

# The Anatomy of Financial Vulnerabilities and Crises

Lee, Seung Jung, Kelly E. Posenau, and Viktors Stebunovs

Please cite paper as:

Lee, Seung Jung, Kelly E. Posenau, and Viktors Stebunovs (2017). The Anatomy of Financial Vulnerabilities and Crises. International Finance Discussion Papers 1191.

<https://doi.org/10.17016/IFDP.2017.1191>



## International Finance Discussion Papers

Board of Governors of the Federal Reserve System

Number 1191

February 2017

Board of Governors of the Federal Reserve System

International Finance Discussion Papers

Number 1191

February 2017

The Anatomy of Financial Vulnerabilities and Crises

Seung Jung Lee

Kelly E. Posenau

Viktors Stebunovs

NOTE: International Finance and Discussion Papers are preliminary materials circulated to stimulate discussion and critical comment. References in publications to International Finance Discussion Papers (other than an acknowledgment that the writer has had access to unpublished material) should be cleared with the author or authors. Recent IDFPs are available on the Web at [www.federalreserve.gov/pubs/ifdp/](http://www.federalreserve.gov/pubs/ifdp/). This paper can be downloaded without charge from Social Science Research Network electronic library at [www.ssrn.com](http://www.ssrn.com).

# The Anatomy of Financial Vulnerabilities and Crises

February, 2017

Seung Jung Lee<sup>†</sup>  
Kelly E. Posenau<sup>#</sup>  
Viktors Stebunovs<sup>‡</sup>

**Abstract:** We extend the framework used in Aikman, Kiley, Lee, Palumbo, and Warusawitharana (2015) that maps vulnerabilities in the U.S. financial system to a broader set of advanced and emerging economies. Our extension tracks a broader set of vulnerabilities and, therefore, captures signs of different types of crises. The typical anatomy of the evolution of vulnerabilities before and after a financial crisis is as follows. Pressures in asset valuations materialize, and a build-up of imbalances in the external, financial, and nonfinancial sectors follows. A financial crisis is typically followed by a build-up of sovereign debt imbalances as the government tries to deal with the consequences of the crisis. Our early warnings indicators which aggregate these vulnerabilities predict banking crises better than the Credit-to-GDP gap at long horizons. Our indicators also predict the severity of banking crises and the duration of recessions, as they take into account possible spill-over and amplification channels of financial stress from one sector to another in the economy. Our indicators are of relevance for macroprudential and crisis management, in part, because they perform better than the Credit-to-GDP gap and do not suffer from the gap's econometric flaws.

**Keywords:** credit-to-GDP gap; crisis management; financial vulnerabilities; early warning system; financial crises; banking crises; currency crises; macroprudential policy.

**JEL Classifications:** C82, D14, G01, G12, G21, G23, G32, H63.

<sup>†</sup> Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue, NW, Washington, DC 20551, U.S.A.; seung.j.lee@frb.gov. URL: <http://www.federalreserve.gov/econresdata/seung-jung-lee.htm>.

<sup>#</sup> The University of Chicago Booth School of Business, 5807 South Woodlawn Ave., Chicago, IL 60637, U.S.A.; kposenau@chicagobooth.edu.

<sup>‡</sup> Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue, NW, Washington, DC 20551, U.S.A.; viktors.stebunovs@frb.gov. URL: <http://www.federalreserve.gov/econresdata/viktors-stebunovs.htm>.

We thank Sarah Adler for excellent research assistance. We also thank John Ammer, Mark Carey, John Clark, Stijn Claessens, Ricardo Correa, Christopher Erceg, Ruth Judson, Steven Kamin, Pavel Kapinos, Helen Popper, Tara Rice, Minh Tam (Tammy) Schlosky, Pierre Siklos, and other participants at presentations at the Federal Reserve Board, the U.S. Department of Treasury, the IFABS 2016 Barcelona Conference, the 2016 IBEFA Summer Meetings, the 2016 CEMLA Regional Conference, the 2016 Federal Reserve System Surveillance Conference, the 2016 Southern Finance Association Meetings, the 2016 Southern Economics Association Meetings, and the 2017 American Economic Association Annual Meetings for helpful comments. We are also grateful to Daniel Beltran, Carol Bertaut, Brett Berger, Jerome Brezillon, Brahmia Coulibaly, Bernardo Morais, and Paul Wood for assisting us with various cross-country datasets, and Beth Anne Wilson with sharing data on recessions. The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System. All errors are our own.

# 1 Introduction

In this paper, we examine how various financial vulnerabilities evolve in the lead-up to different types of financial crises, while providing a holistic framework to track financial imbalances that may render the financial system highly vulnerable to shocks to the economy. The financial crisis that began in the United States and the United Kingdom in 2007, which quickly spread to other financial systems around the world, has profoundly changed the global financial regulatory landscape. Not only have large strands of academic literature (related to financial imbalances, financial crises, and systemic risk) been revived or newly created, but central banks and other official institutions, have established many types of tools to track and monitor financial stability risk.<sup>1</sup> Our paper is one of the many attempts to better align the developments in monitoring tools of public institutions worldwide to the advancements in the financial stability literature within the past decade.

We posit a view that the advent of a financial crisis can be decomposed into a financial vulnerability or imbalances component and a shock component (as in Gorton and Ordonez (2014)). Understanding how much financial vulnerabilities and imbalances matter in the run-up to a financial crisis provides a framework to better understand the role the shock component plays in the realization of a financial crisis. Building upon research on how different types of vulnerabilities in the financial system have set the stage for a dramatic unraveling of financial imbalances (Ferguson, Hartmann, Panetta, and Portes (2007) and Reinhart and Rogoff (2009)), we categorize different vulnerabilities that may contribute to the amplification of economic and financial shocks stemming from five sectors in a financial system. The first is the financial sector, which includes banks and nonbanks, where excessive leverage, maturity transformation, reliance on short-term wholesale funding, and cross-border interconnectedness all played a role in the recent financial crisis and its contagion. The second is the private-nonfinancial sector, where either households or nonfinancial businesses may accumulate excessive debt, which, in the past, has rendered the entire real

---

<sup>1</sup>For example, the Office of Financial Research and the International Monetary Fund publishes the Financial Stability Report and the Global Financial Stability Report, respectively, on a regular basis. In addition, the European Systemic Risk Board also maintains a “Risk Dashboard,” which is a set of quantitative and qualitative indicators of systemic risk in the EU financial system

economy susceptible to severe adverse financial shocks. The third is the sovereign sector, where the government’s strained budget and debt positions has led to sovereign debt crises in mostly developing economies. The fourth is the external sector, where excessive borrowing from abroad has sometimes led to both currency and sovereign crises in times of a loss of confidence from foreign investors. Finally, the fifth category of financial vulnerabilities lie in asset markets where investors’ risk appetite (and, hence, asset-valuation pressures) have led to the overvaluation of various asset prices (in the housing market, the equity market, and the bond market) that have brought on a quick correction in prices or a destabilizing unraveling of financial imbalances.

This holistic view of financial vulnerabilities allows us to track and determine which combinations of financial imbalances are particularly egregious in terms of financial stability risk leading up to different types of financial crisis episodes identified by Laeven and Valencia (2013). We extend the main framework in Aikman, Kiley, Lee, Palumbo, and Warusawitharana (2015) used specifically for the United States to a broader set of countries around the world. In order to account for vulnerabilities that were not accounted for in the United States, we also augment the categories of vulnerabilities to include imbalances stemming from excessive sovereign and external debt accumulation. This extension and augmentation allows us to compare different types of crisis episodes at varying time periods to see whether patterns emerge regarding the sequence of events or combinations of imbalances in the lead-up to financial crises.

We find that vulnerabilities in the financial sector and external borrowing are especially elevated even two years prior to a banking or currency crisis. As an earlier warning indicator, imbalances in asset valuations tend to peak a couple of years before financial crises and corrections to valuations are well under way even before the crises occur. External and financial sector vulnerabilities also become elevated well before and peak around the onset of financial crises. Nonfinancial sector vulnerabilities also become elevated nearing the onset of crises. In our sample of 26 (mostly advanced) non-U.S. countries that have gone through a financial crisis in the past 30 years (1986-2015), sovereign vulnerabilities have played a minimal role prior to financial crises. However, the level of sovereign vulnerabilities usually

become elevated as governments try to deal with the crisis through an increase in sovereign debt after the crises.

We show that an index (the Lee-Posenau-Stebunovs (LPS) Index) from aggregating the vulnerabilities, whether we include or exclude sovereign vulnerabilities, is able to predict financial crisis reasonably well. Aggregating our vulnerability measures to the country level allows us to compare how a bottom-up approach compares to other types of top-down aggregate measures, such as the credit-to-GDP gap. We show that at the far end of the forecast horizon (two to three years prior to banking crises), the LPS indexes performs better than the credit-to-GDP gap. In addition, we show that an aggregated index can be a good indicator for forecasting the severity of banking crises as the aggregation takes into account possible spill-over and amplification channels of financial stress to other sectors in the economy by taking into account multiple vulnerabilities and imbalances in the entire financial system.

Finally, we also investigate how the indexes are associated with both the onset and severity of recessions based on an expanded number of countries. We find that financial vulnerabilities are not as useful in predicting the onset or severity of recessions. However, financial vulnerabilities appear to be positively correlated with how long a recession lasts, implying that recessions last longer when a downturn in economic activity is accompanied by a strained financial system.

The outline of the rest of the paper is as follows. In the next section, we do a brief overview of the growing literature on financial crises. In Section 3, we provide a framework for understanding how financial crises are created. In Section 4, we describe the data used for our analysis and the aggregation method. In Section 5, we examine the evolution of different vulnerabilities leading up to different crises. In Section 6, we compare aggregate LPS indexes with the credit-to-GDP gap measure in predicting both the occurrence and severity of banking crises. In Section 7, we do the same for the onset, duration, and depth of recessions. In the last section, we conclude with the ways in which a measure such as the LPS Index can be used for policy purposes.

## 2 Literature review

Understanding financial crises, its origins, and its aftermath has been at the forefront of policymaker’s minds since the financial crisis. Claessens and Kose (2014), Ferguson, Hartmann, Panetta, and Portes (2007), and Reinhart and Rogoff (2009) provide a more modern view of how financial crises come to fruition and develop. Classical references include Kindelberger (1978) and Eichengreen and Portes (1987). Eichengreen and Portes (1987), in particular, looked closely at the full-fledged global crisis in the 1930s and pointed to linkages between debt defaults, exchange-market disturbances, and bank failures that as crucial in understanding the critical role played by institutional arrangements in that era.

In devising a set of vulnerability categories to analyze, not only do we consider the references listed above, we also consider imbalances that have been featured in the banking crisis literature (Demirguc-Kunt and Dtragiache (1997) and Borio and Lowe (2002)), the currency crisis literature (Kaminsky, Lizondo, and Reinhart (1998)), and the sovereign debt crisis literature (Detragiache and Spilimbergo (2001), Manasse, Roubini, and Schimmelpfennig (2003), Lee (2009), and Manasse and Roubini (2009)). In addition, we consider asset valuation pressures as playing a role in crises (see Cecchetti (2008)). Our framework for considering different types of crises is similar in vein to Adrian, Covitz, and Liang (2013), as crises can occur due to a myriad of different combinations of build-ups in vulnerabilities in the financial system.

We also contribute to the literature that associates different types of crises to output loss. For example, Blanchard, Cerutti, and Summers (2015) looks at the effects of recessions on output. Howard, Martin, and Wilson (2011) attempts to compare how recoveries are affected by different types of recessions—those that are related to banking crises and those that are not. Finally, Kroszner, Laeven, and Klingebiel (2007) looks at 38 developed and developing countries that experienced financial crises during the last quarter century, and find that those sectors that are highly dependent on external finance tend to experience a substantially greater contraction of value added during a banking crisis in countries with deeper financial systems than in countries with shallower financial systems. Claessens, Kose,

and Terrones (2012) and Taylor (2015) also examine the relationship between business cycles and financial disruptions.

### 3 Vulnerabilities and Financial Shocks

In this section, we provide a framework to analyze financial crises. The origins of financial crises can be very diverse, but, as seen in the literature, there are some common themes we exploit. We posit that financial crises mainly arise from shocks to the economy. An example from the recent financial crisis in the United States could be the sudden realization that subprime mortgage-backed securities were not as safe as their ratings would imply or realizing collateral value was not what it seemed in the repo market (see Gorton and Metrick (2012) and Gorton and Ordonez (2014)). From many of the peripheral European countries' perspective, contagion could presumably arise from financial shocks in the U.S., the U.K. and core European countries. However, not all shocks lead to financial crises. Indeed, financial systems around the world, more often than not, are able to withstand shocks to the economy as vulnerabilities or imbalances in the financial system may be very subdued.

For illustrative purposes, Figure 1 allows us to visualize our basic framework for understanding financial crises. Point A, for example, represents an economy with relative subdued vulnerabilities or imbalances in its financial system. Even if this state of the world may be a drag on the real economy, given that a very large shock would be necessary to move the financial system to the “crisis” state, the likelihood of a financial crisis would be fairly low. At point B, however, when vulnerabilities are elevated, even a small shock can trigger the change into a crisis state. As the shock makes its way through the system, vulnerabilities and imbalances unwind or, in a sudden correction, unravel to less elevated levels to point C. The point at which the shock was materialized, therefore, may have implications to the severity of the crisis, if a crisis occurs. This decomposition between vulnerabilities (which one can reasonably define and measure) and shocks (which one cannot) allows us to posit research questions in a tractable manner.

In this context, we can set forth two hypotheses from our framework for understanding



financial crises. First, using extensive data, we will see whether vulnerabilities or imbalances in the financial system can shed light on the likelihood of an onset of a crisis. If we find that it can, we can argue that not only shocks (which are less quantifiable), but the state of imbalances in the financial system is also an important factor in bringing forth financial crises.

For the second hypothesis, we focus on the aftermath of banking crises. We will see if t elevated vulnerabilities or imbalances have any bearing on the severity of the crisis once it occurs can be rejected. We look to see if there is a positive and significant relationship between aggregated vulnerability measures just prior to crises and output loss after the crises have occurred.

## **4 Data and Aggregation Methodology**

### **4.1 Data for Financial Crises**

Our primary data source for financial crisis episodes is from Laeven and Valencia (2013) during 1986-2012. We use data on banking, currency, and sovereign crises. Table 1 provides the years and quarters at which these episodes occurred for 26 countries, eight of which can be considered developing economies. Banking crises are defined as having significant signs of financial distress in the banking system (bank runs, losses in the banking system, and bank liquidations) and significant banking policy intervention measures in response to significant losses in the banking system. The majority of banking crises in our sample occurred in advanced economies from the 2007-2008 financial crisis. Currency crises are defined as nominal depreciation of the currency vis-a-vis the U.S. dollar of at least 30 percent that is also at least 10 percentage points higher than the rate of depreciation the year before. We bring forward currency crisis dates (at most a quarter) if we identify countries all of a sudden floating their currencies. Most of the currency crises are from the 1990s in emerging markets, with the last in Turkey in 2001. Sovereign debt crises are defined as defaults to private creditors and debt rescheduling. Only two are in our sample—Russia in 1998 and

Greece in 2012.

Following the financial cycle literature, we restrict our sample of analysis to the past 30 years (1986-2015) to account for longer cycles than business cycles (see Borio (2014)). In addition, the financial systems in these countries have likely experienced significant structural shifts prior to 1986 and, therefore, data may be subject to different interpretations going further back in time.

## 4.2 Data and Aggregation for Vulnerabilities

As for our data related to vulnerabilities and imbalances in the financial system, we begin by defining five vulnerability categories for each country, similarly to Aikman, Kiley, Lee, Palumbo, and Warusawitharana (2015). Some important differences are the following. We classify vulnerability categories by sector as data is easier to track under this basis for non-U.S. countries. Some additional categories include sovereign imbalances and external imbalances that have been the source of financial stress that has led to sovereign debt crises and currency crises, respectively. Each category may have one or more components, depending on data availability. Similarly, each country may have one or more indicator ratios that are then aggregated to create the components index. We collect data for 26 countries (in Table 1) in the following areas: financial sector vulnerabilities; nonfinancial sector vulnerabilities; sovereign vulnerabilities; external sector vulnerabilities; and valuation pressure. Contributing to these categories are 12 components. Each component and indicator is detailed by category, following a discussion of the general aggregation methodology.

We create monthly category-level components by aggregating from indicator to component, and then from component to category. To accomplish this, we first standardize each indicator time series by subtracting the sample average values (at most 30 years worth) and then dividing by the sample standard deviations. We aggregate the standardized series at the component level by taking an arithmetic mean for indicators grouped in a given component. We then use a kernel density estimation function to estimate the historical distribution of the component index and transform series observations onto a  $[0,1]$  interval where .5 is approximately the median. Importantly, the time an index spends in any point in the  $[0,1]$

interval should be more or less equal to another. Importantly, the indicator time series may have different start dates. We thus incorporate indicators as their data become available in order to lengthen the overall component time series and capture historical conditions. Then, excluding the financial sector, all components are standardized, grouped by categories, and aggregated together with equal weighting.<sup>2</sup> Finally we re-scale as before to create the final category-level index (see below for more detailed information about financial sector aggregation). To create the overall country index (Lee-Posenau-Stebunovs (LPS) Index), we average across the five categories using equal weighting and rescale using the kernel density estimates. We also construct the LPS2 Index which does the aggregation on four components, financial sector, nonfinancial sector, external sector, and valuation pressure vulnerabilities, without sovereign vulnerabilities. Our indicators for each country, therefore, are indicative of how vulnerable each sector is (or how much imbalances each sector has) relative to their own history. There is no cross-country component to our indicators (as in Aikman, Kiley, Lee, Palumbo, and Warusawitharana (2015)). The reason we do not pool the data and also compare across countries is because of severe accounting, reporting, or structural differences across countries in terms of financial sector development. In addition, available data across countries is also very different.

Unlike Aikman, Kiley, Lee, Palumbo, and Warusawitharana (2015), the indicators we collect are at the monthly, quarterly, or annual frequency, and the indexes we construct are at the monthly frequency. When we aggregate up different frequencies, we simply add them together to form a time series at the highest frequency. Our analysis is based on the quarterly frequency of the monthly indexes created by our methodology.

**Financial sector vulnerabilities** Financial sector vulnerabilities are split into the banking vulnerabilities and nonbanking sector vulnerabilities.

Under the banking sector, there are four components: leverage; maturity transformation; wholesale funding; and interconnectedness. Indicators used for each component may differ

---

<sup>2</sup>The only exception on equal weighting is when we combine the banking sector and nonbank sector to formulate the financial sector vulnerabilities. Instead, we weight by credit outstanding at banks and the nonbanking sector, respectively.

between countries. In order to maintain consistency, we use data on a residential basis for domestic banks and deposit-taking institutions (excluding central banks). In some cases, due to data availability, we may use data on a consolidated basis or incorporate other types of lenders, such as development banks. For leverage, in all countries, we use bank credit to the private nonfinancial sector to GDP (relative to a 10-year moving average) and either capital and reserves to total assets of the banking system or equity capital to total assets (with negative signs). Depending on country data availability, we also include regulatory leverage ratios, such as a simple leverage ratio and a regulatory capital to risk-weighted assets ratio (again with negative signs). Maturity transformation is measured across countries using a loans to deposits ratio, although the exact variables used to construct the numerator and denominator may differ between countries. In general, we measure nonfinancial loans to nonfinancial deposits in order to maintain consistency across country. Wholesale funding also varies across countries. In general, we approximate wholesale funding by monetary financial institutions (MFI) liabilities to total assets. When available, we also add other short-term liabilities to MFI liabilities. We incorporate other indicators into the wholesale funding component when data is available. These indicators may include a regulatory liquidity ratio, liquid assets to short-term liabilities (both with negative signs), and short-term liabilities to total assets. Finally, we consider interconnectedness to be foreign assets to total assets. For some countries, foreign assets is unavailable; for instance, euro-area countries foreign assets only includes exposures to other euro-area countries. Therefore, we supplement this indicator with cross-border claims from the Bank of International Settlements (BIS) locational banking statistics to total banking sector assets.

The nonbanking sector index comprises one indicator, leverage. We proxy nonbanking leverage across countries as nonbank-provided credit to the private nonfinancial sector to GDP (relative to a 10-year moving average). Nonbank-provided credit is approximated by subtracting the BIS measure of credit from the banking sector to the private nonfinancial sector from total credit to the private nonfinancial sector. Although this is an imperfect measure of nonbank leverage, it provides an aggregate view of how much credit is being provided by the nonbanking sector relative to its history.

In order to create the financial sector vulnerability index, we aggregate components into a banking sector and nonbanking sector index. Banking sector indicators are aggregated together using an arithmetic mean. We then aggregate the banking and nonbanking sector components together using a weighted mean, where the weights are bank-provided credit to the nonfinancial sector and nonbank-provided credit to the nonfinancial sector, respectively.

**Nonfinancial sector vulnerabilities** Nonfinancial sector vulnerabilities have two components: the corporate sector and the household sector. Depending on data availability, we judge corporate sector vulnerabilities to include the following indicators: aggregated corporate debt to equity, the 90th percentile of corporate debt to equity ratios, the corporate interest coverage ratio, business debt to GDP (relative to a 10-year moving average), and the nonfinancial corporation debt service ratio. Some countries, such as the United Kingdom, have additional information on CRE loan-to-value ratios. Vulnerabilities in the household sector are measured using credit to households and NPISHs to GDP (relative to a 10-year moving average) and the household debt service ratio. Again, some countries have additional information, such as mean loan-to-value ratios on mortgages.

