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Financial Stress, Downturns, and Recoveries

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Abstract

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This paper examines why some financial stress episodes lead to economic downturns. The paper identifies episodes of financial turmoil using a financial stress index (FSI), and proposes an analytical framework to assess the impact of financial stress—in particular banking distress—on the real economy. It concludes that financial turmoil characterized by banking distress is more likely to be associated with severe and protracted downturns than stress mainly in securities or foreign exchange markets. Economies with more arms-length financial systems appear to be particularly vulnerable to sharp contractions, due to the greater procyclicality of leverage in their banking systems.

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Contents	Page
Executive Summary	4
I. Introduction	5
II. Identifying Episodes of Financial Stress	7
A. The Financial Stress Index	9
B. Episodes of Financial Stress	11
III. Financial Stress, Economic Slowdowns, and Recessions	13
A. Why Are Some Financial Stress Episodes Associated with Economic Slowdowns?	15
B. Is Banking Related Financial Stress Different?	16
C. Financial Imbalances and Firm and Household Financial Exposure	17
IV. Financial Innovation, Financial Stress, and Economic Cycles	19
A. The Arm's-Length Index	20
B. Financial Systems and Leverage	21
V. Financial Crisis in Historical Context	23
VI. Conclusions	25
References	55
Figures	
1. Financial Stress and Output Loss	27
2. The Financial Stress Index	28
3. Share of Countries Experiencing Financial Stress	29
4. Shocks	30
5. Descriptive Statistics	31
6. Real GDP around Economic Downturns with and Without Financial Stress	32
7. Selected Macroeconomics Variables and Financial Stress	33
8. Banking-Related Financial Stress, Slowdowns, and Recessions	34
9. Cost of Capital and Bank Asset Growth and Banking-Related Financial Stress	35
10. Selected Macroeconomic Variables around Financial Stress Episodes	36
11. Initial Conditions Preceding Financial Stress Episodes	37
12. Financial Stress, Downturns, and Four Important Shocks	38
13. The Procyclicality of Leverage in Financial Institutions	39
14. Procyclical Leverage and Arm's-Length Financial Systems	40
15. Arm's-Length Financial Systems, GDP Growth, and Bank Leverage	41
16. Financial Stress, Recessions, and Recoveries	42

Tables

1. Descriptive Statistics on Financial Stress Episodes.....	42
2. Descriptive Statistics on Financial Stress Episodes, Slowdowns, and Recessions	43
3. Cross-Section Regressions.....	44
4. Six Major Periods of Financial Stress and Economic Contractions	45

Appendices

1. Major Financial Stress Episodes Identified in the Literature.....	46
2. Data and Methodology.....	50

Appendix Tables

II.1. Average Yearly Share of Total Bank Assets of Banks in Sample.....	53
II.2. Data Sources	54

EXECUTIVE SUMMARY

This paper looks at past episodes of financial stress and their implications for subsequent economic activity. The paper constructs an index of financial stress in banking, securities, and foreign exchange markets in 17 advanced economies over the past 30 years, identifying 113 episodes of financial stress. Using the financial stress index (FSI), the paper proposes an analytical framework to assess the impact of financial stress—in particular banking distress—on the real economy.

About half of these episodes of financial stress were associated with an economic slowdown or recession. **However, when a slowdown or recession is preceded by financial stress—especially when the stress is concentrated in the banking sector—typically it is substantially more severe than slowdowns or recessions not preceded by financial stress.** In particular, slowdowns or recessions preceded by banking-related stress tend to involve two to three times greater cumulative output losses and tend to endure two to four times as long.

The paper suggests that initial conditions are crucial in determining whether a financial stress episode is followed by a downturn. In particular, the likelihood that financial stress will be followed by a downturn is associated with the extent to which house prices and aggregate credit have risen prior to the stress episode. Moreover, while greater reliance on borrowing by nonfinancial corporations is associated with a sharper downturn in the aftermath of financial stress, the size of financial imbalances in the household sector is crucial in determining whether the downturn will turn into a recession.

The paper finds that the development of more arm's-length financial systems has increased the vulnerability to sharp contractions in economic activity if and when banking-related stress strikes. Indeed, activity tends to be weaker in recessions preceded by financial stress in countries with more arm's-length financial systems. This is because leverage in banking systems, defined as the ratio of assets to equity, appears to be more procyclical in countries that have progressed further in terms of development of market-based financial intermediation. However, this does not imply that arm's-length financial systems are more prone to stress.

In a financial crisis where balance sheets were overextended, strong actions by policymakers to deal with the stress and support the restoration of financial system capital seem particularly important. One important take-away from this analysis is the importance of core financial intermediaries, including broker-dealers and investment banks, in the transmission of financial shocks to the real economy. This underlines the importance of restoring the capital bases of these institutions to help alleviate economic downturns.

I. INTRODUCTION

With the financial turmoil that began in the summer of 2007 mutating into a full-blown crisis, encompassing broader securities markets and the banking systems of several advanced economies, a key concern is how macroeconomic activity will be affected going forward, and what policymakers can do both to reduce the economic consequences of this crisis and forestall such crises in the future. Past episodes of stress in banking, securities and/or foreign exchange markets have only sometimes been associated with economic downturns (Figure 1, bottom panel). However, these downturns have tended to be more severe (Figure 1, top panel). In trying to understand the impact of financial stress on economic activity more generally, it is important to recognize that despite the evolution of financial systems through innovation and regulatory changes, the concept of “financial cycles” has been a constant feature of the economic landscape. Financial systems tend to be inherently procyclical, with growth in credit, leverage, and asset prices often reinforcing the underlying economic dynamic—and in some cases leading to a build up of financial imbalances followed by a sharp correction (see Borio, 2007, Goodhart, 1996, and Minsky, 1992).

The impact of financial cycles on the real economy, however, remains a matter of debate in both academic and policy circles. One strand of research has emphasized the role of the financial accelerator in amplifying the effects of financial cycles on the real economy due to the effects of changes in the values of collateral on the willingness of the financial system to provide credit to the economy (Bernanke and Gertler, 1995, and Bernanke, Gertler, and Gilchrist, 1999, Kiyotaki and Moore, 1997). In this view, shocks that affect the creditworthiness of borrowers tend to accentuate swings in output. Another branch of inquiry, focusing on lenders’ balance sheets, has examined the role of bank capital in affecting aggregate credit, the so-called bank capital channel (Bernanke and Lown, 1999, Kashyap and Stein, 1995, and Gambacorta and others, 2007). If bank capital is eroded, banks become more reluctant to lend and may be forced to deleverage, leading to sharper economic downturns. Finally, the literature has also analyzed whether the role of the financial accelerator in the economy varies with the type of financial system (Cardarelli, Lall, and Tytell, 2006, Rajan and Zingales, 2003). One possible implication of changes in financial systems is that the general trend towards financial systems that rely more on arm’s-length based financing and less on relationship-based lending may have made economies better able to absorb financial stress, as both corporates and household can now substitute away from banks to markets, or vice versa (and thus benefit from the so-called twin engines of the financial system).

Against the background of the current financial turmoil and the considerable literature on the interaction between the financial system and macroeconomic cycles, this paper aims to address the following questions: why are some periods of financial stress associated with slowdowns, or even recessions, while others appear to have little impact on the real economy? Does this depend on the size or location of the build up of financial imbalances

and on the state of household and firm balance sheets? Has financial innovation reduced the role of banks in propagating shocks from the financial system to the real economy?

In attempting to answer the above questions, this paper analyzes the experience from episodes of financial stress and economic cycles among 17 advanced economies over the past three decades.² Episodes of financial turmoil are identified using a novel index based on high-frequency price variables that can signal stress stemming from banking, securities, or foreign exchange markets. The FSI not only accurately captures financial stress periods identified in the literature, but also identifies periods of stress not associated with downturns.

Using the FSI, the paper proposes an analytical framework to assess the impact of financial stress—in particular banking distress—on the real economy. Specifically, the paper attempts to draw lessons from these episodes by differentiating them on the basis of the preconditions that were in place at the time that the financial stress episode began, including the state of household and firm balance sheets, the dynamics of credit and asset prices in the run up to the stress episode, the type of financial stress episode (i.e., to what extent was the stress related to banks, securities markets, or foreign exchange markets), and the policy responses that characterized these episodes. Taken together, these factors provide a comprehensive view of the channels and mechanisms through which financial stress affects economic cycles.³ While establishing the causality between financial stress and economic downturns poses an inherently difficult challenge, the analysis in the paper makes an attempt to address this issue by explicitly accounting for the effect of the most common types of shocks studied in the macroeconomic literature.

The key findings of the paper are as follows:

- First, episodes of financial turmoil characterized by banking distress are more likely to be associated with severe and protracted downturns than episodes of stress mainly in securities or foreign exchange markets.
- Second, and related to the first point, recessions associated with banking-related financial stress tend to last at least twice as long as recessions not preceded by financial stress.

² The countries included in this study are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, and the United States.

³ This broader approach complements other recent research on the empirical relationship between asset prices—such as for equity and house prices and bond spreads—and the dynamics of output during the course of the business cycle (see, for example, Cihak and Koeva, 2008 or Claessens, Kose, and Terrones, 2008) or between bank capital, lending and output (see Bayoumi and Melander, 2008, and Kashyap and others, 2008, in the context of the United States).

- Third, the likelihood that financial stress will be followed by a downturn appears to be associated with the extent to which house prices and aggregate credit rise in the period before the financial stress. Moreover, a greater reliance on external financing by households and nonfinancial corporates is associated with a sharper downturn in the aftermath of financial stress.
- Fourth, countries with more arm's length financial systems appear to be vulnerable to sharper contractions in activity in the event of banking stress. This is because leverage in the banking systems appears to be more procyclical in countries that have progressed further in terms of financial innovation.
- Fifth, the importance of core financial intermediaries in the transmission of financial shocks to the real economy suggests that within strong financial stability frameworks policies that help restore the capital base of these institutions can help alleviate downturns.

The rest of the paper is structured as follows. The next section elaborates the concept of financial stress that is employed in this paper and uses this concept to identify episodes of financial stress over the past three decades. The paper then analyzes the behavior of economic cycles in the aftermath of financial stress episodes. The section that follows discusses the factors that differentiate those stress episodes that were associated with economic slowdowns and recessions from those that were not, with emphasis on the characteristics of the financial stress episodes and the initial conditions in credit, asset prices, and household and corporate balance sheets. The subsequent section complements the macro-level analysis by analyzing the procyclicality of investment and commercial banks leverage in both arm's-length and relationship based financial systems, using bank-level data. Based on the analysis of the preceding sections, we discuss the recovery patterns, and then in the penultimate section analyze six well known episodes of banking-related financial stress across the set of advanced economies considered in this paper, and places the current financial turmoil in historical context. The final section concludes with some implications for policy.

II. IDENTIFYING EPISODES OF FINANCIAL STRESS

Throughout history, financial systems—encompassing both financial institutions and the channels of intermediation—have been prone to periods of rapid expansion followed by corrections.⁴ To understand the impact of financial cycles on the economy, particularly at the current conjuncture, it is useful to identify the key features of the ongoing turmoil in financial

⁴ See Kindleberger, Aliber, and Solow (2005) for a history of financial crises. A well known exposition of this procyclical feature of financial systems is Minsky's Financial Instability Hypothesis (Minsky, 1992).

markets and then look for earlier episodes of financial stress that share common features with the current one.

The current episode began in early 2007 as a generally orderly repricing of risk for assets linked to U.S. subprime mortgages, but by the summer had rapidly escalated into a severe liquidity squeeze in the banking systems in the United States and Western Europe, and serious dislocations in the interbank funding market. More recently, the crisis mutated into one where heavy credit losses raised questions about the capital strength of many banks. Moreover, the stress has spread across various market segments—marked by a loss of liquidity, falling valuations, rising risk aversion, and heightened volatility—in emerging as well as advanced economies. Foreign exchange markets have also been affected by heightened uncertainty about the safety and soundness of financial assets and the impact of financial stress on economic performance. Against this background, any characterization of financial stress episodes should take into account conditions in the banking sector, the state of nonbank intermediation through equities and bonds, and the behavior of foreign exchange markets.

The academic literature on financial crises has largely relied on historical narratives of crisis episodes, such as well known cases of systemic banking crises where bank capital was eroded and lending was disrupted, often requiring significant public intervention (see, for example, Caprio and Klingebiel, 2006). An extension of this approach is to augment the episodes of banking crises with those of currency crises, where reserves were depleted and/or there was a significant change in the exchange rate mechanisms (see, for example, Kaminsky and Reinhart, 1999 and Reinhart and Rogoff, 2008b). Pure securities market stress episodes, especially on a cross-country basis, have not been examined as comprehensively, although studies for single countries are instructive (Shiller, 1999).

While historical approaches to identifying financial crises have provided a rich database of episodes, they are less well suited for the purposes of this paper for a number of reasons. First, these episodes are the ones that in retrospect were known to have large output consequences and/or required significant public intervention, and less attention has been given to “near misses” that could serve as useful counterfactuals—episodes of financial stress with little macroeconomic impact. Second, the identified episodes are typically of considerable duration and cover stresses of varying intensity, making it difficult to identify when financial stress peaked, and whether an economic downturn can meaningfully be linked to the financial stress episode. Finally, by focusing on banking crises and currency crises, even the most comprehensive databases pay little attention to pure securities market stresses or liquidity squeezes (such as around the stock market crash of 1987 and the collapse of Long-Term Capital Management (LTCM) in 1998). If leverage in banking systems is linked to securitization, it would appear important to analyze the banking and securities channels of intermediation jointly to determine the degree of interaction between these channels.

A. The Financial Stress Index

To overcome these drawbacks, this paper identifies episodes of financial stress as extreme values of a composite variable—the FSI—built using market-based indicators in real time and high frequency. Related indices have been developed by Illing and Liu (2006) for Canada, and by private sector experts (for example, BCA Research in the case of the United States). The FSI for each country is constructed as a variance-weighted average of three subindices which can be thought of being associated with the banking, securities, and foreign exchange markets. While the details are explained in Appendix II, an overview of the components of the index is as follows:

Banking-related subindex components:

- The slope of the yield curve, which is measured here as the difference between the short- and long-term yields on government issued securities—sometimes also referred to as the inverted term spread. Banks generate income by intermediating short-term liabilities (deposits) into longer-term assets (loans). Therefore, when there is a negative term spread—that is a negative sloping yield curve—bank profitability is seriously jeopardized.
- The TED spread, which is measured here as the difference between interbank rates and the yield on Treasury bills, captures the premium banks charge each other over treasury bill rates, and is a proxy for counterparty risk.
- The beta of banking sector, which is a measure of the correlation between the total returns to the banking-sector stock index and the overall stock market index. In line with the standard capital asset pricing model (CAPM), a beta greater than one—indicating that banking stocks move more than proportionately than the overall stock market—suggests that the banking sector is relatively risky. For the purposes of the paper, the beta is recorded as a non-zero value only during periods when returns are negative to focus on adverse shocks to banks. Accordingly, in high stress episodes this indicator would reflect an unusually large drop of banking stock prices relative to market prices.

Securities markets-related subindex components:

- Corporate bond spreads measured as the difference between corporate bond yields minus long-term government bond yields. The spread is used to proxy risk in the corporate debt market. This spread incorporates credit, market, and liquidity risk premiums. While credit risk is a function of expected loss, the other two elements are a function of risk and uncertainty.
- Stock market returns measured as the monthly return, but with multiplied by -1 so that a sharp drop in stock prices registers as an increase in the index.

- Time-varying stock return volatility derived from a GARCH(1,1) specification (for further details, see Bollerslev, Chou, and Kroner, 1992). This series is used to capture the observation that many asset prices tend to exhibit volatility clustering, especially when financial markets are in a state of uncertainty.

Foreign exchange-related subindex component:

- Time-varying volatility of monthly changes in the nominal effective exchange rate, also derived from a GARCH (1,1) specification.

There are many other potential candidates for inclusion in the FSI, but given the cross-country nature of this study, one objective was to use a uniform set of time series across all 17 countries. Another objective was parsimony: we wanted to use a minimum set of time series that would signal financial stress episodes. Adding tends to be restricted owing to data availability, both across time and country dimensions. It could also potentially contaminate the FSI with noisy indicators. Further, because of common components, among other things, the qualitative patterns of many financial series are similar (many measures of volatility and premiums increase during financial stress episodes). Therefore, the marginal informative content of additional series diminishes quite rapidly.

The FSI can be custom tailored for an individual country, and this would be a natural extension for country-specific case studies. While more series will surely improve the informational content of the country-specific index, this would also complicate the signal extraction problem. With these considerations in mind, it is also important to emphasize that, as we elaborate further below, the FSI is quite robust in capturing the main financial stress episodes documented in narrative descriptions and in the literature.

