Financial Stress and Economic Activity: Evidence from a New Worldwide Index

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April 2025

ABSTRACT: This paper uses text analysis to construct a continuous financial stress index (FSI) for 110 countries over each quarter during the period 1967-2018. It relies on a computer algorithm along with human expert check. The new indicator has a larger country and time coverage and higher frequency than similar measures focusing on advanced economies. And it complements existing binary chronologies in that it can assess the severity of financial crises. We use the indicator to assess the impact of financial stress on the economy using both country- and firm-level data. Our main findings are fivefold: i) consistent with existing literature, we show an economically significant and persistent relationship between financial stress and output; ii) the effect is larger in emerging markets and developing economies and (iii) for higher levels of financial stress; iv) we deal with simultaneous causality by constructing a novel instrument—financial stress originating from other countries—using information from the text analysis, and show that, while there is clear evidence that financial stress harms economic activities, OLS estimates tend to overestimate the magnitude of this effect; (iv) we confirm the presence of an exogenous effect of financial stress through a difference-in-differences exercise and show that effects are larger for firms that are more financially constrained and less profitable.

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We would like thank Tobias Adrian, Shekar Ayair, Menzie Chinn, Simon Baptist, Laurent Ferrara, Pierre-Olivier Gourinchas, Daniel Leigh, Alessandro Previtero, Simon Sheng and participants in various seminars and conferences for their comments and suggestions.This paper benefited from financial support by the U.K.'s Foreign, Commonwealth and Development Office. The views expressed in this study are the sole responsibility of the authors and should not be attributed to the IMF, its Executive Board, or its management.

I. Introduction

Financial crises are to economists what earthquakes are to geologists: phenomena of enormous impact about which we have only limited understanding.[1] We know what makes them more likely to occur, but we find it extremely difficult to predict their timing and intensity. We design policies to increase resiliency *ex ante* and emergency response *ex post*, but we are unable to completely eliminate their devastating consequences. And we are often reminded of the need to develop better forecasting models and policy tools by their sudden reappearance after periods of apparent tranquility. It is therefore not surprising that research about financial crises is often seen as critical in both academia and policy making institutions.

The starting point in understanding the consequences of financial crises is how to define, identify, and measure them. Indeed, while measuring the intensity of an earth tremor is relatively straightforward, evaluating financial stress and defining what counts as a crisis is not. We do not have the economic equivalent of a seismograph. As Romer and Romer (2017) point out, statistical "objective" measures of financial stress, such as credit spreads, may misidentify crisis episodes. They may react to factors other than financial stress (i.e., changes in monetary policy) and may fail to reflect aspects of financial stress episodes (for instance credit rationing) that do not translate into price effects. Further, data on these statistical indicators is typically limited to advanced economies and for relatively short time horizons.

For these reasons, the most broadly used financial-crisis indexes are based on historical analyses of events characterized by major stress in the financial sector combined with statistical indicators. Caprio and Klingebiel (1996) were the first to construct a dataset on bank insolvencies for close to hundred countries. Reinhart and Rogoff (2009) extended the work on banking crisis to 81 countries over the period of 1800 to 2014, and Laeven and Valencia (2013, 2014, and 2020) constructed and later extended one of the most comprehensive financial crises datasets covering 165 countries. All these studies use binary measures to codify financial crises episodes which are admittedly crude as they only capture the occurrence (date) of financial stress but not its intensity (although, Laeven and Valencia also provide more continuous measures such as the fiscal cost of a crisis).

Romer and Romer (2017; RoRo thereafter) take a different tack on the same approach. First, they confine their historical analysis to the "contemporaneous narrative accounts of country conditions" published semi-annually in the OECD Economic Outlook. This limits the analysis to 24 advanced countries for the period 1967-2012,[2] but it allows for more meaningful comparisons across countries and time. Second, they seek to capture variations in crisis intensity and duration and more accurately describe financial stress. In particular, RoRo extends previous binary measures to an index that "classifies financial stress on a relatively fine scale." RoRo demonstrates that, unlike most previous narrative work that sought mainly to identify key crises episodes, it "… may be possible to go further and use narrative sources to code more nuanced developments." This approach has the potential of capturing financial stress in a more wholistic way including in addition to timing and frequency, also intensity, and duration, all from a single narrative source.

[1] Bordo et al. (2001), Reinhart and Rogoff (2009), Sufi and Taylor (2021).
[2] In an update the authors add 6 countries that joined the OECD between 1994 and 2000 and extend the sample to 2017.

