal exception of a few advanced countries, had sovereign debt

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<sup>2</sup> Banking crises which were resolved by a fiscal bailout were quite common in emerging countries before World War I (Grossman, 2010). Even some prominent advanced countries like France in 1889 and Britain in 1890 violated Bagehot's (1873) stricture for a central bank to lend only to illiquid and not insolvent institutions and arranged a government-led, fiscally-backed lifeboat operation rescue (White, 2015). Bordo and Flandreau (2003) show that in emerging countries, the bailouts on several occasions led to a big run up in the debt to GDP ratio and serious fiscal crises (e.g., Portugal, Greece, and Russia). However there were no cases in advanced countries where banking crises led to fiscal crises before the 1930s (Schularick, 2012).

<sup>3</sup> According to Akerlof and Romer (1993) and White (2000) in the case of the U.S. Savings and Loan crisis of the 1980s, guarantees led directly to regulatory forbearance which engendered moral hazard leading to a crisis.

<sup>4</sup> Kaminsky and Vega Garcia (2014) show that most of these defaults followed systemic financial crises in the core countries of Europe.

defaults in the nineteenth and twentieth centuries (Reinhart and Rogoff, 2009). Many of them were serial defaulters (Reinhart, Rogoff and Savastano, 2003).

Currency crises—a speculative attack on a pegged exchange rate reflecting an inconsistency between domestic fundamentals and the peg—also were a frequent occurrence for emerging countries throughout the nineteenth and twentieth centuries (Bordo and Schwartz, 1999). Advanced countries generally avoided them under the pre-1914 gold standard, but they became a bigger problem for them in the interwar and during the Bretton Woods system (Bordo et. al., 2001).

Currency crises often occurred simultaneously with banking crises, referred to as twin crises (Kaminsky and Reinhart, 1999). Causality between them was often two-way. A banking crisis could lead to capital flight by foreign depositors as occurred in 1931 in Germany (Eichengreen, 1992). Per contra, a currency crisis could lead to insolvency for banks with extensive foreign currency denominated liabilities and domestic currency denominated assets as occurred in a number of emerging countries in both the pre-1914 and post-1973 eras of financial globalization (Bordo and Meissner, 2006; Reinhart and Rogoff, 2009).

Currency crises became linked to debt crises for emerging countries who had borrowed abroad in foreign currencies in the 1890s (Bordo and Flandreau, 2003). With the advent of government guarantees on top of foreign currency denominated debt, currency, banking, and debt crises became inter-linked in the emerging market crises of the late 1990s and early 2000s.

Thus the recent Eurozone crisis was the culmination of a long history of different types of crises and their growing interconnections which evolved along with the deep seated forces of financial globalization and a belief in the necessity for government to socialize the income losses of financial crises.

### **3 Financial and Fiscal Crises: A Long-Run Review of Theoretical Developments**

In this section we survey the theoretical literature on financial and fiscal crises. We first survey traditional approaches. Most of the literature treats the two types of crises, along

with currency crises separately. We then examine more recent approaches that often combine banking and fiscal crises along with currency crises.

### 3.1 Banking Crises

The traditional view of a banking crisis was a banking panic or a liquidity crisis. It involved a scramble by the public for means of payment. Two frequent scenarios in which it occurred were: contagious banking panics when the public fearful that banks will not be able to convert their deposits into currency attempts *en masse* to do so; the second is a stock market crash that leads to fears that loans will become unavailable at any price. Without intervention by the monetary authorities or lender of last resort—through open market operations or liberal discount window lending—the real economy will be impacted by a decline in the money supply, by impairment of the payment system, and by the interruption of bank lending.

In the post-World War II period, with the widespread adoption of deposit insurance (both explicit and implicit), and with a generalized understanding of the role of the lender of last resort, old fashioned banking panics have become rare events. Instead, banking crises largely involve the insolvency of significant parts of the banking system. They have occurred when asset prices have plunged, whether prices of equities, real estate or commodities; when the exchange value of a national currency experiences substantial depreciation; when a large financial firm or non-financial firm faces bankruptcy; or a sovereign debtor defaults. Unlike banking panics which are brief episodes resolved by the central bank, a banking crisis is a prolonged disturbance that is resolved by means other than the lender of last resort, although at some stage it may supply liquidity through the discount window or open market operations.

Three traditional approaches to conceptualizing banking crises are: the *monetarist approach*, the *financial fragility approach* and the *business cycles approach*. The contemporary literature based on rational expectations and game theory follows from these.

#### 3.1.1 The Monetarist Approach

The monetarist approach of Friedman and Schwartz (1963) identifies financial crises with banking panics that either produce or aggravate the effects of monetary contractions. In a *Monetary History of the United States 1867-1960*, Friedman and Schwartz devote considerable attention to the role of banking panics in producing monetary instability in the United States. For Friedman and Schwartz, banking panics are important because of their effects on the money supply, and hence on economic activity.

According to them, banking panics occur because the public loses confidence in the ability of banks to convert deposits into currency. A loss of confidence is typically associated with the failure of some important financial institution (as happened in 1873, 1893, and 1907). Attempts by the public in a fractional reserve banking system to increase currency as a fraction of its money holdings, if not offset, can only be met by a multiple contraction of deposits. A banking panic, in turn, if not short-circuited by the monetary authorities, will lead to massive bank failures of otherwise sound banks.<sup>5</sup> They are forced into insolvency by a fall in the value of their assets in a vain attempt to satisfy a mass scramble for liquidity. Banking panics, such as occurred in 1930-33, have deleterious effects on economic activity primarily by reducing the money stock through a decline in both the deposit- currency and deposit- reserve ratios.

An extensive literature in economic history has been devoted to re-examining the banking panics of the 1930s. The debate swirled over the issue of whether the banking crises were really liquidity panics driven by “a contagion of fear” or whether they reflected bank insolvency as an endogenous response to the recession. Temin (1976) and most recently Calomiris and Mason (2003) provided evidence that cast doubt on the Friedman and Schwartz liquidity panic story. Richardson (2007) and Bordo and Landon-Lane (2010) provide evidence in its favor.

### **3.1.2 The Financial Fragility Approach**

A tradition going back to the nineteenth century regards financial crises as an essential part of the upper turning point of the business cycle and as a necessary consequence of the “excesses” of the previous boom. Its twentieth century proponents,

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<sup>5</sup> Carlson, Mitchener, and Richardson (2011) and Richardson and Troost (2009) provide historical evidence on these issues.

Hyman Minsky (1977) and Henry Kaufman (1986), basically extend the views Irving Fisher expressed in *Booms and Depressions* (Fisher, 1932) and in the “Debt Deflation Theory of Great Depressions” (Fisher, 1933).

According to Fisher, the business cycle is explained by two key factors; over-indebtedness and deflation. Some exogenous event (displacement) provides new, profitable opportunities for investment in key sectors of the economy which increases output and prices initiating the upswing in the cycle. Rising prices, by raising profits, encourages more investment and also speculation for capital gain. The whole process is debt financed, primarily by bank loans, which in turn, by increasing deposits and the money supply, raise the price level. An overall sense of optimism raises velocity, fueling the expansion further. Moreover, the rising price level, by reducing the real value of outstanding debt encourages further borrowing. The process continues until a general and precarious state of ‘over-indebtedness’ is reached. It exists when individuals, firms, and banks have insufficient cash flow to service their liabilities perhaps due to a shock to demand or supply. In such a situation a crisis can be triggered by errors in judgment by debtors or creditors. Debtors, unable to pay debts when due or to refinance their positions, may be required to liquidate their assets.

Distress selling, if engaged in by a sufficiently large segment of the market, produces a decline in the price level because, as loans are extinguished and not renewed, bank deposits decline. Falling prices reduce net worth and profits, leading to bankruptcy. Both factors contribute to a decline in output and employment. In addition, while nominal interest rates fall with deflation, real rates increase, worsening the situation. The process continues until either widespread bankruptcy has eliminated the over-indebtedness, or at any stage reflationary monetary policy is adopted. However, once recovery begins, the whole process will repeat itself.

This approach has been revived since the Financial Crisis of 2007-2009. Indeed some commentators have described the failure of Lehman Brothers in September 2007 as a ‘Minsky moment’ (Brunnermeier and Oehmke, 2013).<sup>6</sup> It is also consistent with the credit boom approach of the BIS (Borio, 2012) and the long-run comparative empirical work on credit and asset price booms by Taylor and Schularick (2012) and Jordà, Schularick, and Taylor (2011).

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<sup>6</sup> See Wray (2015).

### **3.1.3 The Business Cycle Approach**

This approach views banking panics as more likely during a recession because the returns on bank assets are likely to fall as borrowers become less likely to repay their loans (Mitchell, 1941). Depositors anticipating an increase in non-performing loans will try to protect their wealth by withdrawing their deposits precipitating a bank run (Allen and Gale, 2007). Gorton (1988) following this approach finds that depositors anticipating a decline in income and in an attempt to smooth their consumption remove their funds from banks before the business cycle peak.

## **3.2 Recent Approaches to Banking Crises**

### **3.2.1 Diamond and Dybvig: The Inherent Instability of Banking**

In a seminal article, Diamond and Dybvig (1983) argue that banks transform illiquid claims by offering liabilities with a different smoother pattern of returns over time. Banks provide efficient risk sharing/insurance which the private market cannot provide. However, banks are vulnerable to runs because of the illiquidity of their assets. Thus there is a liquidity mismatch. One equilibrium in this setup is a run which can be triggered even on a sound bank by a random event (a sunspot) because rational depositors, not wishing to be last in line, will rush to convert deposits into currency. Only the presence of deposit insurance or a lender of last resort can prevent banking instability.

An explosion of articles in the past two decades builds upon the Diamond and Dybvig model. A number of articles were critical of the sequential servicing constraint in the original Diamond and Dybvig model—that depositors had to wait their turn at the bank to access their cash. It was argued that as in the pre-1914 National Banking era, banks could suspend convertibility (Jacklin, 1987). On the other hand, Wallace (1988) justified the sequential constraint endogenously in his model. Other papers that rationalized the Diamond Dybvig sequential service constraint were Diamond and Rajan (2001) and Calomiris and Kahn (2000). Another issue was that of multiple equilibria leading to an inability to make strong predictions. In an influential article on currency crises, Morris and

Shin (1998) used the global games approach to reach a unique equilibrium as a function of fundamentals without using a sunspot equilibrium as a coordinating device as in Diamond Dybvig. Banking crises were analyzed in a similar way by Rochet and Vives (2004) and Goldstein and Pauzner (2005).

Subsequent literature extended the basic Diamond Dybvig (DD) framework to encompass financial markets and the banking system (Allen and Gale, 1998; Allen and Gale 2004); to include bubbles and crises (Allen and Gale, 2000); to include money and monetary policy in the basic DD type model (Diamond and Rajan, 2001, 2005, 2011, 2012); to include interbank markets (Bhattacharya and Gale, 1987). The DD model also is embedded in several articles justifying lender of last resort intervention to provide liquidity in a financial crisis (Holmström and Tirole, 1998; Gorton and Huang, 2010; and Rochet and Vives, 2004).

### **3.2.2 Information Asymmetry**

The explanation of banking panics that the asymmetric information approach offers is that depositors cannot costlessly value individual bank assets, and hence they have difficulty in monitoring the performance of banks (Jacklin and Bhattacharya, 1988; Chari and Jagannathan, 1988). On this view, a panic is a form of monitoring. Faced with new information, which raises the perceived riskiness of bank assets, depositors force out both sound and unsound banks by a system wide panic.

### **3.3 Fiscal Crises**

The canonical fiscal crisis is a debt crisis. It is a situation where a debtor is unable to service the interest and or principle as scheduled. A debt crisis arises when the fiscal authorities are unable to raise sufficient tax revenue in the present and the future to service and amortize the debt.

A debt crisis can then become a financial crisis when it impinges on the banking system and a currency crisis when it threatens the reserves of the central banks as was the case in the Asian crisis of the 1990s. Banking crises can feed into debt crises when the fiscal authorities bail out insolvent banks which then increases sovereign debt to a point where it becomes unsustainable. Debt crises can also spill into banking crises when banks hold significant amounts of sovereign debt whether by choice or because of government attempts to force banks to hold significant levels of government debt.

Below we survey the literature on sovereign debt crises and their linkages to financial (banking) crises.

### **3.3.1 Sovereign Debt Crises: Theory**

Two seminal articles have driven much of the modern literature on sovereign debt crises.<sup>7</sup> Eaton and Gersovitz (1981) explained the existence of sovereign debt markets and the incentive of sovereign borrowers to repay their debt by access to credit markets. Debtors worried that a default could ruin their reputation and cut off future access to the foreign capital needed to finance economic development and to smooth output over time. Bulow and Rogoff (1989a) and Bulow and Rogoff (1989b) argued that other methods of self-insurance can substitute for foreign borrowing and that the main reasons countries avoid default is because of the threat of sanctions. In the nineteenth century, the British (and other European lenders) would send in the gunboats or use other means to seize the defaulting countries customs revenues or other assets. Today, trade sanctions, withholding of trade credit and other legal interference could matter. Another early development was the analysis of excusable default. Grossman and van Huyck (1988) argue that countries that defaulted because of a large shock to their economy not of their own making were treated better by the credit markets than countries which defaulted because of bad economic policy decisions.

The subsequent literature was doubtful of sanctions in the post-World War II era (Cole and Kehoe, 1995; Eaton, 1996; Kletzer and Wright, 2000) although there is considerable historical evidence for this (Mitchener and Weidenmeir, 2005) for the pre-World War I era. Emphasis was placed by some on the collateral damage to the economy

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<sup>7</sup> See Panizza, Sturzenegger and Zettelmeyer (2009) for a recent survey.

from default (Cole and Kehoe, 1998).<sup>8</sup> Bulow and Rogoff (2015) defend the sanctions approach as a way to understanding recent events in Greece and Argentina.

An additional development was the focus on serial default. Reinhart, Rogoff, and Savastano (2003) showed that a number of defaulting emerging countries had a long historical record of debt default. This pattern of persistence extended to a number of European countries (e.g., Spain and France) which had an earlier history of serial defaulting. Moreover they found that countries which were serial defaulters also had *debt intolerance*, (i.e., that they would tend to default at significantly lower debt to GDP ratios than advanced countries). For example, Argentina defaulted in 2002 at a debt-to-GDP ratio of 35% whereas Japan today has a debt-to-GDP ratio well above 200% and it is not even close to defaulting.

Reinhart and Rogoff (2009) make an important distinction between domestic debt and foreign debt. They argue that domestic debt default by inflation, financial repression, redenomination, abrogation of gold clauses, etc. can have consequences as serious as external default. In addition, they argue that defaulting on high domestic debt may be a strong rationale for the use of the inflation tax in many countries.

### **3.4 Fiscal Crises and Financial Crises**

After the breakdown of the Bretton Woods system and the liberalization of global financial markets, as well as domestic financial systems across the world, the stage was set for waves of systemic financial and fiscal crises. A key integrating element between financial and fiscal crises was the widespread use of guarantees by the government of the liabilities of the banking system.<sup>9</sup> The seminal article which lays out clearly the dynamics of fiscal-financial crisis interaction was by Diaz Alejandro (1985).<sup>10</sup> He describes the unfolding disaster that occurred in Chile from 1977 to 1982 after it liberalized its domestic financial system and opened up its capital account. Chile, like the other Latin American countries, had extensive controls over the domestic financial system as well as capital controls since the 1930s. It was part of the plans of Raul Prebisch, the United Nations ECLA (1950) and others to insulate the region from foreign shocks.

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<sup>8</sup> Two recent models of sovereign defaults which occur following adverse shocks to the economy are Aguiar and Gopinath (2006) and Arellano (2008).

<sup>9</sup> See Schularick (2012) and Alessandri and Haldane (2009).

<sup>10</sup> See Reinhart (2015).

The Pinochet regime, under the influence of the “Chicago boys” – students of Al Harberger--liberalized every aspect of the economy. They reduced tariffs, eliminated controls over the domestic financial system, and removed capital controls. They also in 1977 reduced barriers to entry into banking, they explicitly did not introduce deposit insurance, and they forswore a bailout of the banking system in the event of trouble. They also pegged the Chilean peso to the U.S. dollar.