**Sovereign vulnerabilities** The sovereign vulnerabilities category is comprised of three indicators, differing from the previous two categories. We estimate sovereign vulnerabilities using the aggregation of government debt to GDP (relative to a 10-year moving average), the fiscal deficit to GDP, and government revenue to GDP (relative to a 10-year moving average, with a negative sign).

**External sector vulnerabilities** Similarly to sovereign vulnerabilities, the external sector vulnerabilities index is created using the following three indicators: external debt to GDP (relative to a 10-year moving average), the current account deficit to GDP, and reserves to GDP (with a negative sign).

**Valuation pressure vulnerabilities** We estimate valuation pressures using three components: housing market pressures, equity market pressures, and junk bond issuance. For

housing market pressures, we use price-to-rent ratios for OECD countries, along with either nominal price to income or nominal price to GDP. We use nominal price to GDP for countries where personal disposable income is not readily available. Equity market pressures includes the weighted average price/earnings ratio, based on 12-month forward earnings and also dividend to yield ratios (with negative sign), which are backwards-looking but have a longer time series than our forward P/E ratios. Finally, junk bond issuance is calculated as the 12-month moving sum of high-yield nonfinancial issuances over the 12-month moving sum of total issuances.

Figure 2 illustrates how data is structured into to relevant categories and subcategories of vulnerabilities. Each aggregation step is done in the same way as depicted above. The Appendix shows all the data we use in our sample of 26 countries, in addition to five more (Australia, Canada, Hong Kong, Poland, and Singapore), which have not experienced a financial crisis in the past 30 years. We include these additional countries when we investigate if our measures have any association with the onset, duration, and severity of recessions, as all of these countries have experienced recessions in the past 30 years.

## 5 Vulnerabilities and Crises

In this section, we show how our estimated component-based vulnerability measures evolved around financial crises. Because banking crises are, by far, the most numerous, we have a good sample of 23 crisis episodes to analyze (for which we have financial sector data at least 8 quarters before each crisis).<sup>3</sup> We can also provide a good picture of how vulnerabilities developed prior to and after currency crisis, for which we have 12 episodes (for which we have external sector data at least 8 quarters before each crisis). In many cases, currency crises occur in the same country in multiple years. Finally, we also briefly describe what happened prior to and after the two sovereign debt crisis episodes (in Russia and Greece). We convert all our data to quarterly data for this analysis (taking the last month end values

---

<sup>3</sup>For our analysis on the onset of banking crises, we can use all 29 banking crisis episodes in our sample. For our analysis on the severity of banking crises, we use 26 due to the availability of data in Laeven and Valencia (2013).

of each quarter).

**Banking Crises** We begin with banking crises. As mentioned in Section 3, we first wish to determine whether vulnerabilities in the financial system and, in particular, financial sector vulnerabilities were important to the onset of banking crises or if shocks to the financial system may be more of a dominant factor. Figure 3 provides histograms of all the different types of vulnerabilities, including the aggregated LPS Index, one quarter prior to banking crises.

We cannot reject the view that vulnerabilities do not matter for the onset of financial crises. As the top left indicates about 80 percent of countries in our sample had financial vulnerability indicators between 0.6 and 1.0 right before the onset of a banking crisis, indicating that financial imbalances were notably or extremely elevated prior to the crises. What is more striking is the fact that more than 60 percent of countries had extremely elevated external sector vulnerabilities prior to these crises. These fractions are significant given that, by definition, our indexes should spend roughly equal amounts of time in each of the intervals in the histogram. For example, valuation pressure vulnerabilities has a pretty even distribution across countries prior to banking crises. Sovereign imbalances seem to be somewhat negatively associated with financial crises, though, as we will show later below, sovereign imbalances increase dramatically after banking crises to counter the ensuing problems associated with the crises (by increasing sovereign debt, for example). Our aggregate LPS Index, however, is more aligned with view that aggregate vulnerabilities matter in the realization of banking crises. In sum, vulnerabilities in the financial system matter when it comes to banking crises.

Figure 4 illustrates how our financial sector vulnerabilities, in particular, evolve through time with horizontal lines depicting banking crises. Consistent with the framework described in Figure 1, not only do we see elevated imbalances prior to banking crises, we also see the unwinding or unraveling of those balances after the financial crisis has occurred. The unraveling appears to have been most dramatic (and quick) in Austria, Belgium, Germany and Switzerland after 2008 and Japan and Russia after 1998, and Mexico after 1994. Figures

5 and 6 provides another perspective on the same phenomena using radar charts. As the financial crisis nears, imbalances in the financial sector become more and more elevated, generally peaking when the crisis occurs, and then begins to unwind or unravel so that vulnerabilities end up becoming less elevated after two years, again similarly depicted in Figure 1.

Figures 7 to 11 provide a more complete picture of how different types of vulnerabilities evolve surrounding banking crisis. First, valuation pressures develop and then self-corrects almost 2 years prior to a banking crisis (Figure 7). At this time, external vulnerabilities remain elevated and financial and nonfinancial sector vulnerabilities become more and more elevated (Figure 8 to (Figure 10)). As most of our sample is from the recent 2007-2008 financial crisis, we can identify in the data that leverage in the household sector was the driving force behind the increase in nonfinancial vulnerabilities prior to 2008. Then a shock to the financial system occurs, and, as most other imbalances unwind, the sovereign becomes more and more vulnerable due to automatic stabilizers and its attempts to deal actively with the negative effects of the banking crises (Figure 11). Indeed, this reflects what happened to many countries surrounding the 2007-2008 financial crisis. One country, Greece, follows this pattern of events, which ultimately lead to a sovereign debt crisis in 2012, a few years after the banking crisis in 2008.

**Currency Crises** Next, we look at currency crises. Figure 12 provides histograms of all the different types of vulnerabilities, including the aggregated LPS Index, one quarter prior to currency crises. As with banking crises, we cannot reject the view that vulnerabilities do not matter for the onset of currency crises. As the bottom left suggests, in the vast majority of cases of currency crises, imbalances in the external sector were notably or extremely elevated compared to historical norms. Interestingly, again both financial sector and external sector vulnerabilities are elevated prior to currency crises as was the case with banking crises. Nonfinancial sector vulnerabilities do not appear to be important in the realization of currency crises; whereas, valuation pressures are now somewhat positively correlated. As in the banking crises episodes, the aggregate LPS Index is positively correlated with the onset



of currency crises.

Figure 13 illustrates how our external sector vulnerabilities evolve through time with horizontal lines depicting currency crises. Again, consistent with the view that heightened imbalances in the external sector (and financial sector) trigger currency crises, imbalances are generally elevated prior to such crises and unwind or unravel, sometimes very dramatically as in Mexico and South Korea in 1994 and 1997, respectively. Figures 14 and 15 again support the framework discussed in Section 3, which went through a hypothetical evolution of financial crises. Coming into a crisis, vulnerabilities usually become elevated and, in the case of currency crisis, external vulnerabilities usually unravel quickly.

Finally, Figures 16 to 20 provide further details on the evolution of various vulnerabilities surrounding currency crises. Compared to banking crises, valuation pressures are more dispersed (though still relatively elevated) before currency crises. Then, the combination of imbalances in the financial and external sectors appears to be especially egregious in providing fertile ground for currency crises to materialize, as was the case for banking crises. Nonfinancial vulnerabilities do increase a bit, but do not become as elevated as in the case of banking crises; whereas, sovereign vulnerabilities generally increase after currency crises.

**Sovereign Debt Crises** Although we do not have sufficient sovereign crises in our sample to be able to make general statements surrounding sovereign crises, both Russia and Greece had elevated vulnerabilities in the financial and nonfinancial sectors and at least notable vulnerabilities in the external sector. As depicted in Figure 21, though sovereign vulnerabilities were not as notable in Greece just prior to its sovereign debt crisis, it did have extremely high imbalances two years prior to its sovereign crisis.

**Summary of Results** We can summarize our findings related to the evolution of vulnerabilities surrounding various types of financial crises as follows. Regardless of the type of financial crises, financial sector and external sector imbalances appear to be important in the realization of financial crises. In particular, the general lead-lag relationship across the vulnerability categories is as follows—heighted valuation pressures give way to price correc-

tion, external and financial sector imbalances become extremely elevated, then they unwind or unravel as shocks to the financial system are realized. Sovereign vulnerabilities increase as both automatic stabilizers and government intervention works to deal with the crisis.

Aggregating our sector vulnerabilities across all the countries in our sample leads to a heat map (or ribbon chart) as in Figure 22, which reflects the aggregated experience in advanced foreign economies (AFE), especially related to the most recent financial crisis. Here it is clear that valuation pressures mount, followed by heightened external sector vulnerabilities, then by financial sector vulnerabilities. Then imbalances in the nonfinancial sector reach a climax, after which sovereign imbalances grow due to automatic stabilizers and attempts to deal with the crises. Figure 23 depicts the evolution for emerging market economies (EMEs). Consistent with the history of currency crises in emerging economies, external sector vulnerabilities were elevated throughout the beginning of our sample, while the elevated vulnerabilities in the financial sector in the late 1990s correspond with the banking crises in China, South Korea, and Thailand. Such a framework suggests that more recently the financial sector and nonfinancial sector vulnerabilities are worth monitoring for financial stability risk, though vulnerabilities in other sectors of the financial system are not as elevated.

Our main aggregate LPS Index can be plotted as in Figures 24 and 25 with horizontal lines for all types of crises, which shows how the LPS Index can be applied to monitoring financial stability in various dimensions country by country as well. The next section describes how some of our metrics help predict the onset and severity of banking crises.

## 6 The Onset and Severity of Banking Crises

In this section, we analyze whether our measures of vulnerabilities has both significant power in predicting banking crises and the severity of such crises.<sup>4</sup> We consider an index based on financial sector vulnerabilities only (Fin. Index), the LPS Index, which is an aggregate of

---

<sup>4</sup>We do not have enough observations to conduct a rigorous analysis for the onset and severity of currency or sovereign debt crises. In addition, it has been shown that medium term output loss due to currency crises pales in comparison to that associated with banking crises (see Abiad, Balakrishnan, Brooks, Leigh, and Tytell (2014)).

all five vulnerability components, and LPS2 Index, which excludes sovereign vulnerabilities from the LPS Index. We construct the LPS2 Index because we have shown that sovereign vulnerabilities actually lag the other vulnerabilities by significant margins. Our benchmark is the credit-to-GDP gap measure that has been touted as one of the more useful measures in predicting banking crises (as in Drehmann and Juselius (2014)) and has been set forth a main guide variable for determining countercyclical capital buffers by the Basel Committee on Banking Supervision in Basel III.

**Occurrence of Banking Crises** Following the exercise used in Drehmann and Juselius (2014), we estimate the receiver operating characteristic (ROC) curve and calculate the area under the curve (AUC) as a summary measure to determine which variable provides predictive power for banking crises. Five key differences differentiate our comparison to what Drehmann and Juselius (2014) do in their study relative to other measures of financial imbalances. First, we have a different sample of 26 countries. Their 26 countries include countries such as Czech Republic, New Zealand, South Africa, and the United States, which we do not have; whereas, we include countries such as Austria, Brazil, China, Luxembourg, Mexico, Russia, Singapore, and Turkey, which they don't have. In addition, we do not include countries that have not experienced a banking crisis such as Australia, Canada, and Poland.<sup>5</sup> However, if we include these three countries, our results do not change.<sup>6</sup> Second, Drehmann and Juselius (2014) use varying time periods starting from 1980 or up to 2004 and ending all in 2012:Q2. We begin all our data from 1986 the earliest and continue our analysis to the last quarter of 2012. Third, though they also conduct their analysis in full-sample, their main analysis is in real time. Our main analysis is in full sample due to data limitations.<sup>7</sup> Fourth, their main crises dates are for systemic banking crises, which occur one or two quarters after the initial banking crises experienced in most countries. Drehmann and Juselius (2014) also make some adjustments and do not consider data up to two years

---

<sup>5</sup>Although Poland experienced a banking crisis, we do not have data that go far enough to analyze Poland's banking crisis.

<sup>6</sup>Later we add Australia and Canada, along with Singapore and Hong Kong to test how well different measures of vulnerabilities predict the onset, duration, and severity of recessions.

<sup>7</sup>We use the 2-sided Hodrick-Prescott (HP) Filter to calculate the credit-to-GDP gap using the 400,000 lambda smoothing parameter as in Drehmann and Juselius (2014).

post crisis. We only consider the initial date of the banking crisis and remove periods where the crisis continues and three years after a crisis ends in order to better predict the initial advent of a crisis as most countries have experienced one banking crisis in the sample.

Our results are described in Table 2). The higher the AUC, the less false positives and false negatives there are from the model. We use a normal probit function to estimate our results, but doing a nonparametric approach does not change our results. A perfect predictor will have an AUC of one and an uninformative predictor a value of 0.5. The results show that whether we just use an index based on financial sector vulnerabilities only (Fin. Index) or any of the LPS Indexes (LPS Index or LPS2 Index), we do better at predicting the onset of banking crises relative to the CGG in all instances no matter the horizon as the AUCs are always higher. The Fin. Index, however, is especially superior to the CGG one to two quarters ahead of the onset of a banking crisis; whereas, the LPS indexes outperform the CGG at farther horizons. In the case of the LPS Index, anywhere from eight to 12 quarters ahead is statistically different from the CGG. For the LPS2 Index, at any point from three to 12 quarters ahead, the AUC is statistically significantly different from when using the CGG. This implies that there are gains from considering a holistic approach to monitoring vulnerabilities in the financial systems around the world.<sup>8</sup>

The Credit-to-GDP gap is data that is directly comparable across countries and theoretically should convey information about a country relative to others. This result that shows our LPS Index being superior in many dimensions may, therefore, highlight some less attractive features of the credit-to-GDP gap measure. First, large drops in output (the denominator) may influence the measure (whereby an increase in the gap is caused primarily by a decrease in the GDP). Second, the credit-to-GDP gap may also be biased as a measure of financial imbalances as sharp increases in credit (as seen in the recent financial crisis) may temporarily elevate the gap measure as well (but from precautionary motives). Third,

---

<sup>8</sup>When we conduct our analysis in pseudo real-time, assuming data is available up to the point in which the various indexes and CGG are calculated, our index has severe limitations. First, unlike the credit series used in the CGG, our more granular data is not that available going back in time. Since we need a certain amount of data to begin calculating our indexes, we can only reasonably begin in 1996. When we compare our indexes with the CGG in this manner, we find that the AUCs using our indexes are generally similar to those using the CGG and therefore our indexes are not statistically superior to the CGG.

there is difficulty in estimating the trend that is taken away from the credit-to-GDP ratio in calculating the gap (though the HP-filter is widely used).<sup>9</sup> Fourth, as mentioned earlier, more recent literature has shown that vulnerabilities may not only come from credit booms per say, but may also arise from the different types of funding of such booms, so it is less surprising that a holistic approach leads to an earlier warning signal when it comes to crises. Finally, measuring vulnerabilities may need to be done on a country-by-country basis as each country may have very different levels of financial deepening that the credit-to-GDP gap does not account for.<sup>10</sup>

**Severity of Banking Crises** Next, we look at how elevated vulnerability indexes are associated with loss in output from banking crises. The output loss is measured by the real GDP gap, which is the cumulative difference in trend GDP and the actual GDP as in Laeven and Valencia (2013). We take the measures of vulnerabilities one quarter immediately prior to the banking crises and scatter plot different measures of financial vulnerabilities with the output losses. In Figure 26, we find a significant relationship between the aggregate LPS Indexes (LPS Index and LPS2 Index) and output loss, implying that our measure is also useful in detecting possible amplification channels of crises to other parts of the financial system and real economy. Just plotting the financial sector vulnerability index (Fin. Index) or the CGG shows a smaller correlation, possibly due to the fact that they convey less information about the amplification channels of banking crises.

Table 3 shows a simple regression that describes our results. Mainly, the LPS and LPS2 Index explains about 13 to 15 percent of the variation in output loss (Specifications (2) and (3)). Both the Fin. Index and the credit-to-GDP gap measure explains barely anything and would seem to be very bad indicators for predicting the severity of banking crises (in terms of its effect on the real economy) (Specifications (1) and (4)). Together, it is the LPS Index and the LPS2 Index, rather than the credit-to-GDP gap that is statistically significant in

---

<sup>9</sup>Hamilton (2016) argues that the HP filter should never be used due to a variety of econometric reasons such as the HP filter producing spurious dynamic relations that have no basis in the underlying data-generating process.

<sup>10</sup>See Edge and Meisenzahl (2012) for more details on the drawbacks of the credit-to-GDP measure as a guide variable for macroprudential policy.

explaining output losses (Specifications (4) and (5)). Our results hold even when we omit Mexico, for which the output loss is an outlier and the results, except that the CGG has a marginally statistically significant explanatory power (not shown). One caveat to this simple analysis is the number of observations. Our results are based on 23 to 27 observations in the data, which is taken directly from Laeven and Valencia (2013).

In sum, the LPS Indexes, which by definition accounts for imbalances in multiple sectors in the financial system, is superior to the credit-to-GDP gap in predicting both the occurrence and the severity of banking crises even when we consider that the LPS Indexes rely solely on the time series components of the various variables that go into the indicators. In addition, the LPS Indexes outperform the Fin. Index when it comes to predicting the severity of banking crises. These results are not surprising as our aggregation set-up, by definition, considers possible spill-over effects and amplification channels of financial stress to other sectors in the economy.

## 7 The Duration and Severity of Recessions

In this section, we analyze whether our measures of vulnerabilities have both significant power in predicting the onset, duration, and severity of recessions. This allows us to expand our country sample to include countries like Australia, Canada, Singapore, and Hong Kong, who have not experienced a banking or currency crisis in the past 30 years, but have experienced a recession. All told, about 100 recessions are in our sample. As in Section 6, we consider an index based on financial sector vulnerabilities only (Fin. Index), the LPS Index, which is an aggregate of all five vulnerability components, and LPS2 Index, which excludes sovereign vulnerabilities from the LPS Index. We continue to compare against the credit-to-GDP gap measure, but simply to see if aggregate leverage is superior to predicting the onset, duration, and severity of recessions. The recessions data is from Howard, Martin, and Wilson (2011) and measures the length or duration of the recession as the quarters between the peak and trough of the relevant economic activity. The depth of the recession is simply how much economic activity fell between the peak and the trough.

First, none of the measures of financial vulnerabilities appear to be useful in predicting recessions. The AUCs based on our vulnerability indexes range from 0.48 to 0.62; whereas the AUCs based on the CGG range from 0.47 to 0.64. In all but one case, across different horizons up to three years, both types of measures show no statistical difference, and, in general, both are poor indicators of predicting the onset of recessions. However, when it comes to the duration and severity of recessions, our aggregate LPS indexes (LPS Index and LPS2 Index) appear to have some power in explaining some of the variation. Table 4 shows that when our aggregate indexes move from really subdued to very elevated (zero to one), the length of the recession increases by about two to three quarters (Specifications (2) and (3)). As in the case for severity of banking crises, the Fin. Index and the CGG are little correlated with the duration of recessions, again pointing to some of the benefits to considering indexes that reflect potential amplification channels of various shocks to the economy, both real and financial. Table 5 also shows some relationship between the LPS2 Index and the depth of recessions, however the explanatory power is somewhat limited, with an increase in the Index from zero to one leading to a three percentage point decline in GDP, and the results are not as statistically significant as for the duration or length of recessions.

## 8 Conclusions

We use a bottom-up approach in creating vulnerability measures within the financial system. This allows us to investigate how different broad categories of vulnerabilities and imbalances in financial systems evolve around different types of financial crises. In particular, we showed how valuation pressures mount, then external, financial sector, and nonfinancial sector vulnerabilities become elevated prior to financial crises. An aggregate measure of our individual vulnerability indexes has some nice features — mainly, it appears to be helpful in predicting different types of financial crises and, for banking crises in particular, can even give an idea of how severe a crises may be after the crises has occurred. Although vulnerability measures appear to be less associated with the onset of recessions, aggregate measures of financial system vulnerabilities seem to explain some of the length of recessions once they do occur,

as disruptions to economic activity can be spread through the financial system.

Although our analysis is based on a limited number of crisis episodes, our findings have potential to have important policy implications. Mainly, as a financial stability monitoring tool, our framework has not only the power to detect the build-up of vulnerabilities and imbalances in the financial system two to three years before the onset of financial crises, it would also presumably provide useful information regarding how forcefully a government may want to intervene when dealing with financial crises once they have occurred. Not only would measures such as the LPS or LPS2 Indexes be useful before financial crises for macroprudential policy, but potentially even afterwards in the context of crisis management policy as well. The results regarding the aggregate indexes to explain some of the length and depth of recessions also has similar policy implications.

There are some other important caveats to our analysis. First, we base our analysis on crisis data primarily from the 2007-2008 crises episodes. Still, the results in this paper are consistent with the literature on financial crises dating back to several decades ago. Second, which is related to the first caveat, is that our analysis is restricted to vulnerability categories for which data is readily available. The next financial crisis may arise from a sector that has yet to be developed or is difficult to obtain data for or even in a sector that was less relevant for the onset of the 2007-2008 global financial crisis, such as sovereign vulnerabilities. That is why it may still be important to keep track of sovereign vulnerabilities because there has been a history of sovereign debt crises that have accompanied full-blown financial crises for many countries in the past. Third, our methodology may have less meaning for countries that have never experienced financial crises. However, to the extent that we can learn from such countries' experiences, tracking vulnerabilities and imbalances in such countries in our framework may provide useful insights regarding the prevention of financial crises and the alleviation of severe economic activity nonetheless. Our holistic framework can hopefully help to pick up distress in the financial system even for those countries who have never experienced financial crises in the past.