The advantage of utilizing such an index is its ability to identify the beginning and peaks of financial stress episodes more precisely, that is, the specific quarter of a year when an episode can be said to have begun, and its duration. Moreover, constructing such an index facilitates the identification of four fundamental characteristics of financial stress events: large shifts in asset prices (stock and bond market returns); an abrupt increase in risk/uncertainty (stock and foreign exchange volatility); abrupt shifts in liquidity (TED spreads); and the health of the banking system (the beta of banking sector stocks and the yield curve, which affects the profitability of intermediating short-term liabilities into long-term assets). Looking at these subcomponents can help identify which types of financial stress (banking related, securities market related, currency related, or a combination of these) have been associated with larger output consequences.

While the corporate finance literature might suggest using a quantity-based index in order to identify periods when the financial sector is under strain and its ability to intermediate may be impaired, this paper's strategy of using financial market (asset price based) variables has three major advantages. First, asset price based variables are easy to monitor and compute on

a comparable basis across a large set of countries. Second, movements in broader financial asset prices can be expected to play a greater role in the ability of financial firms to supply intermediation services than in the ability of specific nonfinancial corporates to fund new investment, which is much more closely tied to developments in their sector. Third, it is useful to initially consider a broad range of financial stress events based on asset prices, and then use quantity-based variables to identify when financial stress episodes are associated with a significant economic impact. The underlying hypothesis is that, within the universe of asset-price based stress episodes, only some reflect true underlying distress in the balance sheets of financial intermediaries that have an economic impact by restricting the supply of credit, while others merely reflect normal market corrections.

Using the seven subcomponents described above, the FSI is constructed for each of the 17 countries in the sample. Episodes of financial stress are identified as those periods when the index for a country is more than one standard deviation above its trend. These episodes signal that one or more of the banking, securities and/or foreign exchange market subcomponents has shifted abruptly.

The trend is identified using the Hodrick-Prescott (HP) filter, and serves two fundamental purposes: First, because it is a time-varying trend, it captures the notion that financial systems have been evolving. This is useful because the financial stress may manifest itself in different ways across time and across evolving financial systems. Second, the HP filter is used for each country, and thereby picks up country-specific factors not explicitly captured by the index—it could be thought of a time-varying fixed-effect term, which is useful given the cross-country nature of our analysis.

The foundation of our empirical investigation is based on an event analysis. The FSI was used to identify the events: episodes of financial stress. The event study methodology can be traced back to Fama and others (1969), which measured the impact of certain events on security prices. Given the quality and quantity of financial data, financial economics was a fertile area of research where event studies have been used extensively (Gibbons, 1987). However, event studies have also been used in macroeconomics in general, particularly in the field of international economics. For example, event studies have been used in analyzing currency crises in emerging markets (Frankel and Rose, 1996), or for example, towards assessing the implications of current account dynamics (Edwards, 2007, Freund, 2005, and Milesi-Ferretti and Razin, 1998).

B. Episodes of Financial Stress

Overall, 113 financial stress episodes were identified by the FSI in the sample of countries considered in this paper over the last 30 years (Table 1). Of these episodes, 43 were mainly driven by stress in the banking sector—the banking variables accounted for the majority of the increase of the FSI during these episodes—50 episodes mainly reflected turmoil in the securities market, and 20 in the foreign exchange market. In some cases, importantly, stresses

beginning in one segment eventually encompassed the other segments of the financial system. For example, in 17 of the episodes that mainly reflected stress in securities or foreign exchange markets, the banking variables accounted for at least one third of the spike in the FSI. Adding these episodes implies there are 60 episodes with “banking-related” financial stress in the sample, that is, episodes where banks were either the dominant or the second largest factor, with a contribution of at least one-third of the rise in the spike.

In the context of the current turmoil, the FSI indicates that the financial crisis that began in 2007 has a significant global dimension, affecting virtually all countries in the sample (Figure 2 and Figure 3). Earlier episodes of financial stress affecting the majority of countries in the sample simultaneously include the 1987 stock market crash, the high yield market collapse in the late 1980s, the Scandinavian banking crisis, the ERM crisis and the collapse of LTCM, but the current episode appears to be felt most widely. Overall, the index appears to capture global financial episodes accurately.⁵ Narratives of some of the major episodes of financial stress spanning the early 1980s to present are presented in Appendix I.

The FSI also accurately captures the fact that while the origins of the current episode were in the banking sector, by early 2008 the crises had become much more broad based, affecting banking, securities and foreign exchange markets at the same time (Figure 5, top panel). Moreover, the evidence also indicates that past episodes of banking stress appear to have had a significant securities market component.

Looking in detail at the country-specific FSI, for the set of countries considered in this paper the peaks of the FSI—corresponding to periods of financial stress—generally overlap accurately with well-known financial stress episodes in these countries over the past three decades, including the most recent episode (see Figure 2). In fact, an important criterion that was used to gauge the robustness and reliability of the FSI was to ensure that periods of stress signaled by the FSI corresponded to episodes of financial stress in country-specific narratives, which may not have been associated with crises. As an example, we once again cite the 1987 stock market crash, which was clearly an episode of acute financial stress, but not associated with a recession in the United States. Furthermore, we held the FSI to an even more rigorous standard in that we wanted it to pick up financial crises highlighted in the literature—based on papers which include Bordo and Jeanne (2002), Caprio and Klingebiel (2006), Demirgüç-Kunt, Detragiache, and Gupta (2006), Edison (2003), Eichengreen and Bordo (2002), Kaminsky and Reinhart (1999), and Reinhart and Rogoff (2008b)—which cover banking, currency, and other crises, but also stock and house price boom and busts. More concretely, comparing the FSI-based episodes with the episodes of financial crisis identified in the literature suggests that the index captures over 90 percent of the banking

⁵ Overall, of the 113 episodes of financial stress identified in the sample, 87 episodes simultaneously affected two or more countries.

crises and over 80 percent of the currency crises episodes, when the duration of the episodes identified in the literature is interpreted narrowly.⁶

While the paper remains agnostic on the causes of spikes in the FSI, given that spikes in the FSI appear to be associated with well known events such as stock/bond market collapses or banking crises, is the index perhaps a mirror of other fundamentals that can directly affect the economic cycle? Considering four such shocks, namely to oil prices, labor productivity, monetary policy, and fiscal policy, the evidence indicates that spikes in the FSI are not correlated with oil, productivity, or fiscal shocks (Figure 4).⁷ While there appears to be greater correlation with monetary policy, this is expected given that monetary policy (as measured by the term spread) is a subcomponent of the index itself, included because financial stress appears to be associated with the stance of monetary policy as reflected in the term spread.

Overall, these results suggest that the FSI can be considered a comprehensive indicator that successfully identifies the main episodes of financial stress for the sample of countries under consideration and can provide the basis for an examination of the macroeconomic consequences of such stress.

III. FINANCIAL STRESS, ECONOMIC SLOWDOWNS, AND RECESSIONS

Having identified episodes of financial stress, a first question of interest is: How many of these episodes were followed by an economic slowdown or outright recession? Were economic downturns preceded by episodes of financial stress different from those that were not? It should be emphasized that the focus of this paper is on identifying the main characteristics of financial stress episodes that were eventually followed by economic downturns, rather than on assessing whether financial stress “causes” economic downturns, given the significant analytical and empirical challenges in establishing causality.⁸ Nevertheless, the analysis will attempt to control to some extent for other shocks—namely,

⁶ Furthermore, the FSI captures 100 percent of all episodes identified in the literature if the duration of episodes is interpreted more broadly, that is, if the window around the quarter of financial stress identified by the FSI is expanded by a few quarters.

⁷ Mirroring the definition of financial stress episodes, oil price or labor productivity shocks are defined as cases where changes in the oil price or labor productivity are one standard deviation above trend; fiscal policy shocks are defined as episodes where the government net lending/borrowing ratio to GDP is one standard deviation above trend; and finally monetary policy shocks are defined as cases where the inverse term spread is one standard deviation above trend. In all cases, the deviations from trend are calculated using Hodrick-Prescott filters.

⁸ For example, many shocks may affect both the financial system and the economy, and while the financial system may amplify the shock, it would be hard to disentangle the direct effect of the shock from the amplification effect.

monetary, fiscal, oil price, and labor productivity shocks—that may affect the link between financial stress and economic cycles.

To answer these questions the following two definitions of economic downturns are used:

- An episode of financial stress is followed by an economic *slowdown* if the level of real GDP falls below trend (identified using the Hodrick-Prescott filter) within six quarters of the onset of the financial stress episode.
- An episode of financial stress is followed by a *recession* if there was an acute contraction in activity within six quarters of the onset of the financial stress episode.

Intuitively, slowdowns are a milder downturns than recessions. The rule of thumb for dating recessions is two consecutive quarters of negative growth. However, we utilized the business cycle turning point dating methodology based on Harding and Pagan (2002), who show that their algorithm accurately captures the peaks and troughs identified by the National Bureau of Economic Research (NBER) itself in the United States. For the United States we took the dates provided by the NBER, but for the other countries we used the Harding and Pagan (2002) algorithm to date the business cycle turning points.⁹ The turning points we identified were in line with other studies as well as those generated by private sector experts.¹⁰

Based upon these definitions, of the 113 financial stress episodes identified in the previous section, 29 were followed by a slowdown, and an equal number by recessions. The remaining 55 financial stress episodes were not followed by an economic downturn (Table 2).

On average, the time lag between the onset of financial stress and the slowdown/recession that follows was about seven months, although this masks substantial variation in the sample—about half of the slowdown/recessions occurred within a quarter of the beginning of the financial stress, but for one in four episodes it took more than a year for a downturn to materialize after the financial stress (Figure 5, bottom panel).

Most importantly, median cumulative output losses (relative to trend or until recovery) in downturns that follow financial stresses were about 2.8 percent of GDP for slowdowns and about 4.4 percent of GDP for recessions, significantly larger than in episodes of slowdowns and recessions that were not preceded by financial stress (about 1.6 and 2.3 percent,

⁹ For example, in the United States, the most recent recession was in 2001 while the most recent slowdown was when GDP fell below trend during 2007:Q4–2008:Q1.

¹⁰ The turning point dates were compared with Morsink, Helbling, and Tokarick (2002), as well as dates identified by the Economic Cycle Research Institute (www.businesscycle.com)—dates used in this paper are available from authors upon request.

respectively), as shown in Figure 1. This result mainly reflects the longer duration of slowdowns and recessions when preceded by financial stress.

Looking at the dynamics of selected macroeconomic variables around the beginning of the downturn reveals that, in general, the occurrence of financial stress tends to change the patterns of downturns (Figure 6 and Figure 7).¹¹ This change is pronounced for slowdowns but less so for recessions, possibly suggesting that the latter are to a greater extent triggered by the interaction of financial stress with other shocks. In particular, when preceded by financial stress, economic slowdowns tend to be characterized by a flattening in consumption growth, by investment following a boom and bust cycle, and by appreciable turnarounds of current account balances as well as falling inflation and real interest rates.

In this paper, several conclusions are based on visual inspection of the event spaces. The figures are used to highlight the main findings of the paper, whether discussing the dynamics of variables around key events (either financial stress or downturns), or when different groups are contrasted in the form of bar charts. When useful, we also employ a more rigorous assessment of differences among groups using statistical tests. Before continuing, it is important to note that the main summary statistic used in the paper is the median, because it is a measure of central tendency that is robust to episodes that may be outliers. Then, we employ nonparametric tests based on the work by Wilcoxon (1945) and Mann and Whitney (1947) which tests the null hypothesis that the two groups were drawn from populations with the same median. The rank-based nonparametric test is based on the comparison of the number of observations above and below the overall median in each subgroup, and is sometimes referred to as the median test (Conover, 1980). Under the null hypothesis, the median chi-squared test statistic is asymptotically distributed as chi-squared with one degree of freedom in the case of two subgroups. If the null is rejected at the 10 percent level of better, then the test indicates that the difference between the medians across the two groups of episodes is genuinely different.

A. Why Are Some Financial Stress Episodes Associated with Economic Slowdowns?

The previous section has shown that only about half of the episodes of financial stress identified in this paper were followed by economic slowdowns or recessions. What determines the likelihood that financial stress episodes are going to be followed by economic downturns? What characterizes the most severe and prolonged of these downturns?

In order to answer these questions, this section compares the financial stress episodes followed by economic downturns to those that were associated with a decline in economic

¹¹ As a window of 12 quarters is used in the charts, only “complete” episodes (i.e., those episodes preceded and followed by at least 12 quarters) are considered in this chart. This amounts to consider only those downturns and recessions episodes that started between 1983:Q1 and 2005:Q1.

activity along two dimensions: first, the characteristics of the episode itself, that is, the nature of the financial “shock,” and second, the financial position of financial intermediaries, households, and firms at the beginning of the episode.

B. Is Banking Related Financial Stress Different?

An analysis of the episodes suggests that banking system stress tends to be associated with larger output consequences than episodes of pure securities or foreign exchange market stresses, where the banking system remains largely unaffected. Around 60 percent of the episodes of financial stress followed by slowdowns or recessions are banking-related. Moreover banking-related financial stress episodes are followed by more severe economic slowdowns (Figure 8) compared with other types of financial stress episodes. In fact, the difference between banking-related and nonbanking-related episodes is significant at a minimum of 10 percent for the quarters where the largest discrepancy is visible (namely quarters zero to four). Table 2 suggests that both slowdowns and recessions preceded by banking related stress tend to last longer, and are associated with larger average GDP losses, than those preceded by different types of financial stress, or indeed no financial stress at all.¹²

An analysis of the financial stress episodes in the sample also shows that bank asset growth slows significantly in banking related financial stress episodes followed by economic downturns compared with other episodes (Figure 9, top panel). While normal economic downturns can be expected to be associated with a fall in the demand for credit, episodes of banking-related financial stress associated with subsequent slowdowns/recessions had also significantly higher cost of capital after the episode began (Figure 9, bottom panel).¹³ It is also important to point out that the differences between these groups is statistically significant. In particular, the growth in bank assets and the cost of capital for the recessions contrasted with the financial stress episodes that were not associated with downturns (“Other”) is statistically significant at the 5 percent level of better. While the issue of reverse causality between recessions and financial stress is difficult to address empirically, suggesting appropriate caution in interpreting these results, these findings are consistent with the view that that a reduction in the supply of credit—the classic credit crunch or credit squeeze (depending on the extent to which credit supply is curtailed)—is a key factor associating banking related financial stress episodes to economic slowdowns and recessions.

¹² Also, as indicated in Table 2, the duration and cumulative losses between the downturns is statistically significant at least at the 10 percent level.

¹³ The cost of capital is defined here as a weighted average of the real cost of equity, the real cost of debt, and real lending rates, using as weights the relative shares of equity, bonds, and loans in non financial corporate liabilities. See Appendix II for details.

C. Financial Imbalances and Firm and Household Financial Exposure

After looking at the nature of the shocks, the focus now shifts to whether the likelihood of a downturn in economic activity following financial stress depends on initial conditions in terms of asset prices and balance sheets. The evidence suggests that initial conditions are important in determining the economic impact of a financial shock:

- Both house prices and the credit-to-GDP ratio tend to rise significantly faster during the upswing of the financial cycle in those stress episodes that eventually are followed by slowdowns or recessions (Figure 10). Statistical tests confirm that financial turmoil is more likely to be followed by economic slowdown or outright recession when it is preceded by a more rapid buildup in house prices and credit as shown in Figure 11.¹⁴ For example, each of the variables measuring the initial conditions of financial stress episodes are statistically different when followed by a recession as compared to those that were not (“Other”) at the five percent level or better.
- Episodes of financial stress followed by economic slowdowns and recessions tend to be characterized by firms being more heavily dependent on external sources of funding—that is, with higher net borrowing ratios—in the run up to the financial stress episode (see Figure 10 and Figure 11).¹⁵ Such a higher initial reliance on external funding makes firms more vulnerable to a downswing of the financial cycle, and sets the stage for a larger impact on the real economy as firms are forced to adjust their spending plans more drastically in the aftermath of financial stress.
- At the same time, only financial stress followed by recessions (but not slowdowns) seems to be characterized by a “more exposed” household sector in terms of reliance on external financing (Figure 10). Indeed, the median household net borrowing ratio (in deviation from trend) at the outset of financial stress episodes is significantly higher when these episodes are followed by recessions than when they are followed by economic slowdown or no decline in economic activity (Figure 11).

¹⁴ Asset prices, namely real house and stock prices, are measured as deviations from their respective Hodrick-Prescott trends in line with many studies in the literature, especially those focusing on credit booms—see for example, Cardarelli, Igan, and Rebucci (2008) for a recent overview regarding house prices, and Mendoza and Terrones (2008) regarding credit booms.

¹⁵ Net lending (or borrowing) of a sector is a standard national accounts concept and can be measured either through incomes and expenditures or through financial transactions. Under the income and expenditure approach, net lending is the difference between internally generated funds and outlays on nonfinancial capital. A sector’s net lending equals its saving, plus its capital consumption allowance and net capital transfers from nonresidents, less its investment in fixed capital and inventories (the excess of net acquisitions of financial assets by transactions over their net incurrences of liabilities). Net lending (or borrowing) is also referred to as sector surplus (or deficit).

The results thus far suggest that when the financial cycle turns, as signaled by the onset of stress in financial markets, the likelihood that this will be followed by a downturn in economic activity is higher the larger are the initial financial imbalances—the more exposed firms and households are to a decline in credit and asset prices. In particular, household exposure seems to be associated with the more severe contraction of economic activity.