The new liberalized regime encouraged massive capital inflows which led to increases in bank credit and fueled an asset price boom. A major bank failure in 1977 led to a bail out for fear of contagion. Afterwards, the government again forswore against future bailouts. The bailout which soon followed encouraged moral hazard and the credit boom continued. In early 1982, more banks failed and their liabilities were guaranteed. This meant that the government had taken on a new contingent liability which in turn led to a growing fiscal deficit. The central bank financed the deficit with the inflation tax. This led to inflation and set the stage for a speculative attack on its reserves. A major banking and currency crisis ensued in the summer of 1982 leading Chile to abandon its peg and nationalize its banking system. It was followed by a debt crisis in 1983.<sup>11</sup>

McKinnon and Pill (1986) model the effects of liberalization and reform on a previously financially repressed emerging country. In their model, like in Diaz Alejandro (1985), there is a large unsustainable lending boom financed by foreign capital, intermediated by the banks. The banks believe that their foreign loans are guaranteed by the government. This over-borrowing phenomenon leads to rising domestic credit, an increase in money growth, inflation and an asset price boom. A foreign shock leads to a collapse in the boom, a banking crisis, a currency crisis, and a reversal of the reforms.

### **3.4.1 The Japanese and Nordic Banking Crises 1990-1992.**

The background to the Japanese banking crisis in 1990 was a boom bust cycle, which began in the mid-1980s with a run up of real estate prices fueled by an increase in bank lending and loose monetary policy. The Bank of Japan began following a looser monetary policy in the aftermath of the Plaza Accord of 1985 which led to an appreciated yen and a weaker dollar (Funabashi, 1988). The resulting property price boom in turn led to a stock

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<sup>11</sup> Velasco (1987) provided a model of this experience.

market boom as the increased value of property owned by the firms raised expected future profits and hence stock prices (Iwaisako and Ito, 1995). Both rising land prices and stock prices in turn increased firms' collateral encouraging further bank loans adding more fuel for the boom. The bust may have been triggered by the Bank of Japan's pursuit of a tight monetary policy in 1989 to stem the asset price boom.

The subsequent asset price collapse in the next five years led to a collapse in bank lending with a decline in the collateral backing corporate loans. The collapse in asset prices further impinged on the banking system's capital making many banks insolvent.<sup>12</sup> Lender of last resort policy prevented a classic banking panic, but regulatory forbearance propped up insolvent ("zombie") banks. The bailout costs of the bank rescue and the slow economic growth that ensued swelled the already high Japanese debt-to-GDP ratio since then, but Japan has never defaulted on its debt. A fiscal crisis was avoided because Japanese sovereign debt is denominated in yen and is mainly domestically owned.

The Nordic financial crisis of 1991-92 involved a banking crisis, a currency crisis and a large fiscal bailout. In the case of Norway, quantitative restrictions on bank lending were lifted in 1984. This led to a bank credit financed real estate boom and a serious banking crisis (Steigum, 2009). The Swedish financial crisis of 1992 involved both the banking sector and the exchange rate. Liberalization of the financial sector and the capital account in the 1980s after decades of financial repression led to a bank credit fueled asset price boom (stocks and real estate). The deflationary shock of the EMS crisis triggered an asset price bust and a collapse of the banking sector as well as a massive currency crisis and devaluation. A fiscal bailout led to a run up of the debt-to-GDP ratio but not sufficient to trigger a fiscal crisis (Jonung et. al., 2009).

A similar severe crisis occurred in Finland at the same time with the collapse of the Soviet Union a key real fundamental (Honkapohja, 2009). The loan losses in all three countries were considered large (Norway 6% of GDP; Sweden 7% of GDP; Finland 7% of GDP) but the fiscal resolutions in all three cases did not threaten a fiscal crisis (Drees and Pazarbasioglu, 1994). Thus the Nordic crisis may be the forerunner of the guarantee induced fiscal crisis/financial crisis nexus earlier identified for emerging countries.

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<sup>12</sup> Many aspects of the Japanese experience resonate with the financial accelerator approach of Bernanke, Gilchrist and Gertler (1999).

### 3.4.1 The Asian Crisis

The Asian crisis of 1997-98 involved banking, currency, and debt crises and these crises were all connected by government guarantees and an ostensibly new factor “original sin” or foreign currency liabilities.<sup>13</sup> A key mechanism by which foreign borrowing led to banking crises was that the Asian tigers (Thailand, Indonesia, Malaysia, and Korea) borrowed abroad extensively in foreign currency denominated securities. They did this because they had not yet financially developed enough to issue debt in their own currencies as could the advanced countries. Borrowing abroad (e.g., in dollars), gave access to foreign capital at low international interest rates. The risk associated with original sin is that if the country has a currency crisis and ends up devaluing its currency then it will have to generate greater tax revenues in domestic currency and export earnings to service its foreign debt. This in turn would depress the real economy and increase the likelihood of a sovereign default. The likelihood that exports could rise sufficiently depended on strong global demand and high elasticities. Moreover the banking systems in these countries funded their loans with foreign securities (often short-term) and after the devaluation, their balance sheets would become impaired increasing the likelihood of insolvency and a banking crisis.

The Asian crisis led to the creation of ‘third generation’ speculative attack models. They were an extension of both first and second generation speculative attack models. The first generation model of currency crises (Krugman, 1979) posited that a speculative attack would inevitably occur when domestic fiscal and monetary fundamentals were inconsistent with adherence to a pegged exchange rate. The second generation models (Obstfeld, 1995) posited that speculative attacks would occur when agents, who understood the weights that the government placed on the stability of the domestic economy and adhering to a peg, anticipated that the government would prefer domestic stability in the event of a crisis. Speculators would thereby sell the currency short and generate a crisis.

Several authors extended the first and second generation models to incorporate special features of the Asian Crisis including moral hazard (guarantees), short-term borrowing in foreign currencies, and currency depreciation. Krugman (1998) argued that the currency and financial crises in Asia reflected the role of moral hazard as the progenitor of

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<sup>13</sup> See Eichengreen and Hausmann (2005).

financial instability which in turn was a key cause of currency crises. According to his story, financial institutions in these countries engaged in risky lending on the assumption that they would be bailed out while at the same time they financed themselves with offshore loans at close to international interest rates. The capital inflow and domestic bank lending fueled an asset market boom which in turn encouraged the banks to lend more. This process encouraged a domestic investment and consumption boom and a growing current account deficit. When external factors revealed the exchange rate to be overvalued, a classic speculative attack led to devaluation. The devaluation in turn sparked a financial crisis as the banks' short-term, foreign currency denominated loans mushroomed, making them both illiquid and insolvent. Bailouts of the financial system and especially of their dollar obligations in turn precipitated further speculative attacks and exhausted the monetary authorities' international reserves.

Dooley (2000) viewed the liabilities of the monetary authorities backing the financial safety net as an alternative claimant on emerging countries' international reserves. Market agents understood this and staged a speculative attack at the moment that net liabilities exceeded international reserves.

Krugman (1999) focused on the balance sheets of firms which borrowed abroad in foreign currencies. A speculative attack would occur when the market anticipates that a depreciating currency will lead to insolvency and contracting economic activity hence pulling out funds and precipitating the adverse chain of events.

Burnside, Eichenbaum and Rebelo (2004) also emphasize the key role of government guarantees in explaining the Asian crisis. In their model, banks borrow in foreign currencies unhedged because their foreign debt is guaranteed by the government. But when a devaluation occurs, following an external shock, the banks default on their foreign debt and declare bankruptcy, but the government does not have the resources to pay for a bailout. This leads to both a banking crisis and a currency crisis when the central bank uses seigniorage to fund the fiscal deficit.

Corsetti, Pesenti and Roubini (1999) also model the Asian crisis. In their model the government guarantees the banks' foreign currency loans which are used to finance domestic investment. This leads to a capital inflow boom, a current account deficit, and an investment boom. Private sector borrowers believe that they and the banks will be bailed out. When a shock occurs, this leads to both a banking crisis and a possible debt crisis as the

contingent liabilities that the government has to cover increase the fiscal deficit.<sup>14</sup> Thus the Asian crisis had many elements of the Diaz Alejandro story with guarantees that induced fiscal deficits and which were financed largely by money issue rather than increased sovereign borrowing.

### **3.4.2 The Eurozone crisis.**

The Eurozone crisis of 2010-2014 was a sequel to the global financial crisis of 2007 - 2009 involving strong connections between banking and fiscal crises. Reinhart and Rogoff (2009, 2011) suggest that the link between banking and fiscal crises has strong historical roots. They show that banking crises often precede debt crises and that for a large panel of advanced and emerging countries in the twentieth century that the debt to GDP ratio rises by 86% in the three years following a banking crisis setting the stage for a downgrading of credit and a possible default. Schularick (2012) notes that this has mainly occurred in the post-World War II period.

Whenever these connections originated, the Eurozone crisis seems to fit the prediction that fiscal and financial crises have a strong connection. In the aftermath of the subprime mortgage crisis, several European countries that had been connected to the US crisis or which had bank credit driven house price booms, engaged in expensive bond financed bank bailouts. These bailouts and economic collapse increased the fiscal deficit leading to debt surges. The bailouts across Europe followed in some respects the example of Ireland which in September 2008 guaranteed its entire financial system. To fight the recession that accompanied the crisis, they also engaged in expansionary automatic fiscal policy which also increased the deficits.

Reinhart and Rogoff (2009) argue that the decline in tax revenues produced by the fall in output plus the expansionary government expenditures explained more of the run up in deficits and debt than the bailouts themselves. Laeven and Valencia (2013) provide a crude measure that separates out the rise in debt due to bailouts and resolution activity and a remaining portion due to discretionary and automatic fiscal expansion. In their sample, the

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<sup>14</sup> Other papers that model the Asian crisis and place emphasis on government guarantees include: Arellano and Kocherlakota (2014) Burnside, Eichenbaum and Rebelo (2001), Burnside (2004), and Schneider and Tornell (2004).

median rise in the debt-to-GDP ratio after a crisis is 12 (percentage points) with the majority (6.8) attributable to fiscal rescue packages. For advanced economies, the figures are 21.4 and 3.8, and in emerging economies they are 9 and 10. Significant heterogeneity across countries is evident. Inference should recognize this fact and the historical record should be assessed in light of these data.

Against this background of weakening fiscal positions across the Eurozone, the announcement in 2009 that the Greek government had falsified its fiscal books set the stage for the Eurozone debt crisis which first involved the threat of a Greek default and then contagion to other members via their banks which had significant holdings of Greek and other peripheral countries sovereign debt.

The threatened sovereign default by Greece fed into a banking crisis because banks in Greece and the other financially integrated Eurozone countries held large amounts of Greek and other peripheral Eurozone sovereign debt. In the case of Ireland, a blanket guarantee of the Irish financial sector by the Irish government followed the collapse of a property price boom. This collapse made the Irish banks insolvent, and led to a fiscal crisis because markets expected that the Irish government would not be able to service the large run up in its debt that followed. An 85 billion euro international rescue by the IMF, the EU, and others followed in 2010. Later, some private sector actors were bailed-in.

In Spain, where another housing boom turned to bust, the crisis also led to fiscal problems. Spain introduced several costly bailout packages with enhanced guarantees, and took on a European bailout package. Throughout, international pressure--both political and market-based--was harsh leading to higher risk premia. From 2010, Spain adopted a series of "austerity" plans coincident with these bailouts. In addition, Spanish banks increased demand for Spanish sovereign debt in order to take advantage of liquidity funding from the European Central Bank threatening an outcome whereby fiscal problems could be transmitted to the banks. Bond spreads in Portugal and Italy spiked after 2010, but countries such as France and Belgium also faced significant bond market pressure. European countries displayed vulnerabilities in the run-up to the crisis, but the collapse of confidence in international bond markets for many European countries reflected the constraints of nations in a monetary union with no strong fiscal union, a weak/non-existent banking union and (at least initially) hesitant monetary policy from the ECB.

The recent crisis presents several fine examples of the interconnection between fiscal and banking crises and new theoretical models and empirical evidence has been supportive of these links. Bolton and Jeanne (2011) model the interconnection between sovereign risk and the banking system in a currency union where the banks in each country diversify their portfolios by holding the sovereign debt of other member states. Holding government bonds serves as safe collateral which allows them to increase their leverage. The default by one member spreads to the others via the weakening of bank portfolios.<sup>15</sup>

Gennaioli, Martin, and Rossi (2014) also model the interconnection between sovereign default and the banking system. As in Bolton and Jeanne, banks hold sovereign debt as collateral which allows them to increase their lending. A debt crisis leads to a credit crunch and a decline in real income. The authors demonstrate that the costs of a fiscal shock are higher for more financially developed countries.<sup>16</sup>

Acharya, Drechsler and Schnabl (2014) model a two way interconnection between fiscal crises and banking crises. Bank bailouts lead to an increase in sovereign risks because of the increase in fiscal deficits and debt ratios. This in turn weakens the banking system which holds sovereign debt as collateral.

They use the Irish bailout of 2008 as their example. Their model predicts that the spreads between bank CDSs and sovereign CDSs should rise during the banking crisis. Then after the bailout, bank CDSs should decline and Sovereign CDSs should rise. This reflects the transfer of risk from the banks to the government. Empirical evidence for the advanced countries in the Eurozone backs this up. After the subprime crisis began in 2007, bank CDSs rise dramatically with no change in sovereign CDSs. Then after the Lehman collapse and the Irish guarantee at the end of September 2008, sovereign CDSs rise and bank CDSs decline.

Mody and Sandri (2012) examine the behavior of sovereign risk spreads of the Eurozone countries before and after the crisis of 2007-2009. They show that after the creation of the Euro in 1999 sovereign spreads converged across the Eurozone. Then after the Bear Stearns bailout in March 2008 spreads increased in countries which had vulnerable financial sectors likely to be bailed out. After the Lehman failure in September 2008, spreads increased dramatically in countries that had higher debt ratios. Then, after the failure of

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<sup>15</sup> Battistini, Pagano, and Simonelli (2014) observe that in the Eurozone banks increase their holdings of domestic debt even when yields (and risk) rise and when systemic risk rises. Various policy implications for monetary unions like the EMU are discussed.

<sup>16</sup> Also see Uhlig (2013).

Anglo Irish bank in January 2009, spreads increased across the Eurozone reflecting the increased vulnerability of the financial systems of all the member countries.

Martin and Philippon (2014) compare the behavior of member states of the Eurozone to that of the states in the United States during the Great Recession. The key difference between the Eurozone and the U.S. was the absence of a well-functioning fiscal union in the former (Bordo, Jonung, and Markiewicz, 2013). What their analysis shows is that the U.S. and European cross sectional experience in household debt and employment were quite similar in the period 2007-2010. However, after 2010 there was a marked difference between the two currency areas. The peripheral Eurozone countries experienced a sudden stop in capital flows reflected in a spike in borrowing costs (spreads) and a drop in employment and growth. By contrast, the pattern of these variables across U.S. states did not diverge. Past fiscal policy in the Eurozone countries, because of its effect on accumulated debt, impacted their economies both through the perceived risks to repayment and sustainability and the constraints on expansionary fiscal policy it generated after 2010.

Thus the Eurozone crisis represents the culmination of a guarantees-induced connection between financial crises and fiscal crises. The special characteristics of the Eurozone (the absence of fiscal and banking unions, the absence of floating exchange rates, and the ability to offset shocks with domestic monetary policy) made things worse.

#### **4. Empirics of Financial Crises Over the Long Run**

In the following sections we discuss the empirics of financial crises. We take a close look at defining and dating financial crises also exploring the coincidence of several types of crises. We highlight that key concern for researchers should be classification uncertainty. Simply put, leading authors disagree on the definition of a crisis leading to discrepancies between authors and ultimately different conclusions about the impact and causes of crises. We discuss various methods and findings on the empirical determinants of financial crises in the next sub-section. After this, we discuss how to measure output losses associated with financial crises and provide an overview of the literature. A closely related topic is recoveries. In the final section we explore the linkages between government debt and the fiscal costs of bailouts and guarantees. We note a new tradeoff: when bailouts are costly, discretionary fiscal policy may be constrained especially in the face of a large financial crisis.