## References

- ABIAD, A., R. BALAKRISHNAN, P. K. BROOKS, D. LEIGH, AND I. TYTELL (2014): “What’s the Damage? Medium-Term Output Dynamics after Financial Crises,” in *Financial Crises: Causes, Consequences, and Policy Responses*, ed. by S. Claessens, M. A. Kose, L. Laeven, and F. Valencia, pp. 277–307. International Monetary Fund.
- ADRIAN, T., D. COVITZ, AND N. LIANG (2013): “Financial Stability Monitoring,” Finance and Economics Discussion Series 2013-21, Board of Governors of the Federal Reserve System.
- AIKMAN, D., M. T. KILEY, S. LEE, M. G. PALUMBO, AND M. N. WARUSAWITHARANA (2015): “Mapping Heat in the U.S. Financial System,” Finance and Economics Discussion Series 2015-059, Board of Governors of the Federal Reserve System.
- BLANCHARD, O., E. CERUTTI, AND L. SUMMERS (2015): “Inflation and Activity – Two Explorations and Their Monetary Policy Implications,” NBER Working Paper 21726, National Bureau of Economic Research.
- BORIO, C. (2014): “The financial cycle and macroeconomics: What have we learnt?,” *Journal of Banking & Finance*, 45, 182 – 198.
- BORIO, C., AND P. LOWE (2002): “Assessing the Risk of Banking Crises,” BIS Quarterly Review 157, BIS.
- CECCHETTI, S. (2008): “Measuring the Macroeconomic Risks Posed by Asset Price Booms,” in *Asset Prices and Monetary Policy*, pp. 9–43. National Bureau of Economic Research, Inc.
- CLAESSENS, S., AND M. A. KOSE (2014): “Financial Crises: Explanations, Types, and Implications,” in *Financial Crises: Causes, Consequences, and Policy Responses*, ed. by S. Claessens, M. A. Kose, L. Laeven, and F. Valencia, pp. 3–59. International Monetary Fund.
- CLAESSENS, S., M. A. KOSE, AND M. E. TERRONES (2012): “How do business and financial cycles interact?,” *Journal of International Economics*, 87(1), 178 – 190, Symposium on the Global Dimensions of the Financial Crisis.
- DEMIRGUC-KUNT, A., AND E. DTRAGIACHE (1997): “The Determinants of Banking Crises,” Policy Research Working Paper 1828, World Bank.
- DETRAGIACHE, E., AND A. SPILIMBERGO (2001): “Crises and Liquidity: Evidence and Interpretation,” IMF Working Paper WP/01/2, International Monetary Fund.
- DREHMANN, M., AND M. JUSELIUS (2014): “Evaluating early warning indicators of banking crises: Satisfying policy requirements,” *International Journal of Forecasting*, 30(3), 759 – 780.
- EDGE, R. M., AND R. R. MEISENZAHN (2012): “the Unreliability of Credit-to-GDP Ratio Gaps in Real Time: Implications for Countercyclical Capital Buffers,” *International Journal of Central Banking*, 7(4), 261–98.

- EICHENGREEN, B., AND R. PORTES (1987): “Anatomy of Financial Crises,” in *Threats to International Financial Stability*, ed. by R. Portes, and A. K. Swoboda, pp. 10–58. Cambridge University Press, New York.
- FERGUSON, R. W., P. HARTMANN, F. PANETTA, AND R. PORTES (2007): *International Financial Stability*, Geneva Report on the World Economy. Center for Economic Policy Research.
- GORTON, G., AND A. METRICK (2012): “Securitized banking and the run on repo,” *Journal of Financial Economics*, 104(3), 425 – 451.
- GORTON, G., AND G. ORDONEZ (2014): “Collateral Crises,” *American Economic Review*, 104(2), 343–78.
- HAMILTON, J. D. (2016): “Why You Should Never Use the Hodrick-Prescott Filter,” Discussion paper.
- HOWARD, G., R. MARTIN, AND B. WILSON (2011): “Are Recoveries from Banking and Financial Crises Really So Different?,” International Finance Discussion Papers 1037, Board of Governors of the Federal Reserve System.
- KAMINSKY, G., S. LIZONDO, AND C. REINHART (1998): “Leading Indicators of Currency Crises,” IMF Staff Papers 1, International Monetary Fund.
- KINDELBERGER, C. P. (1978): *Manias, Panics, and Crashes: A History of Financial Crises*. Wiley Investment Classics.
- KROSZNER, R. S., L. LAEVEN, AND D. KLINGEBIEL (2007): “Banking crises, financial dependence, and growth,” *Journal of Financial Economics*, 84(1), 187 – 228.
- LAEVEN, L., AND F. VALENCIA (2013): “Systemic Banking Crises Database,” *IMF Economic Review*, 61, 225–270.
- LEE, S. (2009): “How Information Quality of Macro Aggregates Affects Sovereign Risk: An Empirical Investigation,” *Review of International Economics*, 17(3), 510–532.
- MANASSE, P., AND N. ROUBINI (2009): “Rules of thumb for sovereign debt crises,” *Journal of International Economics*, 78(2), 192 – 205.
- MANASSE, P., N. ROUBINI, AND A. SCHIMMELPFENNIG (2003): “Predicting Sovereign Debt Crises,” IMF Working Paper WP/03/221, International Monetary Fund.
- REINHART, C. M., AND K. S. ROGOFF (2009): *This Time Is Different: Eight Centuries of Financial Folly*. Princeton University Press, Princeton, New Jersey.
- TAYLOR, A. M. (2015): “Credit, Financial Stability, and the Macroeconomy,” *Annual Review of Economics*, 7(1), 309–339.

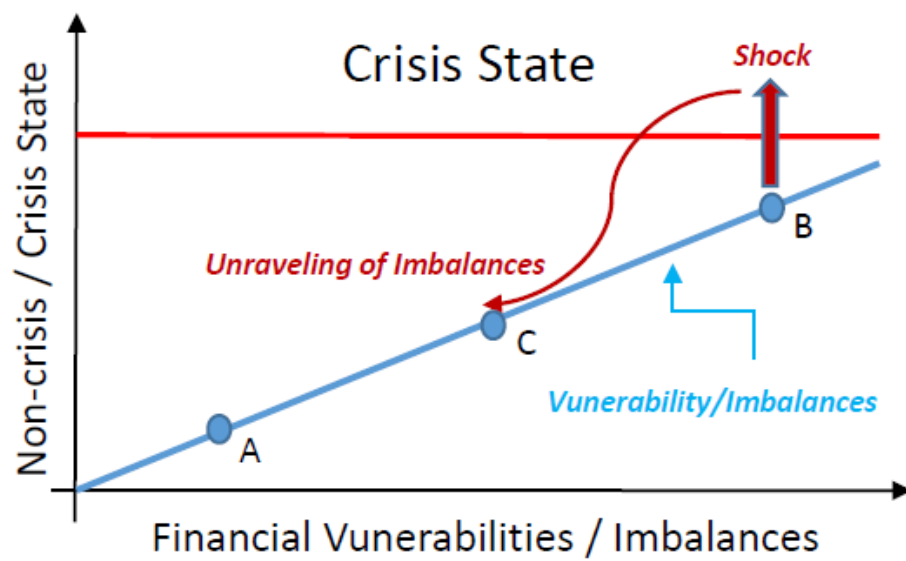


Figure 1: Understanding Financial Crises

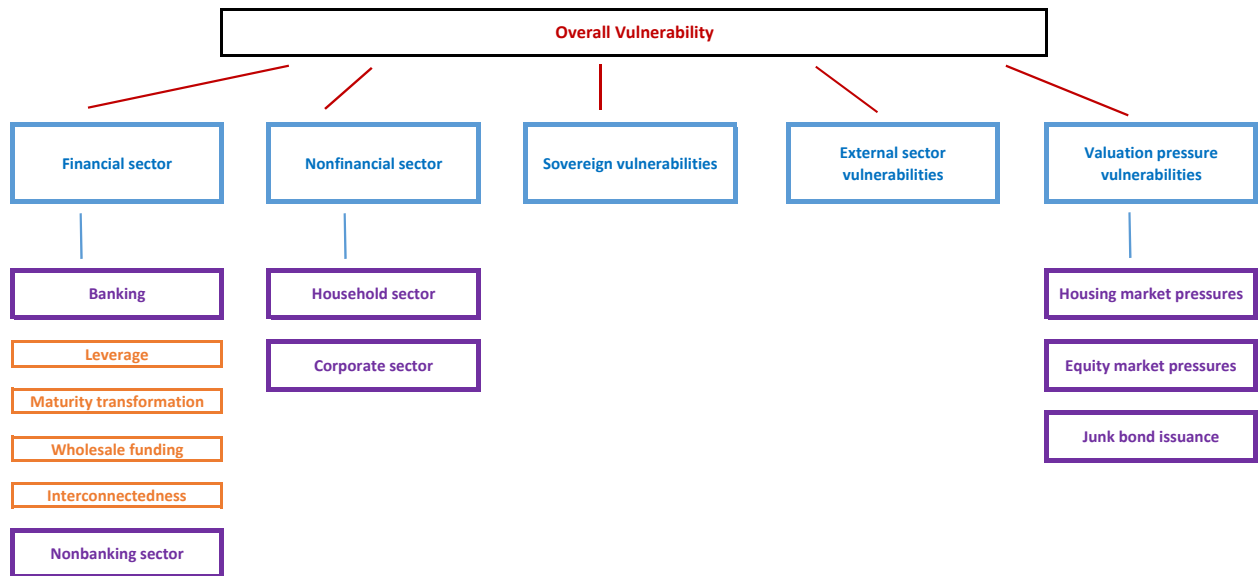


Figure 2: Categorization of Vulnerabilities Schematic

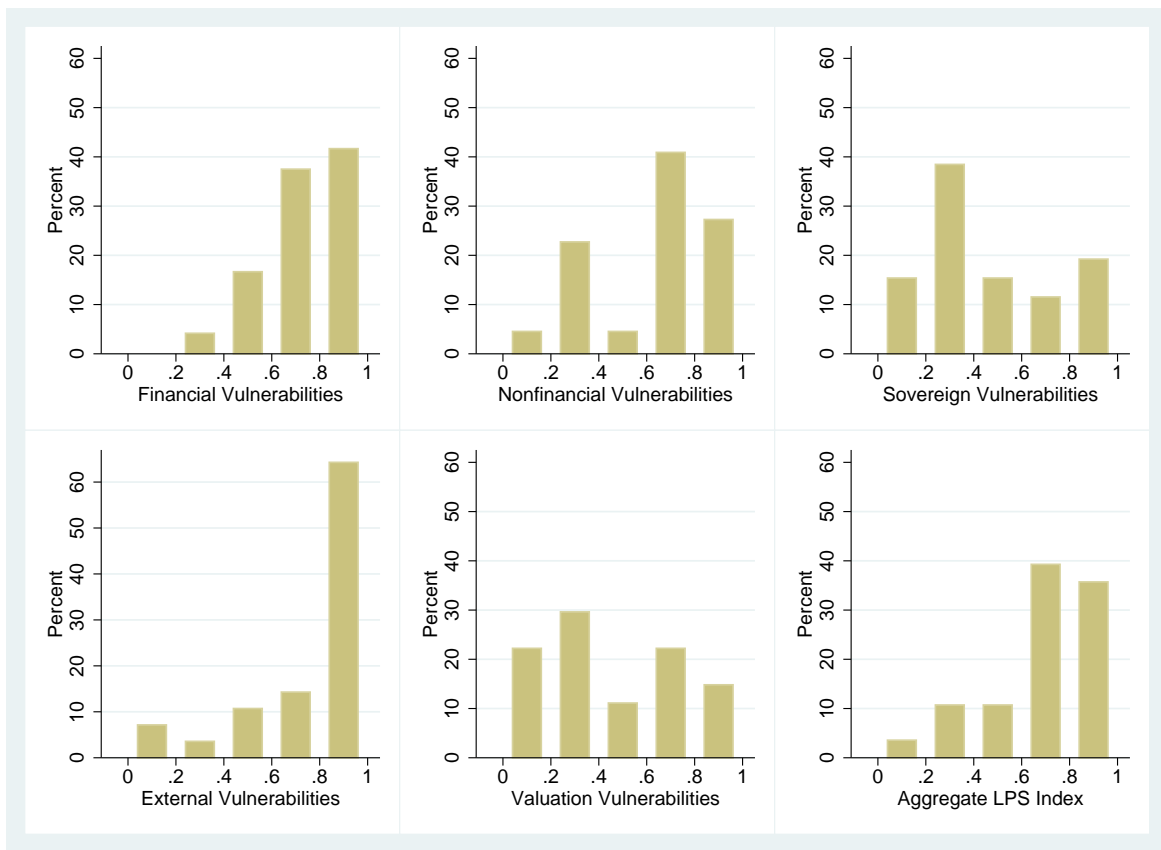


Figure 3: **Histogram of Vulnerabilities 1 Quarter Prior to Banking Crises**

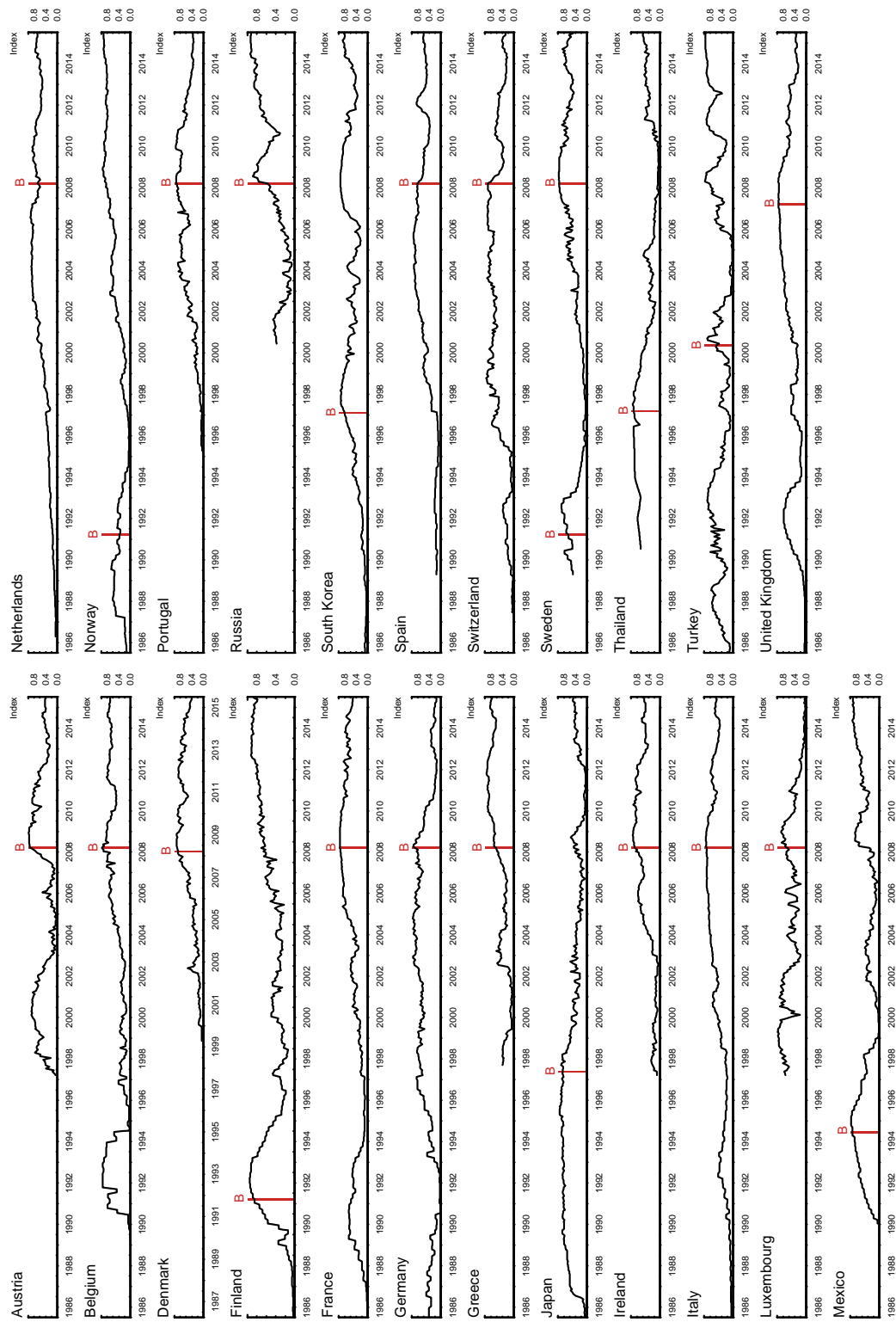


Figure 4: Financial Vulnerabilities Index and Banking Crises

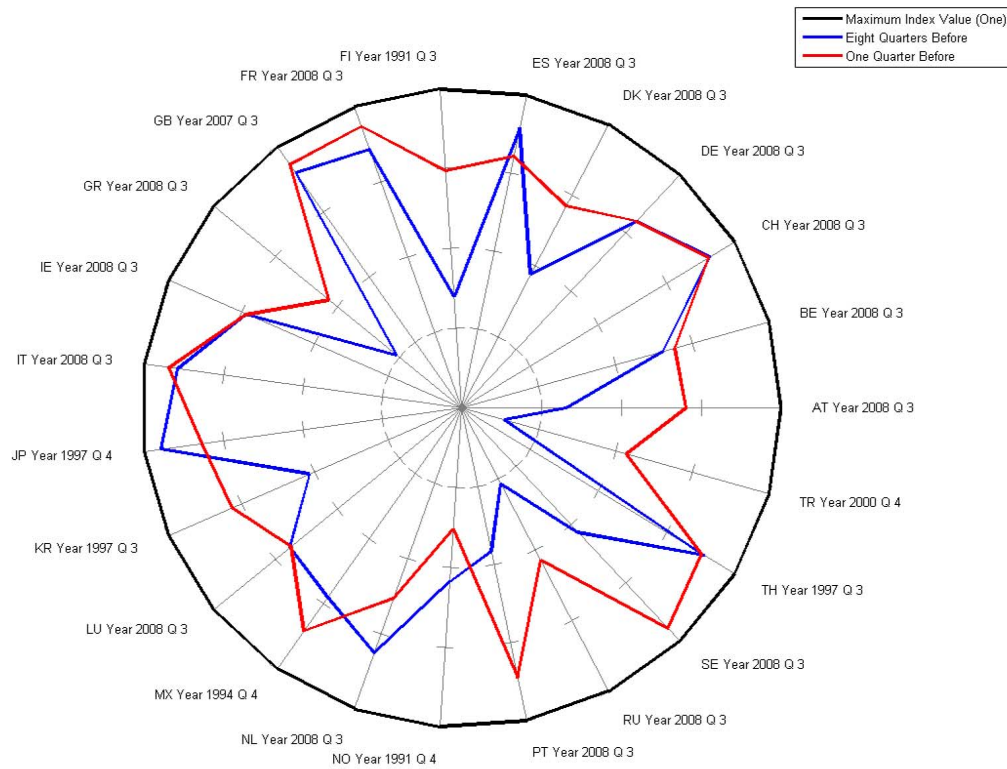


Figure 5: **Financial Vulnerabilities 2 Years and 1 Quarter Prior to Banking Crises, Respectively**

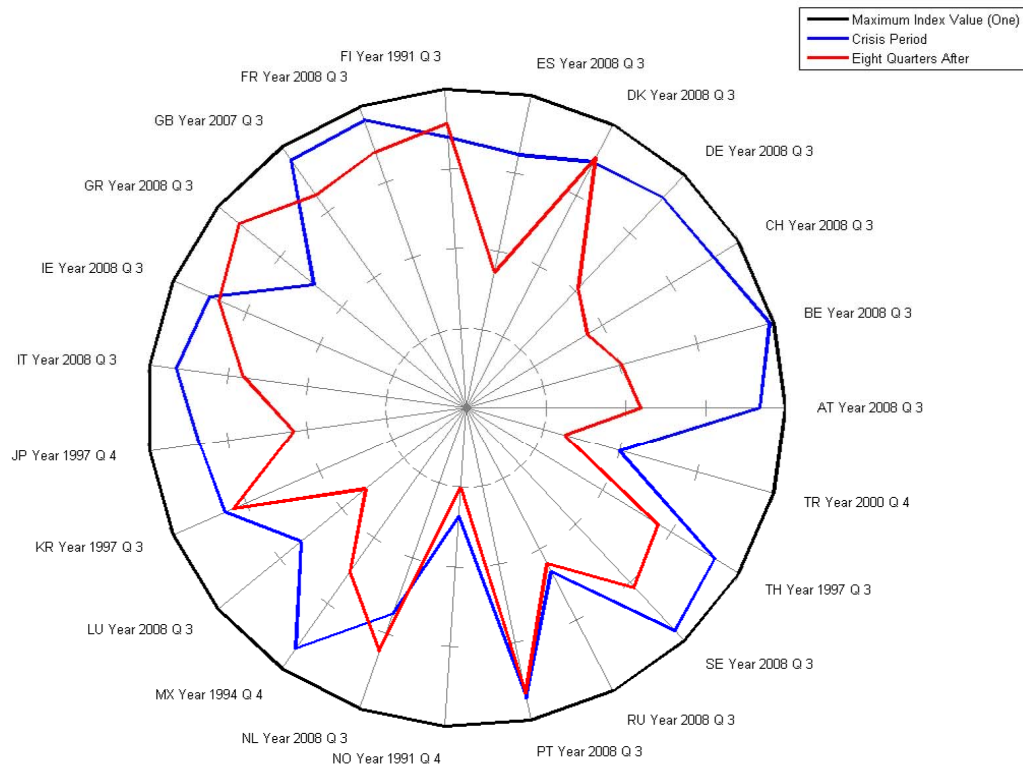


Figure 6: Financial Vulnerabilities at the Time of and 2 Years After Banking Crises, Respectively