To investigate the role of initial financial imbalances and firms and households' reliance on external funding in explaining the severity of the ensuing economic downturn more formally, the cumulative loss of output in the aftermath of financial stress episodes is regressed on the run up in credit and assets prices before the onset of the financial stress, firms and households' net borrowing ratios at the start of the episodes, and a proxy for the severity of the financial shock, namely, the duration of the stress episode.

It is important to emphasize that the regression analysis presented below is not meant to make causal assertions, but instead to uncover statistical associations in a multivariate context. The regressions are used to measure conditional correlations—that is, to assess whether some of the relationships discussed above are still statistically significant, after controlling for other relevant factors. The main results of the regressions are (Table 3):¹⁶

- Firms' net borrowing ratio at the onset of the financial stress episode enters significantly in almost all specifications, confirming the importance of the link between initial firms' reliance on external credit and the severity of the decline in economic activity.
- The household net borrowing ratio at the onset of the financial stress episode is statistically significant when considered alone, but loses significance when firms' net borrowing position is added. In this case, though it continues affecting the severity of the output losses when interacted with the duration of the financial episode, suggesting that household position matters especially when the economy is hit by a sustained financial “shock.”

Since this paper tries to address the factors that determine whether or not financial stress is followed by a downturn, a key challenge is to determine the origins of the shocks that hit the economy and that subsequently set off the complex interactions between the real and financial sectors. In identifying periods of financial stress, which are interpreted as exogenous shocks to the financial sector, it is useful to ask whether financial stress leads to deeper and more protracted downturns? As inferred from Figure 8, downturns preceded by

¹⁶ Slowdown severity is measured using the cumulative output loss during the period that output is below trend, see Table 1 for further details; recession severity is measured by losses until recovery.

banking-related financial stress are indeed more severe than episodes not preceded by financial stress.¹⁷

However, the observation that financial sector stress precedes an economic downturn still does not necessarily mean that financial stress has been the key driving factor of subsequently observed real sector developments: since financial market participants are forward looking, the financial stress may merely be a manifestation of their anticipation of a fundamental deterioration in the real sector environment. To address this problem, the paper considers four shocks that could be considered mainly fundamental, exogenous deteriorations in the real sector environment: oil price shocks, labor productivity shocks, and two policy shocks, namely monetary and fiscal policy. As shown in Figure 12, any one of these four shocks combined with financial stress brings about a more severe downturn in contrast to just the shock on its own. Reinforcing this point, we find that the largest differences between the series preceded by financial stress and the shock versus the series only preceded by the shock is statistically significant at the 10 percent level of better. This suggests that financial stress probably has a separately identifiable impact, which could be attributed to, among other things, to financial accelerator mechanisms as discussed in Bernanke, Gertler, and Gilchrist (1999), Iacoviello (2005), or Kiyotaki and Moore (1997).

IV. FINANCIAL INNOVATION, FINANCIAL STRESS, AND ECONOMIC CYCLES

The continued importance of banks in explaining why certain financial stress episodes are associated with greater output consequences leads to the question of why banks remain crucial despite financial innovation and the emergence of nonbank sources of funding.

Financial innovation could reduce the pivotal role of banks by providing an alternative channel for firms and households to access financing, one that depends less on the collateral constraints faced by borrowers and the adverse impact of financial stresses on the cost of capital for banks. However, while the role of banks has evolved over time, their symbiotic relationship with markets remains an essential feature of financial systems, especially those characterized by a prevalence of arm's-length financing (see Lall, Cardarelli, and Tytell, 2006).¹⁸ As a result, banking distress is likely to affect nonbank sources of financing as well.

¹⁷ While we do not want to repeat this point too many times, it is important to underscore that large discrepancies shown in the figures are statistically different. For example, in the bottom panel of Figure 8, the differences between slowdowns preceded by banking-related financial stress and slowdowns not preceded by financial stress is significant at a minimum of 10 percent for $t - 6$ to $t + 6$.

¹⁸ Banks increasingly depend on market-based funding sources to finance their assets (such as through their CD and off-balance sheet CP programs). Conversely, investment and now increasingly commercial banks also remain at the center of the originate-to-distribute model of securitized financing, and provide credit to hedge funds and other leveraged intermediaries through repurchase facilities to invest in securities markets.

A. The Arm's-Length Index

Before continuing, it will be useful to discuss key differences among financial systems in advanced economies. While there are various ways of classifying financial systems, the approach used in this paper is based on previous work (Lall, Cardarelli, and Tytell, 2006) that focuses on the degree to which financial transactions are conducted on the basis of a direct (and generally longer-term) relationship between two entities, usually a bank and a customer, or are conducted at arm's length—where entities typically do not have any special knowledge about each other that is not available publicly.

A more arm's-length financial system is highly dependent on publicly available information and the enforcement of contracts through formal and standard legal mechanisms and procedures applicable to unrelated parties. There is a strong role for price signals and open competition among lenders. On the other hand, in a more relationship-based system, transactions between two parties—such as a bank and a corporate borrower—primarily rely on information the lender has about the borrower that is not available publicly. Mechanisms for enforcement of contracts rely more heavily on the lender's direct influence on the borrower and/or the lender's monopolistic power in the market. In practice, no system is purely relationship-based or purely arm's length, and even systems that are more reliant on arm's length transactions do not preclude the use of relationships in certain types of transactions.

To quantify the differences between financial systems, this paper uses the index developed by Lall, Cardarelli, and Tytell (2006), which summarizes the extent of the arm's-length content of a financial system. The index ranges between zero and one for each country, with a higher value representing a greater arm's length content in the financial system. The overall index is derived from three subindices that seek to capture key elements of a financial system:

- The degree of *traditional bank intermediation*, which is the most obvious manifestation of a high degree of relationship-based financial transactions. This measure of the extent to which deposit-taking institutions dominate the process of intermediating savings takes into account factors that may weaken the role of relationships in lending decisions, most notably the degree of competition between banks and the availability of public financial information.¹⁹
- The degree to which *new financial intermediation* has developed to provide an alternative nonbank channel for financing and/or to facilitate the transformation of traditional relationships between intermediaries and final customers. New financial

¹⁹ The role of relationships is likely to be weaker in a system where banks pose greater competitive challenges to each other and where inside information about borrowers is much more limited.

intermediation includes the activities of a range of nondeposit taking institutions such as pension and insurance companies, nontraditional activities undertaken by banks including the securitization of loans, and the extent of financial innovation through the use of new financial instruments, including derivatives. The measures of financial innovation used in this subindex are intended to gauge the transformation of aspects of traditional relationship-based lending not captured elsewhere. For example, the market for credit derivatives and collateralized debt obligations (CDOs) may allow banks to develop lending relationships less influenced by long term credit risk considerations. Similarly, the use of interest rate swaps allows lenders to meet the demand for specific loan structures by their customers, while transferring interest rate risk to investors more willing to assume such exposures.

- The role played by *financial markets*, which have a symbiotic relationship with nonbank financial intermediation and the expansion of banks into nontraditional activities described above (see, for example, Allen and Santomero, 2001). Deep and liquid financial markets are essential, for example, for the efficient functioning of a mutual fund industry. The ease of market access, efficiency of contract enforcement, and the degree of investor protection are important determinants of how well financial markets can perform their functions.

While further details are relegated to Lall, Cardarelli, and Tytell (2006), one conclusion their study finds is that the evolution of the index suggests that despite an increase in the arm's length content of financial systems across advanced economies, important differences remain.

B. Financial Systems and Leverage

To explain the continuing importance of banks, it is revealing to look in more detail at the procyclical behavior of bank leverage around financial cycles. In particular, how banks manage their leverage during upturns and downturns in the financial cycle appears to be key in explaining why banking stress translates into lower credit supply, a higher cost of capital, and a softening of economic activity. The hypothesis is that when banks overextend their balance sheets on the back of higher asset values and lower perceived risk during booms, this leads to a build up of financial imbalances while supporting a rapid expansion in activity, boosting asset values further, reducing perceived risk, and fostering another round of lending and economic expansion.²⁰ Subsequently, a financial shock that either increases risk or reduces the return on assets could prompt a cycle of severe deleveraging, with banks sharply reducing their lending (or their growth in lending) as bank capital falls, prompting an economic slowdown that feeds back into a further reduction in credit supply.

²⁰ This is in line with Minsky's Financial Instability Hypothesis.

This procyclicality of leverage is likely to be more pronounced in financial systems where banks are more exposed to fluctuations in market values of assets—through their holdings of securities and their repurchase facilities, for example.²¹ As this behavior is typical of non-depository financial intermediaries, one should expect to see evidence of procyclical leverage especially for investment banks (Shin, 2008). On the other hand, commercial banks should be less prone to procyclically adjusting their balance sheets during asset price or liquidity booms and busts, as they rely less on wholesale funding and more on retail deposits, and are also less subject to mark-to-market changes in their asset values.

Evidence from bank balance sheet data confirms that the leverage of investment banks tends to be procyclical, with banks expanding their leverage at the same time as they are expanding their assets (Figure 13, upper panel).²² The evidence on procyclicality of commercial banks—that is, banks that rely much more on retail deposits and whose main activities consist in making long-term, illiquid loans—is less uniform (Figure 13, lower two panels). However, the evidence suggests commercial banks operating in more arm’s length financial systems, that is, those where a greater share of financial intermediation relies on financial markets rather than on traditional relationship based (and bank dominated) activities, also tend to be more procyclical (Figure 14). Thus, more arm’s length financial systems are associated with overall more procyclical bank behavior, and may be more vulnerable to banking stress.²³ Moreover, as a proportion of all cases of banking-related financial stress, the share of more arm’s-length financial systems has remained about equal to that of more relationship-based systems (Table 1).

Indeed, slowdowns and recessions tend to be deeper in economies with more arm’s-length financial systems, although the duration of such downturns is broadly similar across both types of systems (Figure 15), indicating that deleveraging matters, and its impact depends on how procyclical the leverage of a country’s banking system is.²⁴ This implies that more arm’s length systems are vulnerable to sharper contractions in activity following banking stress.²⁵

²¹ It is important to note that in a systemic crisis it will still be difficult for all banks to adjust their leverage simultaneously, as there would be few buyers for these assets among other banks, unless other cash-rich investors who do not rely on bank leverage to fund their positions emerge.

²² See also Shin and Adrian (2007, 2008).

²³ This is consistent with the findings in Paper 3 of the October 2008 GFSR, showing that fair value accounting tends to lead to more procyclical movements in financial intermediaries’ balance sheets.

²⁴ Contrasting experiences with economic cycles may also reflect divergences in other areas, notably in the degree of flexibility in labor and product markets and the social welfare systems, between economies characterized by arm’s-length as opposed to relationship based financial systems (see Lall, Cardarelli, and Tytell, 2006).

²⁵ While not indicated in Figure 15, top panel, the difference between growth rates in the first year after financial stress is statistically significant at the 10 percent level.

Consistent with this channel, the leverage of banks in more arm's-length systems also tends to fall more sharply than in other types of financial systems, albeit starting from a lower base. In fact, the differences between the leverage ratios (defined as the asset-to-equity ratio) is statistically different at the 10 percent level of better for all periods shown in Figure 15 (bottom panel). This casts doubt on the presumption that these systems are more likely to soften the blow from financial-stress driven downturns of the economy thanks to the availability of the twin engines for financial intermediation (both banks and markets).

It is important to emphasize that while more arm's length financial systems are associated with sharper contractions in activity following banking stress, this does not imply that they are inherently more prone to such stress (see Table 1). Moreover, arm's-length financial systems offer several advantages over relationship based systems in terms of the reallocation of resources in response to changing economic opportunities (see Lall, Cardarelli, and Tytell, 2006). However, as the current crisis underscores, the trend towards greater securitization in more arm's-length systems—which was thought to permit portfolio diversification to overcome the cost of monitoring idiosyncratic risk inherent in traditional relationship based systems—does not eliminate the need for banks and markets to independently assess the risk of their exposures. Indeed, lack of information about the value and risks of many securitized products and associated losses appears to have played a significant role in amplifying the current crisis.

V. FINANCIAL CRISIS IN HISTORICAL CONTEXT

In order to put the current episode of financial stress in context, and gain insight into the potential macroeconomic impact going forward, this section discusses the evidence from six well known episodes of banking-related financial stress among advanced economies during the 1990s. These episodes relate to Finland, Norway, Sweden, the United Kingdom, and the United States in early 1990s, and Japan throughout the 1990s. Given the importance of banking distress in the ongoing episode of financial turmoil, these episodes can serve as a useful benchmark for analyzing the current conjuncture, in line with other studies (including Reinhart and Rogoff, 2008a).²⁶

Examining the initial conditions before the onset of these episodes confirms the main findings of the event analysis, namely that financial stress episodes are more likely to be followed by severe economic downturns when occurring in the context of a rapid build up in credit and house prices and a heavier reliance on credit by firms and household sectors. Broadly speaking, the largest asset price and credit booms were in the Nordic countries—the financial crises in these countries were all preceded by abnormally high increases in credit ratios, assets prices, and bank assets (Table 4, top panel). At the same time, household and corporate borrowing at the onset of the crisis was much larger in Finland and Norway when

²⁶ See also JP Morgan (2008).

compared to the other countries. While Japanese corporates relied extensively on external financing, this was at least partially balanced by the savings patterns of households. In contrast, among the Anglophone countries, asset price imbalances were moderate, and balance sheets were not under tremendous strain.

At the same time, the countries with larger financial imbalances and balance sheet vulnerability at the onset of the episodes also experienced more severe output contractions (Table 4, lower panel). As it turns out, the most dramatic collapse in asset prices, bank asset growth, and credit occurred in the countries that had the largest buildups of financial imbalances. These countries were also those that suffered the deepest and longest recessions.

Moreover, household and firms in these countries also generally experienced a stronger deleveraging process. Deleveraging to reduce the stock of debt through higher savings and consequently lower consumption and investment had direct implications for the dynamics of growth. The degree of corporate deleveraging in particular corresponds remarkably well with the length and depth of the recessions—underscored by the contrast between the Nordic and Anglophone country groups.

As a complementing viewpoint, we discuss the dynamics of recoveries associated with financial stress. Specifically, we consider the evolution of the level of real GDP for (1) recessions not preceded by financial stress, (2) those preceded by banking-related financial stress, and (3) six prominent financial stress episodes highlighted above as shown in Figure 16. Reinforcing one of the main messages in the paper, banking-related financial stress episodes are characterized by having the deepest and longest downturns. As shown in the figure, it takes two quarters for recessions not preceded by financial stress to revert back to output levels before the economic contraction began—an example of a “V-shaped” recession. In contrast, banking-related recessions take at least twice as long to recover from—typically between four to five quarters. The more severe and protracted nature of recessions associated with banking-related financial stress is therefore characterized as having a “U-shaped” recovery pattern.

The evidence from these historical experiences underlines the key role of policy responses to financial stress in affecting outcomes. Policies to restore sound financial intermediation are discussed in further detail in Cardarelli, Elekdag, and Lall (2008), and here we summarize a few key principles. First, the analysis in this paper underscores the need for a sound framework to be in place for assuring financial stability, encompassing a framework for intervention and appropriate legal, institutional and procedural mechanisms to deal with distress. Second, policy responses need to be rapid, involving early recognition of losses, determination of the scale of the problem and timely steps to ensure financial institutions are adequately capitalized, to minimize the impact on real activity. Third, the adverse impact of financial stress on the real economy may need to be contained directly, to preserve or restore household and corporate balance sheet health. Finally, adequate safeguards need to be in

place to limit the fiscal cost of support, and prevent creating inappropriate incentives for the longer term that could lead to excessive reliance on publicly financed bailouts.