## 4.1 Dating of Financial Crises: A History of Comprehensive Chronologies

A number of different chronologies of financial crises exist. The crisis dates enumerated by each source are quite different as we will show. The coverage also varies in terms of the years and number of countries included in each sample. Because of all these discrepancies, the conclusions from each study are likely to differ and sometimes dramatically so. In this section, we survey the methodologies of the leading databases for dating financial crises.

Economists for the last 200 years have been drawn to major financial events and used them to learn about the macro-economy. Charles Conant (1915) surveys the history of central banking in many different nations in the early 20<sup>th</sup> century along the way detailing the prospective causes and impacts of financial events. The National Monetary Commission of the United States held lengthy hearings from leading financial experts, and significant amounts of evidence on the financial histories of many countries were submitted as evidence. Grossman (1994) was one of the first papers to systematically collect data on banking crises in the Great Depression.

Edwards and Santaella (1993) provide a chronology of currency devaluations from the Bretton Woods period. By the 1990s, researchers at the World Bank like Caprio and Klingebiel (1996) were providing dates for systemic banking crises in a large sample of countries. These crises were an economic phenomenon that had mainly disappeared between the 1940s and the early 1970s. By the late 1970s and into the early 1990s, such crises became increasingly commonplace first in Less Developed Countries and Emerging Market Economies (EMEs) and then in advanced countries. These events attracted significant interest by policy makers and academic researchers alike.

Kaminsky and Reinhart (1999) provide an account of banking, currency, and “twin” crises for non-advanced countries. Laeven and Valencia (2008, 2012) compile a comprehensive dataset of banking, currency, and debt crises for the period 1970-2011. Laeven and Valencia’s dataset covers the experience of 162 advanced, emerging and less developed economies.

For the long run, three major, comprehensive contributions stand out. Bordo, Eichengreen, Klingebiel and Martinez-Peria (2001) date banking, currency, and twin crises

for all years between 1880 and 1997. For the years 1880-1945 their sample includes 21 now mostly-advanced countries (with the exceptions of Argentina, Brazil, and Chile) and from 1945 data from 56 countries is available. Reinhart and Rogoff (2009) and Reinhart (2010) provide accessible data on banking, currency, and debt crises for 70 countries. Their record on sovereign debt crises extends back to the medieval period but only for a select number of European polities. From 1800 Reinhart and Rogoff track banking, currency, and debt crises. Carmen Reinhart's website provides a set of open-access excel spreadsheets.<sup>17</sup> Finally, Alan Taylor (forthcoming), based on research with Jordà, Schularick and Taylor (2011) provides the dates for "systemic" financial crises (mainly banking crises) for 17 countries 1870-2010.

Recently Romer and Romer (2015) have collected a new set of dates for *financial distress* based on readings of the OECD Economic Outlook 1967-2007. While previous studies have mainly provided binary indicators of the various financial crises, Romer and Romer generate a measure based on a scale of 0 to 15. This measure is substantially different from traditional measures of crises, so we do not use it further in our analysis.

## 4.2 Crises Definitions

Table 1 gives the stated definitions for dating the various types of crises in each of the leading data sets: Bordo et. al.(BEKM); Laeven and Valencia (LV); Reinhart and Rogoff (RR); and Jordà et. al (JST). As is evident, for banking and currency crises, the definitions vary by sets of authors leading to significant disagreements both about timing and whether there was or was not a crisis. In particular, for banking crises, authors disagree about how many banks must be closed or what percentage of the financial system's capital must be impaired for a crisis to be classified as systemic. Laeven and Valencia require that major policy interventions take place. Reinhart and Rogoff classify more crises than other authors likely because they only require bank runs to lead to the "closing of *one* or more financial institutions" (our emphasis).

<< TABLE 1 HERE >>

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<sup>17</sup> <http://www.carmenreinhart.com/>

Currency crises are generally defined as sharp declines in the nominal exchange rate. Many authors use a threshold decline (e.g., 15% or 30%) in the nominal exchange rate possibly conditional on having only limited flexibility in the preceding years. BEKM use an exchange market pressure index as developed in Eichengreen, Rose and Wyplosz (1995) where possible. Prior to the 1970s, and especially prior to the 1930s, the required data are relatively hard to obtain and so the emphasis is generally on nominal exchange rate movements. Laeven and Valencia follow Frankel and Rose (1996) as do Reinhart and Rogoff. There are some differences in the cutoffs used by the latter two sets of authors.

Comprehensive data on sovereign debt crises from the 19<sup>th</sup> century up to the 21<sup>st</sup> century comes from Reinhart, Rogoff and Savastano (2003) and is also presented in the spreadsheets on Reinhart's website. Laeven and Valencia also provide their own dates based on a multitude of sources. The latter do not cite Reinhart and Rogoff as a source for their crisis dates. Laeven and Valencia date moments of sovereign default and restructuring. Reinhart and Rogoff date external debt crises when there is "outright default on payment of debt obligations incurred under foreign legal jurisdiction, repudiation, or the restructuring of debt into terms less favorable to the lender than in the original" (Reinhart and Rogoff, 2011).

As is visible, substantial disagreement across teams of authors exists. We re-visit this below after exploring the record on the frequency of financial crises.

### **4.3 Financial Crises: The Historical Record**

Figures 1a, 1b, 1c, and 1d show the sample percentage of country-year observations for the first year of four different kinds of financial crisis. This variable is calculated as the ratio of the number of years in which the set of countries in the sample is in the first year of a banking, currency, debt, twin (banking and currency) or triple (banking, currency, debt) crisis to the total number of country years.<sup>18</sup> We compare outcomes for various

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<sup>18</sup> Twin crises happen when a currency crisis event takes place within one year before or after a banking crisis. Triple crises are twin crises with an associated sovereign default within a one-year window of either a currency or banking crisis. We avoid double counting by assigning a zero to all banking and currency crises that occur in the context of twin or triple crisis. Similarly any twin crisis that occurs with a sovereign default within a year is only counted as a triple crisis.

chronologies and across four time periods: The classical gold standard (1880-1913), the interwar period (1919-1939), Bretton Woods (1945-1972), and the recent period of globalization (1973-present). We note, as Bordo et. al. (2001) do, the sample of countries does change over time within the BEKM data set going from 21 to 56 countries in the post-1972 period which changes sample frequencies somewhat.

**<<FIGURES 1A-1D HERE>>**

Currency crises are the most frequent variety of crisis followed by banking crises, debt crises, twin crises, and finally triple crises. By and large, all of the different chronologies agree on the trends. For the three datasets that cover the interwar period, only two out of three agree (Bordo et. al. and Jordà et. al.) that this period saw the highest frequency. Reinhart and Rogoff's data suggest that the recent period has a higher incidence of banking, triple, and debt crises (not pictured) than in the interwar period. Reinhart and Rogoff also show roughly the same frequency of twin crises in the Interwar and the post-1973 period and a higher likelihood of a currency crisis in the Bretton Woods period and the post-1973 period. As in Bordo et. al. (2001) there is little evidence that crises became more frequent over the long run with the possible exception of currency crises.

Figure 1b shows that currency crises shot up in probability in the Interwar period and from then on have intensified slightly with Bordo et. al and Reinhart and Rogoff reporting probabilities in the range of 0.06 to 0.08. These two datasets are in strong disagreement with the Laeven and Valencia dataset in the recent period (1973-present). Even in samples where the years and countries overlap exactly Laeven and Valencia report only half the currency crises that are recorded in Reinhart and Rogoff or Bordo et. al.

In terms of time trends in twin crises, Bordo et. al find that their frequency was highest in the Interwar period (0.03) and lowest in the Bretton Woods period. Reinhart and Rogoff's data disagree showing that a country would be equally likely to suffer a twin crisis in the interwar period as in the recent period (1973-2012). Laeven and Valencia date far fewer twin crises due to the comparatively low number of currency crises recorded.

Finally, for triple crises, both Bordo et. al. and Reinhart and Rogoff agree that these are rare events and they occur in less than 1% of the country-years within sample. The data sets disagree with Reinhart and Rogoff showing that they are now more frequent than in the

previous three periods while Bordo et. al. show the pre-World War I period and the Interwar as those with the highest likelihood of a triple crisis.<sup>19</sup> Once again, Laeven and Valencia do not concur with Reinhart and Rogoff for the 1973-2012 period suggesting that triple crises are much more rare than in the other two datasets.

Figures 2a, 2b, 2c, 2d, and 2e show the number of crises that occur alone or coincident with other types of crises. With these diagrams, the connection between banking crises and outright sovereign default can be explored. The fraction of debt crises associated with banking crises (or both a banking crisis and a currency crisis) was nearly 0.21 in the years 1880 to 1913. In this constant country sample, this figure falls by over one half to 0.10 for the period 1919-1939. Since 1973, the figure is 0.30 when we use crisis dates from Laeven and Valencia. Using Reinhart and Rogoff's data, the number stands at 0.29 for the 1973-2012 period.<sup>20</sup>

**<< FIGURES 2A-2E HERE >>**

Of course research along the lines of Kaminsky and Reinhart (1999) provides evidence that currency crises frequently accompany banking crises in LDCs and Reinhart and Rogoff (2009) suggest that many debt crises are preceded by banking crises. It is interesting to note that according to our strict definitions “many” here equals only about 17% if a one year window is given. Bordo and Meissner (2006) discuss the historical relationship between banking, currency, and debt crises. They find that a significant fraction of crises in the pre-World War I era could be classified as twin or triple crises. As Figure 2a shows, 50% of the recorded currency crises prior to 1913 were accompanied by a banking crisis.

### **4.3 Classification Uncertainty: Definitions and Disagreements in Crisis Dates**

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<sup>19</sup> Note we use Reinhart and Rogoff's debt crisis dates when dating a triple crisis within the Bordo et. al. dataset.

<sup>20</sup> Some readers will note a difference between our numbers in Figure 2d and those in the comparably designed Figure 4 of Laeven and Valencia (2012). There are some discrepancies within the Laeven and Valencia dataset which we have corrected.

In our view the leading chronologies are those based on data underlying Bordo et. al. (2001), Reinhart and Rogoff (2009) and Laeven and Valencia (2012). The dataset provided by Taylor (forthcoming), which underlies Jordà, Schularick and Taylor (2011), is somewhat limited and less comparable since it restricts attention to “systemic crises” only for a small set of 17 advanced countries. The other three datasets allow researchers to separate currency, banking, debt, twin, and triple crises, each of which are important phenomena in their own right. Two questions immediately arise. How well do these sources agree on their documented dates, and which source(s) is(are) the best?

In answer to the first question, regarding agreement, there is some significant evidence that the correlation between dating methodologies is not extremely high even within constant country samples. Tables 2a through 2e show cross-tabulations of banking crisis indicators for each of four sources (Bordo et. al., Reinhart and Rogoff, Taylor and Laeven and Valencia) for four different periods (1880-1913, 1919-1939, 1945-1972, and the years after 1973). We restrict attention in these tables to the first year of a banking crisis for a country.

**<< TABLES 2A-2E HERE >>**

In each sub-table we show the number of non-crisis country-years, and the number of country-years with a crisis in either of two datasets for the countries that are common to both datasets. The entry in row 2 column 2 of each table records the number of times both datasets are in agreement, and the last two columns provide a measure of the agreement between sources calculated as the percentage of all crisis years dated within the period and the country sample in which the two sources agree. We provide this percentage for crises occurring in the same year and then allow for a one year-window to allow for small, but reasonable variations in timing.

The minimum percentage in Tables 2a through 2e is 0.26 (comparing Bordo et. al and Laeven and Valencia for 55 countries in the years 1973-1997). For the years excluding the Bretton Woods period when all data sets are in agreement, the maxima are 0.69 (Jordà et. al. vs. Reinhart and Rogoff for 17 countries 1919-1939) and 0.65 (Bordo et. al. vs. Jordà et. al. for 17 countries 1919-1939). The average percentage of times that the head-to-head

comparisons agree is 0.42 excluding the Bretton Woods period where agreement is nearly complete.

Matters are obviously slightly worse in terms of correspondence than these numbers suggest since the figures are calculated based only on overlapping samples of countries. The fact that Reinhart and Rogoff and Laeven and Valencia provide much larger samples means that the absolute number of crises reported will be higher. Frequencies also vary as seen in Figures 1a-1d.<sup>21</sup>

Disagreement and classification uncertainty amongst datasets exists for several reasons. Datasets differ on their definitions of what constitutes a particular kind of crisis. As seen in Table 1, definitions of banking crises vary substantively across researchers. In addition, since we have divided the sample space or possible outcomes into non-overlapping categories (banking, currency, debt, twin, triple etc.) dis-agreement for example can occur when one dataset codes a twin crisis but another dataset codes only a banking or currency crisis. A third reason data sets can disagree is due to near-miss timing when one set of authors has a particular date more than two or more years away from another set of authors. Finding the exact timing of an event is also a challenge in periods of high volatility. Latin American countries had prolonged periods of currency distress and banking instability in the 1970s, 1980s and 1990s leading to such discrepancies.

An example comparing the Reinhart and Rogoff data set with that of Bordo et al. is germane. The case of Argentina 1973-1992 is particularly difficult. Reinhart and Rogoff date a currency crisis in every year from 1973 to 1992 and two banking crises that occur during this extended currency crisis (1980-1982) and (1989-1990). Bordo et. al. have the following: currency crisis (1975-1978), twin crisis (1980-1982), currency crisis (1984-1985), currency crisis (1987), twin crisis (1989) which was not associated with the currency crisis in 1987. It is evident that different authors take different routes to finding the first year of a given type of crisis and discrepancies emanate from periods of great macro-economic instability.

Another issue with the historical dating of crises is that authors must rely on the research of other economic historians or significant amounts of scattered primary sources from multiple country-specific sources. Often historical sources are vague as to how many

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<sup>21</sup> Cechetti, Kohler and Upper (2009) report that all crises in Laeven and Valencia are in Reinhart and Rogoff. However this cannot strictly be true since Laeven and Valencia have a much larger sample of countries. In addition, we separate banking crisis from twin and triple crises which Cechetti et. al did not do.

financial institutions were closed or faced runs which leads to discrepancies in the dating of banking crises. Jalil (2015) studies six leading chronologies of the American banking system in the 19<sup>th</sup> and early 20<sup>th</sup> century and observed major disagreements amongst them. Jalil argues that “quantitative sources alone are not sufficient to identify banking panics”, and carries out an extensive and careful reading of contemporary sources to identify banking panics (as opposed to systemic banking crises).

Matters are significantly worse for dating currency crises in history especially in the 19<sup>th</sup> century. As it turns out, finding reliable exchange rate data for samples outside of the leading 21 countries is extremely difficult, if not impossible, since active and liquid markets in foreign exchange did not exist without some prior financial development. Reinhart and Rogoff (2009) provide an extensive list of dates for which nominal exchange rates are available with some relevant cases in point such as: Argentina (available from 1880 only), Finland (from 1900), Korea (1905), Greece (1872), New Zealand (1892), South Africa (1900), Uruguay (1900) etc. In other cases, using an exchange market pressure index will be difficult prior to the 1930s or even the 1950s due to missing reserve and interest rate data. In these cases, the Frankel and Romer approach of using a cutoff for changes in the nominal exchange rate will have to suffice. Relying exclusively on exchange rate changes however neglects many important episodes.

More disconcerting is the disagreement on sovereign defaults in the period since 1973. These data are mainly gathered from primary and secondary sources as noted in Laeven and Valencia (2012) and Reinhart and Rogoff (2009). While Reinhart and Rogoff find 64 defaults between 1973 and 2009 Laeven and Valencia (2012), *in the same set of countries*, only find 34. This is not simply a matter of widening the window of years in which a default is classified. Many defaults in Reinhart and Rogoff such as Algeria (1991), Brazil (2002), Uruguay (1990), etc. are not recorded in the Laeven and Valencia dataset. This is due to the fact that Laeven and Valencia record an event only when a payment is missed. Reinhart and Rogoff seem to follow a more lenient approach classifying events where there are ratings downgrades, loss of market access, issues of confidence etc.<sup>22</sup> This classification is seemingly at odds with the seemingly stricter definition described in Table 1 and Reinhart and Rogoff

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<sup>22</sup> This conclusion is drawn from direct e-mail correspondence with Luc Laeven on February 11, 2016. He cites the case of Brazil in 2002 as an example where no payments were missed but Reinhart and Rogoff declare a debt crisis.