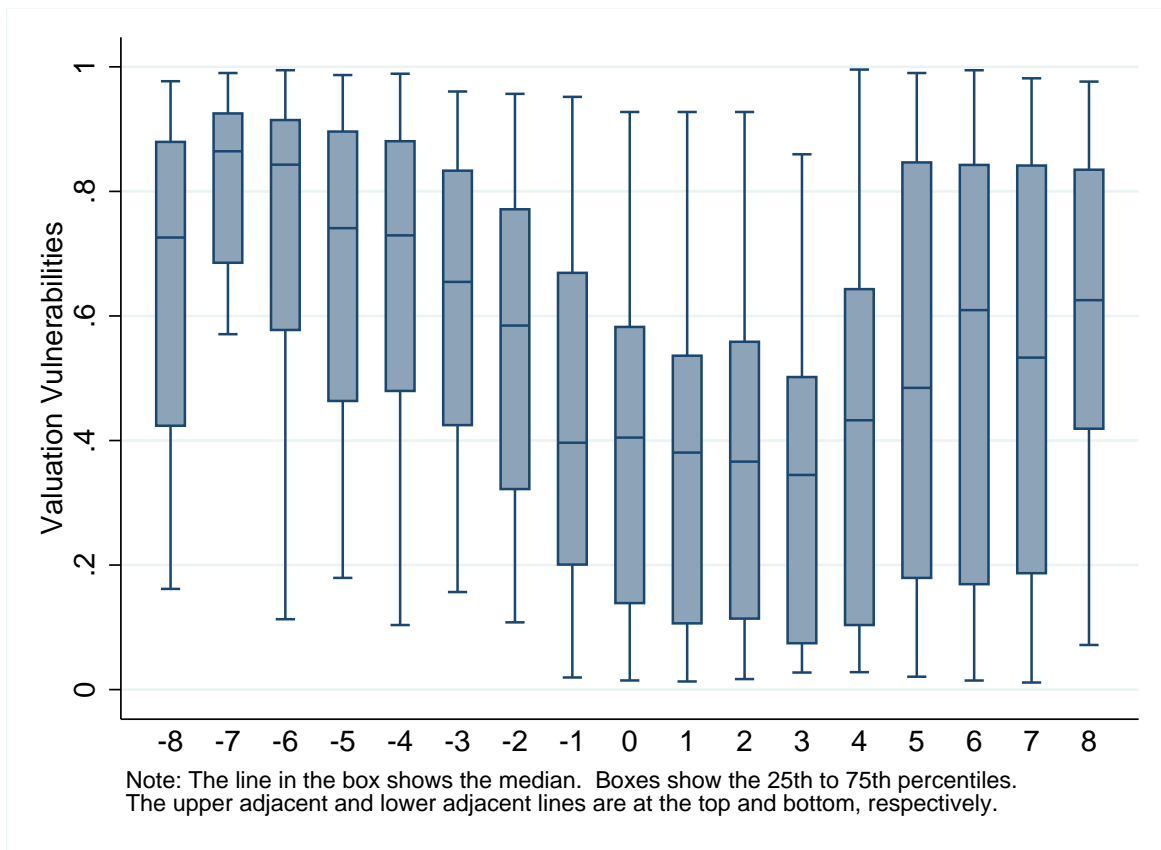


Figure 7: Distribution of Valuation Vulnerabilities Around Banking Crises ( $t=0$ )

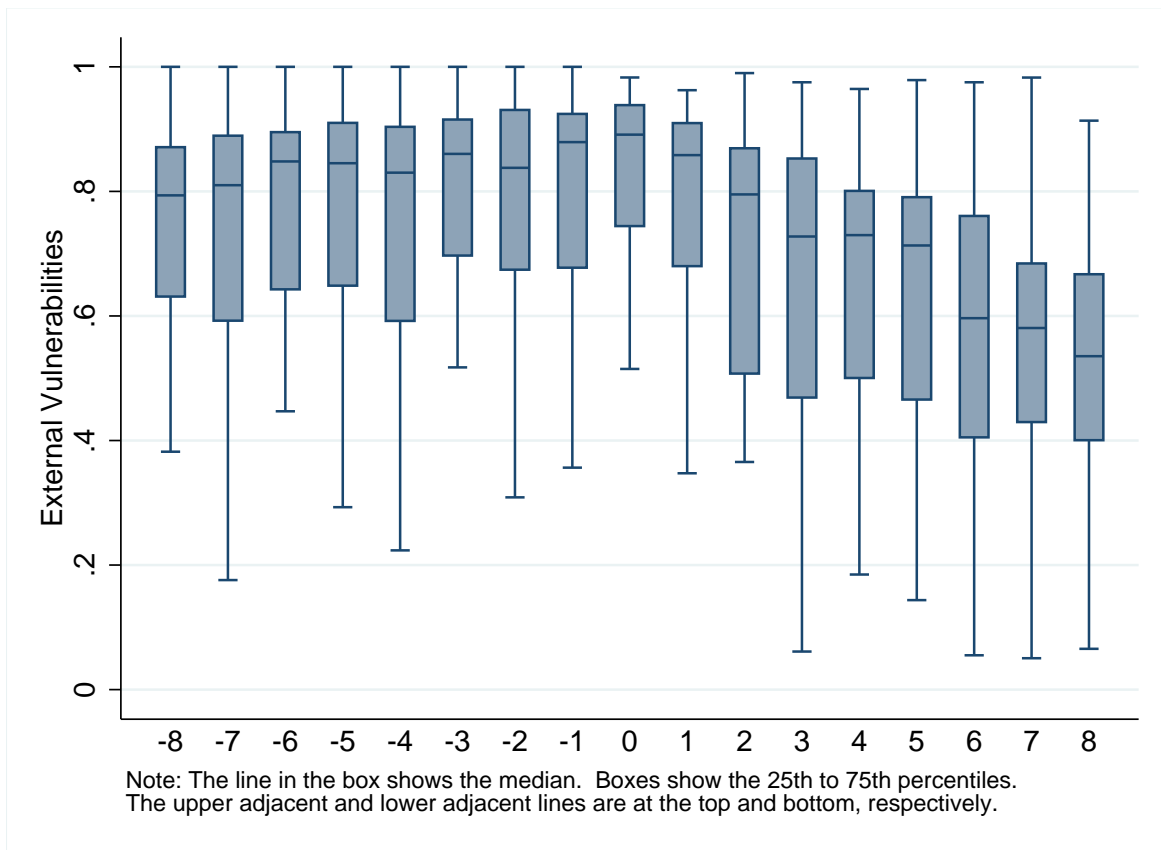


Figure 8: **Distribution of External Vulnerabilities Around Banking Crises ( $t=0$ )**

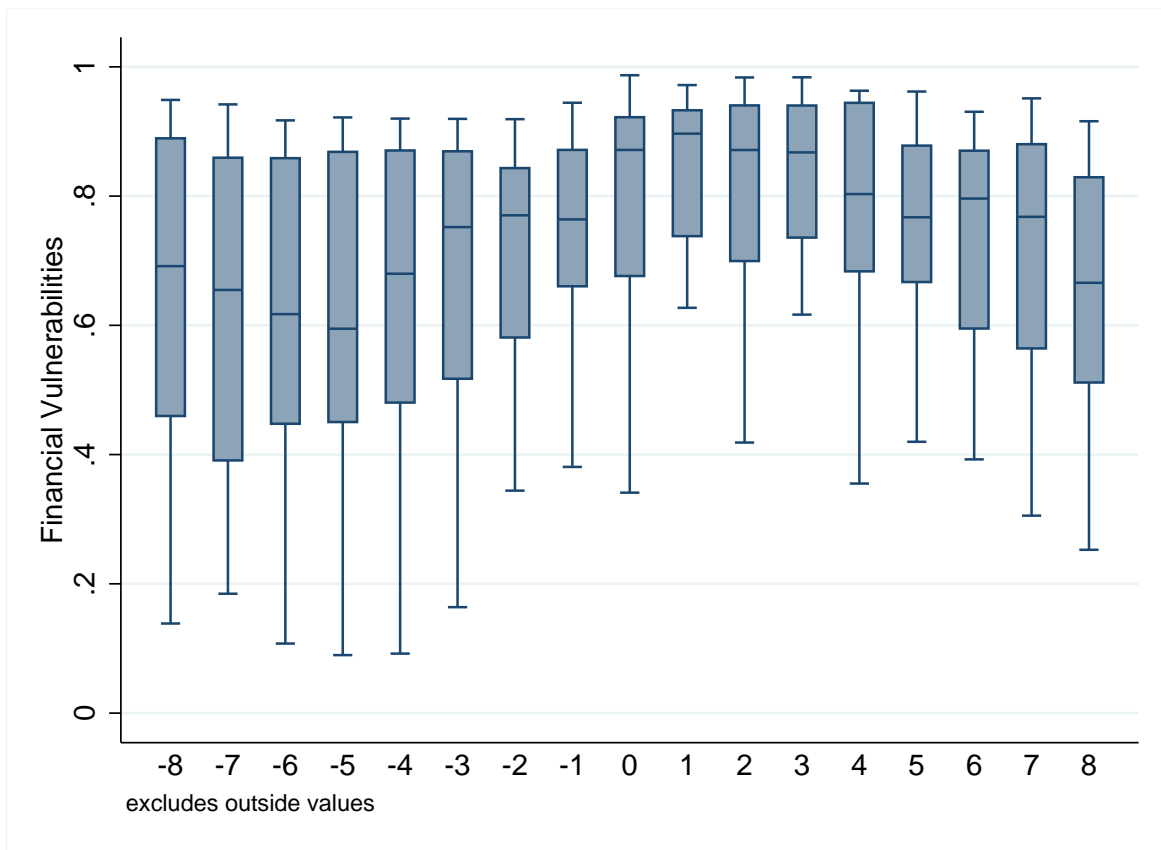


Figure 9: **Distribution of Financial Vulnerabilities Around Banking Crises ( $t=0$ )**

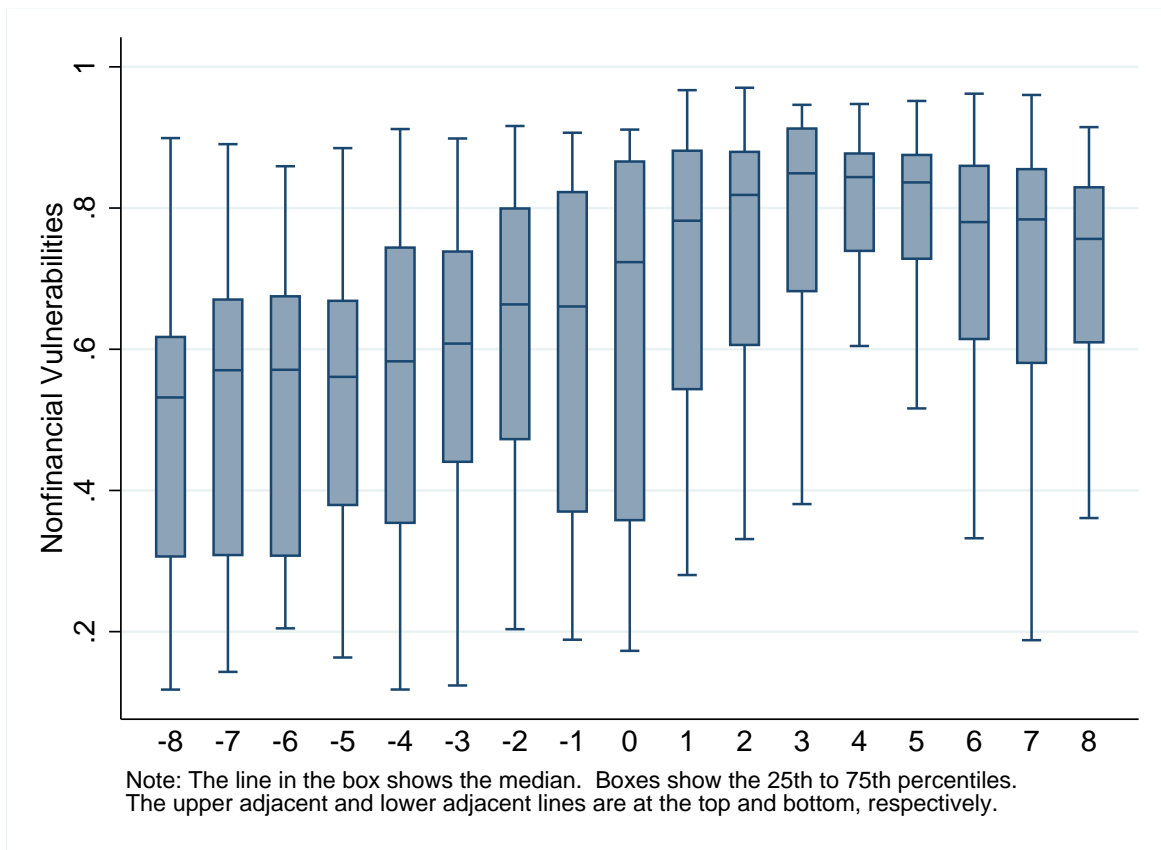


Figure 10: **Distribution of Nonfinancial Vulnerabilities Around Banking Crises ( $t=0$ )**

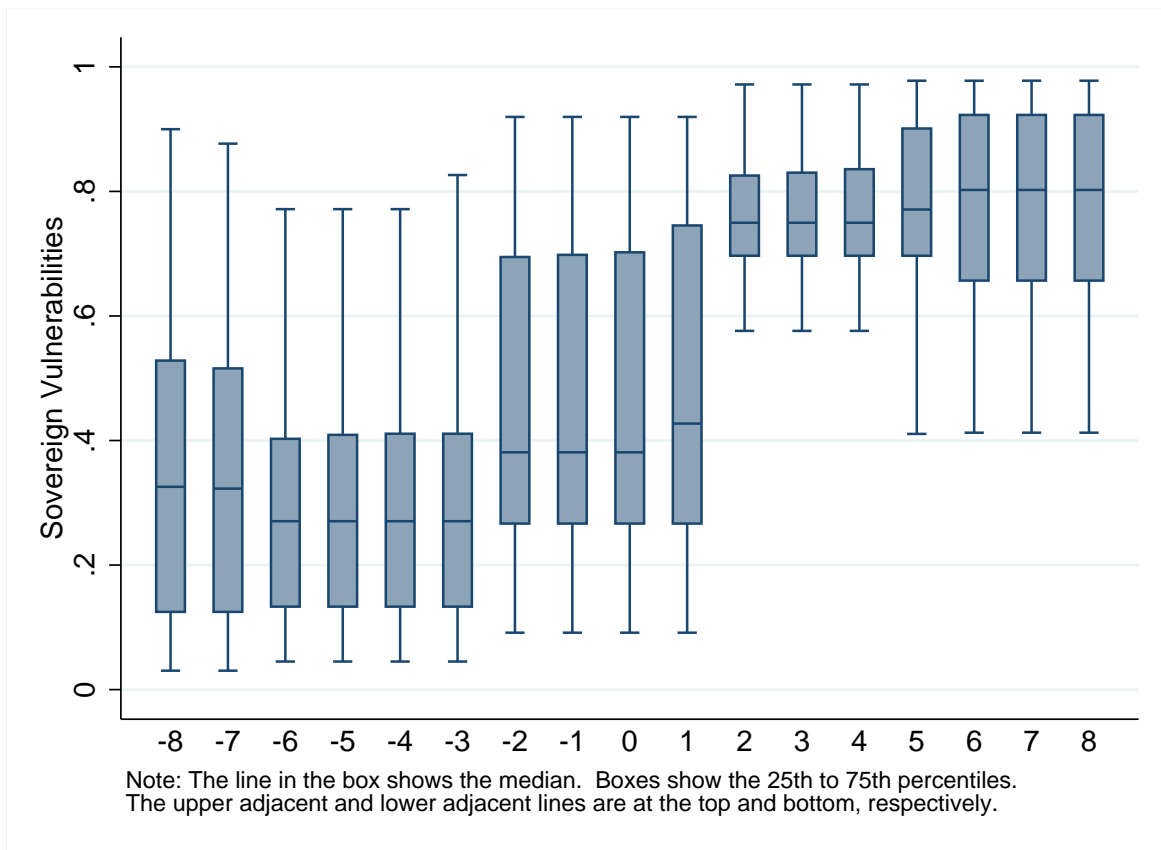


Figure 11: **Distribution of Sovereign Vulnerabilities Around Banking Crises ( $t=0$ )**