VI. CONCLUSIONS

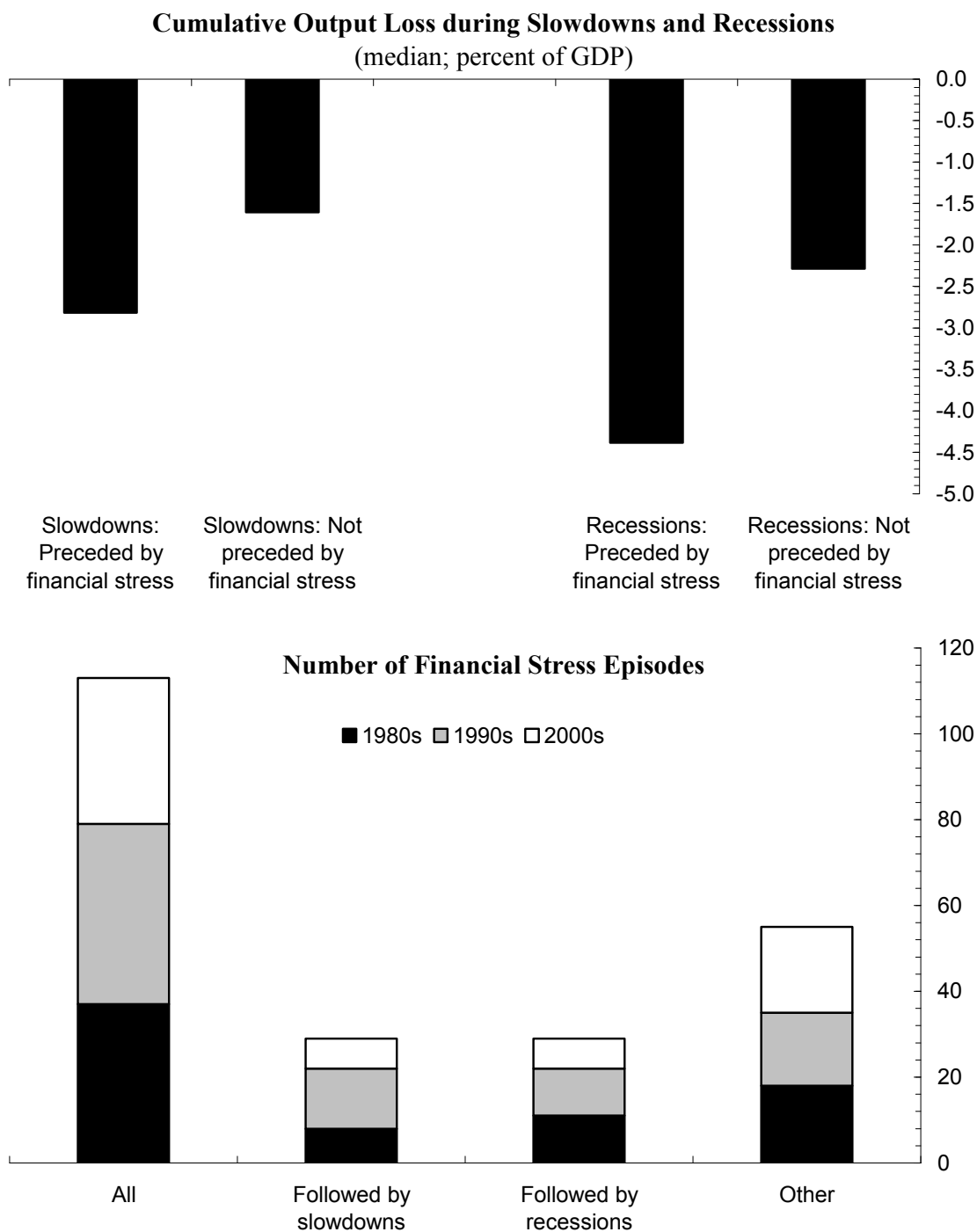
Based on an index of financial stress, this paper has analyzed the experience of episodes of stress in banking, securities and foreign exchange markets, in 17 advanced economies over the past 30 years. The focus is on assessing the factors that determine the extent to which financial stress has affected economic activity.

This paper finds that financial stress is often, but not always a precursor to an economic slowdown or recession. A rapid expansion of credit, a run-up in house prices, and large borrowings by the corporate and household sectors all contribute to a higher likelihood that stress in the financial system will lead to more severe economic downturns. Banking stress in particular tends to lead to greater effects on activity, despite financial innovation that has increased the role of securities markets in many countries. In fact, recessions associated with banking-related financial stress take about five quarters to recover.

Why are banking-related financial stress episodes associated with the most severe downturns? This can be explained by the procyclicality of leverage, especially among investment banks, but also commercial banks in many countries. Indeed, countries whose financial systems are dominated by more arm's-length based transactions, as opposed to traditional relationship-based intermediation, tend to exhibit higher procyclical leverage, indicating that the amplifying role of financial systems in propagating shocks is more pronounced. As a result, when shocks affect core financial institutions, the downturns that follow tend to be deeper in more arm's-length financial systems. However, it should be emphasized that arm's-length systems are not in general more prone to such shocks, and that such systems are better able to reallocate resources across various sectors of the economy in response to changing economic opportunities.

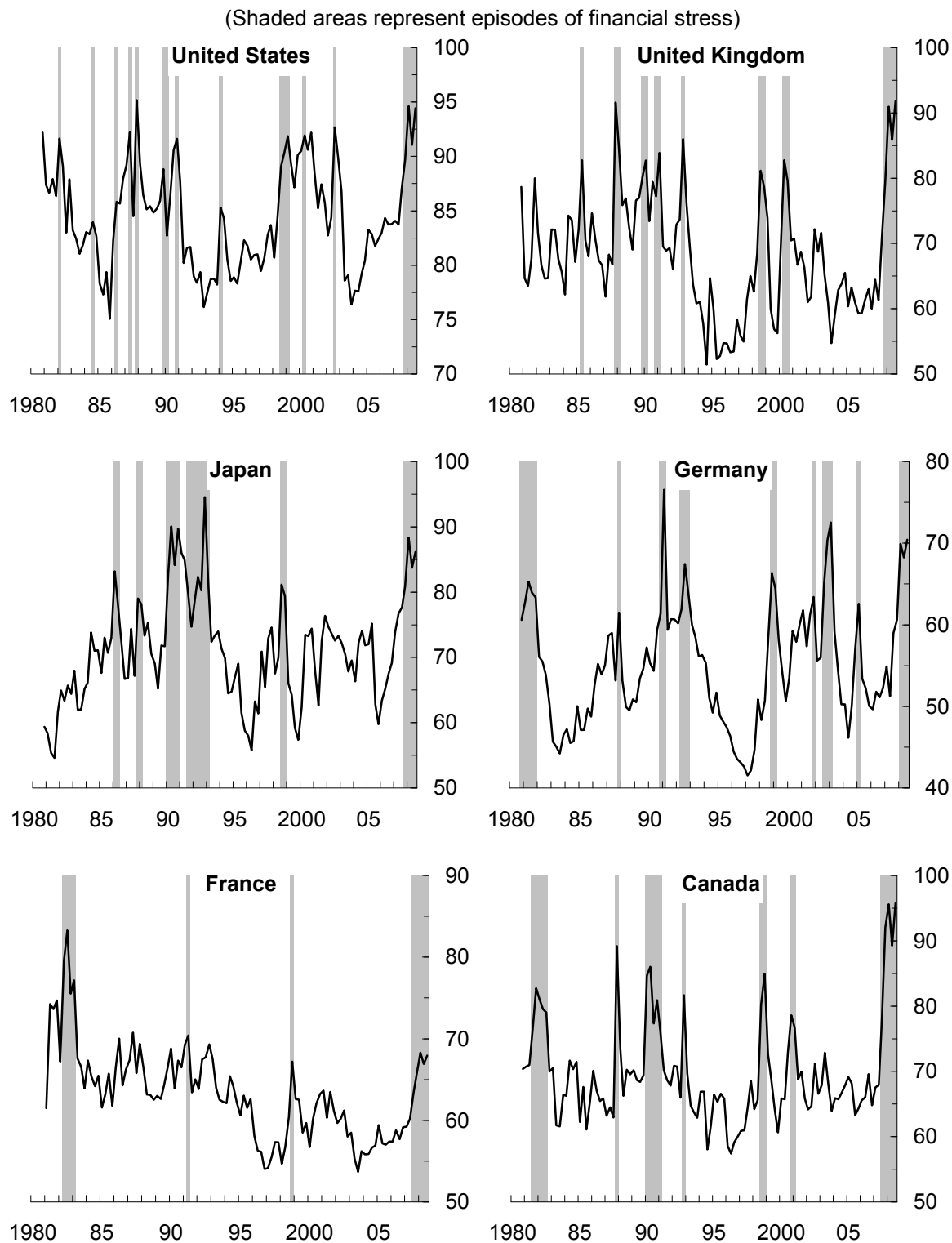
Given the role of build up in balance sheet vulnerabilities associated with rising asset prices and credit in explaining why some stress periods lead to downturns, policymakers need to be alert to these factors during the run-up of the financial cycle. Prudential measures as well as monetary policy should pay due regard to the vulnerabilities that may build up and that eventually lead to greater output losses if the financial system is hit by a severe shock.

In the event of significant financial stress that affects the core of the banking system, the early recognition of losses and measures to support the speedy restoration of capital can help reduce the output consequences of financial crises. At the same time, attention needs to be paid to the longer-term moral hazard implications of any strategy to restore financial stability.

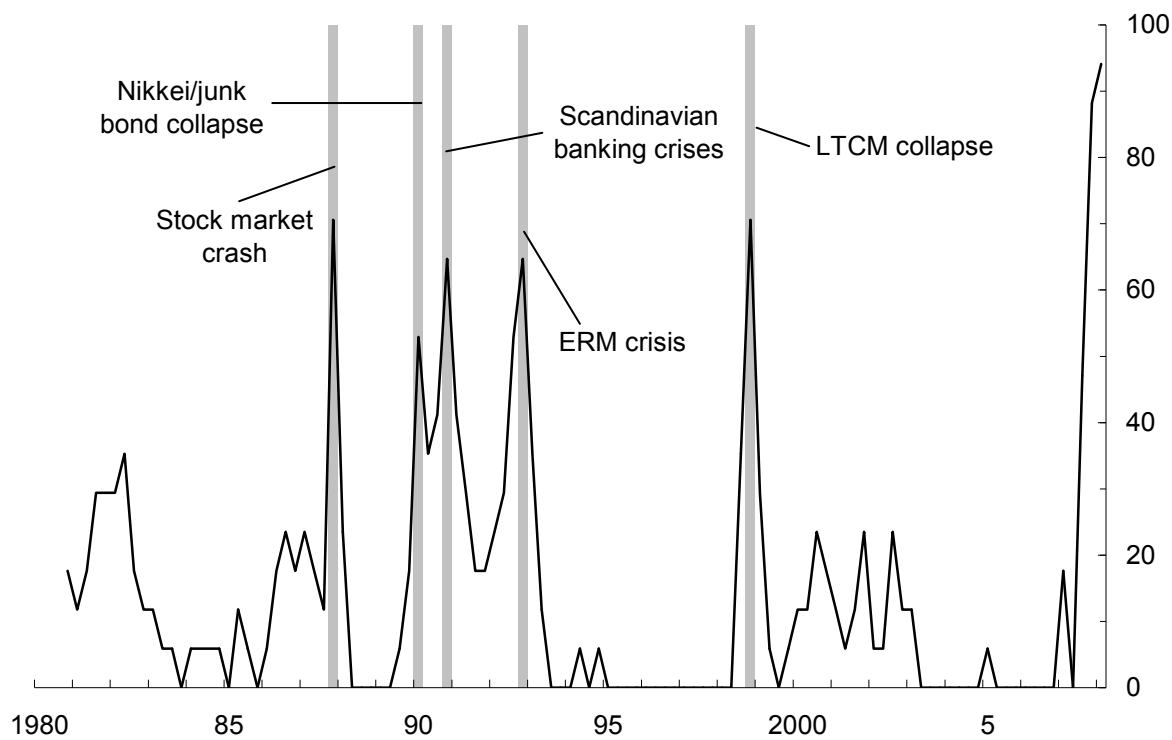
Figure 1. Financial Stress and Output Loss

Source: Authors' calculations.

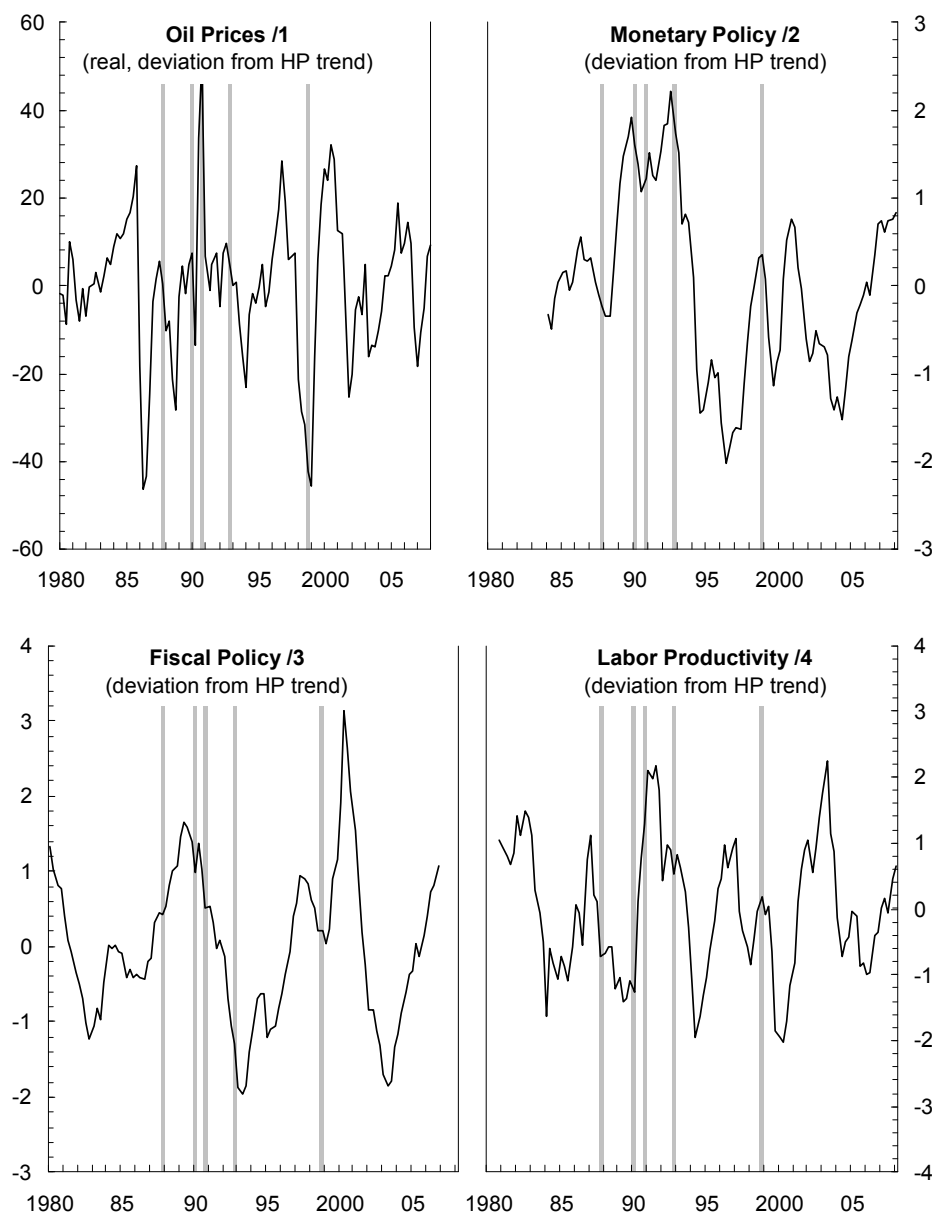
Note: Measured as the cumulative output loss when output was below the Hodrick-Prescott (HP) trend for slowdowns and cumulative output loss until recovery for recessions.

Figure 2. The Financial Stress Index

Source: Authors' calculations.

Figure 3. Share of Countries Experiencing Financial Stress

Source: Authors' calculations.

Figure 4. Shocks

Source: Authors' calculations.

Note: the shaded areas represent financial stress episodes discussed in the text: the 1987 stock market crash, the Nikkei/junk bond collapse, the Scandinavian banking crises, the ERM crises, and the LTCM collapse.

/1 Oil prices are scaled by U.S. CPI and represent deviation from HP-trend.

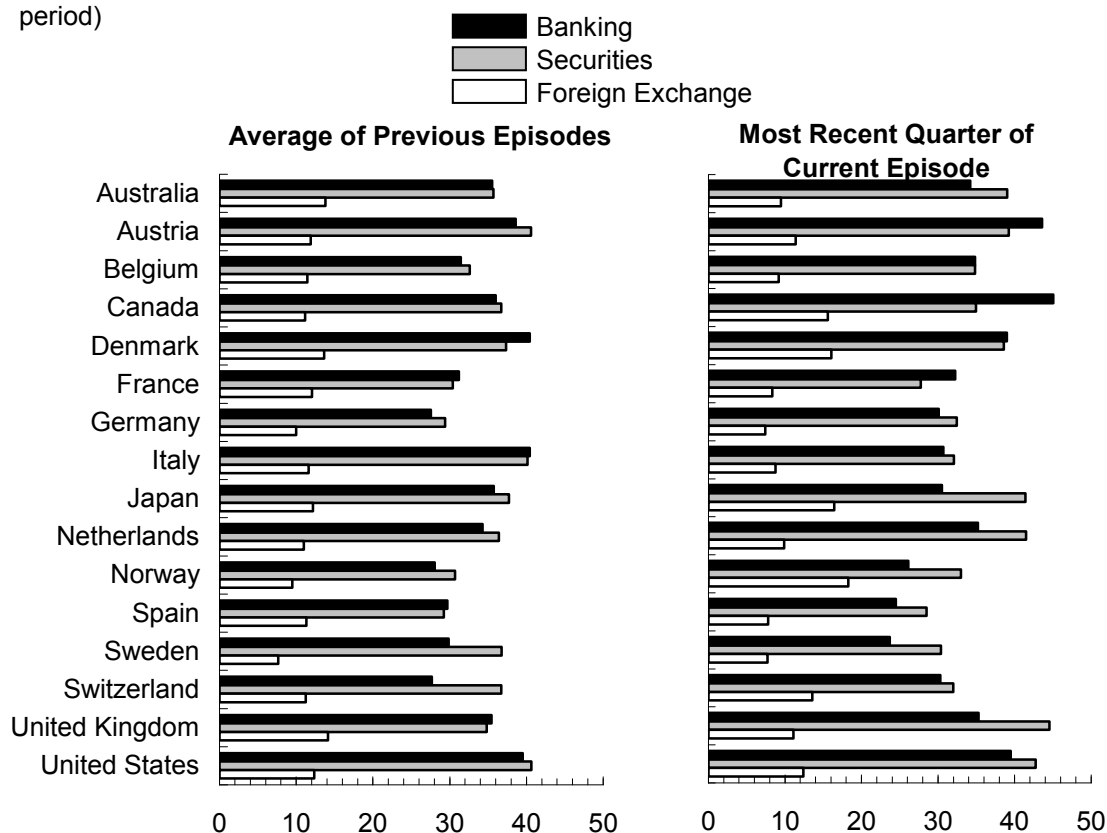
/2 Monetary policy is measured using the inverse term spread's deviation from HP-trend.