(2011). Such discrepancies across authors obviously seriously impinge on interpretation of the historical record and inferences drawn about the frequency, duration, costs and causes of crises.

#### 4.4 Causes of Crises

With the reappearance of financial crises associated with financial liberalization in the 1970s and 1980s and better international data, researchers began to focus energy on isolating the leading determinants of financial crises. Theory and analytical frameworks developed in the 1970s and 1980s provided guidelines for the key variables of interest, but explicit structural tests of particular models still remain few and far between. Most of the research in this area focusses on a large set of macroeconomic, financial and international variables and attempts to exclude variables with the lowest statistical power for predicting financial crises.

Subsequent to these early efforts, a new (near-consensus) view emerged, based in part on the experience of the 2007 crisis, assigning a primary role to credit booms as the key determinant and predictor of financial crises (e.g., Borio and Drehman 2009; Schularick and Taylor, 2012; Gourinchas and Obstfeld, 2012). Notwithstanding this view, it is appropriate to recognize that not all banking crises are driven by credit booms. It is also useful to recognize that not all housing, equity booms or capital inflow bonanzas end in crises.<sup>23</sup> A more satisfactory approach to understanding the drivers of financial crises recognizes that the micro-structure of the financial system matters as well as credit's interaction with a number of other macroeconomic determinants.

Four key approaches to understanding the causes of crises have been taken since the 1990s with subsequent refinements in recent years. The first approach uses cross-country data and limited dependent variable models such as logit or conditional logit to find statistically significant determinants (e.g., Demirgüç-Kunt and Detragiache, 1998). Kaminsky, Lizondo and Reinhart (1998), Kaminsky and Reinhart (1999), and Kaminsky (1999) show that the early warning indicators (EWI/EWS) methodology developed for

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<sup>23</sup> See Bordo and Landon Lane (2013), Jordà, Schularick and Taylor (forthcoming) and Goetzman (2015) for perspectives on housing booms and financial crises. Gorton and Ordoñez (2016) study *good booms* and *bad booms* arguing that not all credit booms end in crises.

predicting the business cycle can be satisfactorily employed. In addition, qualitative and descriptive analysis as well as “Big Data” methods have been used.

In a highly influential paper, Kaminsky and Reinhart (1999) apply and adapt the EWI approach to predict banking, currency, and twin crises in a sample of 20 countries between 1970 and 1995. From a large set of variables, they select 16 as the most important based on their changes in the months preceding and following the different types of crises in play. These variables are classified into four categories (Financial Sector, External Sector, Real Sector, and Fiscal Sector). Kaminsky and Reinhart (1999) check whether a variable signaled a crisis within a particular window of time (12 months for a banking crisis and 24 months for a currency crisis) and then find thresholds by finding the level or change in a variable that minimizes the noise-to-signal ratio. In this way, a sophisticated use of information criteria is used to balance type I vs. type II errors.

Two tradeoffs relevant to policy makers are immediately evident in the context of this strand of the EWI literature. First, what is the optimal size of the prediction window? Calling a crisis too early could put the brakes on an otherwise healthy economy, but failing to act at an early date might preclude avoiding a crisis. Another tradeoff concerns the loss function for policy makers. Babecky et al (2014) note that minimizing the noise-to-signal indicator ignores the relative losses (to the policy maker) from missed crises vs. false alarms. In this case the optimal threshold would depend on the relative weights in a loss function as well as the predictive power of the signals. Obviously such a calculation has direct relevance for macro-prudential policy. Jordà, Schularick and Taylor (2011) illustrate the tradeoffs in finding an optimal threshold for any given indicator of a crisis with a correct classification frontier (CCF) akin to a production possibilities frontier trading off type I and type II errors. They suggest that the area under their CCF, which is equivalent to the AUC criteria, be used in determining whether a particular model has predictive power.

Returning to the pioneering study of Kaminsky and Reinhart, their data suggest that growth of money and interest rates are above trend before crises, while an appreciating real exchange rate and exports below trend help predict crises. In addition, in their sample, output falls below trend prior to a crisis. The best predictors (i.e., those with the lowest noise-to-signal ratio) for banking crises are: appreciation of the real exchange rate, equity price booms and the money multiplier. The lowest type I error (missed crises) is provided by

high real interest rates which were strongly associated with financial liberalization especially in the 1980s.

Recent research in a similar vein (Babecky et. al, 2014, Drehman et. al, 2012, Gourinchas and Obstfeld, 2012) emphasizes the financial cycle highlighting above trend growth in the ratio of domestic private credit to GDP, equity, and property prices. The earlier literature (e.g., Kaminsky and Reinhart, 1999) did not deny that credit was important, but in Kaminsky and Reinhart's sample the percentage of crises correctly called by this variable (when above its threshold) is only 50% while its noise-to-signal ratio was a relatively low 0.59. While these results are not equally comparable to the results in Schularick and Taylor (2012) who argue that credit is a very strong predictor of crises alone and of itself, it would appear that the role of credit depends on the particular sample chosen and definition of a crisis.

Another strand of the literature attempted to predict banking crises using logit analysis. Demirgüç-Kunt and Detragiache (1998) find the following:

- low GDP growth, high real interest rates, and high inflation are significantly correlated with the occurrence of a banking crisis.
- banking sector variables such as the ratio of broad money to foreign exchange reserves, credit to the private sector, and mis-managed liberalization are associated with banking crises
- the level of GDP/capita is negatively related to crises
- deposit insurance which is overly generous may also be associated with moral hazard and banking instability.

Subsequent work by the same authors emphasized the role of financial liberalization in environments with weak regulatory capacity and generally weak institutions giving rise to corruption, weak rule of law, and poor contract enforcement. This result echoes the general experience we highlight above that deposit insurance and guarantees have fomented regulatory forbearance and in many instances this has led to banking crises.

Research over the past five to ten years has made refinements to the general methods proposed above. For instance, Bussiere and Fratzscher (2006) note that a binary logit model that predicts the onset of a crisis may ignore the fact that macro-economic variables and relationships may behave differently in the wake of a crisis. Using information from the quarters immediately following a crisis to predict a crisis may thus lead to poor predictions. Instead of running binary response models to predict banking crises, Bussiere and Fratzscher estimate a multinomial response which allows for three states of the world: non-crisis, crisis and post-crisis. Better prediction is also achieved by using the tools from the model selection literature. In this vein, Babecky et. al. (2014) use Bayesian averaging of regression estimates to select the strongest set of determinants rather than focusing on a small set of indicators.

Other authors have moved the goalposts slightly by incorporating more information to generate continuous indicators of crises. Rose and Spiegel (2011) and Babecky et. al (2013) cover banking crises while Frankel and Saravelos (2012) study currency crises. Here the indicators of crises incorporate information on the severity of the crisis. Rose and Spiegel (2012) study a Multiple Indicators Multiple Causes (MIMC) model to study the crisis of 2007-2008. Their indicators are quite distinct from the simple binary banking crisis indicators in Table 1. Instead their indicators focus on the output drop between 2007 and 2008, exchange rate movements, credit ratings changes, and equity price changes. The advantages in such procedures are that one does not need to use limited dependent variable models which are biased in the case of rare events and deal poorly with unobservable heterogeneity. However, the regressand of interest has changed significantly in terms of the economic meaning compared to the previous literature on early warning indicators.

The conclusions from this strand of the literature are not entirely consistent with the earlier EWI literature. Frankel and Saravelos (2012) conclude that foreign exchange reserves, the real exchange rate, the growth rate of credit, GDP, and the current account are the most frequent statistically significant indicators (of currency crises) in the literature reviewed. While somewhat consistent with Kaminsky and Reinhart, the finding obviously has little light to shed on the correlates of banking crises. Rose and Spiegel (2011) and Rose and Spiegel (2012) use indicators that overlap with those in Kaminsky and Reinhart but find little predictive power for any of the leading causes explored in Kaminsky and Reinhart--most notably the level of the ratio of domestic credit to GDP. Since the crisis of 2007 manifested

itself in different ways in different countries, it is not surprising that Rose and Spiegel (2011, 2012) find few reliable predictors to explain the diversity of experience. Exploration of this issue by Sayek and Taskin (2014) provides interesting evidence. In fact, the Eurozone crises were different from each other, but they bore some similarity to previous crises (i.e., a small set of variables moved in the same way prior to these and previous crises). They emphasize that each recent crisis has a reasonable match to other historical crises in the model, but that each match is likely to be to a separate and distinct crisis. In other words, the causes of the most recent crisis are heterogeneous and not driven by one particular variable.

International Monetary Fund (2009) discusses some of the differences in the way the recent crisis unfolded across countries, and hence why EWI analysis may be challenging. While some countries were exposed to offshore borrowing, others had significant housing booms. Still others had cross-border assets in the US---the epicenter of the crisis, and several countries had unsustainable fiscal and financial problems (as discussed above) as well as policy constraints (e.g., countries in the EMU). While one might infer from some of the recent theoretical and empirical literature that growth of the ratio of domestic credit to GDP is the key to understanding financial crises, this does not appear to be the only, nor the main, determinant of crises over the last few decades. Consequently a focus solely on credit may not go very far in helping us understanding the recent crisis or future crises.

In addition, a large debate exists on the role of capital inflow surges versus credit booms. Both factors were cited as potential risks in the run up to the 2007 crisis and have perennially been in the spotlight in the empirical and theoretical literature. Many conceptual frameworks suggest that capital inflows fuel lending booms in open economies (Borio, James, and Shin, 2014; Díaz Alejandro, 1985; Mackinnon and Pill, 1986). In a widely cited study, Jordà, Schularick and Taylor (2011) find that prior to 1945 current account deficits are associated with systemic crises, but that after 1945 this is no longer the case. These authors cite the growth of the ratio of credit-to-GDP as a key determinant and a good predictor of systemic crises. In addition they find no evidence that capital inflows which coincide with credit booms raise the probability of a systemic crisis.

In opposition to these findings, Caballero (2014) re-examines the connections between credit and capital flows in an interesting empirical treatment finding a role for both capital inflow surges and credit booms. Caballero (2014) uses a limited dependent variable model that allows for unobservable country level heterogeneity and yet allows for non-crisis

countries to appear in the sample, unlike in Jordà et. al (2011) who use conditional logit models. Caballero's sample covers a large sample of countries (both developed and less developed) from 1973-2008 while Jordà et. al (2011) feature data from 14 countries 1870-2008.

Caballero finds that inflow bonanzas and credit booms are both statistically significant predictors of banking crises (using a similar definition of crises to Laeven and Valencia). However capital inflow bonanzas do not solely operate through bank intermediated credit booms. Moreover, portfolio-equity capital flows, but not bonanzas associated with a rise in net debt are statistically significant. The evidence here suggests capital inflow bonanzas may also generate instability by fueling asset price booms and enhancing liquidity. Based on these results, it seems imprudent to ignore the role of large capital inflows even if domestic private credit is not growing above trend.

Could monitoring of the credit to GDP ratio have been sufficient to avoid the recent global crisis? It is unlikely. Caballero (2014) as well Babecky (2014) and IMF (2009) suggest a more eclectic approach that simultaneously incorporates multiple variables. In addition, IMF (2009) emphasizes that while the sub-prime crisis is often thought of as a credit-driven event accompanied by unsustainable levels of leverage this characterization is at odds with the data. In the US, for instance, private domestic credit to GDP did not grow strongly above trend because borrowing by corporates eased while household debt and leverage increased.<sup>24</sup> Contrariwise, the East Asian crisis was associated with strong growth of leverage in the corporate and financial sector and less so in the household sector (IMF, 2009). In addition, leverage amongst financial institutions in the 1990s was as high as in the years before 2007 (Portes, 2010). It should not be forgotten that in the recent crisis, leverage in many financial institutions was hidden in off-balance sheet vehicles and so forth giving credence to the idea that Goodhart's law is in play. Ideally, any surveillance of the financial system, any conclusions regarding causes of crises, and any macro-prudential policy would pay close attention to where exactly risk was concentrated and where maturity mis-matches are the most pronounced. Surveillance and policy must also carefully weigh the costs and benefits of

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<sup>24</sup> Jordà et. al (2013) note that the level of "excess credit" was in the 60<sup>th</sup> percentile for all crisis events in their data and emphasize the issues related to shadow banking. They emphasize that a broader measure of credit shows a more significant boom.

imposing policy in light of the potential for type I and type II errors as highlighted in this literature.

#### 4.5 Output Losses of Financial Crises

Financial crises are often associated with economic downturns and deviations of output from long-run trends. A large number of studies investigate the impact of crises on output, output growth, other macroeconomic aggregates, and even health indicators (Stuckler, Meissner, Fishback, Basu, and Mckee, 2010; Stuckler, Meissner, and King, 2008).

Table 3 provides a list of leading papers, methodologies and baseline estimates for the impact of financial crises on output.<sup>25</sup> In this literature, most authors define output losses as the deviations from a pre-crisis peak in output or a pre-crisis output trend. However, there is substantial variation in the methodologies used for calculating the costs of financial crises. Some authors study the marginal impact of crises and financial distress on growth rates. Others calculate the cumulative loss of output or GDP per capita from the peak of economic activity at various post-peak window lengths. Differences in methodologies, dependent variables, and samples lead to significant differences in the point estimates of the output costs of financial crises. Still, nearly all studies agree that financial crises are associated with economically significant downturns in output and output growth.

**<< TABLE 3 HERE >>**

One major issue in determining the size of the output losses attributable to a crisis is causality or endogeneity. Real shocks may cause an output decline and problems in the financial sector, but equally, financial shocks are widely believed to generate output

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<sup>25</sup> The Basel Committee on Banking Supervision at the Bank for International Settlements (2010) also provides a similar table and calculates median and average output losses across studies (with no “permanent” effects) as 19%. See Table A1.1 in that paper.

declines.<sup>26</sup> The problem comes down to identifying the sources of variation in outcomes when un-observable financial frictions and shocks matter and are correlated. More precisely demand and supply may change in response to the same shocks that contribute to financial problems thus making it difficult to cleanly identify the impact of financial shock itself. Empirically, Reinhart and Rogoff (2014) observe in their sample that the peak of economic expansions usually coincides with banking crises but that in several instances the peak pre-dates the crisis. Calomiris and Hubbard (1989) argue that output turns down prior to difficulties in the financial sector.

Two main approaches have been taken to deal with heterogeneity, unobservable factors and endogeneity bias. Bordo et. al. (2001) compare recessions without financial crises to recessions with financial crises. After controlling for a small set of observables, the authors find that financial crises are associated with higher output losses than recessions without financial crises. In a similar vein, Jordà, Schularick and Taylor (2013) report statistically and economically significant differences between output downturns associated with financial crises and downturns not associated with financial crises even after conditioning on a number of pre-determined macro-economic variables. Jordà et. al. (2011) also find that output losses in financial recessions are positively associated with the size of the pre-crisis rise in the ratio of credit to GDP.

Another way of dealing with causality is to put more theoretical structure on the data. Della'Ariccia et. al. (2008) argue that if financial sector distress matters then it should be the case that sectors which are more dependent on external finance should be the hardest hit when the banking sector is in trouble. Their evidence is consistent with this line of reasoning. Mladjan (2012) provides similar evidence for the Great Depression. In addition, Ziebarth (2013) found quasi-experimental evidence from the 1930s that where bank failures were larger these were associated with greater declines in output, lower revenue and a slower pace of entry by firms.

We provide some baseline estimates for output losses that are comparable in terms of methodology. We use crisis data from Bordo et. al, Reinhart and Rogoff, and Laeven and Valencia, and data on output per capita for 42 countries between 1865-2009 from Barro and

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<sup>26</sup> In general, the theoretical literature in macroeconomics shows how output losses due to shocks can be amplified in the presence of financial frictions. Financial shocks arise from capital quality shocks in a model with financial frictions as in Gertler and Karadi (2011). See also Bernanke, Gertler and Gilchrist (1999).