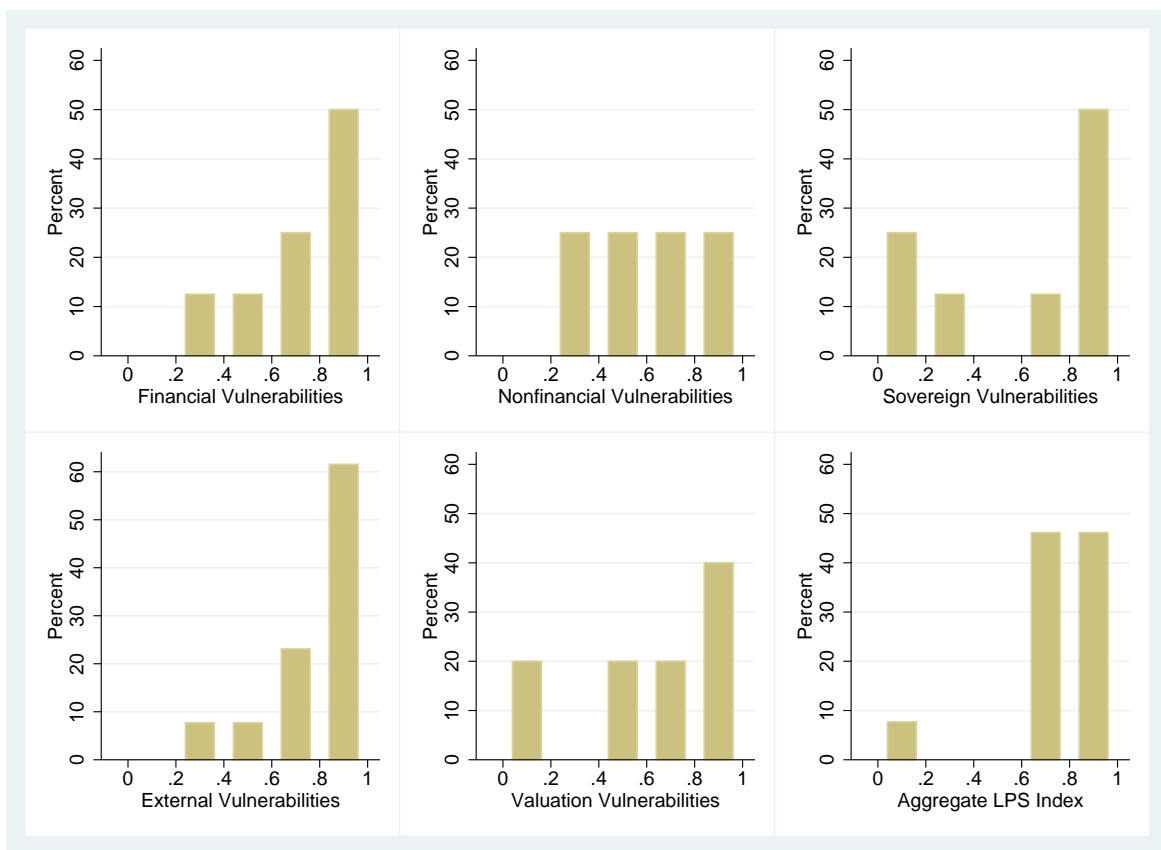


Figure 12: Histogram of Vulnerabilities 1 Quarter Prior to Currency Crises

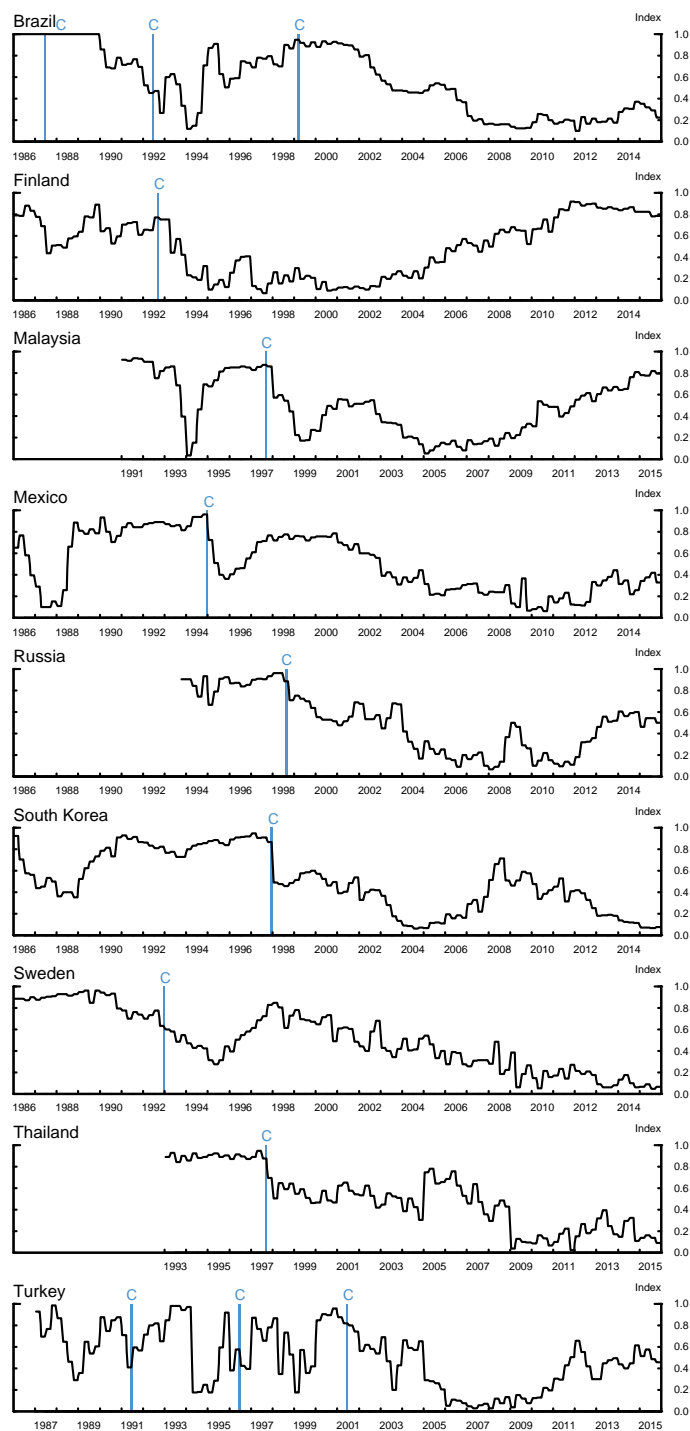


Figure 13: **External Vulnerabilities Index and Currency Crises**

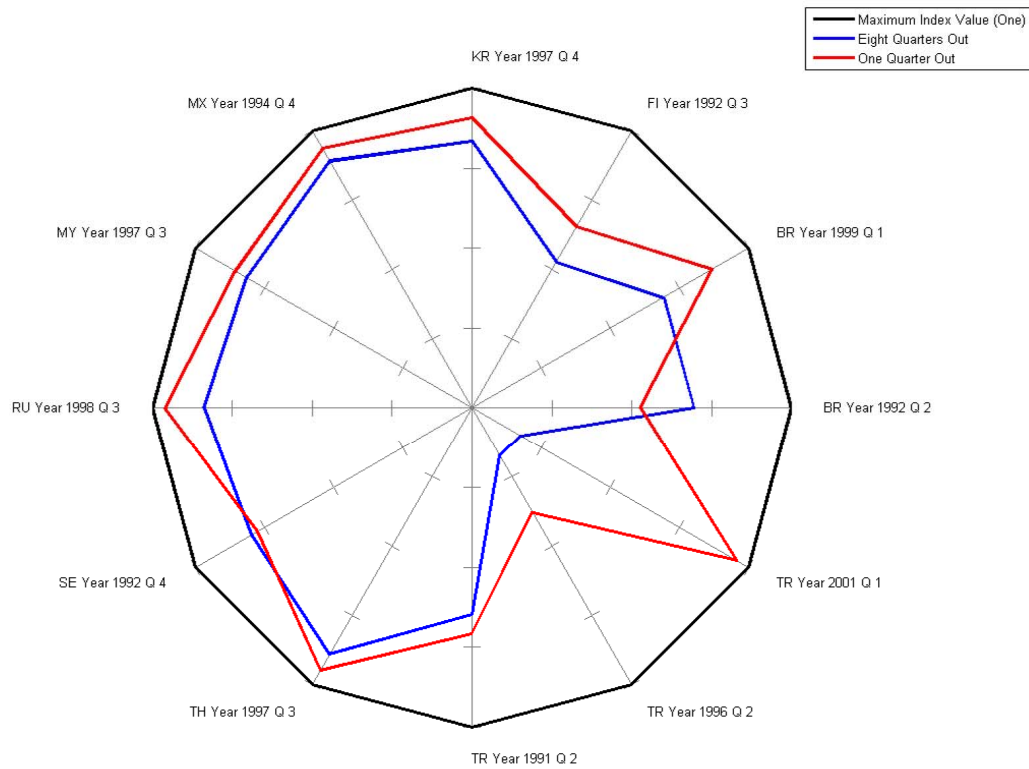


Figure 14: Financial Vulnerabilities 2 Years and 1 Quarter Prior to Currency Crises, Respectively



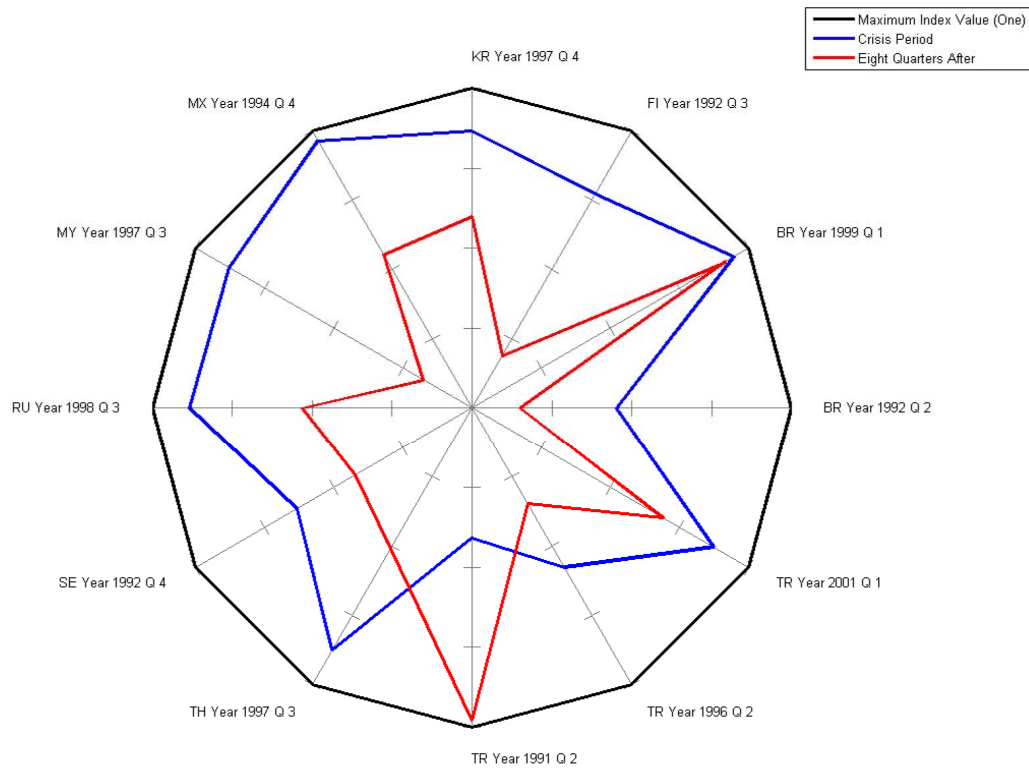


Figure 15: **Financial Vulnerabilities at the Time of and 2 Years After Currency Crises, Respectively**

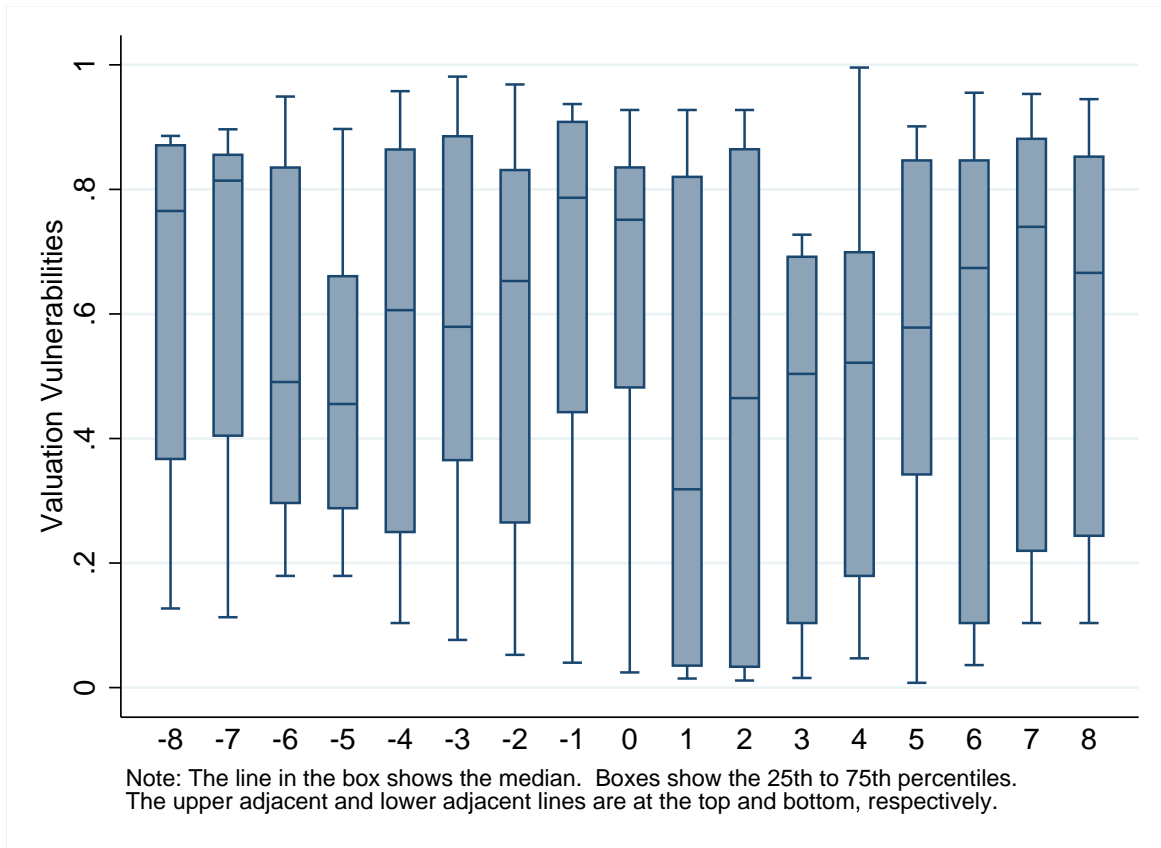


Figure 16: **Distribution of Valuation Vulnerabilities Around Currency Crises ( $t=0$ )**

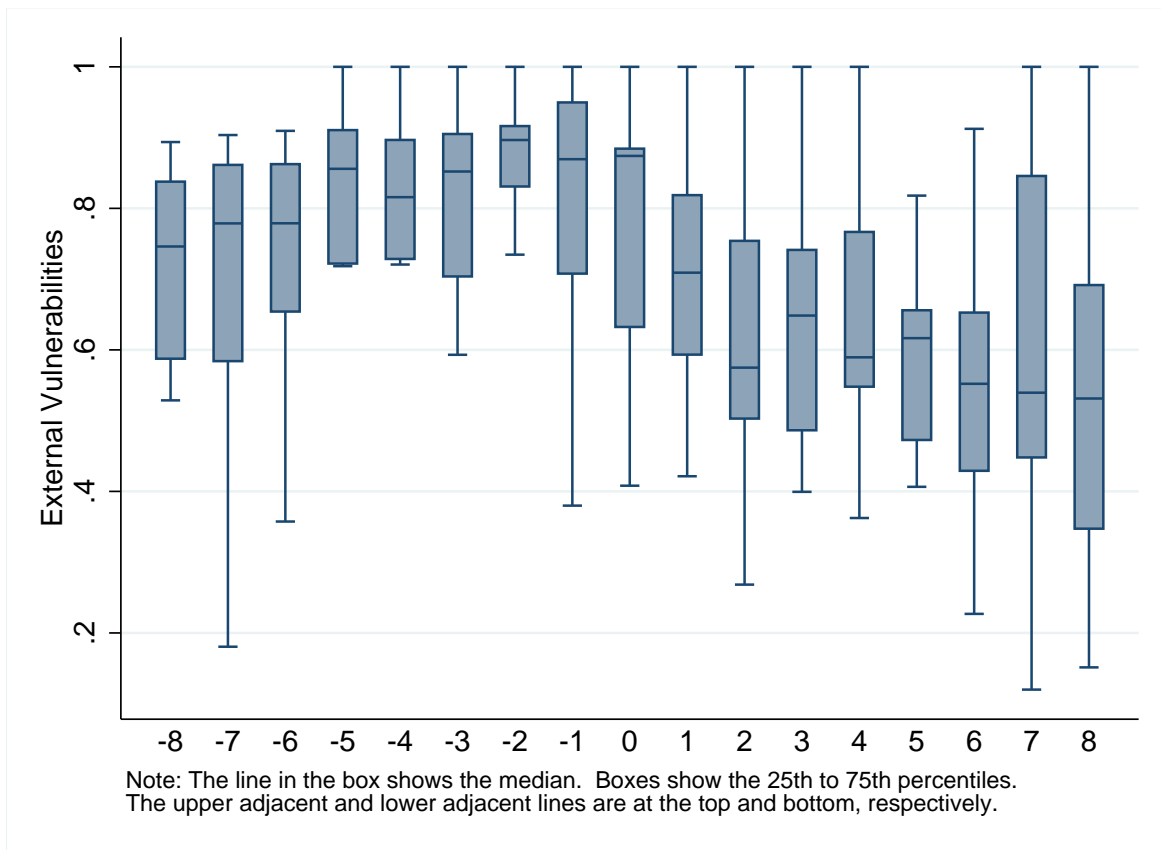


Figure 17: **Distribution of External Vulnerabilities Around Currency Crises ( $t=0$ )**

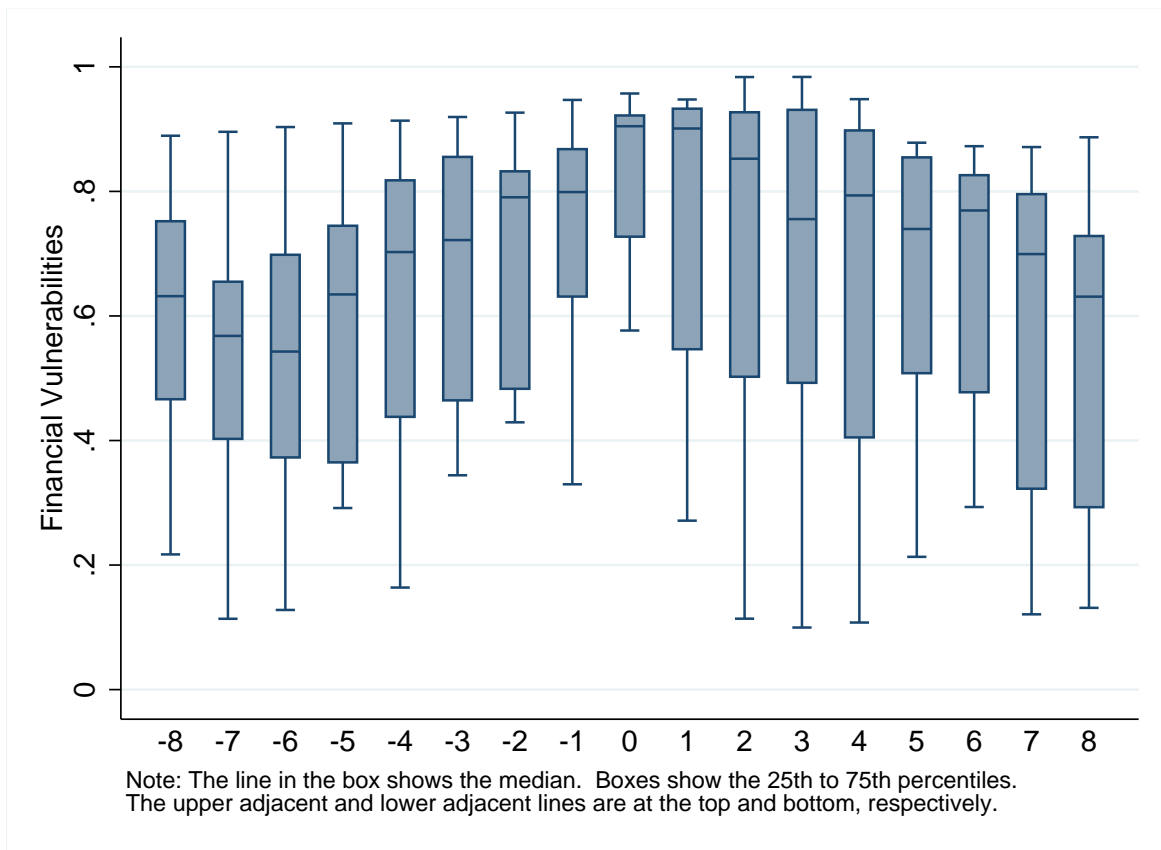


Figure 18: **Distribution of Financial Vulnerabilities Around Currency Crises ( $t=0$ )**

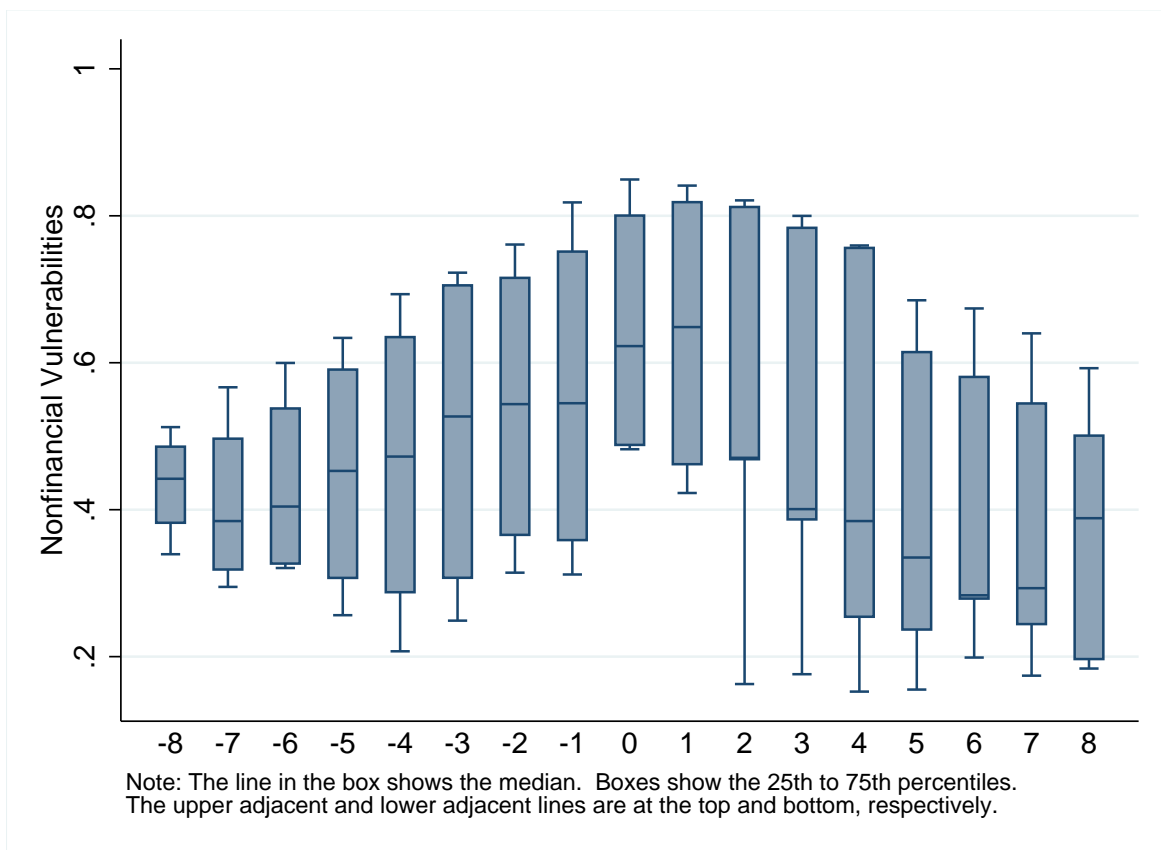


Figure 19: **Distribution of Financial Vulnerabilities Around Currency Crises ( $t=0$ )**