/3 Fiscal policy is measured using government net lending's deviation from HP-trend.

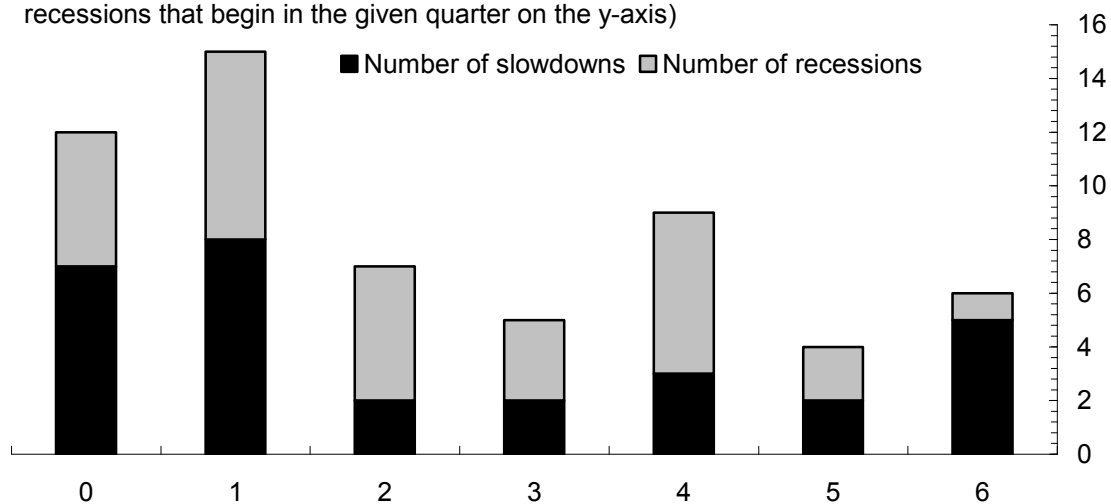
/4 Labor productivity of the total economy is measured as the ratio of real GDP and total employment and represents deviations from HP trend. Data are not available for Austria, Belgium, Denmark, Spain, and Switzerland.

Figure 5. Descriptive Statistics**Contribution of Banking, Securities, and Foreign Exchange**

(the sum of the components equals the level of the Financial Stress Index in the given period)

**Lag between Financial Stress and Downturns**

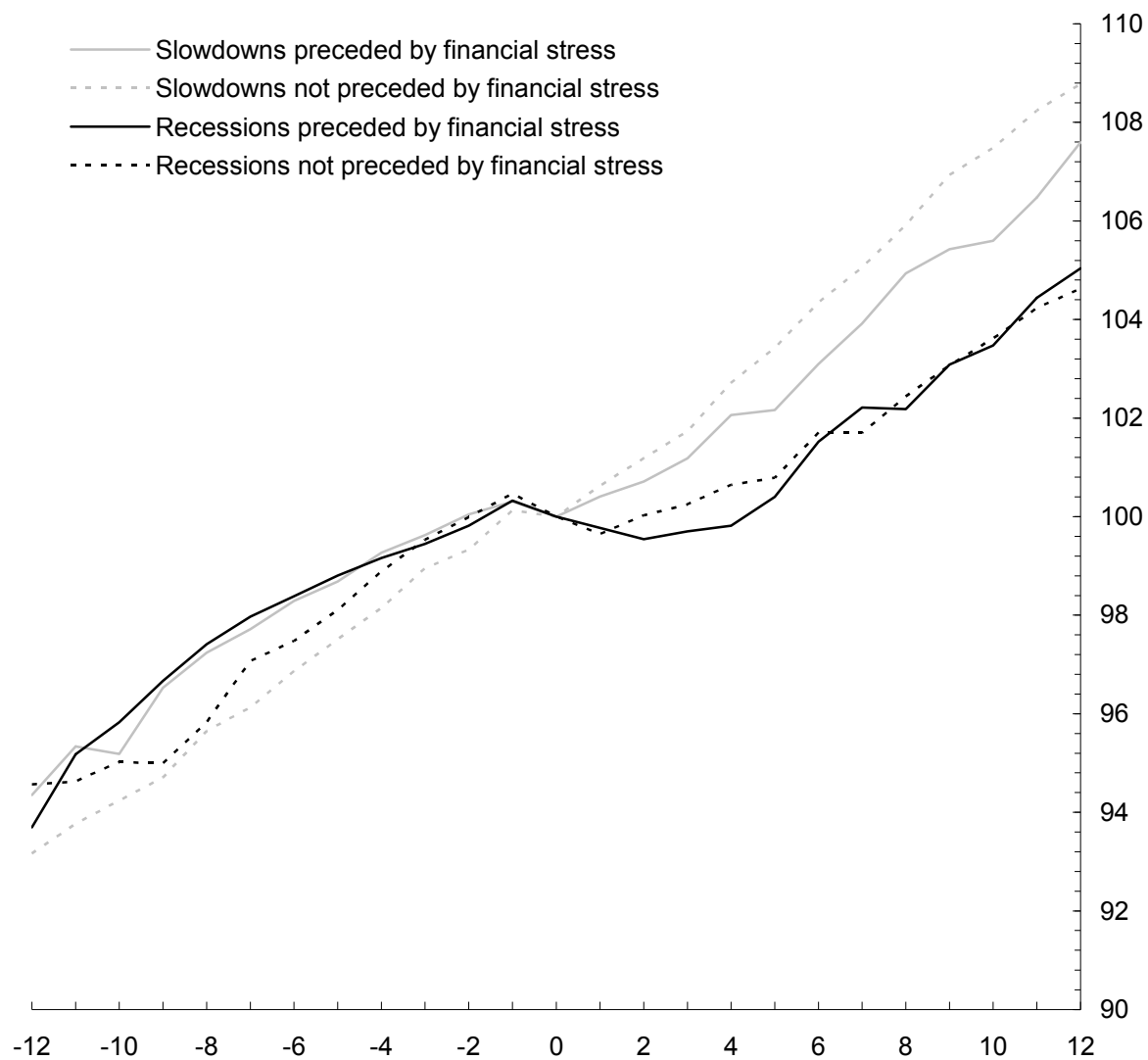
(start of financial stress episode at $t = 0$; quarters on the x-axis; number of slowdowns or recessions that begin in the given quarter on the y-axis)



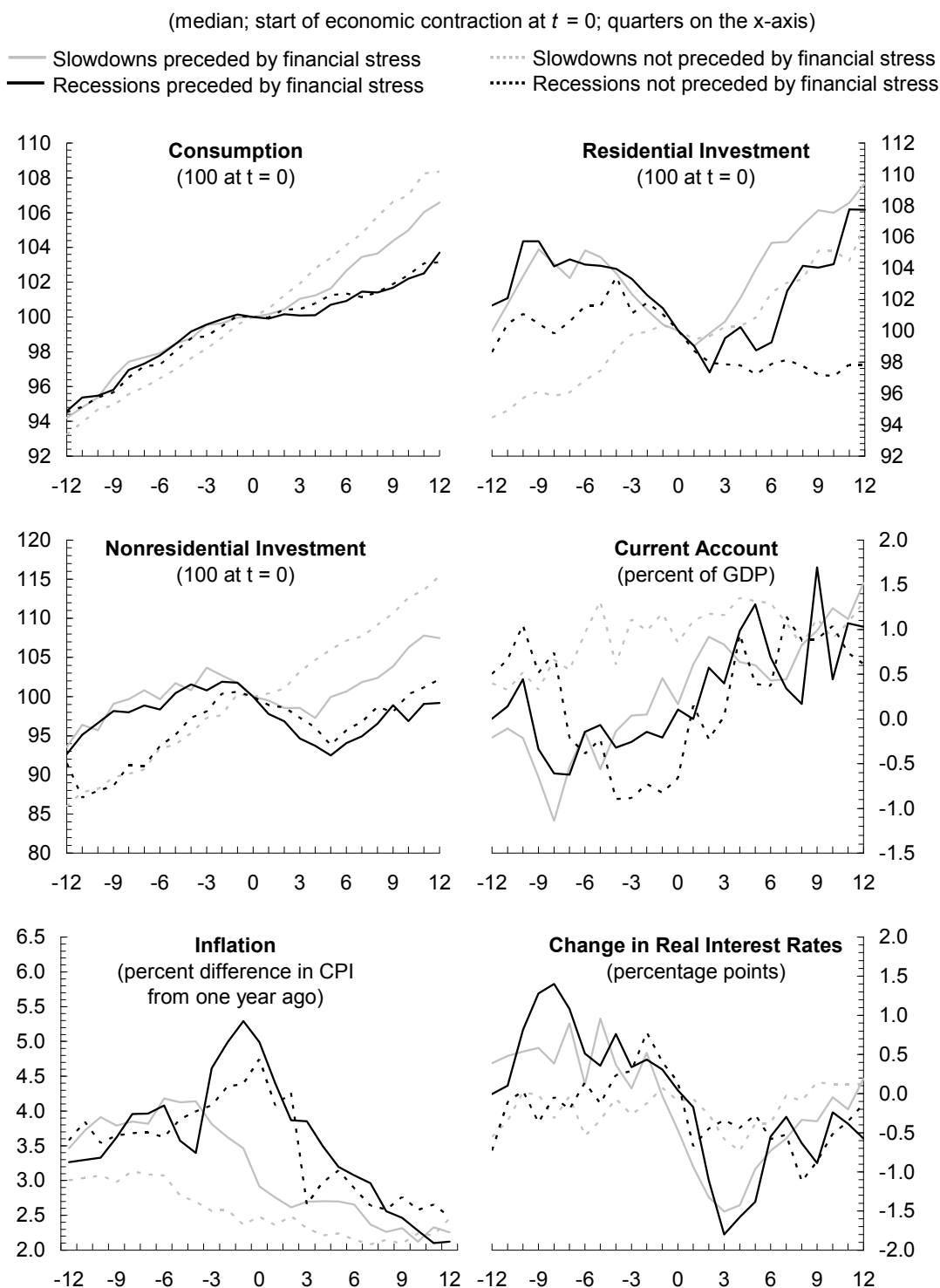
Source: Authors' calculations.

Figure 6. Real GDP Around Economic Downturns With and Without Financial Stress

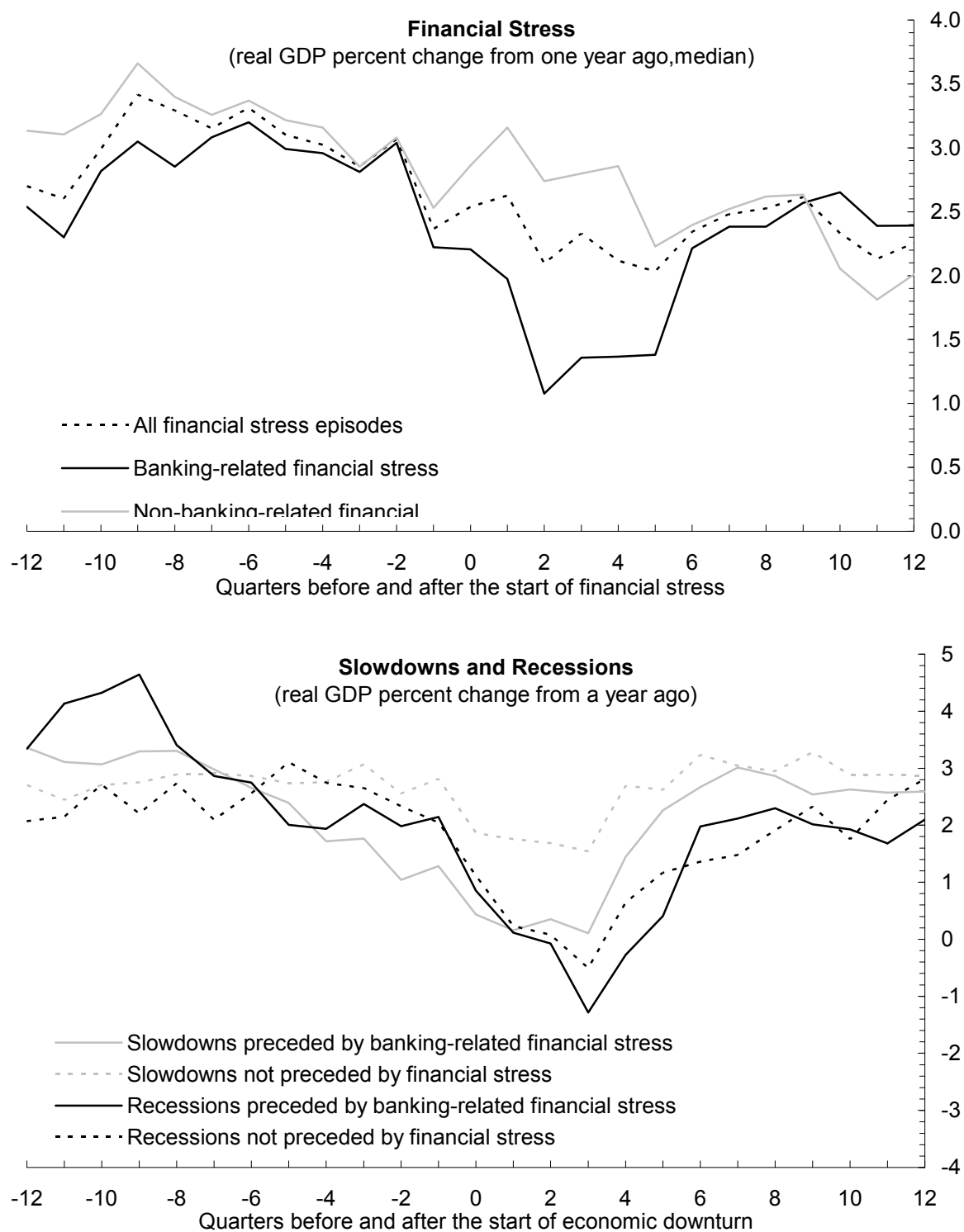
(Real GDP = 100 at $t = 0$)



Source: Authors' calculations.

Figure 7. Selected Macroeconomic Variables and Financial Stress

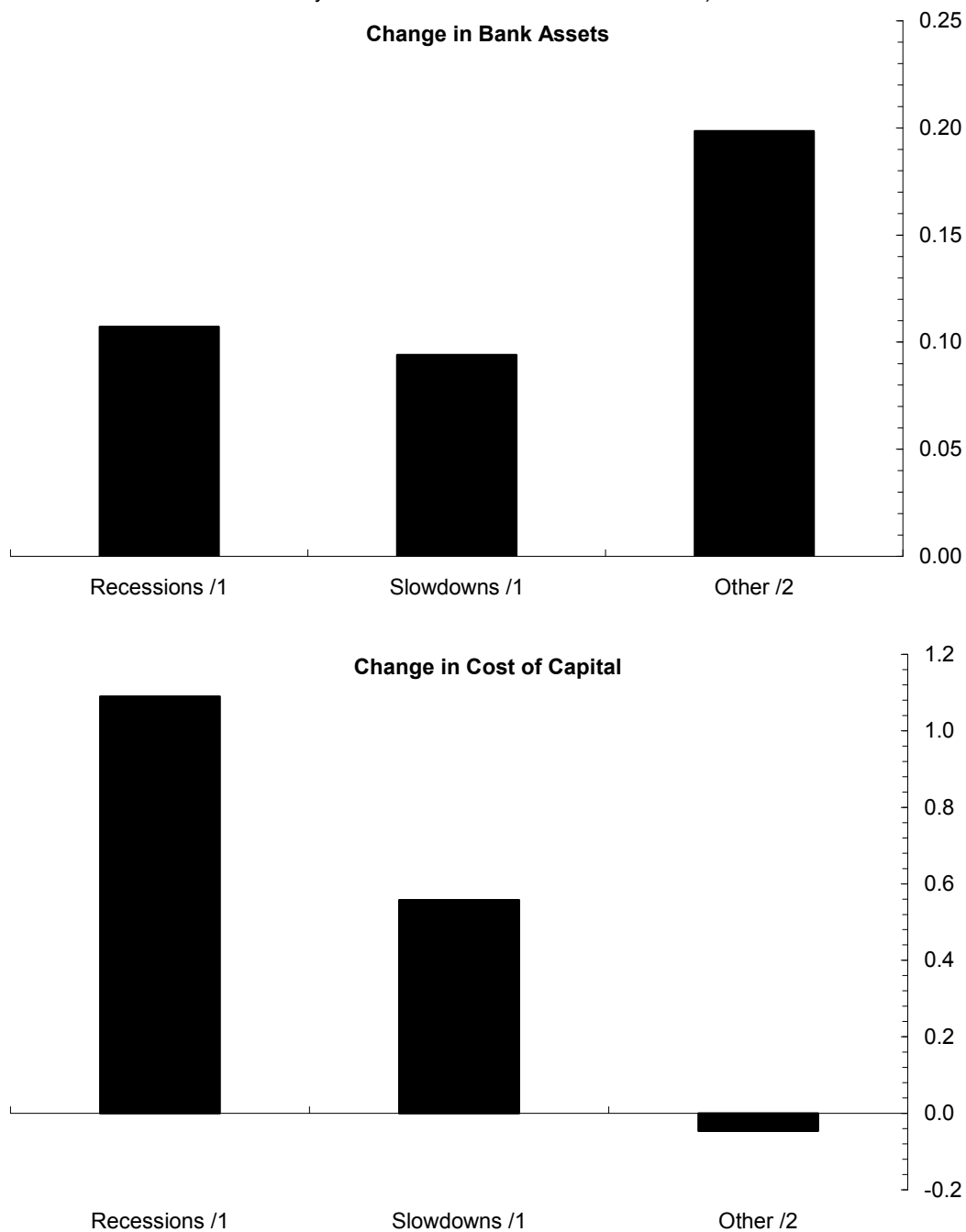
Source: Authors' calculations.