Ursua (2008). For the period 2000-2014 we use real GDP per capita (in local currency) from the World Economic Outlook database in order to calculate trends and output losses from the recent crisis that started in 2007. We calculate unconditional output losses in different periods using the crisis dates from the various data sets surveyed in Section 4. In particular, we study the cumulative percentage deviation of GDP per capita from the pre-crisis trend level of GDP per capita. The window we use is the year of the crisis to three years after the crisis starts. Pre-crisis trends are given by the average annual change of the logarithm of GDP per capita in up to 10 years prior to a crisis.<sup>27</sup>

**<< FIGURES 3A-3D HERE >>**

We provide these losses for banking, twin, and triple crises in Figures 3a ,3b, 3c, and 3d. Figures 4a, 4b, 4c, 4d, 4e, and 4f provide illustrations of specific country examples. Output losses, as we define them here, are economically very large. In the period 1880-1913 Figure 3a shows that for banking crises average output losses are nearly 3 percent in BEKM's data (median = 0.20, standard deviation = 38.9) and 6 percent in RR (median = 5, standard deviation = 33). Losses are much larger in the interwar, largely driven by the Great Depression. Here, for the three different types of crises, losses are never lower than 40 percent (0.4 log points) in the BEKM data set. In the post-Bretton Woods period, losses in the BEKM and RR data sets are smaller than the interwar period but larger than the 1880-1913 period. Here the average losses are on the order of 14 percent in the BEKM data (median = 18, standard deviation = 23), 21 percent in the RR data (median = 24 standard deviation = 28) and 29 percent in the LV data (median = 30, standard deviation = 28). The higher losses in the LV data set stem from the inclusion of a wider range of countries and the inclusion of the crisis of 2007 which witnessed much higher output losses than previous crises.

**<< FIGURES 4A-4F HERE >>**

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<sup>27</sup> We eliminate crises that occur within three years of another crisis. Previous crises may have an impact on the trend and level of output. We also estimate losses separately for banking crises without currency and currency and debt crises so as to separate the sample space into mutually exclusive bins as above.

Output losses are different in size due to different methodologies in calculating trends, in dating crises, defining the type of crisis of interest, and country/time coverage. When we restrict the sample to BEKM's 56 countries and the years 1973-1997 which are covered in all data sets, then the output losses from banking crises are calculated as 14 percent (BEKM), 15 percent (RR), and 19 percent (LV). Using different sample years and countries leads to different headline numbers as is immediately obvious. In addition, LV use GDP and not per capita GDP, although, in practice this has only a minimal effect. LV also use an HP filter whereas we have opted for a simplified exponential de-trending procedure. While we find some instances where losses are not positive (i.e., output per capita is not below trend), probably because the pre-trend is already quite low, LV report no instances where this is the case. It appears that the lag length for calculating the trend also matters. Jordà, Schularick and Taylor (2013) study deviations from the business cycle peak (Table 5, p. 13, Table 6, p. 15, and Table 7 p. 19). This could lead them to offer smaller losses since no assumptions are made regarding the continuing trend of GDP per capita.

One surprise when looking at the long run is that output losses seem to be larger in the recent period compared to the pre-World War I period despite today's greater reliance on liquidity support, fiscal interventions and other policies which attempt to remedy the market failures associated with financial shocks. However, compared to the interwar period/Great Depression years, a period when policy was counter-productive, the losses from banking crises are lower on average. Without recent interventions, output losses might have been higher -- although without further work and careful research design to sort out endogeneity and selection biases we can take no firm stance on the causal impact of financial distress and systemic banking crises. As for the pre-World War I period, it may be the case that the economies of the time were more flexible or that the financial sector's size was limited mitigating the overall negative impact on output. In the historical period, countries avoided output drops comparable to those today even without a comprehensive crisis-fighting playbook beyond lender of last resort actions and ad hoc rescues. An interesting avenue for future empirical research is to study the size of output losses after properly accounting for variance in policy action.

#### **4.6 The Speed of Recovery after Financial Crises**

Reinhart and Rogoff (2009, 2014) as well as Roubini (2009) posited that recessions with financial crises (i.e., financial recessions) are followed by slow recoveries. These authors generally gauge time to recovery as the number years until the level of real per capita GDP attains the prior peak it reached. Reinhart and Rogoff (2009) study a small sample of “severe” financial crises while Reinhart and Rogoff (2014) study 100 systemic banking crises 1857-2013. Reinhart and Rogoff find that recessions with systemic crises have longer times to recovery than those recessions which are not accompanied by a crisis.

In contrast to the above studies, Bordo and Haubrich (2012) posit that financial recessions generally are followed by faster recoveries. They start with Milton Friedman's (1993) plucking model which shows that deep recessions will be followed by fast recoveries. Zarnowitz (1992) documents this stylized fact for the US. Bordo and Haubrich then compare the recovery from recessions with crises to those that did not have crises for 22 business cycles 1880 to 2010 in the USA. Bordo and Haubrich measure the depth of the contraction as the percentage drop in quarterly GDP from the peak to the trough of NBER cycles. They then measure the “strength” of the recovery as the percentage change in GDP in the first 4 quarters of the expansion. Bordo and Haubrich also measured the recovery as the same number of quarters that output declined in the preceding downturn, so e.g., if output declined for six quarters they measure the strength of the recovery as the percentage change in GDP in the first six quarters of the expansion. They find that recessions with financial crises (using crisis dates in BEKM) were one percentage point deeper than non-financial recessions and the recoveries were 1.5 percentage points stronger than recoveries in non-financial recessions. Other studies confirm Bordo and Haubrich including: Howard, Martin and Wilson (2011) and Romer and Romer (2015). Results in Jordà et. al. (2013) show that the US recovery after 2007 was faster than what would have been predicted by their empirical models.

## **5. Fiscal Crises, Banking Crises and the Fiscal Crisis Trilemma**

Following the research of Reinhart and Rogoff (2009) and after observation of events in Europe, research has focused on the impact of banking crises on the probability of a debt crisis especially in advanced countries. While developing countries faced such troubles from the 1970s, advanced countries largely had fewer and smaller crises until recently. The

exceptions being of course Japan, Sweden, and Finland in the 1990s. Reinhart and Rogoff suggest however that public debt (not the debt-to-GDP ratio) increased by about 86 percent in the wake of banking crises due to the impact of falling revenues. According to Reinhart and Rogoff, these increases, “in several cases,” were not wholly due to the fiscal costs of bailouts. Schularick (2012) shows that the (systemic) crises of the late 20<sup>th</sup> century are associated with large rises in the debt-to-GDP ratio, but that in the same sample of 14 advanced countries, the crises prior to the 1970s were not associated with significant rises in this ratio.

Laeven and Valencia provide a systematic data set on the rise in debt-to-GDP ratios for all of the banking crises in their data set. The median rise in the debt to GDP ratio for all systemic crises in their data was 12 percent of GDP while in advanced economies this figure rises to 21.4 percent of GDP. Fiscal costs, measured as the rise in outlays due to restructuring the financial sector had a median of 6.8 percent of GDP. Laeven and Valencia subtract the rise in fiscal outlays due to restructuring from the rise in total debt to calculate a rough measure of the degree of discretionary fiscal policy. The median for this variable is 7 percent of GDP.

Tagkalakis (2013) empirically examines the feedback loop from fiscal policy to financial markets and back in a sample of 20 OECD countries 1990-2010. Fiscal instability leads to financial instability and financial instability leads to fiscal instability via bailouts. Fratzscher and Rieth (2015) using structural VARs with daily financial markets data for 2003-2013 confirm the two way causality between sovereign risk shocks and bank risk. They find that sovereign risk shocks are more important in explaining bank risk than the reverse. In another report carried out by the European Commission (2009) the average unconditional post-crisis rise in the debt-to-GDP ratio was 18.9 percent of GDP. This figure is cumulative until the “end” of each crisis in the sample and covers 49 crises (Laeven and Valencia dates) for advanced and emerging economies 1970-2007.

The findings in Tagkalakis (2013) are intriguing since it appears that the rise in debt following a financial crisis is larger the bigger the size of the financial sector relative to total output. Laeven and Valencia (2013) also argue that the largest fiscal costs of crises since the 1970s have been in Ireland, Iceland, Israel (1977), Greece, and Japan (1990s).

Putting all of these findings together suggests the possibility that there is a potential tradeoff for countries along the lines of a trilemma. This financial/fiscal trilemma suggests

that countries have *two* of the following three choices: a large financial sector, a large bailout package, and a strong discretionary reaction to the downturn associated with financial crises. The logic is as follows by way of an example. Assume a country with a large financial sector faces a banking crisis. If so, then the government can provide a bailout package of a size that is commensurate with the size of the financial sector. If so it uses up its fiscal space. Otherwise it could lower the size of the bailout and devote its fiscal space to discretionary fiscal policy. With a smaller financial sector, and the same amount of fiscal space, since the size of the bailout would by definition be smaller, the size of the rise in debt due to expansionary policy could rise.

The cases of the United States and Greece post-2007 are illustrative. The US had a large financial sector, but its bailout, as measured by the fiscal costs was relatively small (4.5 percent of GDP). On the other hand, the rise in the debt to GDP ratio not attributable to the gross costs of the bailout was on the order of 19 percent of GDP (Laeven and Valencia, 2012). While Greece had a rise in the ratio of debt-to- GDP (after accounting for the fiscal rescue costs) of about 17 percent, its downturn was much larger and likely merited, based on past experience, a much larger discretionary response. Greece's fiscal costs of the bailout are reported by LV to be 27 percent of GDP. Obviously, the ability of countries to finance either a bailout or a discretionary package depends on the willingness of capital markets to fund deficits. In this regard, the trilemma would be more applicable or more binding for countries which had better debt sustainability measures at the beginning of their crisis events.

To test the idea of a financial trilemma we used data from Laeven and Valencia (2012) on the change in the ratios of total government debt to GDP in the three years following a banking, twin, or triple crisis, the fiscal costs of bailouts to GDP and a residual which is the difference between the change in the debt-to-GDP ratio and the ratio of the fiscal costs-to-GDP. We used data for 19 banking crises in the advanced countries since 1970. We omit the case of Switzerland in 2008 since it had a decline in the overall debt to GDP ratio and our econometric model is in logs. Also emerging economies had many episodes of declines in the debt-to-GDP due to inflation which poses some issues for our initial exploration in a log-linear regression.

In the spirit of measuring a tradeoff we run the following regression

$$\ln\left(\Delta\frac{Debt_{it}}{GDP_{it}}\right) = \kappa + \theta_1 \left[\ln\left(\Delta\frac{Fiscal\ Costs_{it}}{GDP_{it}}\right)\right] + \theta_2 \left[\ln\left(\Delta\frac{Discretion_{it}}{GDP_{it}}\right)\right] + \varepsilon_{it} \quad (1)$$

We do not use panel data methods in this case. Instead we study 19 episodes for the years 1970 to 2012. Data are for 18 countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Sweden, UK, USA). Fiscal costs are given by Laeven and Valencia and “Discretion” is the change in the debt-to-GDP ratio minus the ratio of fiscal costs-to-GDP. Of course, countries have differing abilities and desires for the target variable “debt” depending on market conditions, political economy issues, and the size of the financial crisis. Here we assume that crises create a need for bailouts, but that when a country spends resources on a bailout that this is associated with a tradeoff in the size of the “discretionary” response.

The results of the regression, with robust standard errors underneath the coefficients in parentheses are:

$$\ln\left(\Delta\frac{Debt_{it}}{GDP_{it}}\right) = \frac{0.69}{(0.13)} + \frac{0.25}{(0.03)} \left[\ln\left(\Delta\frac{Fiscal\ Costs_{it}}{GDP_{it}}\right)\right] + \frac{0.74}{(0.04)} \left[\ln\left(\Delta\frac{Discretion_{it}}{GDP_{it}}\right)\right]$$

The results suggest that the coefficients on the two regressors add up to one and imply a tradeoff between bailouts and discretion. In Figure 5 we plot the predicted iso-lines at given levels of the change in the ratio of debt-to-GDP. Alongside these iso-lines, we also plot the data for the 18 countries and 19 crises in our sample. The rise in the ratio of debt-to-GDP matches the data relatively well especially in the mid-range of the changes in the debt-to-GDP ratio (the R-squared of equation (1) is 0.97).

**<< FIGURE 5 HERE >>**

We also checked whether the tradeoff is apparent by interacting the fiscal costs variable with the size of the financial sector (the ratio of domestic private credit-to-GDP from IMF IFS). If the interaction term is positive then it implies that the countries with large

financial sectors devote more of their fiscal space to bailouts. This is indeed what we find as seen in the following results:

$$\ln\left(\frac{\Delta Debt_{it}}{GDP_{it}}\right) = \frac{1.72}{(0.49)} + \frac{-0.27}{(0.24)} \left[ \ln\left(\Delta \frac{Fiscal\ Costs_{it}}{GDP_{it}}\right) \right] + \frac{0.11}{0.05} \left[ \ln\left(\Delta \frac{Fiscal\ Costs_{it}}{GDP_{it}}\right) \times \right. \\ \left. \ln\left(\frac{Domestic\ Credit_{it}}{GDP_{it}}\right) \right] + \frac{0.72}{(0.04)} \left[ \ln\left(\Delta \frac{Discretion_{it}}{GDP_{it}}\right) \right] - \frac{0.22}{(0.10)} \left[ \ln\left(\frac{Domestic\ Credit_{it}}{GDP_{it}}\right) \right] +$$

Further investigation from a univariate regression reveals that the share of the rise in the ratio of debt-to-GDP accounted for by bailouts was a positive function of the size of the financial sector though this coefficient is not highly statistically significant. Results of the regression are seen in Figure 6. Overall then, we find that as the size of fiscal bailouts increases, that what might be termed the discretionary component of the fiscal response is often smaller. A third factor generates a trilemma. Large financial sectors necessitate larger bailouts. If countries had small financial sectors, the constraints on discretionary fiscal action would be less binding.

<<FIGURE 6 HERE>>

## 6. Conclusions

This paper surveyed the history, theory and empirics of financial crises, fiscal crises and their interconnections. The history of the last two centuries shows clearly the presence of financial crises, currency crises, and debt crises somewhere in the world about every decade with five global systemic crises since the advent of globalization in the 19<sup>th</sup> century. The connection between financial crises and fiscal crises is primarily a more recent event, at least since the 1930s, although there were a number of such events in emerging market countries going back to the late nineteenth century. The key link between the two types of crises has been the increased use of government guarantees of financial institutions. These have surged in incidence and magnitude greatly since the Great Depression and especially since the 1980s. Governments after the Great Slump realized that banking panics were very

costly events both in economic and political terms, and they have gone to great lengths to avoid the classic banking panics of the nineteenth and early twentieth centuries and to avoid the perception of inaction. The consequence has been both more virulent modern banking crises with an increasingly strong likelihood of fiscal resolution and the accompanying fiscal resolution costs. This reflects the general phenomenon that when government intervenes to prevent costly events like forest fires and floods from occurring that economic agents adjust their behavior accordingly and use more of the protected resource than is in the long run optimal (Ip, 2015). This has been the case with banking crises where the establishment of a safety net based on deposit insurance and other guarantees has led to regulatory forbearance and moral hazard and increased leverage by the protected financial institutions. Thus there is a tradeoff between the costs of the financial crises that accompany financial development and growth and the moral hazard costs of insurance. Under many plausible assumptions, eliminating financial crises entirely is not necessarily an achievable nor a desirable outcome (Tornell and Westerman 2006). But neither is letting crises burn out on their own as was common in the early nineteenth century an ideal strategy. The optimal amount of financial crisis insurance in a world rife with market and regulatory imperfections is a subject for ongoing and future research.<sup>28</sup>

The theoretical literature has evolved greatly since the mid-twentieth century in its treatment of different crisis phenomenon incorporating the tools of rational expectations, game theory, and dynamics. There was a burst of literature explaining banking panics in qualitative terms after the Great Depression, starting with Minsky (1957) and Friedman and Schwartz (1963) amongst others. Then, after the opening up of global financial markets and the liberalization of financial markets from the post-Great Depression controls and

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<sup>28</sup> Allen and Gale (2007) discuss these issues from a theoretical perspective.

repression a wave of currency and banking crises swept the global economy. New innovations in theory including the Diamond-Dybvig model and first generation speculative attack models were developed. The emerging market crises of the 1990s led to a spate of new theory with emphasis on multiple equilibria and endogenous self-fulfilling crises. Since the 1990s, most macroeconomic models emphasize the interplay between real shocks and financial frictions with increasing sophistication. In addition, dynamic general equilibrium models are beginning to incorporate a banking sector with bank runs and liquidity.<sup>29</sup> The recent subprime mortgage crisis followed by the Eurozone crisis has led to new literature focusing on the link between financial and fiscal crises linked together by government guarantees. Many of the ideas developed recently stemmed from work done after the Asian crisis of 1997. Judging from the explosion in theoretical modeling that followed the earlier waves of crises, more work will likely be done in the future on the fiscal-financial crisis nexus. Some questions that might be posed include:

- What do we know about optimal bank regulation, macro-prudential policy and the political economy of resolution? What do we know about the market failures that generate a need for such interventions?