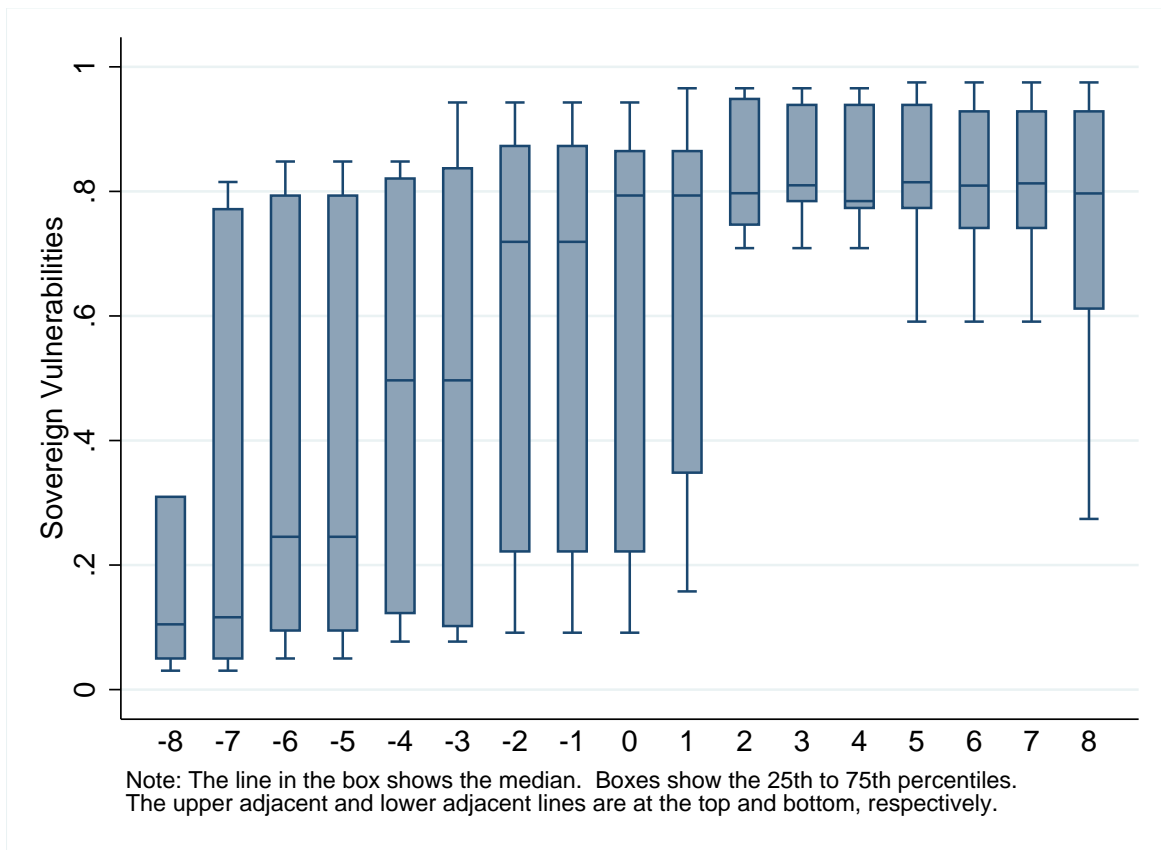


Figure 20: **Distribution of Sovereign Vulnerabilities Around Currency Crises ( $t=0$ )**

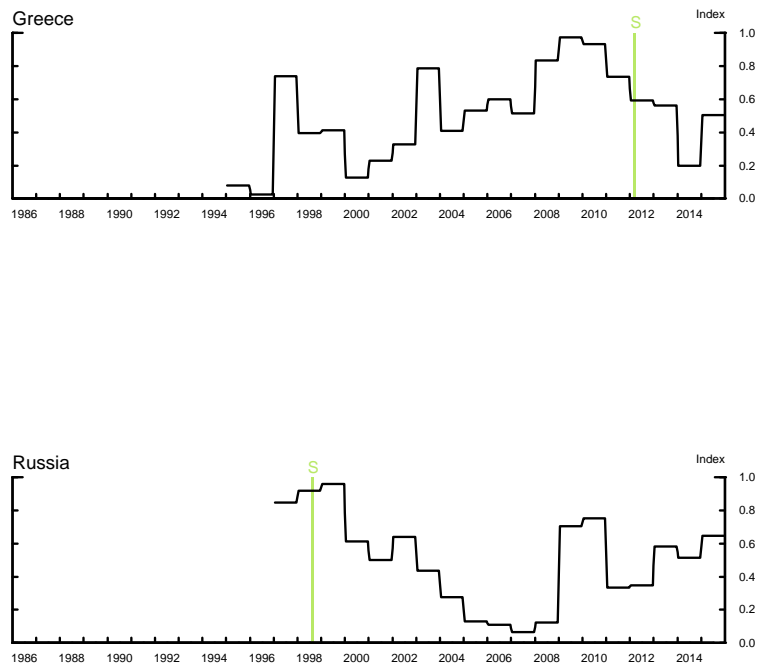


Figure 21: Sovereign Vulnerabilities Index and Sovereign Debt Crises

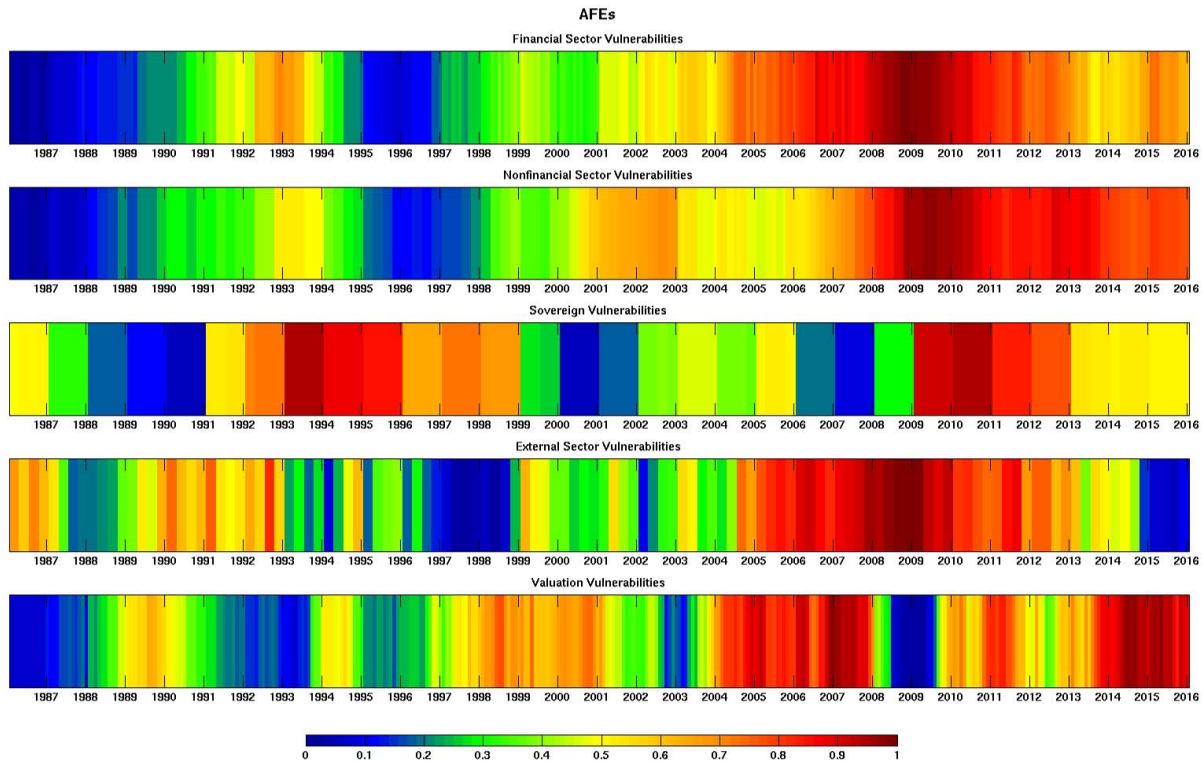


Figure 22: Heat Map of Different Vulnerabilities (Aggregated for advanced economies)



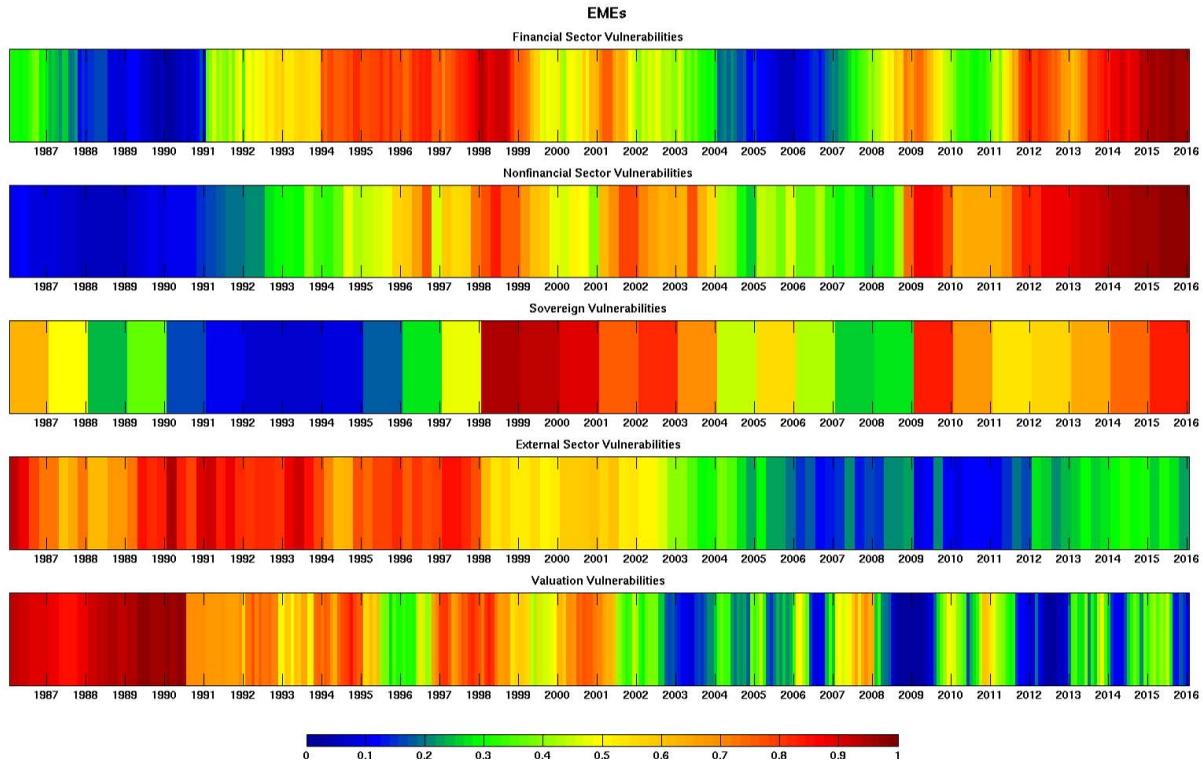


Figure 23: Heat Map of Different Vulnerabilities (Aggregated for emerging economies)

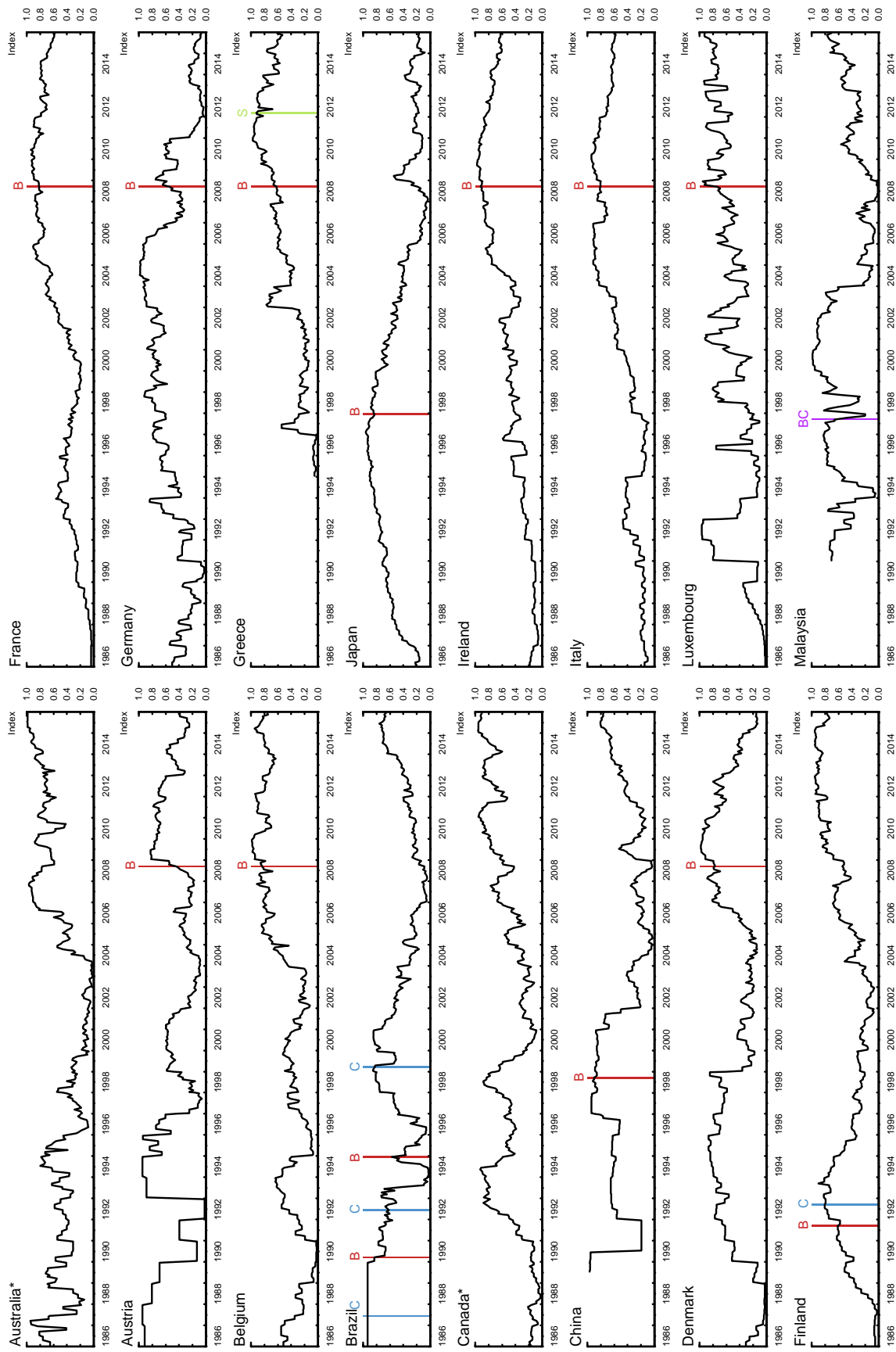


Figure 24: Aggregate LPS Index and Financial Crises

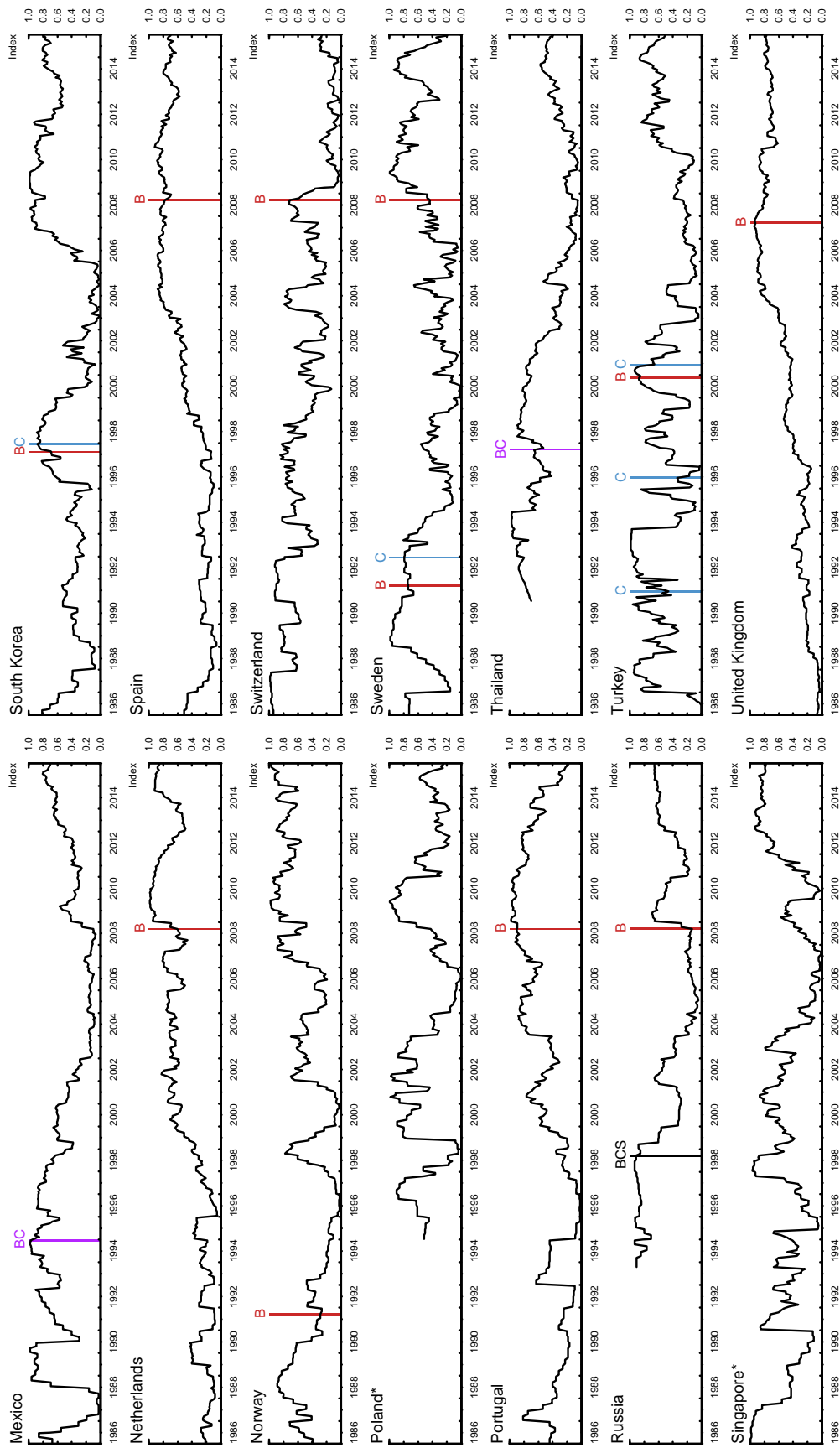


Figure 25: Aggregate LPS Index and Financial Crises, continued

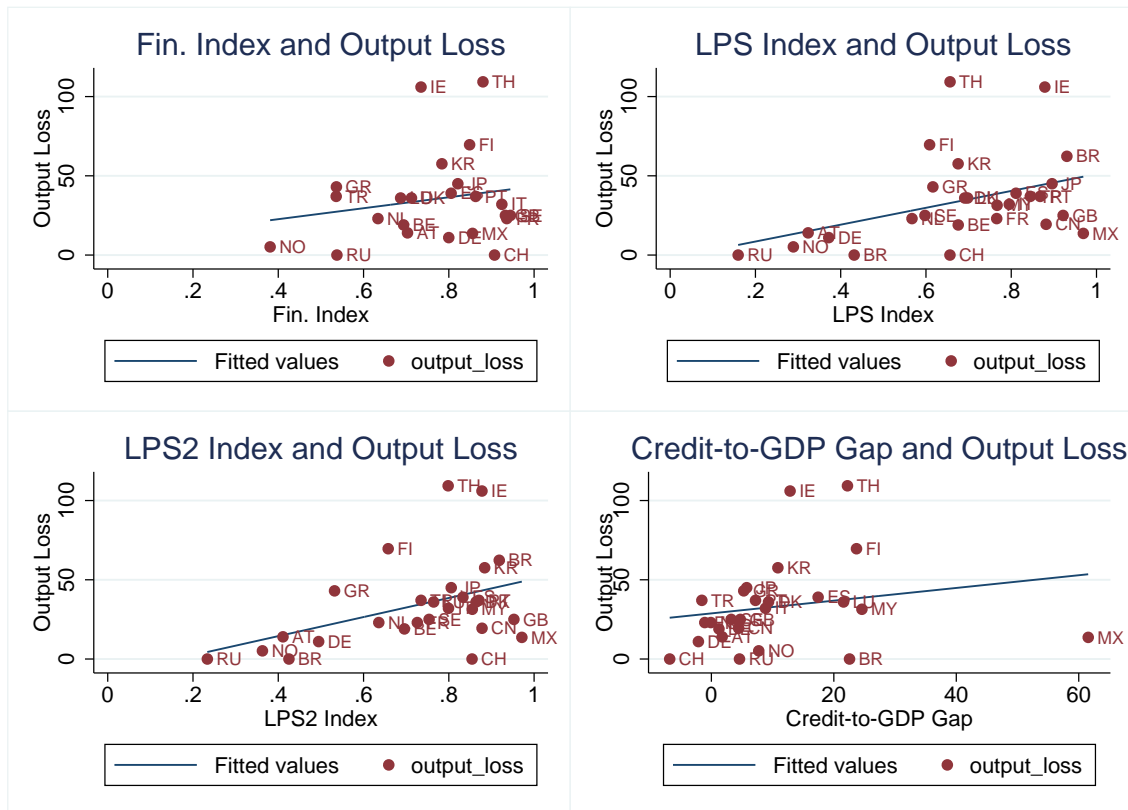


Figure 26: Measures of Vulnerabilities and Output Loss

Table 1: Financial Crises from Laeven and Valencia (2013)

Country	Banking Crises	Currency Crises	Sovereign Crises
Austria	2008:Q3		
Belgium	2008:Q3		
Brazil	1990:Q1, 1994:Q4	1987:Q2, 1992:Q2, 1999:Q1	
Denmark	2008:Q3		
China	1998:Q3		
Finland	1991:Q3	1992:Q3*	
France	2008:Q3		
Germany	2008:Q3		
Greece	2008:Q3		2012:Q1
Japan	1997:Q4		
Ireland	2008:Q3		
Italy	2008:Q3		
Luxembourg	2008:Q3		
Malaysia	1997:Q3	1997:Q3	
Mexico	1994:Q4	1994:Q4*	
Netherlands	2008:Q3		
Norway	1991:Q4		
Portugal	2008:Q3		
Russia	1998:Q3, 2008:Q3	1998:Q3	1998:Q3
South Korea	1997:Q3	1997:Q4*	
Spain	2008:Q3		
Switzerland	2008:Q3		
Sweden	1991:Q3, 2008:Q3	1992:Q4*	
Thailand	1997:Q3	1997:Q3	
Turkey	2000:Q4	1991:Q2, 1996:Q2, 2001:Q1	
United Kingdom	2007:Q3		

Note. \* indicates a one quarter earlier designation of currency crisis compared to Laeven and Valencia (2013) as fixed or actively managed exchange rates were first allowed to float prior to the date in Laeven and Valencia (2013).