Figure 8. Banking-Related Financial Stress, Slowdowns, and Recessions

Source: Authors' calculations.

Figure 9. Cost of Capital and Bank Asset Growth and Banking-Related Financial Stress

(average; change from one year before
to one year after the start of the financial stress)

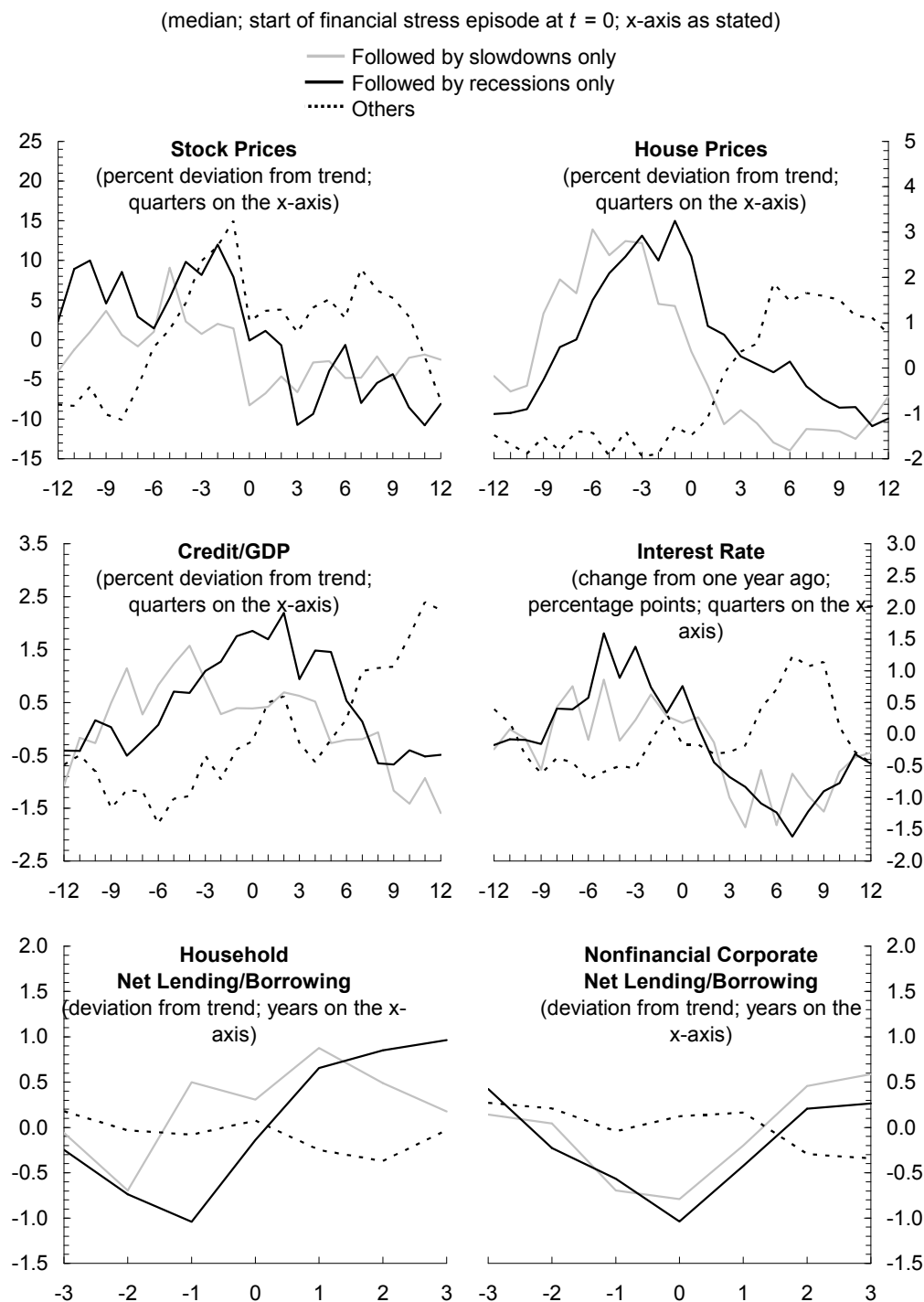


Source: Authors' calculations.

/1 Banking-related financial stress episodes followed by slowdowns or recessions.

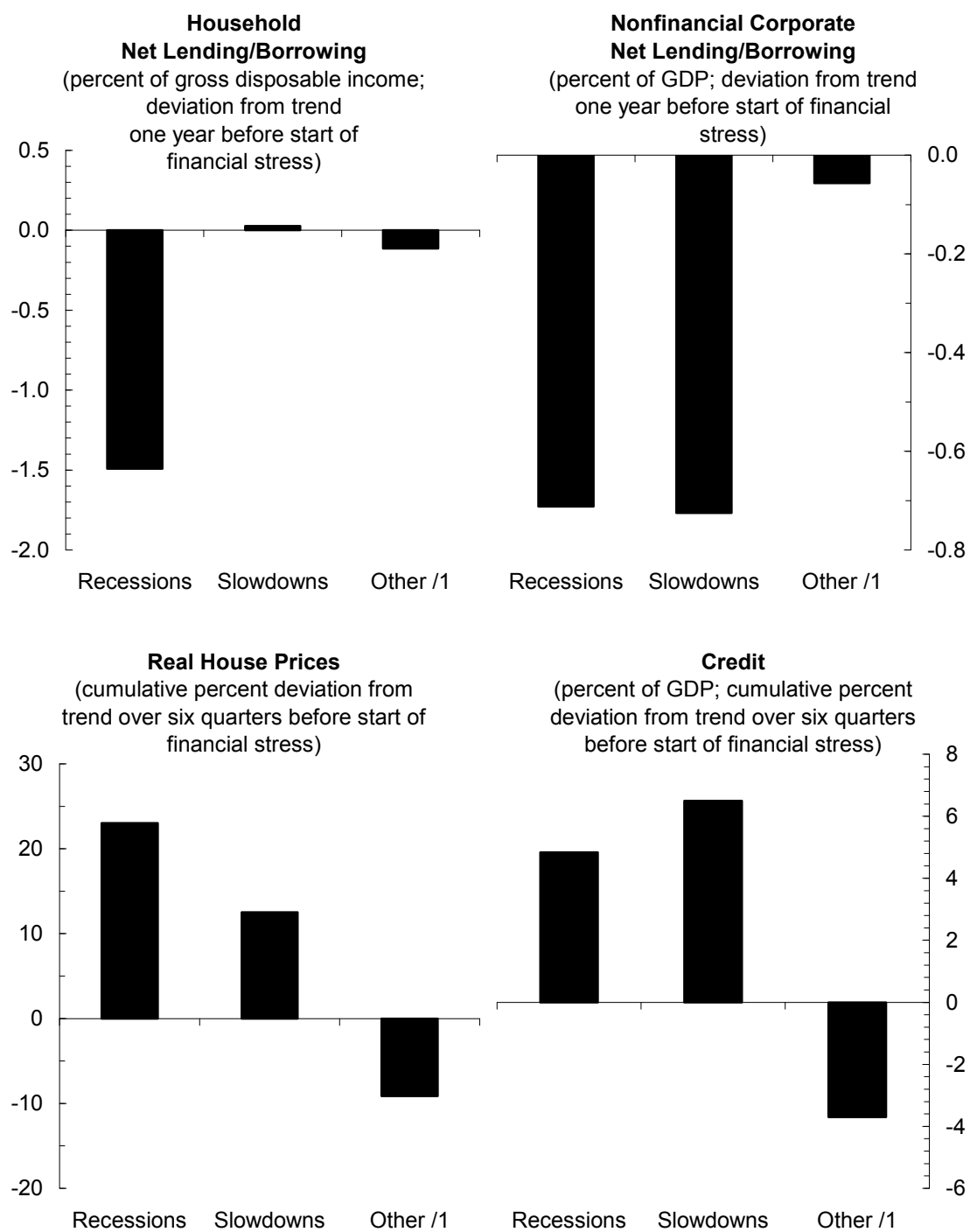
/2 Financial stress episodes not followed by slowdowns or recessions.

Figure 10. Selected Macroeconomic Variables Around Financial Stress Episodes



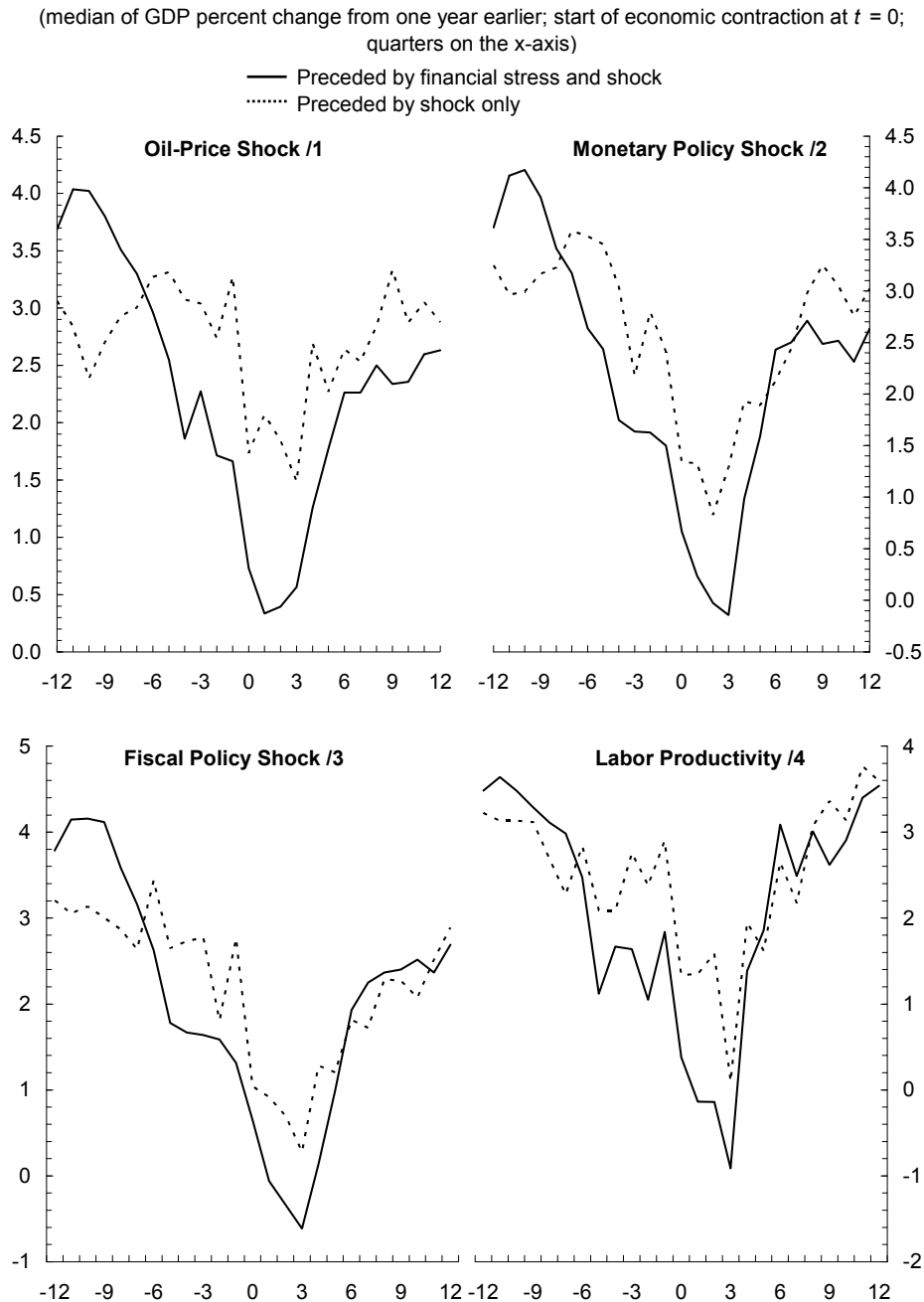
Source: Authors' calculations.

Note: All variables in real terms, except for household and nonfinancial net lending ratios. The sample is constant for all quarters and years.

Figure 11. Initial Conditions Preceding Financial Stress Episodes

Source: Authors' calculations.

/1 Financial stress episodes not followed by slowdowns or recessions.

Figure 12. Financial Stress, Downturns, and Four Important Shocks

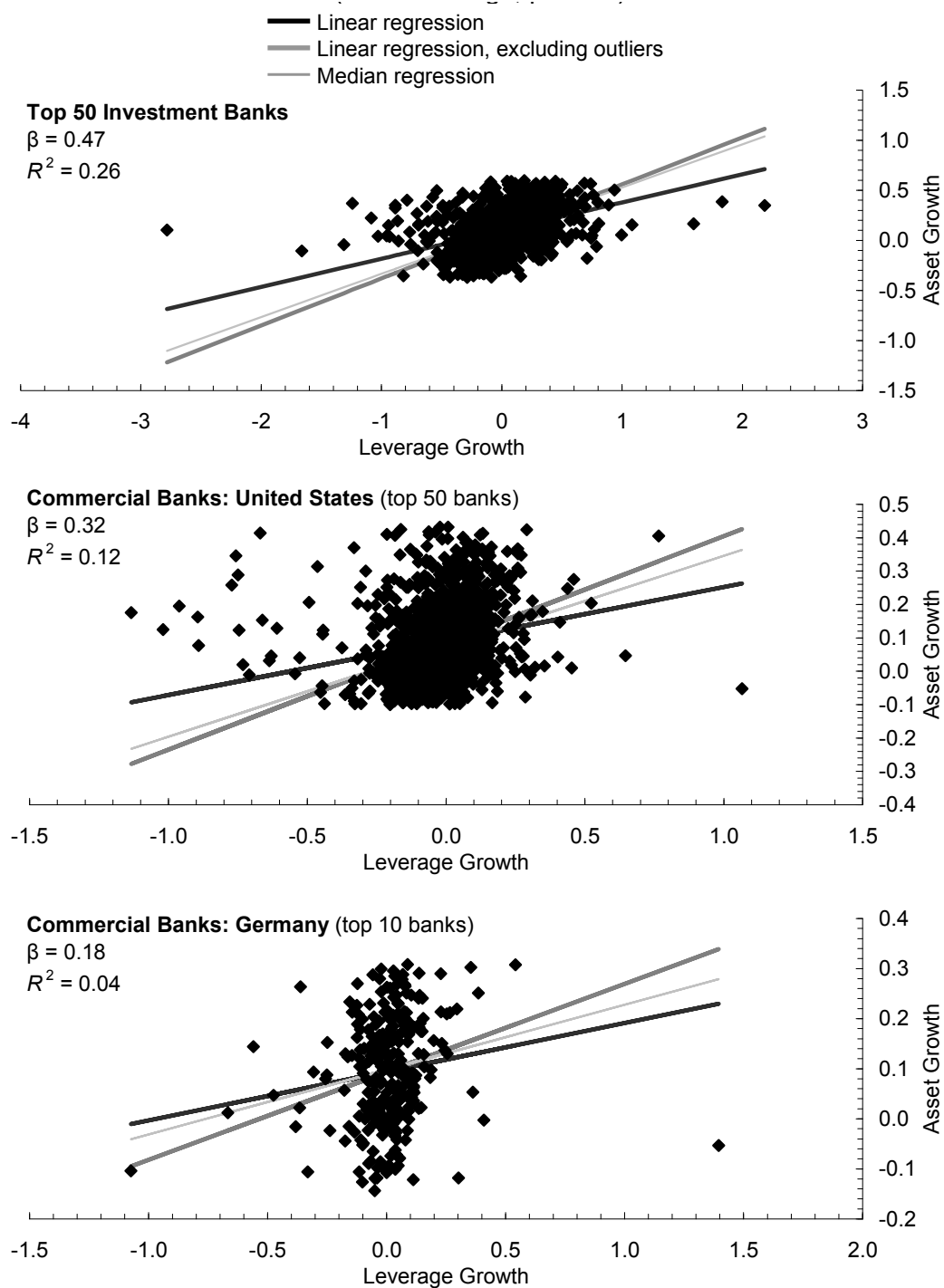
Source: Authors' calculations.