- If it is hard to predict financial crises, can macro-prudential policy and fiscal rules be reliable? Empirical research based on cross-country panel data sets has only just begun here (e.g., Cerutti, Claessens, and Laeven, forthcoming).

- What role does fiscal space play in the resolution phase of systemic financial crises?

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<sup>29</sup> See for example Gertler and Kiyotaki (2015), Boissay et. al. (forthcoming), and Paul (2016).

- Is the way in which resolution proceeds dependent upon initial conditions and other institutional constraints?<sup>30</sup>

- What kinds of fiscal union are feasible both economically and politically in a monetary union and how important are fiscal constraints under such arrangements? What fiscal arrangements are feasible and efficient in a monetary union facing systemic shocks?

Our survey of the empirical evidence on financial and fiscal crises led to our uncovering two very basic controversies: 1) Classification uncertainty: how do we define different types of financial crises and how do we date them? 2) What do we know about the costs and causes of crises? Our review of the literature and our own results based on a multi-country and multi-year database reveal that there are crucial differences over the definition of crises among the leading approaches taken in the literature. This has led to very different chronologies of the incidence of crises. This creates a serious problem for theorists and policy makers. Who should you believe? Picking the wrong approach can lead to misleading models calibrated to the wrong targets and ultimately to incorrect or mis-guided policy prescriptions.

If economists and policy makers truly believed that crises were an important phenomenon to understand and possibly avoid then it might be the case that an independent crisis dating committee could help set the standard in much the same way the NBER business cycle dating committee works. The advantage of following this model is that the NBER is a respected non-governmental, non-partisan organization. Other organizations such as the IMF are not sufficiently politically independent. If crises are becoming increasingly global and crisis fighting is a global public good, then the importance of such a

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<sup>30</sup> Steinkamp and Westermann (2014) show that the way in which resolution lending proceeds especially as regards junior or senior creditor status is associated with the country interest rates.

reform should be obvious. Such a committee could, if initiated, choose not only how to sensibly define crises in a uniform and consistent way, but also with an agreed definition this could help predict crises and to inform about the costs of crises.

With respect to measuring output losses, there are great differences in methodologies taken and techniques used. However, despite these differences, all of the studies agree that the output losses of financial crises are economically significant. This suggests that the stakes are high and the need for new theoretical and policy approaches to mitigate the crisis problem more compelling. The literature has some initial evidence that crises can be more severe when guarantees are not safeguarded or embedded in a reliable institutional framework. As of yet, we do not have a clear understanding of the magnitude of the impact of policies intended to mitigate crises (monetary policy, bailouts, fiscal policy). This surely must be a priority for research going forward. Any work in this direction must surely strive to meet the empirical standards set by the policy evaluation literature using credible research designs and/or sensible structural models of the phenomena in question.

Other empirical issues open up the door for further work. The question whether financial recessions lead to slow recoveries has not been resolved. Determining the leading causes of financial crises also is an open question. It is not at all obvious from the historical record that credit financed asset price boom-busts (i.e., what has come to be known as the financial cycle) have always been, or will always be, the key explanation despite the recent emphasis on that explanation. Given the complexities of the financial eco-system, perhaps some very general precepts should be at hand such as what is the level of risk and where are the risks residing?<sup>31</sup> Over-emphasis on one or a handful of indicators can be mis-leading if not dangerous for economic and financial stability. Due regard to the inter-connections and

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<sup>31</sup> See Haldane and May (2011) on complexity and interconnections in the financial system.

systemic risks is required. Finally a question that needs more research is the connection between financial development, fiscal resolutions of crises, and overall fiscal policy goals.

Answering these questions is of the utmost importance for public policy toward financial crises. Understanding theoretically the causes and mechanics of crises and how they impinge on the real economy are crucial for the development of reasonable policies for crisis prevention, crisis management and crisis resolution. But of course, getting the historical facts straight is also crucial. It is vital to avoid making rash generalizations which are based on over-reading or mis-reading of economic history. Such analysis leads to pitfalls for theorizing based on stylized events that may be very far from reality and for policies designed to fight the next crisis based on a misunderstanding of what happened the last time.

The bottom line from our study is more work needs to be done on getting the historical facts correct in measuring the incidence and impact of financial crises and in understanding the true causes of crises and how they impact the real economy.

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Figure 1a Banking Crisis Frequencies 1880-2012

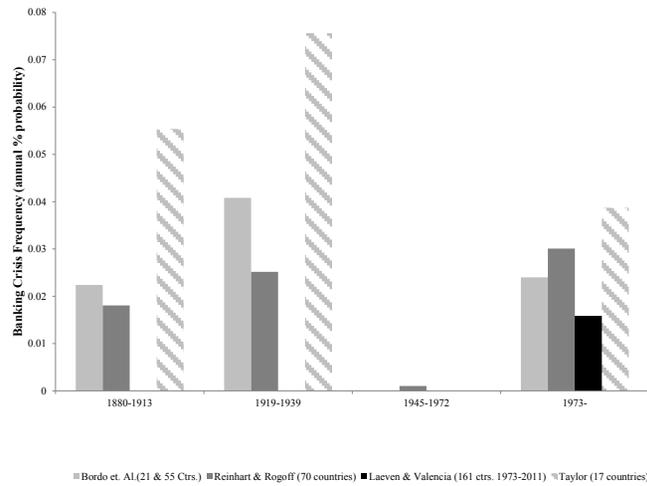


Figure 1b Currency Crisis Frequencies. 1880-2009

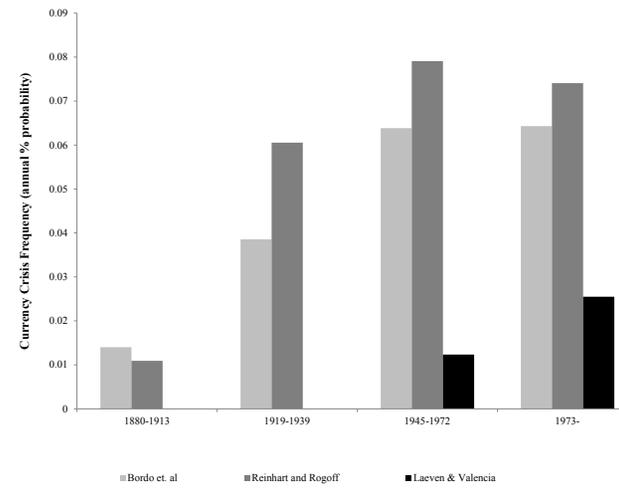


Figure 1c Twin Crisis Frequencies Three Datasets, 1880-2012

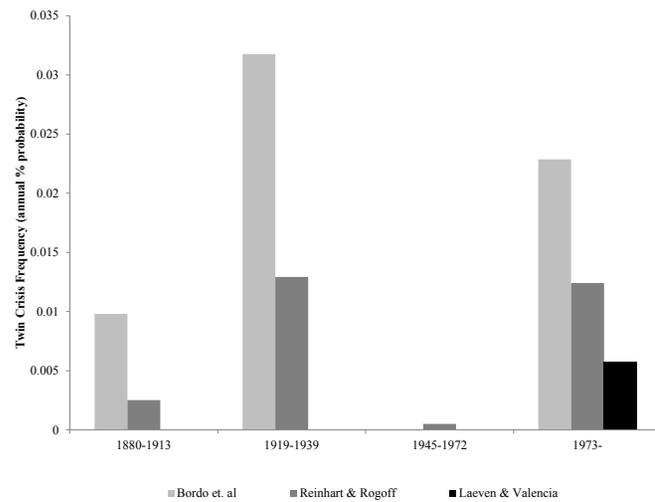
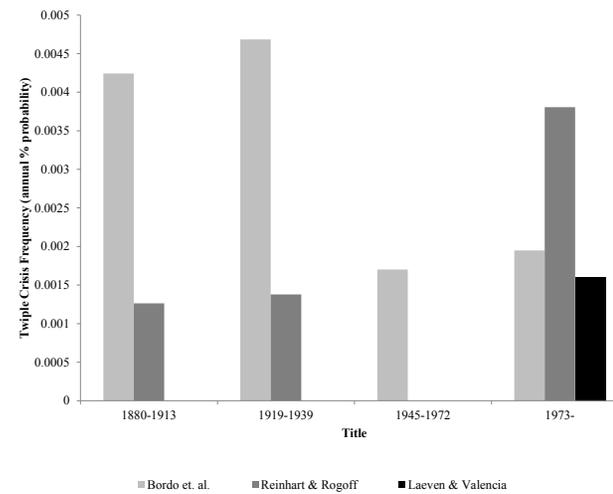


Figure 1d Triple Crisis Frequencies, Four Datasets, 1880-2012



Notes to Figure 1a-1d: Bars in Figure 1a show the ratio of the number of country-years when a country was in the first year of a banking crisis to the total number of country years in the sample. A banking crisis is defined differently according to each data set. Banking crises are events not preceded or followed within one year by a currency crisis or a currency and debt crisis. Taylor (forthcoming) studies “systemic crises”. Laeven and Valencia have no data prior to 1970 so these data are excluded from the first three sub-samples. Bars in Figure 1b show the ratio of the number of country-years when a country was in the first year of a currency crisis to the total number of country years in the sample. A currency crisis is defined differently according to each data set. Currency crises are events not preceded or followed by banking crises or banking and debt crises. Laeven and Valencia have no data prior to 1970 so these data are excluded from the first three sub-samples. Bars in Figure 1c show the ratio of the number of country-years when a country was in the first year of a twin crisis to the total number of country years in the sample. Currency crisis and banking crises are defined differently according to each data set. Twin crises are banking crises preceded or followed within one year by a currency crisis. Triple crises involving a debt default, banking and currency crisis are excluded. Laeven and Valencia have no data prior to 1970 so these data are excluded from the first three sub-samples. Bars in Figure 1d show the ratio of the number of country-years when a country was in the first year of a triple crisis to the total number of country years in the sample. Currency crises and banking crises are defined differently according to each data set. Triple crises are banking crises preceded or followed within one year by a currency crisis and a debt crisis. Laeven and Valencia have no data prior to 1970 so these data are excluded from the first three sub-samples.

Figure 2a Coincidence of Banking, Currency and Debt Crises, 1880-1913 (Bordo et. al.)

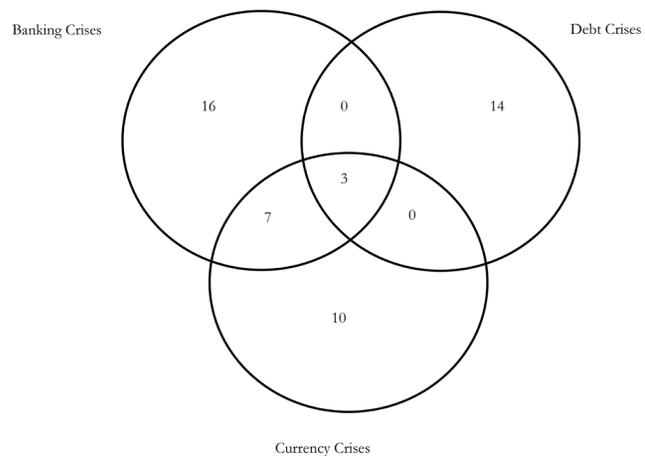


Figure 2b Coincidence of Banking, Currency and Debt Crises, 1919-1939 (Bordo et. al.)

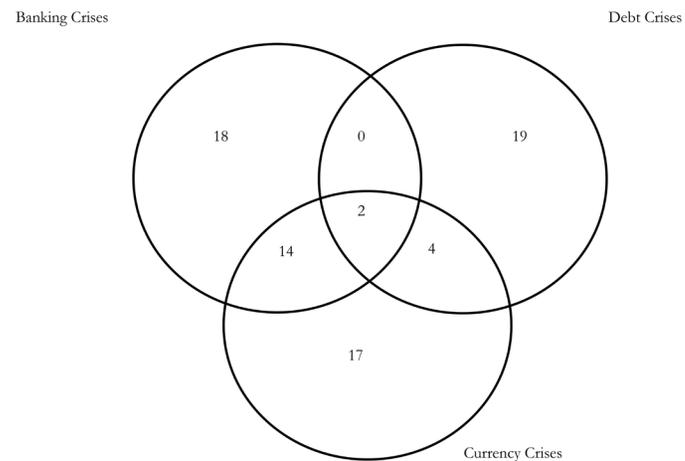


Figure 2c Coincidence of Banking, Currency and Debt Crises, 1970-2012 (Laeven and Valencia)

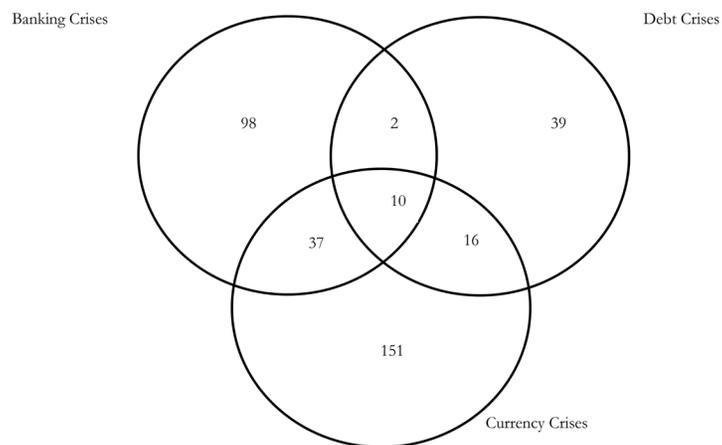


Figure 2d Coincidence of Banking, Currency and Debt Crises within a two year Window, 1970-2012 (Laeven and Valencia)

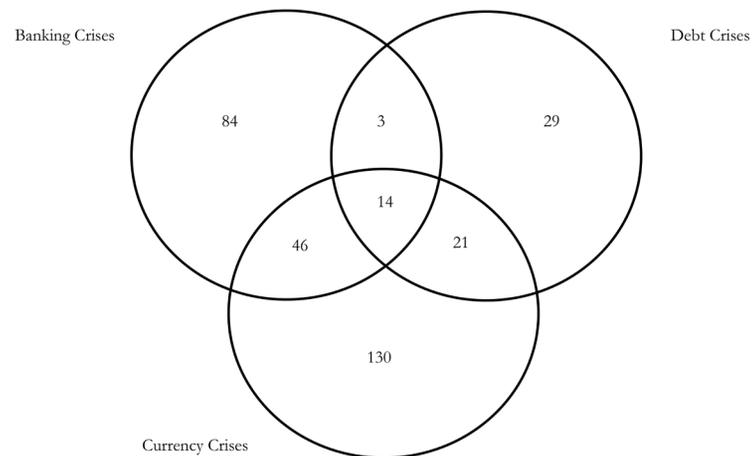
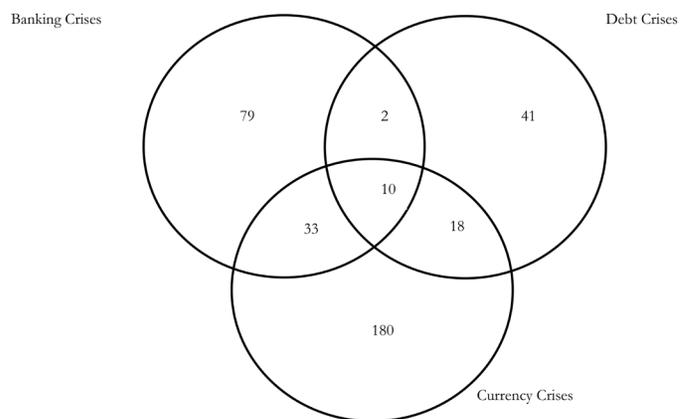


Figure 2e Coincidence of Banking, Currency and Debt Crises, 1970-2012 (Reinhart and Rogoff dates)



Notes to Figures 2a-2e: Source data for Figures 2a and 2b is Bordo et. al. (2001) Source data for Figures 2c and 2d is Laeven and Valencia (2013). Source data for Figure 2e is Reinhart and Rogoff (2008).