Table 2: Area Under the ROC Curve (AUC) prior to Banking Crises across Different Horizons

	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Fin. Index	0.71*	0.72	0.72	0.73	0.74*	0.71	0.69	0.71	0.75	0.77	0.81*	0.84**
CGG*	0.60	0.60	0.60	0.61	0.62	0.65	0.66	0.70	0.72	0.72	0.74	0.74
LPS Index	0.72*	0.75*	0.73**	0.73*	0.73*	0.74	0.73	0.73	0.73	0.75	0.77	0.77
LPS2 Index	0.76**	0.78**	0.79***	0.79***	0.79***	0.80*	0.80***	0.80**	0.80*	0.81*	0.79	0.79
CGG	0.60	0.61	0.60	0.61	0.62	0.64	0.65	0.69	0.72	0.72	0.74	0.75

Note. Each row signifies the horizon in which banking crises are predicted, which ranges from 12 quarters ahead to 1 quarter before the onset of banking crises. Fin. Index is the Financial Sector Vulnerability Index; CGG is the Credit-to-GDP gap; LPS Index is the aggregated index of the five vulnerability components (Financial Sector, Nonfinancial Sector, External Sector, Sovereign, and Valuation Pressure Vulnerabilities); LPS2 Index is the aggregated index of four vulnerability components that excludes the sovereign vulnerability component. The Fin. Index is compared to the CGG\*, which uses a more limited sample than when comparing LPS and LPS2 Indexes with CGG. Differences between an index and the CGG are significant according to the following criterion—\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ .

Table 3: Output Loss and Financial Vulnerability Measures

	(1)	(2)	(3)	(4)	(5)	(6)
Fin. Index	34.5 (0.86)					
LPS Index		53.2** (2.22)			46.1* (1.75)	
LPS2 Index			60.2** (2.33)			53.0* (1.88)
CGG				0.40 (0.98)	0.21 (0.51)	0.20 (0.49)
Constant	8.84 (0.29)	-2.11 (-0.12)	-9.64 (-0.50)	-18.17 (-1.07)	-0.05 (-0.00)	-7.13 (-0.35)
Obs.	23	27	27	26	26	26
R-sq. adj.	-0.01	0.13	0.15	-0.00	0.08	0.09

Note. The explained variable: output loss for three years after a banking crisis. The explanatory variables: The Fin. Index is the aggregated financial sector vulnerability index; the LPS Index, which is an aggregate index of financial sector, nonfinancial sector, external sector, sovereign, and valuation pressure vulnerabilities; the LPS2 Index is an aggregate index of the financial sector, nonfinancial sector, external sector, and valuation pressure vulnerabilities; the CGG is the Credit-to-GDP gap.  $t$  statistics in parentheses. \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Table 4: Length of Recession and Financial Vulnerability Measures

	(1)	(2)	(3)	(4)	(5)	(6)
Fin. Index	-0.55 (-0.39)					
LPS Index		2.14* (1.86)			2.36 (1.58)	
LPS2 Index			2.94** (2.46)			3.50** (1.88)
CGG				0.01 (0.44)	-0.01 (-0.29)	-0.02 (-0.64)
Constant	5.02*** (5.67)	3.26*** (4.56)	2.76*** (3.58)	4.48*** (13.02)	3.32*** (3.79)	2.62*** (2.88)
Obs.	87	103	101	104	92	82
R-sq. adj.	-0.01	0.02	0.05	-0.01	0.01	0.04

Note. The explained variable: length of the recession as defined by Howard, Martin, and Wilson (2011) where it is defined as the duration between the peak and trough of the relevant economic activity. The explanatory variables: The Fin. Index is the aggregated financial sector vulnerability index; the LPS Index, which is an aggregate index of financial sector, nonfinancial sector, external sector, sovereign, and valuation pressure vulnerabilities; the LPS2 Index is an aggregate index of the financial sector, nonfinancial sector, external sector, and valuation pressure vulnerabilities; the CGG is the Credit-to-GDP gap.  $t$  statistics in parentheses. \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$



Table 5: Depth of Recession and Financial Vulnerability Measures

	(1)	(2)	(3)	(4)	(5)	(6)
Fin. Index	0.00 (0.28)					
LPS Index		0.02 (1.05)			0.00 (0.23)	
LPS2 Index			0.03* (1.95)			0.03 (1.36)
CGG				0.00 (1.20)	0.00 (0.92)	0.00 (0.41)
Constant	0.04*** (3.80)	0.03*** (3.68)	0.03*** (3.58)	0.04*** (9.86)	0.04*** (3.69)	0.03** (2.48)
Obs.	87	103	101	104	92	82
R-sq. adj.	-0.01	0.00	0.03	0.00	-0.01	0.01

Note. The explained variable: the depth of a recession as defined by Howard, Martin, and Wilson (2011), which it is defined as the output loss from peak to trough of the relevant economic activity. The explanatory variables: The Fin. Index is the aggregated financial sector vulnerability index; the LPS Index, which is an aggregate index of financial sector, nonfinancial sector, external sector, sovereign, and valuation pressure vulnerabilities; the LPS2 Index is an aggregate index of the financial sector, nonfinancial sector, external sector, and valuation pressure vulnerabilities; the CGG is the Credit-to-GDP gap.  $t$  statistics in parentheses. \*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

**Australia**

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector							
Banking							
	Leverage	Total equity over total assets Bank-provided credit to GDP	2004Q2 1959Q3	Quarterly Quarterly	- +	 Y	Australian Prudential Regulation Authority BIS Credit Series
	Maturity transformation	Loans to deposits	2004Q2	Quarterly	+		Australian Prudential Regulation Authority
	Wholesale funding	MFI liabilities to total assets	2004Q2	Quarterly	+		Australian Prudential Regulation Authority
	Interconnectedness	Cross-border claims to assets	2004Q2	Quarterly	+		BIS Locational Banking Statistics and Australian Prudential Regulation Authority
Nonbanking							
	Leverage	Nonbank-provided credit to GDP	1959Q3	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector							
	Household leverage	Household credit to GDP Household debt service ratio	1977Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
	Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+	Y	S&P Capital IQ
		Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
		Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
		Corporate debt to GDP	1977Q4	Quarterly	+		BIS Credit Series
		Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Sovereign vulnerabilities							
		Government debt to GDP	1989	Annual	+	Y	OECD
		Government fiscal balance to GDP	1989	Annual	-		OECD
		Government revenue to GDP	1997	Annual	-		Moody's
		Government interest to revenue	1997	Annual	+		Moody's
External sector vulnerabilities							
		External debt to GDP	1988Q3	Quarterly	+	Y	Haver
		Current account balance to GDP	1959Q3	Quarterly	-		Haver
		Reserves to GDP	1959Q3	Quarterly	-		International Financial Statistics
Valuation pressures							
	Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
		Price to rent	1972Q3	Quarterly	+		Dallas Fed cross-country housing price database
	Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
		Dividend yield	July 1993	Monthly	-		Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Austria**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	September 1997 1959Q3	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets Cross-border claims to assets	September 1997 1999Q1	Monthly Quarterly	+		ECB Statistical Data Warehouse Authority BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1995Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1995Q4 January 2003	Quarterly Monthly	+	Y	BIS Credit Series Haver
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1995Q4	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	January 2003	Monthly	+		Haver
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1995	Annual	+	Y	OECD
	Government fiscal balance to GDP	1960	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2006Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	2006Q1	Quarterly	-		Haver
	Reserves to GDP	1995Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to GDP	2000Q1	Quarterly	+		BIS Housing Price Series
	Price to rent	2000Q1	Quarterly	+		OECD Analytical House Price database
Equity market	Not available for Austria					
Junk bond issuance	Not available for Austria					

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Belgium

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets	September 1997	Monthly	-		ECB Statistical Data Warehouse
	Bank-provided credit to GDP	1980Q1	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets	September 1997	Monthly	+		ECB Statistical Data Warehouse Authority
	Cross-border claims to assets	1999Q1	Quarterly	+		BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1980Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1980Q4	Quarterly	+	Y	BIS Credit Series
	Household debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1980Q4	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1969	Annual	+	Y	OECD
	Government fiscal balance to GDP	1970	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2003Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1995Q1	Quarterly	-		Haver
	Reserves to GDP	1980Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1976Q2	Quarterly	+		OECD Analytical House Price database
Equity market	Dividend yield	June 1993	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Brazil**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector						
Banking						
Leverage	Regulatory capital ratio	December 2000	Monthly	-	Y	Central Bank of Brazil
	Total equity over total assets	December 2000	Monthly	-		Central Bank of Brazil
	Bank-provided credit to GDP	1994Q1	Quarterly	+		BIS Credit Series
Maturity transformation	Loans to deposits	December 2004	Monthly	+		Central Bank of Brazil
Wholesale funding	Liquidity ratio	January 2006	Monthly	-		Central Bank of Brazil
	Liquid assets to short-term liabilities	2005Q1	Quarterly	+		Central Bank of Brazil
	Short-term liabilities to total assets	2005Q1	Quarterly	+		Central Bank of Brazil
	Liquidity ratio for public-owned institutions	January 2006	Monthly	-		Central Bank of Brazil
	Liquidity ratio for national private banks	January 2006	Monthly	-		Central Bank of Brazil
	Liquidity ratio for foreign banks	January 2006	Monthly	-		Central Bank of Brazil
Interconnectedness	Foreign assets to total assets	December 2004	Monthly	+		Central Bank of Brazil
Nonbanking						
Leverage	Nonbank-provided credit to GDP	1994Q1	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector						
Household leverage	Not available for Brazil					
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
Sovereign vulnerabilities						
	Government debt to GDP	2000	Annual	+	Y	WEO
	Government fiscal balance to GDP	2000	Annual	-		WEO
	Government revenue to GDP	1998	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
External sector vulnerabilities						
	External debt to GDP	1990Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1990Q1	Quarterly	-		Haver
	Reserves to GDP	1990Q1	Quarterly	-		International Financial Statistics
	External vulnerability indicator	1997	Annual	+		Moody's
Valuation pressures						
Housing market	House price to GDP	2001Q1	Quarterly	+		BIS Housing Price series
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters
	Dividend yield	January 2001	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Canada**

Canada	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector							
Banking							
	Leverage	Total equity over total assets Bank-provided credit to GDP	November 1981 1961Q1	Monthly Quarterly	- +	Y	Haver BIS Credit Series
	Maturity transformation	Loans to deposits	November 1981	Monthly	+		Haver
	Wholesale funding	MFI Liabilities to total assets	January 1999	Monthly	+		Haver and Bank of Canada
	Interconnectedness	Foreign assets to total assets	1978Q2	Quarterly	+		Haver and Bank of Canada
Nonbanking							
	Leverage	Nonbank-provided credit to GDP	1961Q1	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector							
	Household leverage	Household credit to GDP Household debt service ratio	1969Q1 2005Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
	Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
		Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
		Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
		Corporate debt to GDP	1969Q1	Quarterly	+	Y	BIS Credit Series
		Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Sovereign vulnerabilities							
		Government debt to GDP	1970Q1	Quarterly	+	Y	OECD
		Government fiscal balance to GDP	1970	Annual	-		OECD
		Government revenue to GDP	1997	Annual	-		Moody's
		Government interest to revenue	1997	Annual	+		Moody's
External sector vulnerabilities							
		External debt to GDP	2002Q4	Quarterly	+	Y	Haver
		Current account balance to GDP	1981Q1	Quarterly	-		Haver
		Reserves to GDP	1961Q1	Quarterly	-		International Financial Statistics
Valuation pressures							
	Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
		Price to rent	1970Q1	Quarterly	+		OECD Analytical House Price Database
	Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters
		Dividend yield	June 1993	Monthly	-		Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**China**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total equity over total assets Bank-provided credit to GDP	January 2006 1992Q1	Monthly Quarterly	- +	Y	Haver BIS Credit Series
Maturity transformation	Loans to deposits	January 2008	Monthly	+		Haver
Wholesale funding	MFI Liabilities to total assets	January 2006	Monthly	+		Haver
Interconnectedness	Foreign assets to total assets	January 2006	Monthly	+		Haver
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1992Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	2006Q1	Quarterly	+	Y	BIS Credit Series
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	2006Q1	Quarterly	+	Y	BIS Credit Series
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1995	Annual	+	Y	WEO
	Government fiscal balance to GDP	1995	Annual	-		WEO
	Government revenue to GDP	1997	Annual	+		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2003Q2	Quarterly	+	Y	CEIC
	Current account balance to GDP	1981Q1	Quarterly	-		Haver
	Reserves to GDP	1992Q1	Quarterly	-		International Financial Statistics
	External vulnerability indicator	1997	Annual	+		Moody's
<b>Valuation pressures</b>						
Housing market	House price to income	1996Q4	Quarterly	+		Economist and Thomson Reuters
	Price to rent	2001Q1	Quarterly	+		Economist and Thomson Reuters
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters
	Dividend yield	December 1997	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Denmark**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	July 2000 1990Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
Maturity transformation	Loans to deposits	July 2000	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	July 2000	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Cross-border claims to assets	2000Q3	Quarterly	+		BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1990Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1994Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1994Q4	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1980	Annual	+	Y	OECD
	Government fiscal balance to GDP	1971	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2003Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1997Q1	Quarterly	-		Haver
	Reserves to GDP	1957Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1970Q1	Quarterly	+		OECD Analytical House Price database
Equity market	Dividend yield	July 2001	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 2003	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.



**Finland**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	September 1997 1975Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets Cross-border claims to assets	September 1997 1999Q1	Monthly Quarterly	+		ECB Statistical Data Warehouse BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1975Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1975Q1 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile Aggregated corporate leverage Interest rate coverage ratio Corporate debt to GDP Nonfinancial corporation debt service ratio	2005Q1 2005Q1 2005Q1 1975Q1 1999Q1	Quarterly Quarterly Quarterly Quarterly Quarterly	+	Y	S&P Capital IQ S&P Capital IQ S&P Capital IQ BIS Credit Series BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1975	Annual	+	Y	OECD
	Government fiscal balance to GDP	1960	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1991Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1980Q1	Quarterly	-		Haver
	Reserves to GDP	1975Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income Price to rent	1975Q1 1970Q1	Quarterly Quarterly	+		Dallas Fed cross-country housing price database OECD Analytical House Price database
Equity market	Price to earnings ratio Dividend yield	January 2006 October 1993	Monthly Monthly	+		Thomson Reuters Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**France**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	September 1997 1969Q4	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets Cross-border claims to assets	September 1997 1999Q1	Monthly Quarterly	+		ECB Statistical Data Warehouse BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1969Q4	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1977Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1969Q1	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1969	Annual	+	Y	OECD
	Government fiscal balance to GDP	1978	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2008Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	2008Q1	Quarterly	-		Haver
	Reserves to GDP	1975Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1970Q1	Quarterly	+		OECD Analytical House Price database
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters
	Dividend yield	January 1994	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Germany

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector							
Banking							
	Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	September 1997 1960Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
	Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Interconnectedness	Foreign assets Cross-border claims to assets	September 1997 1999Q1	Monthly Quarterly	+		ECB Statistical Data Warehouse BIS Locational Banking Statistics and ECB Statistical Data Warehouse
Nonbanking							
	Leverage	Nonbank-provided credit to GDP	1960Q1	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector							
	Household leverage	Household credit to GDP Household debt service ratio	1970Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
	Corporate leverage	Corporate leverage 90th percentile Aggregated corporate leverage Interest rate coverage ratio Corporate debt to GDP Nonfinancial corporation debt service ratio	2005Q1 2005Q1 2005Q1 1970Q4 1999Q1	Quarterly Quarterly Quarterly Quarterly Quarterly	+	Y	S&P Capital IQ S&P Capital IQ S&P Capital IQ BIS Credit Series BIS debt service ratios for the private nonfinancial sector
Sovereign vulnerabilities							
		Government debt to GDP	1991	Annual	+	Y	OECD
		Government fiscal balance to GDP	1991	Annual	-		OECD
		Government revenue to GDP	1997	Annual	-		Moody's
		Government interest to revenue	1997	Annual	+		Moody's
External sector vulnerabilities							
		External debt to GDP	1999Q2	Quarterly	+	Y	Haver
		Current account balance to GDP	1971Q1	Quarterly	-		Haver
		Reserves to GDP	1960Q1	Quarterly	-		International Financial Statistics
Valuation pressures							
	Housing market	Nominal house price to income Price to rent	1975Q1 1970Q1	Quarterly Quarterly	+		Dallas Fed cross-country housing price database OECD Analytical House Price database
	Equity market	Price to earnings ratio Dividend yield	January 2006 January 1997	Monthly Monthly	+		Thomson Reuters Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Greece

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	March 1998 1995Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
Maturity transformation	Loans to deposits	March 1998	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	March 1998	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets Cross-border claims to assets	March 1998 1999Q1	Monthly Quarterly	+		ECB Statistical Data Warehouse BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1995Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1995Q1 January 2006	Quarterly Monthly	+	Y	BIS Credit Series Haver
Corporate leverage	Corporate leverage 90th percentile Aggregated corporate leverage Interest rate coverage ratio Corporate debt to GDP Nonfinancial corporation debt service ratio	2005Q1 2005Q1 2005Q1 1995Q1 January 2006	Quarterly Quarterly Quarterly Quarterly Monthly	+	Y	S&P Capital IQ S&P Capital IQ S&P Capital IQ BIS Credit Series Haver
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1995	Annual	+	Y	OECD
	Government fiscal balance to GDP	1995	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2008Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1997Q1	Quarterly	-		Haver
	Reserves to GDP	1995Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income Price to rent	2006Q1 1997Q1	Quarterly Quarterly	+		BIS Housing Price Series OECD Analytical House Price database
Equity market	Dividend yield	May 1999	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Hong Kong**

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector							
Banking							
	Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	December 1993 1978Q4	Monthly Quarterly	- +	 Y	Haver BIS Credit Series
	Maturity transformation	Loans to deposits	December 1993	Monthly	+		Haver
	Wholesale funding	MFI Liabilities to total assets	December 1993	Monthly	+		Haver
	Interconnectedness	Foreign assets to total assets	December 1993	Monthly	+		Haver
Nonbanking							
	Leverage	Nonbank-provided credit to GDP	1978Q4	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector							
	Household leverage	Household credit to GDP	1990Q4	Quarterly	+	Y	BIS Credit Series
	Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
		Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
		Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
		Corporate debt to GDP	1990Q4	Quarterly	+	Y	BIS Credit Series
Sovereign vulnerabilities							
		Government debt to GDP	2001Q1	Quarterly	+	Y	WEO
		Government fiscal balance to GDP	1985Q1	Quarterly	-		WEO
		Government revenue to GDP	1997Q1	Quarterly	-		Moody's
		Government interest to revenue	1997	Annual	+		Moody's
External sector vulnerabilities							
		External debt to GDP	2002Q1	Quarterly	+	Y	Haver
		Current account balance to GDP	1999Q1	Quarterly	-		Haver
		Reserves to GDP	1970Q1	Quarterly	-		International Financial Statistics
Valuation pressures							
	Housing market	Nominal house price to GDP	1993Q1	Quarterly	+		BIS Housing Price Series
	Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters
		Dividend yield	October 1993	Monthly	-		Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Ireland**

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>							
<b>Banking</b>							
	Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	September 1997 1990Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
	Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Interconnectedness	Foreign assetss Cross-border claims to assets	September 1997 1999Q1	Monthly Quarterly	+		ECB Statistical Data Warehouse BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>							
	Leverage	Nonbank-provided credit to GDP	1990Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>							
	Household leverage	Household credit to GDP Household debt service ratio	2002Q1 January 2003	Quarterly Monthly	+	Y	BIS Credit Series Haver
	Corporate leverage	Corporate leverage 90th percentile Aggregated corporate leverage Interest rate coverage ratio Corporate debt to GDP Nonfinancial corporation debt service ratio	2005Q1 2005Q1 2005Q1 2002Q1 January 2003	Quarterly Quarterly Quarterly Quarterly Monthly	+	Y	S&P Capital IQ S&P Capital IQ S&P Capital IQ BIS Credit Series Haver
<b>Sovereign vulnerabilities</b>							
		Government debt to GDP	1997	Annual	+	Y	OECD
		Government fiscal balance to GDP	1990	Annual	-		OECD
		Government revenue to GDP	1997	Annual	-		Moody's
		Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>							
		External debt to GDP	2002Q4	Quarterly	+	Y	Haver
		Current account balance to GDP	1997Q1	Quarterly	-		Haver
		Reserves to GDP	1970Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>							
	Housing market	Nominal house price to GDP Price to rent	1975Q1 1970Q1	Quarterly Quarterly	+		Dallas Fed cross-country housing price database OECD Analytical House Price database
	Equity market	Dividend yield	October 1996	Monthly	-		Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Italy

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets	September 1997	Monthly	-		ECB Statistical Data Warehouse
	Bank-provided credit to GDP	1974Q4	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assetss	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Cross-border claims to assets	1999Q1	Quarterly	+		BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1974Q4	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1970Q1	Quarterly	+	Y	BIS Credit Series
	Household debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1970Q1	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1960Q1	Quarterly	+	Y	OECD
	Government fiscal balance to GDP	1960Q1	Quarterly	-		OECD
	Government revenue to GDP	1997Q1	Quarterly	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2002Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1995Q1	Quarterly	-		Haver
	Reserves to GDP	1970Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to GDP	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1970Q1	Quarterly	+		OECD Analytical House Price database
Equity market	Dividend yield	August 2003	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Japan**

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>							
<b>Banking</b>							
	Leverage	Total equity over total assets Bank-provided credit to GDP	January 1983 1962Q4	Monthly Quarterly	- +	 Y	Haver BIS Credit Series
	Maturity transformation	Loans to deposits	January 1983	Monthly	+		Haver
	Wholesale funding	MFI Liabilities to total assets	January 1983	Monthly	+		Haver
	Interconnectedness	Cross-border claims to assets	1983Q1	Quarterly	+		BIS Locational Banking Statistics and Bank of Japan
<b>Nonbanking</b>							
	Leverage	Nonbank-provided credit to GDP	1964Q4	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>							
	Household leverage	Household credit to GDP Household debt service ratio	1964Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
	Corporate leverage	Corporate leverage 90th percentile Aggregated corporate leverage Interest rate coverage ratio Corporate debt to GDP Nonfinancial corporation debt service ratio	2005Q1 2005Q1 2005Q1 1964Q4 1999Q1	Quarterly Quarterly Quarterly Quarterly Quarterly	+	Y	S&P Capital IQ S&P Capital IQ S&P Capital IQ BIS Credit Series BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>							
		Government debt to GDP	1970Q4	Quarterly	+	Y	OECD
		Government fiscal balance to GDP	1960Q1	Quarterly	-		OECD
		Government revenue to GDP	1997Q1	Quarterly	-		Moody's
		Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>							
		External debt to GDP	2003Q1	Quarterly	+	Y	Haver
		Current account balance to GDP	1985Q1	Quarterly	-		Haver
		Reserves to GDP	1957Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>							
	Housing market	Nominal house price to income Price to rent	1975Q1 1970Q1	Quarterly Quarterly	+		Dallas Fed cross-country housing price database OECD Analytical House Price database
	Equity market	Price to earnings ratio Dividend yield	January 2006 June 1993	Monthly Monthly	+		Thomson Reuters I/B/E/S Aggregates Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.