/1 Oil prices are scaled by U.S. CPI and represent deviations from HP-trend.

/2 Monetary policy is measured using the inverse term spread's deviation from HP-trend.

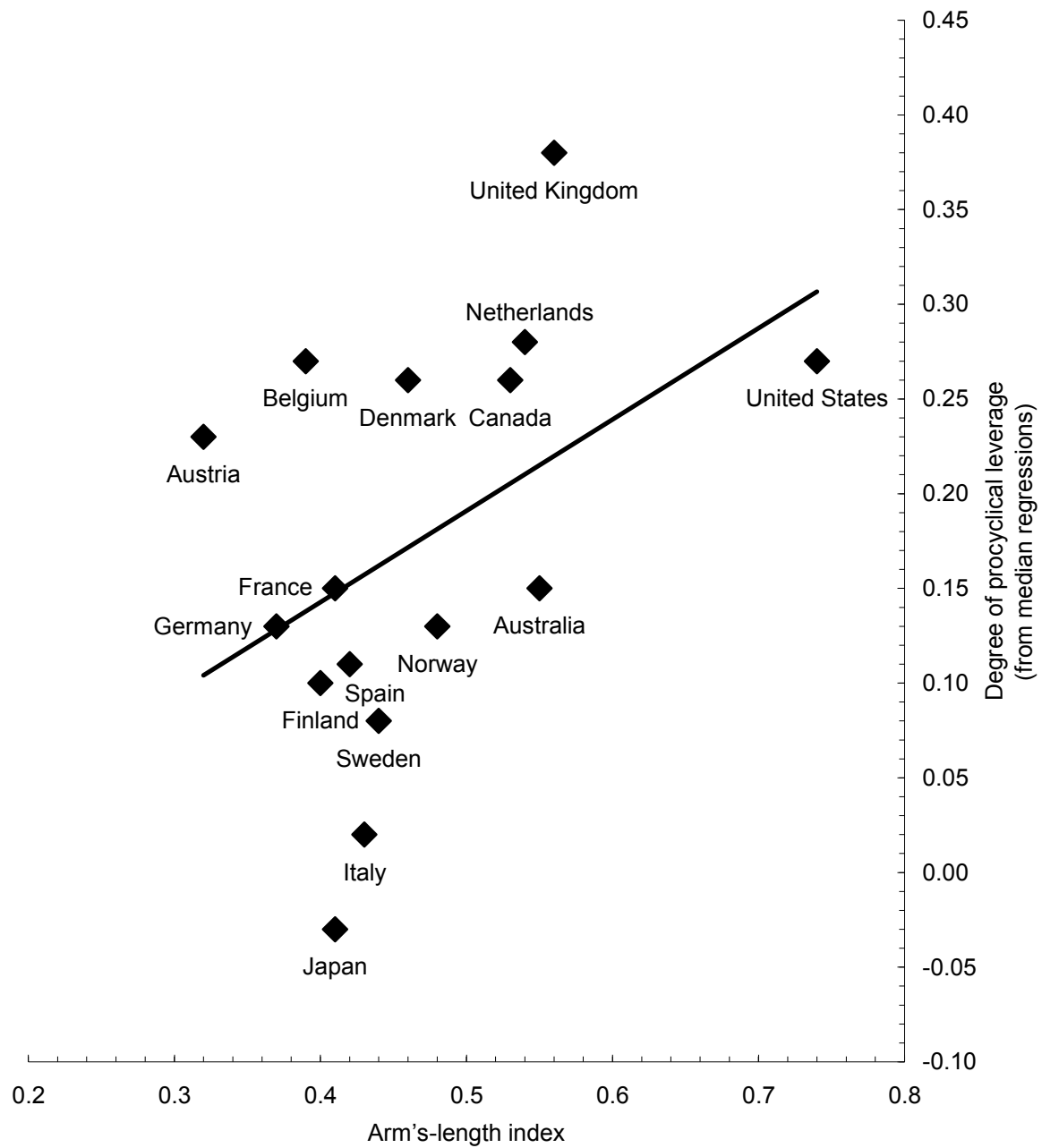
/3 Fiscal policy is measured using government net lending ratio's deviation from HP-trend.

/4 Labor productivity of the total economy is measured as the ratio of real GDP and total employment and represents deviations from HP-trend. Data are not available for Austria, Belgium, Denmark, Spain, and Switzerland.

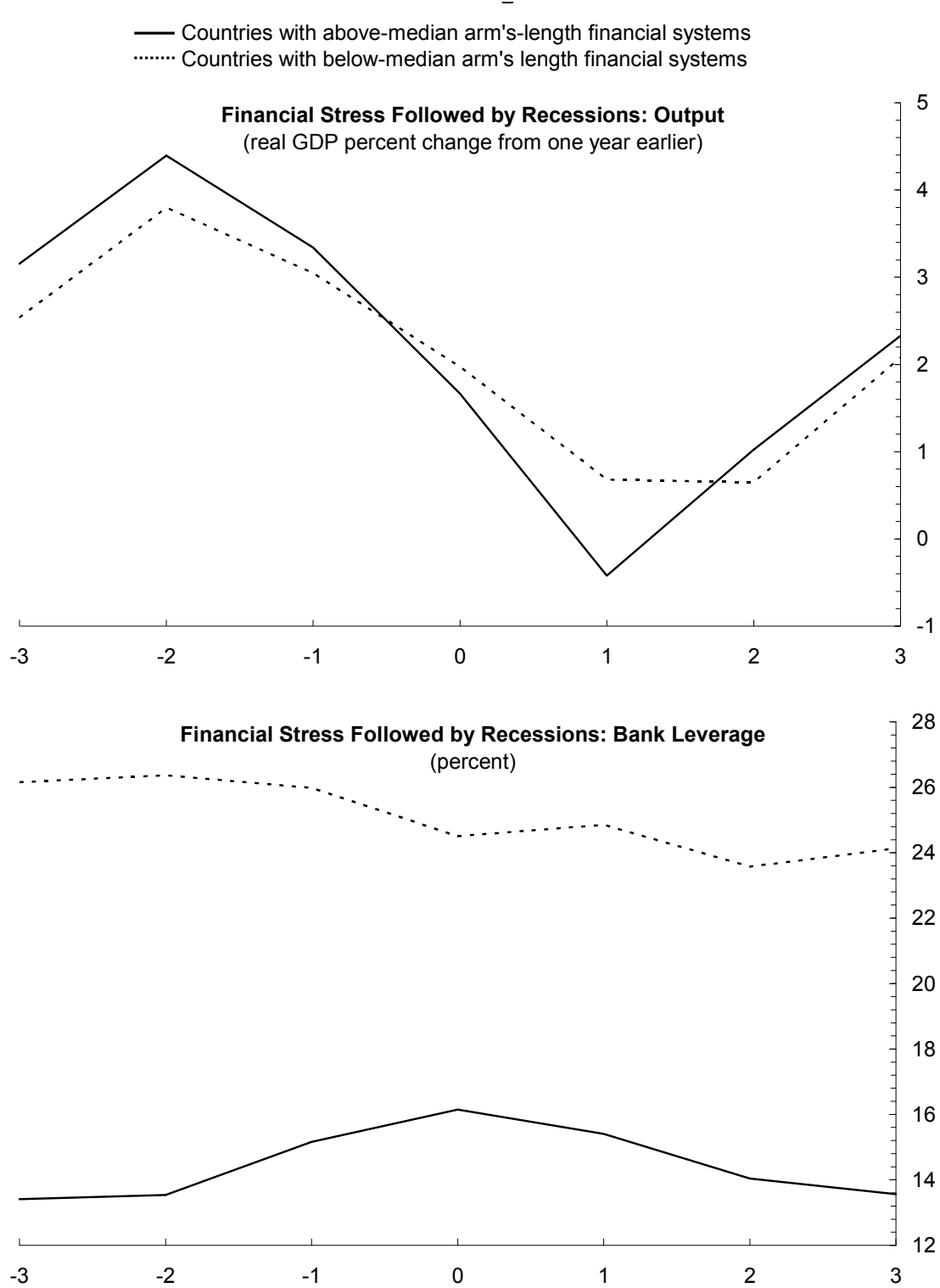
Figure 13. The Procyclicality of Leverage in Financial Institutions.

Source: Authors' calculations.

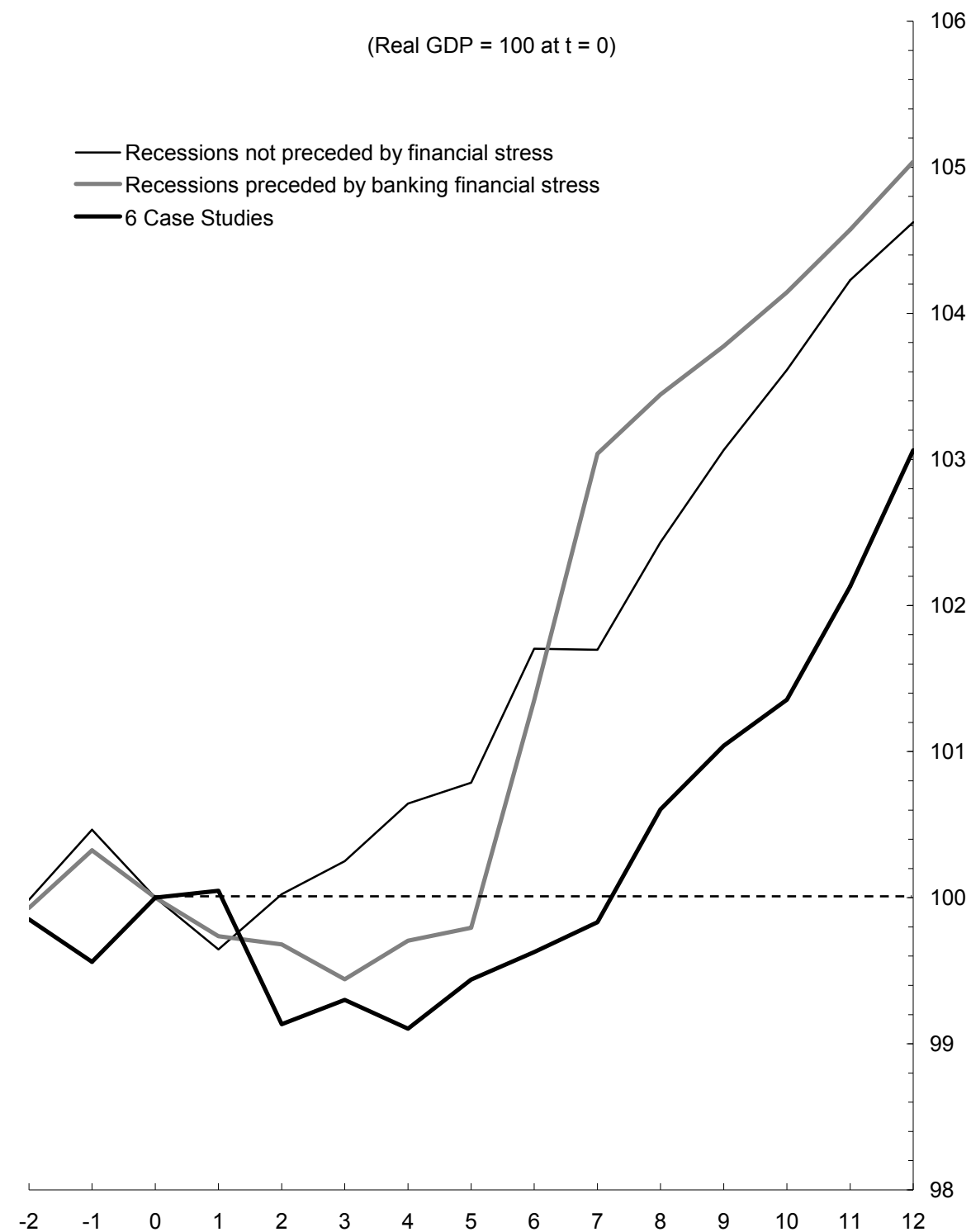
Note: β and R^2 refer to the linear regressions, excluding outliers, of asset (annual) growth over leverage (annual) growth.

Figure 14. Procyclical Leverage and Arm's-Length Financial Systems

Source: Authors' calculations.

Figure 15. Arm's-Length Financial Systems, GDP Growth, and Bank Leverage

Source: Authors' calculations.

Figure 16. Financial Stress, Recessions, and Recoveries

Source: Authors' calculations.

Table 1. Descriptive Statistics on Financial Stress Episodes

	Number of Episodes					Financial stress duration (average; quarters)
	Total	1980s	1990s	2000s	Current	
Financial Stress	113	37	42	34	16	2.42
<i>Of which:</i>						
Banking	43	12	19	12	4	2.44
Securities Markets	50	19	12	19	11	2.4
Foreign Exchange	20	6	11	3	1	2.4
<i>Memo:</i>						
Banking-Related	60	16	25	19	10	2.6
<i>Of which:</i>						
Above median arm's length	31	9	13	9	4	2.42
Below median arm's length	27	7	11	9	5	2.85

Source: Authors' calculations.

Table 2. Descriptive Statistics on Financial Stress Episodes, Slowdowns, and Recessions.

	Number	Duration (average; quarters)		Output Loss (average; percent of GDP)		Number of quarters after start of FS to slowdown or recession
		Financial Stress (FS)	Slowdown or Recession ¹	Cumulative ²	Average	
Financial Stress	113	2.4				
<i>Of which:</i>						
followed by Slowdown	29	2.7	7.6	-7.6	-0.7	2.4
Banking-related	18	3.2	8.4	-9.3	-0.8	1.8
followed by Recessions	29	3	6.8	-13.8	-1.2	2.3
Banking-related	17	4	7.6	-19.8	-1.5	2
Others	55	2				
Slowdown not preceded by Financial Stress ³	109		5.1*	-4.1*	-0.6	
Recession not preceded by Financial Stress ⁴	31		3.1*	-5.4*	-0.9	

Source: Authors' calculations.

Notes:

/1 Slowdown: number of quarters where GDP is below (Hodrick-Prescott) trend; Recession: number of quarters until GDP is at or exceeds previous peak level.

/2 Slowdown: cumulative output loss below HP-trend; Recession: cumulative output loss until recovery.

/3 Asterisks indicate difference from slowdowns preceded by financial stress is significant at 10 percent.

/4 Asterisks indicate difference from recessions preceded by financial stress is significant at 10 percent.

Table 3. Cross-Section Regressions

Dependent Variable: Cumulative Output Loss /1	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Duration of Financial Stress	1.324 (0.100)	1.591 (0.100)	0.641 (0.430)	1.023 (0.330)	0.963 (0.300)	1.377 (0.090)	1.034 (0.200)	0.888 (0.070)	0.711 (0.300)
Real interest rates /2	0.890 0.000	0.808 (0.010)	0.470 (0.120)	0.835 (0.010)	0.877 0.000	0.870 0.000	0.841 (0.010)	0.887 0.000	0.869 (0.010)
Nonfinancial corporation net borrowing ratio /3	2.000 (0.010)					1.753 (0.020)	0.849 (0.350)	1.986 0.000	1.439 (0.070)
Household net borrowing ratio /3		1.050 (0.100)				0.480 (0.440)	0.668 (0.330)	-1.086 (0.220)	-0.890 (0.320)
Real house price /4			14.304 (0.010)						
Real stock price /4				-0.785 (0.720)					
Credit ratio /4					-1.090 (0.900)				
Household net borrowing ratio * duration								0.593 (0.040)	0.561 (0.040)
Nonfinancial corporation net borrowing ratio * duration							0.229 (0.430)		0.136 (0.480)
Constant	-2.014 (0.450)	-0.803 (0.790)	2.076 (0.390)	0.809 (0.740)	0.482 (0.860)	-1.877 (0.500)	-0.727 (0.780)	-1.161 (0.640)	-0.519 (0.850)
N	42.000	40.000	52.000	52.000	52.000	40.000	40.000	40.000	40.000
Adjusted R-squared	0.418	0.287	0.254	0.128	0.126	0.418	0.420	0.493	0.485

Source: Authors' calculations.

Notes: Robust p-values in parentheses.

/1 Dependent variable is cumulative output loss in episodes of financial stress followed by slowdowns or recessions.

/2 Average or real interest rates in six quarters before financial stress.