Figure 3a Output Losses for Three Varieties of Crises 1880-1913 Bordo et. al. vs. Reinhart & Rogoff

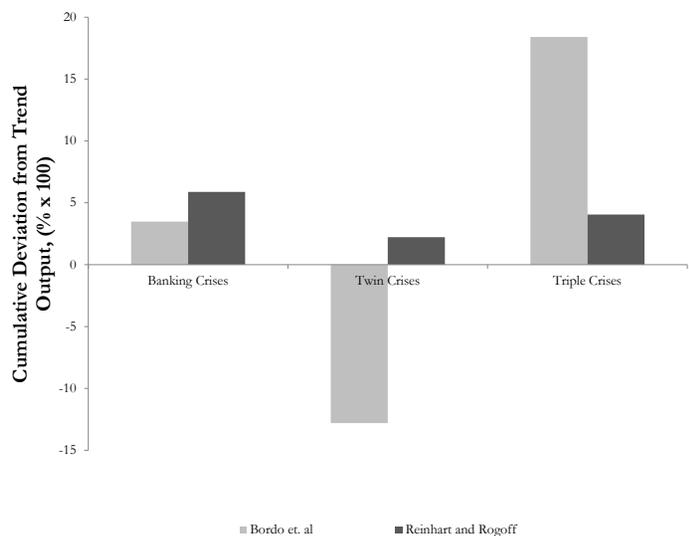


Figure 3b Output Losses, Three Varieties of Crises 1919-1939 Bordo et. al. and Reinhart & Rogoff

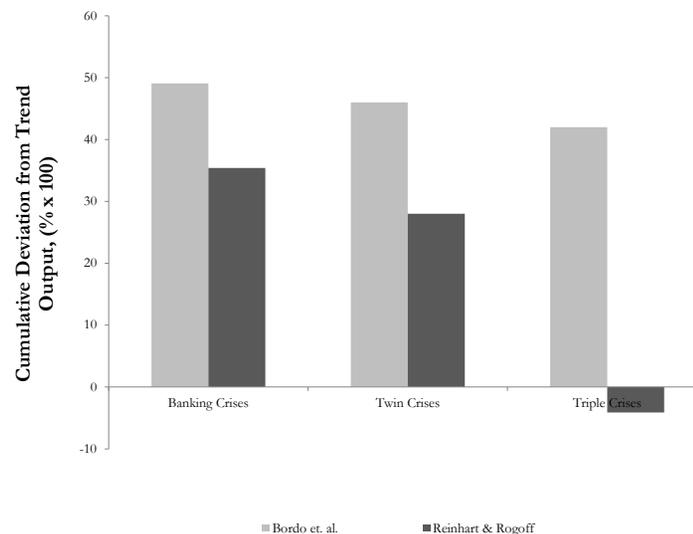


Figure 3c Output Losses, Three Varieties of Crises 1973-1997 (Bordo et. al.), 1973-2012 (Reinhart and Rogoff), 1973-2012 (Laeven and Valencia)

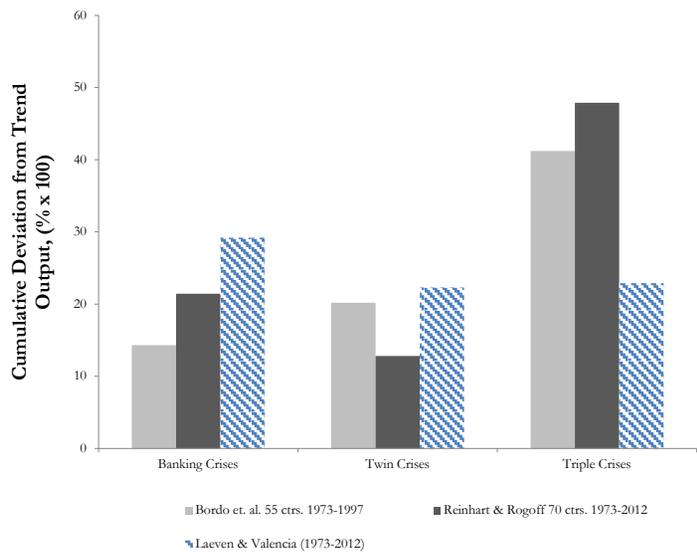
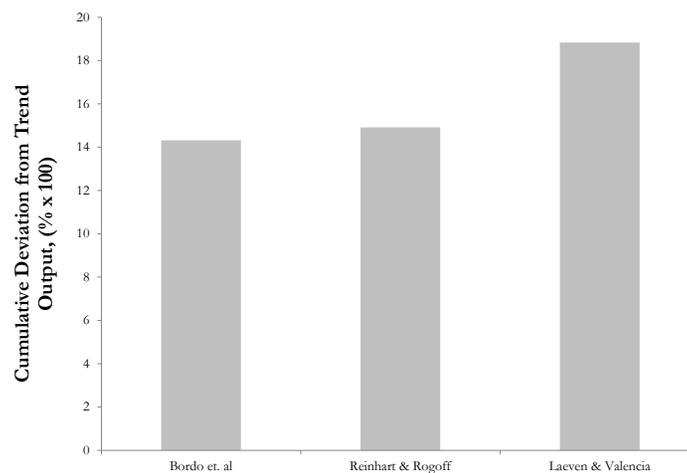


Figure 3d Output Losses from Banking Crises 1973-1997 Three Data Sets.



Notes to Figures 3a-3d: Output losses are calculated as the difference between the level of GDP per capita in the three years following a crisis and the extrapolated trend of GDP per capita. The trend is calculated as the average growth rate in the 10 years prior to crisis. See the text for additional information.

Figure 4a GDP per person Actual and Counterfactual, USA, 1907

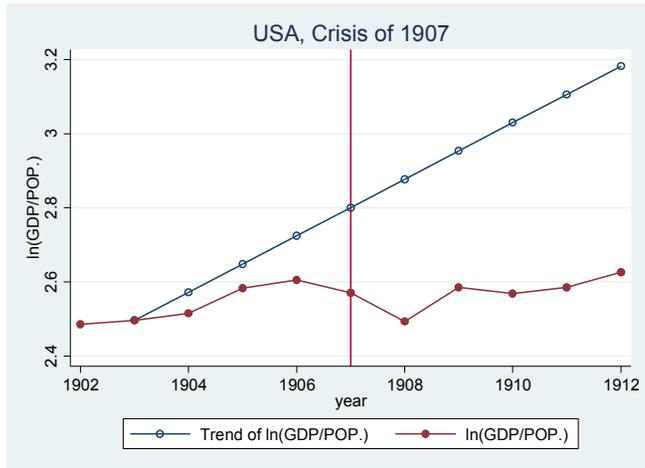


Figure 4b GDP per person Actual and Counterfactual, Argentina, Baring Crisis

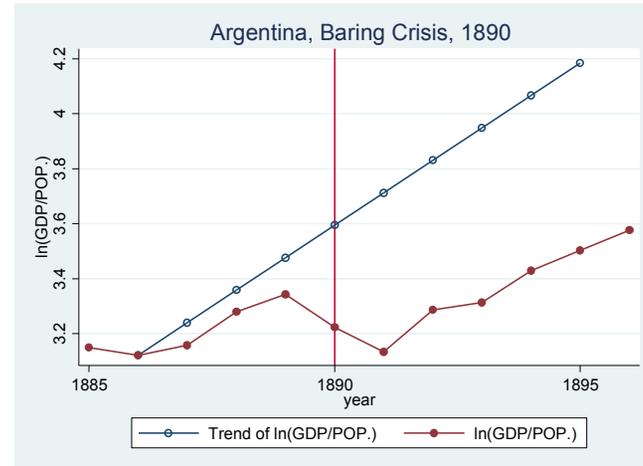


Figure 4c GDP per person Actual and Counterfactual, France, Great Depression

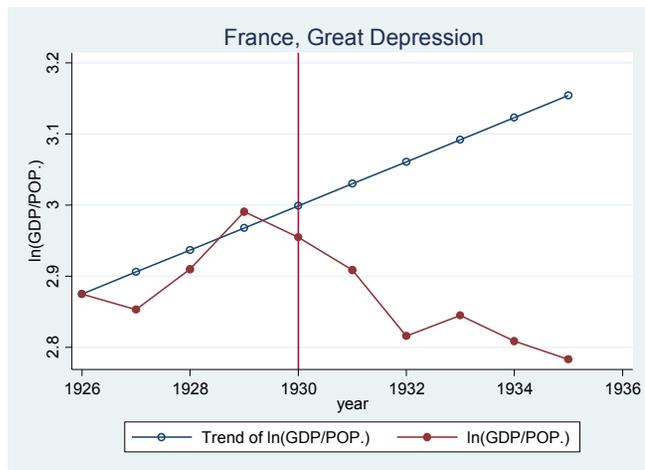


Figure 4d GDP per person Actual and Counterfactual, United States, Great Depression

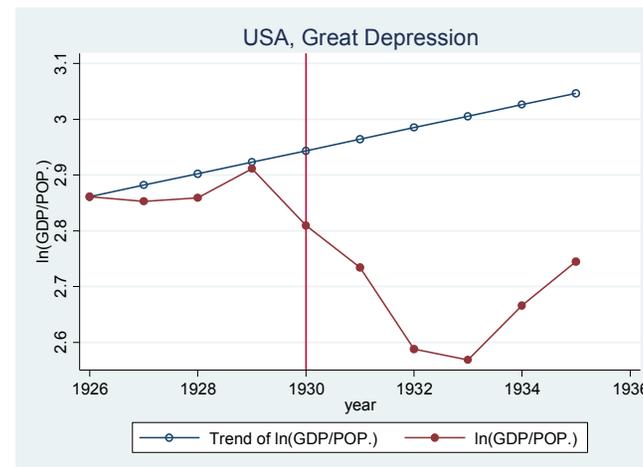


Figure 4e GDP per person Actual and Counterfactual, Sweden, 1991

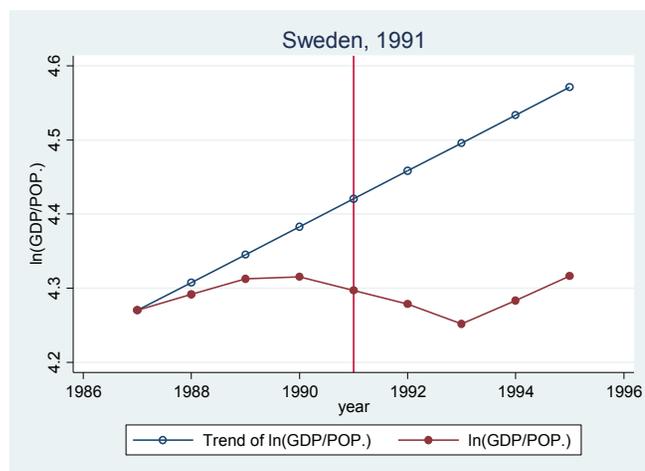
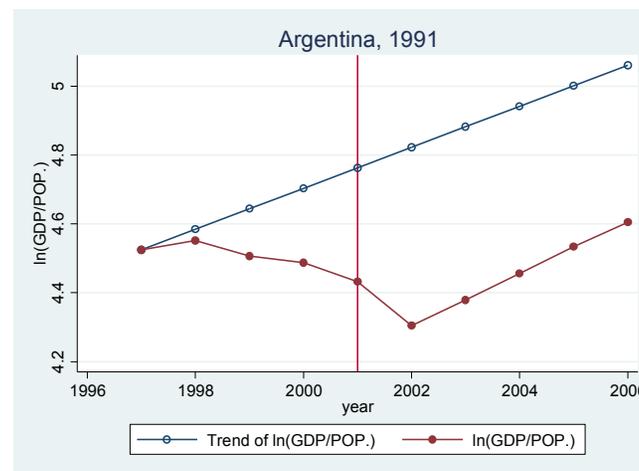
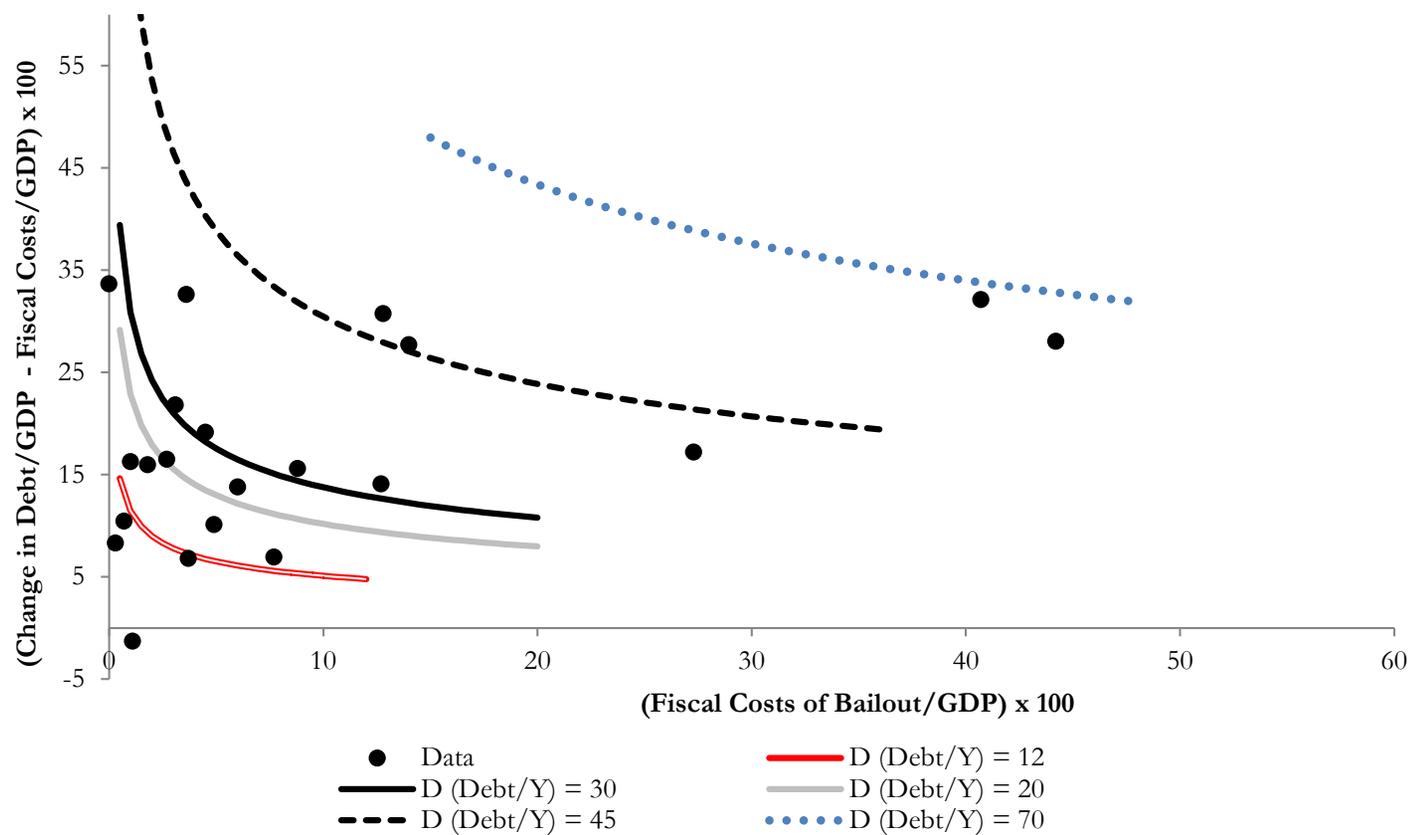