**Luxembourg**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets	September 1997	Monthly	-		ECB Statistical Data Warehouse
	Bank-provided credit to GDP	2003Q1	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Cross-border claims to assets	1999Q1	Quarterly	+		BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	2003Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	2002Q1	Quarterly	+	Y	BIS Credit Series
	Household debt service ratio	January 2003	Monthly	+		Haver
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	2002Q1	Quarterly	+	Y	BIS Credit Series
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1995	Annual	+	Y	OECD
	Government fiscal balance to GDP	1990	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2002Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1995Q1	Quarterly	-		Haver
	Reserves to GDP	2000Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to GDP	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	2007Q1	Quarterly	+		OECD Analytical House Price database
Equity market	Not available for Luxembourg					
Junk bond issuance	Not available for Luxembourg					

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Malaysia

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector							
Banking							
	Leverage	Equity over total assets Bank-provided credit to GDP	January 2007 1991Q1	Monthly Quarterly	- +	Y	Haver BIS Credit Series
	Maturity transformation	Loans to deposits	January 2007	Monthly	+		Haver
	Wholesale funding	MFI Liabilities to total assets	January 2007	Monthly	+		Haver
	Interconnectedness	Foreign assets to total assets	January 2007	Monthly	+		Haver
Nonbanking							
	Leverage	Nonbank-provided credit to GDP	1991Q1	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector							
	Household leverage	Household credit to GDP	2006Q1	Quarterly	+	Y	BIS Credit Series
	Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
		Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
		Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
		Corporate debt to GDP	2006Q1	Quarterly	+		BIS Credit Series
Sovereign vulnerabilities							
		Government debt to GDP	1980	Annual	+	Y	WEO
		Government fiscal balance to GDP	1980	Annual	-		WEO
		Government revenue to GDP	1997	Annual	-		Moody's
		Government interest to revenue	1997	Annual	+	Y	Moody's
External sector vulnerabilities							
		External debt to GDP	2009Q1	Quarterly	+	Y	Haver
		Current account balance to GDP	1999Q1	Quarterly	-		Haver
		Reserves to GDP	1991Q1	Quarterly	-		International Financial Statistics
Valuation pressures							
	Housing market	House price to GDP	1999Q1	Quarterly	+		BIS Housing Price series
	Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
		Dividend yield	May 1993	Monthly	-		Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Mexico**

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector							
Banking							
	Leverage	Total equity over total assets Bank-provided credit to GDP	December 2000 1980Q4	Monthly Quarterly	- +	Y	Banco de Mxico BIS Credit Series
	Maturity transformation	Loans to deposits	December 2000	Monthly	+		Banco de Mxico
	Wholesale funding	MFI Liabilities to total assets	December 2000	Monthly	+		Banco de Mxico
	Interconnectedness	Foreign assets to total assets	December 2000	Monthly	+		Banco de Mxico
Nonbanking							
	Leverage	Nonbank-provided credit to GDP	1980Q4	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector							
	Household leverage	Household credit to GDP	1994Q4	Quarterly	+	Y	BIS Credit Series
	Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
		Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
		Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
		Corporate debt to GDP	1994Q4	Quarterly	+	Y	BIS Credit Series
Sovereign vulnerabilities							
		Government debt to GDP	1996	Annual	+	Y	WEO
		Government fiscal balance to GDP	1996	Annual	-		WEO
		Government revenue to GDP	1998	Annual	-		Moody's
		Government interest to revenue	1998	Annual	+		Moody's
External sector vulnerabilities							
		External debt to GDP	2002Q1	Quarterly	+	Y	Haver
		Current account balance to GDP	1980Q1	Quarterly	-		Haver
		Reserves to GDP	1980Q1	Quarterly	-		International Financial Statistics
		External vulnerability indicator	1997	Annual	+		Moodys
Valuation pressures							
	Housing market	House price to GDP	2005Q1	Quarterly	+		BIS Housing Price series
		Price to rent	2005Q1	Quarterly	+		OECD Analytical House Price Database
	Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
		Dividend yield	April 1994	Monthly	-		Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Netherlands**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	September 1997 1977Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets Cross-border claims to assets	September 1997 1999Q1	Monthly Quarterly	+		ECB Statistical Data Warehouse BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1977Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1990Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile Aggregated corporate leverage Interest rate coverage ratio Corporate debt to GDP Nonfinancial corporation debt service ratio	2005Q1 2005Q1 2005Q1 1990Q4 1999Q1	Quarterly Quarterly Quarterly Quarterly Quarterly	+	Y	S&P Capital IQ S&P Capital IQ S&P Capital IQ BIS Credit Series BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1960	Annual	+	Y	OECD
	Government fiscal balance to GDP	1969	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2003Q2	Quarterly	+	Y	Haver
	Current account balance to GDP	2003Q2	Quarterly	-		Haver
	Reserves to GDP	1977Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income Price to rent	1975Q1 1970Q1	Quarterly Quarterly	+		Dallas Fed cross-country housing price database OECD Analytical House Price Database
Equity market	Price to earnings ratio Dividend yield	January 2006 July 1993	Monthly Monthly	+		Thomson Reuters I/B/E/S Aggregates Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Norway

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total equity over total assets	January 1980	Monthly	-		Statistics Norway
	Bank-provided credit to GDP	1978Q1	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	January 1980	Monthly	+		Statistics Norway and Norges Bank Historical monetary statistics
Wholesale funding	MFI Liabilities to total assets	May 2009	Monthly	+		Statistics Norway
Interconnectedness	Cross-border claims to assets	1983Q4	Quarterly	+		BIS Locational Banking Statistics and Statistics Norway
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1978Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1978Q1	Quarterly	+	Y	BIS Credit Series
	Household debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1978Q1	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1970	Annual	+	Y	OECD
	Government fiscal balance to GDP	1962	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2005Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1981Q1	Quarterly	-		Haver
	Reserves to GDP	1978Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1979Q1	Quarterly	+		OECD Analytical House Price Database
Equity market	Dividend yield	July 2001	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1997	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Poland**

	Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
Financial Sector							
Banking							
	Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	January 2004 1995Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
	Maturity transformation	Loans to deposits	January 2004	Monthly	+		ECB Statistical Data Warehouse
	Wholesale funding	MFI Liabilities to total assets	January 2004	Monthly	+		ECB Statistical Data Warehouse
	Interconnectedness	Foreign assets	January 2004	Monthly	+		ECB Statistical Data Warehouse
Nonbanking							
	Leverage	Nonbank-provided credit to GDP	1995Q1	Quarterly	+	Y	BIS Credit Series
Nonfinancial sector							
	Household leverage	Household credit to GDP	1995Q4	Quarterly	+	Y	BIS Credit Series
	Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+	Y	S&P Capital IQ
		Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
		Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
		Corporate debt to GDP	1995Q4	Quarterly	+		BIS Credit Series
		Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Sovereign vulnerabilities							
		Government debt to GDP	1995	Annual	+	Y	OECD
		Government fiscal balance to GDP	1995	Annual	-		OECD
		Government revenue to GDP	1997	Annual	-		Moody's
		Government interest to revenue	1997	Annual	+		Moody's
External sector vulnerabilities							
		External debt to GDP	1995Q4	Quarterly	+	Y	Haver
		Current account balance to GDP	1997Q1	Quarterly	-		Haver
		Reserves to GDP	1995Q1	Quarterly	-		International Financial Statistics
Valuation pressures							
	Housing market	House price to GDP 1	2006Q3	Quarterly	+		BIS Housing Price series
		House price to GDP 2	2006Q3	Quarterly	+		BIS Housing Price series
		House price to GDP 3	2006Q3	Quarterly	+		BIS Housing Price series
	Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
		Dividend yield	June 2001	Monthly	-		Bloomberg
	Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Portugal

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets	September 1997	Monthly	-		ECB Statistical Data Warehouse
	Bank-provided credit to GDP	1986Q1	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Cross-border claims to assets	1999Q1	Quarterly	+		BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1986Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1986Q1	Quarterly	+	Y	BIS Credit Series
	Household debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1986Q1	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1995	Annual	+	Y	OECD
	Government fiscal balance to GDP	1977	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1996Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1996Q1	Quarterly	-		Haver
	Reserves to GDP	1986Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	House price to GDP	2008Q1	Quarterly	+		BIS Housing Price series
	Price to rent	1988Q1	Quarterly	+		OECD Analytical House Price database
Equity market	Dividend yield	October 1997	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Russia**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total equity over total assets Bank-provided credit to GDP	December 2000 1995Q2	Monthly Quarterly	- +	Y	Haver BIS Credit Series
Maturity transformation	Loans to deposits	December 2000	Monthly	+		Haver
Wholesale funding	MFI Liabilities to total assets	January 2000	Monthly	+		Haver
Interconnectedness	Foreign assets	January 2000	Monthly	+		Haver
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1995Q2	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Not available for Russia					
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1999	Annual	+	Y	WEO
	Government fiscal balance to GDP	1997	Annual	-		WEO
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1993Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1995Q1	Quarterly	-		Haver
	Reserves to GDP	1993Q4	Quarterly	-		International Financial Statistics
	External vulnerability indicator	1997	Annual	+		Moody's
<b>Valuation pressures</b>						
Housing market	House price to GDP 1	2001Q1	Quarterly	+		BIS Housing Price series
	House price to GDP 2	2001Q1	Quarterly	+		BIS Housing Price series
Equity market	Price to earnings ratio	January 2006	Monthly	-		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	August 2003	Monthly	+		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.



## Singapore

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Capital and reserves over total assets	January 1991	Monthly	-		Haver
	Bank-provided credit to GDP	1975Q1	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	January 1991	Monthly	+		Haver
Wholesale funding	MFI Liabilities to total assets	January 1991	Monthly	+		Haver
Interconnectedness	Foreign assets to total assets	January 1991	Monthly	+		Haver
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1975Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1991Q1	Quarterly	+	Y	BIS Credit Series
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1991Q1	Quarterly	+	Y	BIS Credit Series
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1980	Annual	+	Y	WEO
	Government fiscal balance to GDP	1980	Annual	-		WEO
	Government revenue to GDP	1997	Annual	-		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2003Q2	Quarterly	+	Y	Haver
	Current account balance to GDP	1986Q1	Quarterly	-		Haver
	Reserves to GDP	1975Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	House price to GDP	1998Q1	Quarterly	+		BIS Housing Price series
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	February 2008	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**South Korea**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total equity over total assets Bank-provided credit to GDP	January 1991 1962Q4	Monthly Quarterly	- +	Y	Haver BIS Credit Series
Maturity transformation	Loans to deposits	January 1991	Monthly	+		Haver
Wholesale funding	MFI Liabilities to total assets	January 1991	Monthly	+		Haver
Interconnectedness	Foreign assets to total assets	January 1991	Monthly	+		Haver
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1962Q4	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1962Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1962Q4	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	2002	Annual	+	Y	OECD
	Government fiscal balance to GDP	1970	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	2000	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1994Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1980Q1	Quarterly	-		Haver
	Reserves to GDP	1970Q1	Quarterly	-		International Financial Statistics
	External vulnerability indicator	1997	Annual	+		Moody's
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1986Q1	Quarterly	+		OECD Analytical House Price Database
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	February 2002	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Spain

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets	September 1997	Monthly	-		ECB Statistical Data Warehouse
	Bank-provided credit to GDP	1980Q1	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	September 1997	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Cross-border claims to assets	1999Q1	Quarterly	+		BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1980Q4	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1980Q4	Quarterly	+	Y	BIS Credit Series
	Household debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1980Q4	Quarterly	+	Y	BIS Credit Series
	Nonfinancial corporation debt service ratio	1999Q1	Quarterly	+		BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1980	Annual	+	Y	OECD
	Government fiscal balance to GDP	1964	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	2002Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1990Q1	Quarterly	-		Haver
	Reserves to GDP	1980Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1971Q1	Quarterly	+		OECD Analytical House Price Database
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	November 1996	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Sweden**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets Bank-provided credit to GDP	December 2001 1980Q1	Monthly Quarterly	- +	Y	ECB Statistical Data Warehouse BIS Credit Series
Maturity transformation	Loans to deposits	December 2001	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	December 2001	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets to total assets Cross-border claims to assets	December 2001 2001Q4	Monthly Quarterly	+		ECB Statistical Data Warehouse BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1980Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP Household debt service ratio	1980Q4 1999Q1	Quarterly Quarterly	+	Y	BIS Credit Series BIS debt service ratios for the private nonfinancial sector
Corporate leverage	Corporate leverage 90th percentile Aggregated corporate leverage Interest rate coverage ratio Corporate debt to GDP Nonfinancial corporation debt service ratio	2005Q1 2005Q1 2005Q1 1980Q4 1999Q1	Quarterly Quarterly Quarterly Quarterly Quarterly	+	Y	S&P Capital IQ S&P Capital IQ S&P Capital IQ BIS Credit Series BIS debt service ratios for the private nonfinancial sector
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1960	Annual	+	Y	OECD
	Government fiscal balance to GDP	1960	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1997Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1982Q1	Quarterly	-		Haver
	Reserves to GDP	1980Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income Price to rent	1975Q1 1980Q1	Quarterly Quarterly	+		Dallas Fed cross-country housing price database OECD Analytical House Price Database
Equity market	Price to earnings ratio Dividend yield	January 2006 October 1993	Monthly Monthly	+		Thomson Reuters I/B/E/S Aggregates Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Switzerland**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total equity over total assets Bank-provided credit to GDP	December 1996 1980Q1	Monthly Quarterly	- +	Y	SNB BIS Credit Series
Maturity transformation	Loans to deposits	December 1996	Monthly	+		SNB
Wholesale funding	MFI Liabilities to total assets	December 1996	Monthly	+		SNB
Interconnectedness	Foreign assets to total assets	December 1996	Monthly	+		SNB
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1980Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1999Q4	Quarterly	+	Y	BIS Credit Series
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1999Q4	Quarterly	+	Y	BIS Credit Series
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1990	Annual	+	Y	OECD
	Government fiscal balance to GDP	1990	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1999Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1980Q1	Quarterly	-		Haver
	Reserves to GDP	1980Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1970Q1	Quarterly	+		OECD Analytical House Price Database
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	June 1993	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

**Thailand**

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Equity over total assets Bank-provided credit to GDP	January 1997 1993Q1	Monthly Quarterly	- +	Y	Haver BIS Credit Series
Maturity transformation	Loans to deposits	January 1991	Monthly	+		Haver
Wholesale funding	MFI Liabilities to total assets	January 1997	Monthly	+		Haver
Interconnectedness	Foreign assets to total assets	January 2003	Monthly	+		Haver
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1993Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1993Q1	Quarterly	+	Y	BIS Credit Series
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1993Q1	Quarterly	+	Y	BIS Credit Series
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1980	Annual	+	Y	WEO
	Government fiscal balance to GDP	1980	Annual	-		WEO
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1999Q1	Quarterly	+	Y	Haver
	Current account balance to GDP	1986Q1	Quarterly	-		Haver
	Reserves to GDP	1993Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	House price to GDP 1	2008Q1	Quarterly	+		BIS Housing Price series
	House price to GDP 2	2008Q1	Quarterly	+		BIS Housing Price series
	House price to GDP 3	2008Q1	Quarterly	+		BIS Housing Price series
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	September 1993	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## Turkey

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total equity over total assets Bank-provided credit to GDP	January 1986 1987Q1	Monthly Quarterly	- +	Y	Central Bank of the Republic of Turkey BIS Credit Series
Maturity transformation	Loans to deposits	January 1986	Monthly	+		Central Bank of the Republic of Turkey
Wholesale funding	MFI Liabilities to total assets	January 1986	Monthly	+		Central Bank of the Republic of Turkey
Interconnectedness	Foreign assets to total assets	January 1986	Monthly	+		Central Bank of the Republic of Turkey
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1987Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household credit to GDP	1987Q1	Quarterly	+	Y	BIS Credit Series
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1987Q4	Quarterly	+	Y	BIS Credit Series
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	2001	Annual	+	Y	WEO
	Government fiscal balance to GDP	2002	Annual	-		WEO
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1989Q4	Quarterly	+	Y	Haver
	Current account balance to GDP	1987Q1	Quarterly	-		Haver
	Reserves to GDP	1987Q1	Quarterly	-		International Financial Statistics
	External vulnerability indicator	1997	Annual	+		Moody's
<b>Valuation pressures</b>						
Housing market	House price to GDP	2010Q1	Quarterly	+		BIS Housing Price series
	Price to rent	2010Q1	Quarterly	+		OECD Analytical House Price Database
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	February 2004	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, “+” indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a “Y” in the “detrend” column, we use the detrended series based on the difference between the current value and the ten-year moving average.

## United Kingdom

Vulnerability Category	Variables	Data Start Date	Frequency	Sign*	Detrend	Source of Data
<b>Financial Sector</b>						
<b>Banking</b>						
Leverage	Total capital and reserves over total assets	January 1999	Monthly	-		ECB Statistical Data Warehouse
	Leverage ratio	2005Q1	Quarterly	-		Bank of England CCB Core Indicators
	Bank-provided credit to GDP	1963Q1	Quarterly	+	Y	BIS Credit Series
Maturity transformation	Loans to deposits	January 1999	Monthly	+		ECB Statistical Data Warehouse
Wholesale funding	MFI Liabilities to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
Interconnectedness	Foreign assets to total assets	September 1997	Monthly	+		ECB Statistical Data Warehouse
	Cross-border claims to assets	1999Q1	Quarterly	+		BIS Locational Banking Statistics and ECB Statistical Data Warehouse
<b>Nonbanking</b>						
Leverage	Nonbank-provided credit to GDP	1963Q1	Quarterly	+	Y	BIS Credit Series
<b>Nonfinancial sector</b>						
Household leverage	Household debt service ratio	January 2004	Monthly	+		Haver
	Household credit to GDP	1963Q4	Quarterly	+	Y	Bank of England SCR Core Indicators
	Residential mortgage terms	2005Q2	Quarterly	+		Bank of England SCR Core Indicators
Corporate leverage	Corporate leverage 90th percentile	2005Q1	Quarterly	+		S&P Capital IQ
	Aggregated corporate leverage	2005Q1	Quarterly	+		S&P Capital IQ
	Interest rate coverage ratio	2005Q1	Quarterly	-		S&P Capital IQ
	Corporate debt to GDP	1976Q1	Quarterly	+	Y	BIS Credit Series
	Commercial real estate loan terms	1999Q1	Quarterly	+		Bank of England SCR Core Indicators
	Debt to profit	1964Q1	Quarterly	+		Bank of England SCR Core Indicators
	Nonfinancial corporation debt service ratio	January 2004	Monthly	+		Haver
<b>Sovereign vulnerabilities</b>						
	Government debt to GDP	1970	Annual	+	Y	OECD
	Government fiscal balance to GDP	1970	Annual	-		OECD
	Government revenue to GDP	1997	Annual	-		Moody's
	Government interest to revenue	1997	Annual	+		Moody's
<b>External sector vulnerabilities</b>						
	External debt to GDP	1987Q1	Quarterly	+		Haver
	Current account balance to GDP	1955Q1	Quarterly	-		Haver
	Reserves to GDP	1957Q1	Quarterly	-		International Financial Statistics
<b>Valuation pressures</b>						
Housing market	Nominal house price to income	1975Q1	Quarterly	+		Dallas Fed cross-country housing price database
	Price to rent	1987Q1	Quarterly	+		Bank of England SCR Core Indicators
Equity market	Price to earnings ratio	January 2006	Monthly	+		Thomson Reuters I/B/E/S Aggregates
	Dividend yield	June 1993	Monthly	-		Bloomberg
Junk bond issuance	Corporate junk bond issuance	January 1980	Monthly	+		Thomson Reuters

Note: Sign\* signifies the direction of the variable in which vulnerabilities increase. For example, "+" indicates that larger values of the variable are associated with more elevated vulnerabilities. For variables with a "Y" in the "detrend" column, we use the detrended series based on the difference between the current value and the ten-year moving average.