/3 Net borrowing ratios one year before financial stress (deviation from HP-trend).

/4 Cumulative percent deviation from HP-trend over six quarters before financial stress.

Table 4. Six Major Periods of Financial Stress and Economic Contractions

	Initial Conditions							
	Asset price buildup /1				Net lending ratio /3			
	Equity prices	House prices	Credit/GDP	Bank Assets /2	Households	Corporates		
Finland early 1990s	80	36.1	16.6	21	-6.5	-5.1		
Sweden early 1990s	68.5	17.5	19.1	27.2		
Norway early 1990s	73.9	26.5	18.8	27.6	-6.9	-3.6		
Japan 1990s	54.4	12.2	7.4	22.4	5.3	-5.1		
United Kingdom early 1990s	19.9	22.9	2.5	16.1	-2.3	-3.4		
United States early 1990s	14.5	4.9	3.1	9.5	-0.4	-0.3		
Average	51.9	20	11.3	20.6	-2.1	-3.5		
Current episode								
United States	27.7	5.9	3	9.9	1.4	-0.7		
Euro Area	44	2.9	4.5	9.7	-0.5	-0.4		
Japan /4	25.1	5.4	6.4	-0.8	0.1	-2.9		
United Kingdom	29.4	3.2	5.1	11.2	-0.8	-0.8		
Outcomes								
	Asset price decline				Macroeconomic Deleverage /7		Output Loss /8	Quarters to Recovery
	Equity prices	House prices	Credit/GDP	Bank Assets /6	Households	Corporates		
Finland early 1990s	-85.9	-39.8	-16.8	-5.1	16.2	17	-13.6	27
Sweden early 1990s	-69.5	-20.1	-21.3	-4.9	-5.8	19
Norway early 1990s	-76.9	-24.6	-2.7	-12.5	16.5	8.5	-3.9	12
Japan 1990s	-58.5	-11.1	-6.8	-8.5	0.5	15.4	-5.1	19
United Kingdom early 1990s	-21.4	-23.3	-5.6	-6.5	9.6	4.4	-2.6	13
United States early 1990s	-21	-4.8	-3.8	-5.4	0.8	0.6	-1.3	5
Average	-55.5	-20.6	-9.5	-7.2	8.7	9.2	-5.4	15.8

Source: Authors' calculations.

/1 Trough-to-peak changes before the start of the crisis in the HP-detrended level of the variables.

/2 Maximum percent deviation from HP-detrended levels of bank assets before the start of the crisis.

/3 Deviation from HP-trend at the year before the crisis.

/4 Data in net lending ratios are for 2008.

/5 Peak-to-trough changes after the start of the crisis in the HP-detrended level of the variables.

/6 Minimum percent deviation from HP-detrended level of bank assets after the start of the crisis.

/7 Trough-to-peak changes in HP-detrended net lending ratios.

/8 Output loss is measured as the loss from peak to trough in percent of peak level of output.

APPENDIX I. MAJOR FINANCIAL STRESS EPISODES IDENTIFIED IN THE LITERATURE

1982

Savings and Loans Crisis begins. Several small midwest banks in the United States collapse, leading to bank runs on some larger U.S. banks including Continental Illinois.

Latin American Debt Crisis. In August, Mexico declared that it would no longer be able to service its debt. Subsequently, credit lines were cut and many countries in the region could not roll over their short-term debt obligations, thus generating a systemic crisis.

1984

S&L Crisis grows. During the first quarter of the year, the Federal Reserves and the Federal Deposit Insurance Corporation (FDIC) rescue Continental Illinois (US\$ 10 billion).

1985

S&L Crisis intensifies. In March, emergency bank holiday in Ohio to stave off run on deposits (Home State Savings Bank of Cincinnati collapsed). First significant S&L failures in Maryland, but still not yet widespread.

Plaza Accord (September). U.S. initiated devaluation, coordinated with Japan and Germany.

Second Latin American Debt Crisis. Argentina, Mexico, and Nigeria can not meet debt obligations, Baker initiates debt rescheduling.

1986

S&L Crisis spreads. U.S. Federal S&L Insurance Corporation (FSLIC) declares bankruptcy.

1987

Louvre Accord. Before the Accord, the U.S. dollar hits record low (50 percent off 1985 peak). U.S. initiated coordinated intervention to support the dollar (lasts about 18 months).

October 1987—Stock Market Crash

Stock Market Crash. Largest one-day decline in stock market values in the United States. On October 19, 1987, Dow Jones fell by 23 percent (Mishkin and White, 2002; furthermore, depending on the exact index used, this represent a 25 standard deviation shock). Brokerage firms and specialists were severely in need of additional funds to finance their activities. Despite the financial strength of these firms, the heightened uncertainty implied that banks were reluctant to lend to the securities industry at a time when it was most needed.

Brazil declares debt service moratorium.

1990

Junk bond market collapse in the United States.

Nikkei Crash. Tokyo stock market falls by 50 percent.

Drexel Burnham Lambert (DBL) bankruptcy (February). DBL, at its height, was the fifth-largest investment bank in the United States, which first rose to prominence and then was driven into bankruptcy in February 1990 by its involvement in illegal activities in the junk bond market.²⁷

1991

Scandinavian banking crises. Finland most severely affected relative to Norway and Sweden.

1992

ERM crisis. The European Exchange Rate Mechanism (ERM) is effectively abandoned. The British government was forced to withdraw the pound from the ERM on Wednesday September 16, 1992 after they were unable to keep the Sterling above the agreed lower limit.

1994

Global bond rout (first quarter).

Turkish currency crisis—Lira depreciated against the dollar by about 50 percent.

Mexican “Tequila” Crisis (started in December 1994).

1997

Asian Crisis. Begins in July 2, 1997 with the float of the Thai baht. Indonesia (August), Korea (November), and Malaysia (December) get affected by the crisis sequentially.

1998

Russian Crisis (August)

²⁷ Furthermore, in August, a major stock market decline began, with Dow and S&P falling by 16 percent and 15 percent, respectively. A likely source of financial stress was the very weak conditions of depository institutions. The S&L bailout required a bailout of \$150 billion, while loan losses were increasing and commercial bank failures had risen to over 200 a year by late 1980s.

LTCM Collapse (September).

S&P 500 fell by 13 percent in two months.

1999**Brazilian Devaluation** (January).2000

Stock market crash. NASDAQ declines by 40 percent during March and April. Furthermore, the decline in S&P began in August 2000, falling 23 percent by December 2001. However, stock collapse not evenly felt across the market, but higher tech and higher risk stocks severely affected. Yet, this did not translate into higher risk premiums even in the aftermath of the September 11, 2001 attacks. Some argue that one explanation is that the financial system has been stronger than any time since the 1960s (Mishkin and White, 2002).

2001**September(9/11) attacks on the United States.**

Enron scandal. The scandal involved Enron Corporation and its accounting firm Arthur Andersen revealed in late 2001. After a series of revelations involving irregular accounting procedures conducted throughout the 1990s, Enron was on the verge of bankruptcy by November of 2001. Eventually, Enron filed for bankruptcy on December 2, 2001—*at the time, the largest bankruptcy in history.*²⁸

Turkish financial crisis (worst in post-war history) occurs in February.

2002

The **demise of Arthur Andersen**, which was convicted of obstruction of justice in conjunction with the Enron scandal on June 15, 2002. Andersen was on of the “Big Five “ large international accounting firms—there are only four left.

WorldCom files for bankruptcy on July 21, 2002, the largest in U.S. history at the time.

Argentine crisis. The 10-year currency board (Convertibility) is abandoned during January 2002, and default in the last week of 2001.

²⁸ The fallout from the scandal quickly extended beyond Enron and all those formerly associated with it. The trial of Arthur Andersen on charges of obstruction of justice related to Enron helped to expose accounting fraud at WorldCom (see below), and set off a wave of other accounting scandals.

2003

Mutual fund scandals. On September 3, 2003, the New York State Attorney General announced he had “obtained evidence of widespread illegal trading schemes, ‘late trading’ and ‘market timing,’ that potentially cost mutual fund shareholders billions of dollars annually.”²⁹ On April 28, 2003, every major U.S. investment bank, including Merrill Lynch, Goldman Sachs, Morgan Stanley, Citigroup, Credit Suisse First Boston, Lehman Brothers Holdings, J.P. Morgan Chase, UBS Warburg, and U.S. Bancorp Piper Jaffray, were found to have aided and abetted efforts to defraud investors. The firms were fined a total of \$1.4 billion by the Securities and Exchange Commission (SEC), triggering the creation of a Global Research Analyst Settlement Fund.

2006

May/June. Tightening global liquidity conditions triggered increased risk aversion and a substantial retrenchment by investors from a wide range of risky assets. Many emerging market countries adversely affected by sell-off (including Brazil, Hungary, Indonesia, Poland, South Africa, and Turkey).

²⁹ On September 4, 2003, a major investment bank, Goldman Sachs, admitted that it had violated anti-fraud laws. Specifically, the firm misused material, nonpublic information that the U.S. Treasury would suspend issuance of the 30-year bond. The firm agreed to pay over \$9.3 million in penalties—for a total of 120 million.

APPENDIX II. DATA AND METHODOLOGY

The Financial Stress Index

This section of the appendix describes the components and the methodology used to construct the FSI, with a particular emphasis on data sources. The FSI is an equal-variance weighted average of seven variables, grouped into three categories.

Banking Sector

- Banking sector β : covariance of the year-on-year percentage change of a country's banking sector equity index and its overall stock market index, divided by the variance of the year-on-year percentage change of the overall stock market index. Source: DataStream, Haver Analytics, and the Organization for Economic Cooperation and Development (OECD).
- TED spread: 3-month LIBOR or commercial paper rate minus the government short-term rate. Source: Haver Analytics
- Inverted term spread: government short-term rate minus government long-term rate. Source: DataStream and Haver Analytics.

Securities Market

- Corporate spread: corporate bond yield minus long-term government bond yield. Source: DataStream and Haver Analytics.
- Stock decline: stock index_{t-1} minus stock index_t, then divided by the stock index_{t-1}. Source: OECD.
- Time-varying stock volatility: GARCH(1,1) volatility of overall stock market index monthly return. Source: OECD.

Foreign Exchange

- Time-varying real effective exchange rate volatility: GARCH(1,1) volatility of real effective exchange rate monthly percent change. Source: IMF.

All components are originally in monthly frequency. The index is constructed by taking the average of the components after adjusting for the sample mean and standardizing by the sample standard deviation. Then, the index is rebased so that it ranges from 0 to 100. Finally, it is converted into quarterly frequency by taking the average of the monthly data. The FSI is available for 17 advanced countries from 1980. Data on long-term corporate bond yield for Greece, Ireland, New Zealand, and Portugal were not available and were therefore excluded from the sample.

Episodes of financial stress are identified when the index is one standard deviation above its trend. Episodes that are only two quarters apart are considered one episode. To classify if an episode of financial stress is either due to banking, securities, or foreign exchange stress, we look at the change in the FSI from the quarter prior to the start of the episode to the maximum value of the FSI within the episode. If majority of the increase is due to the banking sector components, then the FSI is classified as banking. The same rule applies if the change is mostly due to the securities markets components or the foreign exchange component. Additionally, if banking contributes at least one-third of the change in the FSI, then the episode is also classified as “banking-related”.

The Cost of Capital

The cost of capital used in the paper is defined as a weighted average of the real cost of bank loans, the real cost of debt, and real cost of equity, using as weights the relative shares of equity, bonds, and loans in nonfinancial corporate liabilities. This is based on the calculation of cost of capital as outlined in Box 4 on page 37 of the March 2005 European Central Bank (ECB) *Monthly Bulletin*. The real cost of bank loans, real cost of debt, and real cost of equity are derived as follows:

- *Real Cost of Bank Loans*: bank lending rates minus one-year-forward Consensus inflation forecast. Sources: IFS, ECB, and Consensus Forecasts.
- *Real Cost of Debt*: corporate bond yield minus one-year-forward Consensus inflation forecast. Sources: Thomson Datastream, Haver Analytics, and Consensus Forecasts.
- *Real Cost of Equity*: the real cost of equity is an extension of a standard dividend discount model and derived using a model specified in Box 2 on page 76 of the November 2004 ECB *Monthly Bulletin*. Using available data for the other variables, the real cost of equity, h_t , can be calculated using the following equation:

$$P_t = \frac{D_t[(1 + g) + 8(g_t^{IBES} - g)]}{h_t - g}$$

where

P_t = real stock price,

D_t = the current level of real dividends,

g^{IBES} = I/B/E/S long term earnings-per-share growth forecast minus Consensus long-term inflation forecast,

g = long-term growth rate of real corporate earnings, assumed constant at 2.5 percent.

The overall cost of capital is calculated as a weighted average of these three components with the weights defined (respectively) as loans, debt, and equity as shares of nonfinancial corporate liabilities from the OECD national accounts data.

BankScope Data

Two datasets were constructed using bank-level data obtained from the Bankscope database.³⁰ The first dataset included only investment banks as classified by the Bankscope database (“Investment Bank/Securities House”). The second dataset, referenced in the paper as commercial banks, included banks with the following Bankscope classifications: Commercial Bank, Savings Bank, Cooperative Bank, Real Estate / Mortgage Bank, and Medium & Long Term Credit Bank.

Sample of Banks

- Investment Banks: the sample of banks contained banks that were in the top 50 investment banks globally by total assets in one or more years from 1988 to 2007.
- Commercial Banks: the sample of banks consisted of those banks that were in the top 10 banks (top 30 banks for the United Kingdom and Japan, top 50 banks for the United States) by total assets for each country in one or more years from 1988 to 2007. Also included were any banks that were acquired by or that merged with a top 10 bank. (See below for an explanation of accounting for mergers and acquisition.)

The number of commercial banks per country used in the sample was chosen to provide a representative sample of banking activity within each country. The following table summarizes the average share of total bank assets (as reported by OECD) per year represented by the banks in the sample:

Consolidated Versus Unconsolidated Balance Sheets

- Investment Banks: Data from consolidated statements were used for investment banks. If consolidated data were unavailable, data from unconsolidated statements were used.
- Commercial Banks: In order to isolate as much as possible the domestic activities of commercial banks, unconsolidated bank data were used for commercial banks in the sample. If unconsolidated statements were unavailable, data from consolidated data were used.

³⁰BankScope database published by Bureau van Dijk Electronic Publishing (BvDEP). www.bvdep.com

Data from multiple statements for the same bank were combined to form a single set of bank level data if the statement types (consolidated or unconsolidated) were the same. In addition, the data were cleaned (by country, in the case of commercial banks) by excluding observations where the growth rate of total assets was above the 95th percentile or below the 5th percentile.

Mergers and Acquisitions

For consistency, banks that were acquired by or that merged with banks included in the original sample set were also included in the dataset. For years prior to a merger or acquisition, the banks involved were treated as separate banks; for years subsequent to a merger or acquisition, the bank resulting from the merger or acquisition was naturally a single bank in the database. In order to calculate level changes or growth rates of a bank *in the year of a merger or acquisition*, a data point was constructed for the year prior to the merger or acquisition by summing the data values of the banks involved in the merger or acquisition.

Appendix II
Table II.1. Average Yearly Share of Total Bank Assets of Banks in Sample

Country	Number of Top Banks in Sample Per Year	Percentage of Country's Total Bank Assets
Australia	10	78%
Austria	10	71%
Belgium	10	94%
Canada	10	88%
Denmark	10	92%
Finland	10	79%
France	10	73%
Germany	10	65%
Italy	10	40%
Japan	30	74%
Netherlands	10	90%
Norway	10	78%
Spain	10	78%
Sweden	10	94%
Switzerland	10	64%
United Kingdom	30	67%
United States	50	60%

Appendix II
Table II.2. Data Sources

Variable	Source	Frequency
GDP	Haver Analytics, Organization for Economic Cooperation and Development (OECD) Analytical Database	Quarterly
Average petroleum spot price	IMF, <i>World Economic Outlook</i> Database	Quarterly
CPI inflation	Haver Analytics, OECD Analytical Database	Quarterly
Real private consumption	OECD Analytical Database	Quarterly
Money supply	GDS, OECD Analytical Database	Quarterly
Interest rate	Haver Analytics, International Financial Statistics (IFS) database	Quarterly
Banking sector equity index	Thomson Datastream, Haver Analytics	Monthly
Stock market index	OECD	Monthly
3-month LIBOR (or commercial paper rate)	Haver Analytics	Monthly
Government short-term rate	Haver Analytics	Monthly
Government bond yields	Haver Analytics, Thomson Datastream	Monthly
Corporate bond yields	Thomson Datastream, Haver Analytics	Monthly
Real effective exchange rate	International Monetary Fund	Monthly
Residential investment	OECD Analytical Database	Quarterly
Nonresidential investment	OECD Analytical Database	Quarterly
Current account	OECD Analytical Database	Quarterly
Real house price	OECD	Quarterly
Credit	IFS Database	Quarterly
Household net lending	OECD	Annual
Nonfinancial corporate net lending	OECD	Annual
Bank assets	OECD	Annual
Bank equity	OECD	Annual

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