Figure 4f GDP per person Actual and Counterfactual, Argentina, 2001



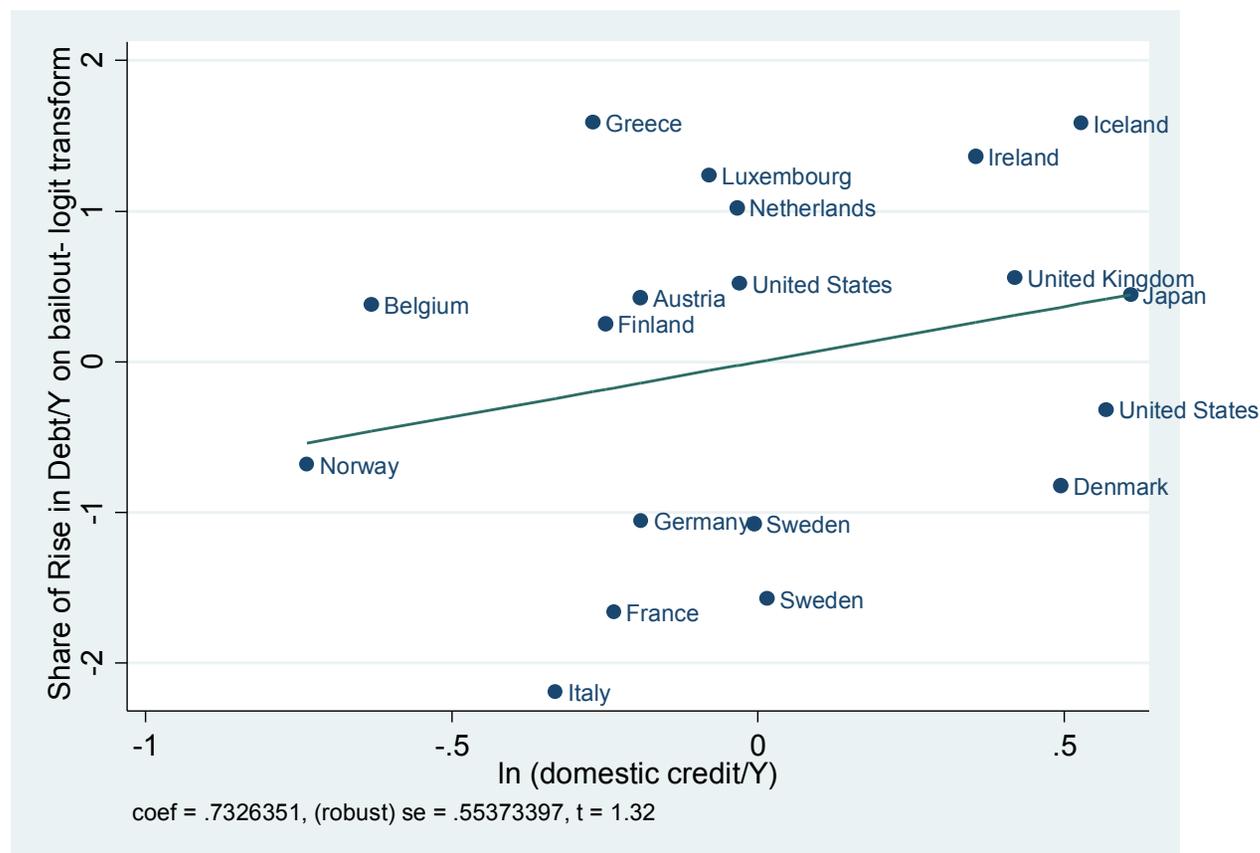
Notes to Figures 4a-4f: Data are underlying Bordo et. al except for Figure 4f. Data real GDP per capita for Figure 4f are from the World Economic Outlook database. Trend (counterfactual) line is calculated based on simple extrapolation of the average growth rate in the previous 10 years.

Figure 5 Fiscal Costs of Bailouts vs. the Rise in Government Debt/GDP from other Non-Bailout Costs, 19 Crises, 1970-2012



Notes to Figure 5: Data are from Laeven and Valencia (2012). Iso-lines are the predicted values for the debt to GDP ratio from equation (1).

Figure 6 Fiscal Costs of a Bailout as a share of the Rise in Debt-to-GDP vs. Size of the Financial Sector



Notes for Figure 6: Figure presents the predicted regression line/partial regression plot from a univariate regression of the share in the rise in debt as a percentage of GDP against the logarithm of the level of private domestic credit to GDP. We perform a logit transform on the dependent variable prior to estimation. Debt data are from Laeven and Valencia and the credit data are from IMF IFS.

Table 1 Crisis Definitions Four Leading Data sets

Authors	Sample	Banking Crisis Definition	Currency Crisis Definition	Debt Crisis Definition
Bordo et. al. (2001)	1880-1939 21 Advanced Countries 1945-1997 21 Advanced Countries + 34 Less Developed Countries and Emerging Market Economies	Financial distress resulting in the erosion of most or all of aggregate banking system capital as in Caprio and Klingebiel (1996)	Forced change in parity, abandonment of a pegged exchange rate, or an international rescue. Or: an exchange market pressure (EMP) above a critical threshold (calculated as a weighted average of exchange rate change, short-term interest rate change, and reserve change relative to the same for the center country, the UK before 1913 and the US after). A crisis is said to occur when this index exceeds a critical threshold. We score an episode as a currency crisis when it shows up according to either or both of these indicators	No debt crises are dated in this data set.

Reinhart and Rogoff (2009)	1800-2011 70 Countries	A banking crisis occurs when there are one of two types of events: (1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; or (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions), that marks the start of a string of similar outcomes for other financial institutions.	Reinhart (2010) refers to a working paper version of Reinhart and Rogoff (2011) stating they follow Frankel and Rose (1996). Frankel and Rose date a currency crisis as a period with a nominal depreciation of more than 25% which represents a greater than 10% increase in the rate of depreciation. Reinhart's website provides the following definition: "An annual depreciation versus the US Dollar...of 15 percent or more.	"External debt crises involve outright default on payment of debt obligations incurred under foreign legal jurisdiction, repudiation, or the restructuring of debt into terms less favorable to the lender than in the original" (Reinhart and Rogoff, 2011)
Laeven and Valencia (2012)	1970-2011 162 countries	Two conditions 1. "Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations) 2. Significant banking policy intervention measures in response to significant losses in the banking system.	Nominal depreciation of the currency against the dollar of at least 30% that is also 10 percentage points higher than the rate of depreciation in the year before.	"default and restructuring" Data from Calomiris and Beim (2001), World Bank (2002), Sturzenegger and Zettlemeyer (2006), IMF staff reports and reports from rating agencies.
Taylor (forthcoming)/ Jordà et. al. (2011)	1870-2011 17 Countries	Taylor (2015) and Jordà et. al. (2011) describe their coding as following Bordo et. al. Reinhart and Rogoff, Laeven and Valencia and Cechetti et. al (2009).	Not dated.	Not dated.

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Table 2a Comparison of Leading Crisis Chronologies, 1880-1913

PRE-WWI		1880-1913		Bordo et. al. vs. RR	
Bordo et. al.		Reinhart & Rogoff		% agree	
		No crisis	Banking Crisis	same year	+/-1 year
	No crisis	681	17	0.33	0.38
	Banking Crisis	5	11		
21 countries (21 in Bordo et. al. & 70 in Reinhart & Rogoff)					
1880-1913		RR vs. Taylor			
Reinhart & Rogoff		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/-1 year
	No crisis	533	16	0.36	0.55
	Banking Crisis	13	16		
17 countries (70 in Reinhart & Rogoff & 17 in Taylor)					
1880-1913		Bordo et. al. vs. Taylor			
Bordo et. al.		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/-1 year
	No crisis	538	20	0.30	0.41
	Banking Crisis	8	12		
17 countries (21 in Bordo et. al. & 17 in Taylor)					

Table 2b Comparison of Leading Crisis Chronologies, 1919-1939

INTERWAR		1919-1939		Bordo et. al. vs. RR	
Bordo et. al.		Reinhart & Rogoff		% agree	
		No crisis	Banking Crisis	same year	+/-1 year
	No crisis	409	14	0.31	0.34
	Banking Crisis	8	10		
21 countries (21 in Bordo et. al. & 70 in Reinhart & Rogoff)					
1919-1939		RR vs. Taylor			
Reinhart & Rogoff		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/-1 year
	No crisis	321	2	0.69	0.74
	Banking Crisis	9	25		
17 countries (17 in Taylor & 70 in Reinhart & Rogoff)					
1919-1939		Bordo et. al. vs. Taylor			
Bordo et. al.		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/-1 year
	No crisis	323	5	0.65	0.87
	Banking Crisis	7	22		
17 countries (21 in Bordo et. al. & 17 in Taylor)					

Table 2c Comparison of Leading Crisis Chronologies, 1950-1972

BRETTON WOODS		1950-1972		Bordo et. al. vs. RR	
Bordo et. al.		Reinhart & Rogoff		% agree	
		No crisis	Banking Crisis	same year	+/- 1 year
	No crisis	539	0	1.00	1.00
	Banking Crisis	0	0		
21 countries (21 in Bordo et. al. & 70 in Reinhart & Rogoff)					
1950-1972		RR vs. Taylor			
Reinhart & Rogoff		Taylor		% Agree	
		No crisis	Banking Crisis	% Agree	+/- 1 year
	No crisis	391	0	1.00	1.00
	Banking Crisis	0	0		
17 countries (17 in Taylor & 70 in Reinhart & Rogoff)					
1950-1972		Bordo et. al. vs. Taylor			
Bordo et. al.		Taylor		% Agree	
		No crisis	Banking Crisis	% Agree	+/- 1 year
	No crisis	391	0	1.00	1.00
	Banking Crisis	0	0		
17 countries (21 in Bordo et. al. & 17 in Taylor)					

Table 2d Comparison of Leading Crisis Chronologies, 1973-2012

POST-BRETTON WOODS		1973-1997		Bordo et. al. vs. RR	
Bordo et. al.		Reinhart & Rogoff		% agree	
		No crisis	Banking Crisis	same year	+/- 1 year
	No crisis	1171	25	0.37	0.37
	Banking Crisis	9	20		
49 countries (55 in Bordo et. al. & 70 in Reinhart & Rogoff)					
1973-2010		RR vs. Taylor			
Reinhart & Rogoff		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/- 1 year
	No crisis	614	6	0.59	0.70
	Banking Crisis	7	19		
17 countries (17 in Taylor & 70 in Reinhart & Rogoff)					
1973-1997		Bordo et. al. vs. LV			
Bordo et. al.		LV		% agree	
		No crisis	Banking Crisis	same year	+/- 1 year
	No crisis	1308	12	0.26	0.26
	Banking Crisis	19	11		
55 countries (55 in Bordo et. al. & 162 in Laeven & Valencia)					

Table 2e Comparison of Leading Crisis Chronologies, 1973-2012 (cont.)

1973-1997 Bordo et. al. vs. Taylor		Taylor		% agree	
		No crisis	Banking Crisis	same year	+/- 1 year
Bordo et. al.	No crisis	407	6	0.39	0.39
	Banking Crisis	5	7		
17 countries (55 in Bordo et. al. & 17 in Taylor)					

1973-2011 RR vs. LV		LV		% agree	
		No crisis	Banking Crisis	same year	+/- 1 year
Reinhart & Rogoff	No crisis	2520	24	0.26	0.29
	Banking Crisis	51	27		
70 countries (70 in Reinhart & Rogoff & 162 in Laeven & Valencia)					

1973-2010 Taylor vs. LV		LV		% agree	
		No crisis	Banking Crisis	same year	+/- 1 year
Taylor	No crisis	618	3	0.54	0.59
	Banking Crisis	10	15		
17 countries (17 in Taylor & 162 in Laeven and Valencia)					

Notes to Tables 2a-2e: Tables present cross-tabulations of banking crisis indicators for each of four sources (Bordo et. al., Reinhart and Rogoff, Taylor and Laeven and Valencia) in four periods. We restrict attention to the first year of a banking crisis for a country. In each entry we show the number of non-crisis country-years, and the number of country-years with a crisis in either of two datasets for the countries that are common to both datasets. The entry in row 2 column 2 of each table records the number of times both datasets agree. The last two columns provide a measure of the agreement between sources calculated as the percentage of all crisis-years dated within the period and the country sample in which the two sources agree. We provide this percentage for crises occurring in the same year and then allow for a one year-window to allow for small variations in timing.

Table 3 Definitions and Values of Output Losses from Financial Crises

Authors	Sample	Crisis Definition	Methodology for Calculating the Economic Costs of Financial Crises	Average “losses”
Bordo et. al. (2001)	1880-1939 21 Advanced Countries 1945-1997 21 Advanced Countries + 34 LDCs and Emerging Markets	Banking Crises	Cumulative loss of output between onset and recovery found by subtracting pre-crisis trend growth from actual growth. Recovery occurs when growth obtains its pre-crisis trend level.	7% (21 countries, 1973-1997) 6.2 % (56 countries, 1973-1997)
Hoggarth, Reis, and Saporta (2002)	1977-1998 47 Countries 47 Banking Crises	Banking crises (systemic and borderline)	<ol style="list-style-type: none"> <li><b>GAP1</b> sum of the differences between growth in potential output and actual output growth during the crisis period. Potential growth = arithmetic average of GDP growth in the three years prior to the crisis. End of crisis is when output growth returns to trend.</li> <li><b>GAP2</b> Cumulative difference between level of potential output and actual output over the</li> </ol>	GAP1 = 14.5% GAP2 = 16.5%

Hoggarth, Reis, and Saporta  
(2002) cont.

crisis period. Output potential is based on trend growth over the 10-year pre-crisis period using an HP filter.

Hutchison and Noy (2005) 1975-1997  
24 emerging markets

Twin crises

Regressions of growth of real GDP on crisis indicators and lags.

Average loss of GDP of 15-18% over the average duration of 3-4 years after the onset of a crisis.

Dell'ariccia et. al (2008) 1980-2000  
41 countries  
48 Crises

Banking crises: there were extensive depositor runs; the government took emergency measures to protect the banking system, such as bank holidays or nationalization; the fiscal cost of the bank rescue was at least 2 percent of GDP; or non-performing loans reached at least 10 percent of bank assets.

Marginal impact of banking crises on the annual growth rate of sectoral value added

Growth rate is 1.1 percentage points lower in sectors with highly dependent on external finance.

Angkinand, A.P. (2009) 1970s-2003  
35 countries  
47 crises (systemic and non-systemic)

Banking Crisis identified in Caprio and Klingebiel (2003).

Cumulative deviation in real GDP from an extrapolated HP trend. Calculated between the onset of a crisis and time when GDP reaches the trend.

3.13% (mean for all banking crises)

3.99% (mean for systemic banking crises)

Cechetti, Kohler, Upper (2009)	1980-2007 Number of Countries is not stated 40 crises	Banking Crisis defined as in Laeven and Valencia.	Output loss is the cumulative loss in GDP from the onset of a crisis until GDP reaches the pre-crisis peak.	18.4% (mean) 9.2% (median)
Laeven and Valencia (2013)	1970-2011 162 countries	Systemic Banking Crises possibly accompanied by currency, or debt crises or both.	Cumulative loss of real GDP between onset of crisis and 3 years after crisis starts calculated as the difference between actual output and the HP filter trend calculated over the 20 years prior to a crisis (or fewer years if data are not available)	23% (mean) 32% (mean advanced) 26% (mean emerging markets)
Jordà et. al. (2013)	1870-2008 14 Countries	“Financial Recessions” (i.e., recessions associated with systemic financial crises) with and without large growth in real credit.	Local projections from year T+1, to T+5 of log differences of GDP per capita in year $t$ from peak year level.	16.9% Cumulative deviations from peak for “financial recessions” for T to T+5 (Table 7 Row 1, p. 19)
Reinhart and Rogoff (2014)	1800-2011 70 Countries	100 Systemic Banking Crises defined as in Reinhart and Rogoff (2009) possibly accompanied by currency, or debt crises or both.	<ol style="list-style-type: none"> <li>1. Peak to trough decline in GDP per capita</li> <li>2. Severity index = <math>-1 * (\text{peak to trough decline in GDP per capita}) + \text{number of years until peak level of GDP per capita is attained. This is defined as}</math></li> </ol>	11.5% (mean) 8.8% (median) 8.3 years peak to recovery (mean) 6.5 years peak to recovery (median)

da Rocha and Solomou (2015)	24 countries 1920-1938 19 crises	Systemic banking crises. “classification is based on qualitative informed judgement, documenting the extent of financial distress in the banking system of a country.”	recovery time.  Cumulative growth in real GDP and industrial production up to 7 years after a crisis starts.	33% cumulative deviations from peak for T to T+7.
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