This paper introduces a new index that builds on RoRo's approach. We make three important modifications. First, instead of the OECD reports, we rely on the Economist Intelligence Unit (EIU) country reports which allows us to extend the country coverage to 110 countries and the frequency from semi-annual to quarterly over the period 1967-2018. Second, we take a more mechanistic approach at measuring the intensity of financial stress: we rely on search algorithms and word counts in addition to expert judgement. This has two benefits and one cost. On the benefits side: it allows for a updating of the series and it further increases cross-country and time-series comparability. On the costs side: it may fail to identify some potentially important information that an expert reader devoted to reading all the relevant reports could exploit to better measure the intensity of financial stress. Our third modification follows suggestions in RoRo on the desirability to assess more accurately the exogenous contribution of financial stress to declines in output. To this purpose, we follow the same approach of Peak and Rosengren (2000) who use financial stress in Japan to identify exogenous declines in the supply of credit in the United States. In particular, we carefully examine the narrative in the EIU reports and identify, for each country, episodes of financial stress stemming from financial stress in other countries. Arguably, these episodes are less driven by domestic economic conditions and could be deemed more exogenous to domestic economic activity. [3]

The new series performs well when put to the test. For OECD countries, our index essentially mimics RoRo (the correlation is 0.9). Considering the two indexes use different sources and a different approach at measuring intensity, this reassures us that our search algorithm and word count do a more-than-decent job at measuring financial stress. In addition, our measure confirms RoRo's findings that financial stress is often building up ahead of the crisis year picked up by most existing binary measures.

The new index contributes to the existing measures of financial stress in several ways. Compared to previous studies using chronologies, the index allows us to capture to the intensity and duration of financial stress. Compared to continuous measures of financial stress (RoRo), the index covers a much larger set of (110) countries at the quarterly frequency for a longer time period (1967-2018). It also overcomes two potential problems related with available statistical measures of financial stress—such as sovereign yields, corporate spreads, equity indices, sovereign yields, corporate spreads, equity indices. First, and as discussed by RoRo, these measures may react to factors other than financial stress (i.e., changes in monetary policy) and may fail to reflect aspects of financial stress episodes (for instance credit rationing) that do not translate into price effects. Second, data on these statistical indicators are typically limited to advanced economies and for relatively short time horizons.

In the second part of the paper, we use local projections (Jordà, 2005) to examine the effect of our measure of financial stress on economic activity (GDP and other economic outcomes such as stock market returns, productivity, employment, and uncertainty). We have five main findings. First, consistent with much of the literature, increases in financial stress have detrimental effects on economic activity. In particular, we find that a one-standard deviation increase in our financial stress index is associated with a reduction in the level of output by 0.35 percent one year after the increase in financial stress and by 0.2 percent 5 years after. Second, the extension of the country coverage to

[3] A potential concern in using foreign stress as an instrument is that it could lead to reduced domestic economic activity also through trade linkages. We show that our instrumental variable approach produces similar results when we account for this transmission channel by controlling for trading partners weighted GDP growth.

emerging markets and developing countries shows quantitative differences in the relationship between financial stress and output across different country groups. The effects of crises tend to be significantly larger for emerging markets and developing economies than for advanced economies. Third, the effect of financial stress on economic activity is non-linear: the effect is small and not statistically significantly different from zero for lower levels of financial stress, while it is large and more precisely estimated for medium-to-high levels of financial stress. This non-linearity is markedly more significant and robust in emerging markets than in advanced economies, adding a qualitative dimension to the quantitative differences reported above. Fourth, using our external financial stress series as an instrumental variable, we show that, while financial stress has a statistically significant exogenous effect on economic activity, simultaneous causality biases OLS coefficients downward—as weaker economic activity tends to intensify financial stress. Finally, we use a large sample of firm-level data covering advanced and emerging economies and a difference-in-differences approach to further strengthen exogeneity and examine firms' heterogeneity in response to financial stress. The results suggest that increases in financial stress lead to persistent declines in the level of firms' investment, with the effect being larger for firms that are less profitable (characterized by lower profits, revenues and return on assets) and more financially constrained (characterized by higher debt-to-asset ratios and being smaller and younger).

The remainder of the paper is organized as follows. Section II provides a brief literature review with focus on recent papers aiming to measure financial crises and discusses our contribution to this literature. Section III describes the data sources and methodology used in the construction of the new index. Section IV takes a first look at the index, presenting selected examples of country cases and some notable global trends. Section V empirically examines the effects of FSI on economic activity. The section first reports the empirical strategy used followed by baseline and robustness results. The section ends with an investigation of mechanisms at the macro- and firm-levels. Section VI draws conclusions and poses questions for future research.

II. Literature Review

Existing measures on financial stress fall into two broad strands.[4] The first, codifies financial crises with binary variables, and further differentiates them into systemic and non-systemic. Some of the work that fall under this strand include: Bordo et al. (2001), Caprio and Klingebiel (2003), Demirgüç-Kunt and Detragiache (2005), Reinhart and Rogoff (2009), Schularick and Taylor (2012), and Laeven and Valencia (2013, 2014, and 2020).

Bordo et al. (2001) define financial crises as episodes of financial-market volatility marked by significant problems of illiquidity and insolvency among financial-market participants and/or by official intervention to contain those consequences. They identify episodes of financial crises from a review of the historical literature for 56 countries from 1880 to 1998. Caprio and Klingebiel (2003) compile a list of 113 systemic banking crises (defined as much or all of bank capital being exhausted) that have occurred in 93 countries since the late 1970s to 1999. They also provide information on 50 borderline and smaller (non-systemic) banking crises in 44 countries during the late 1970s to 1999

[4] Our literature review focuses on measures of financial stress. We do not provide a comprehensive literature of the studies examining asymmetric effects of financial stress on future GDP growth. For example, Adrian et al. (2022), using panel quantile regressions for 11 economies, explore how different states of the economy can potentially interact with financial conditions in nonlinear ways in forecasting the GDP growth distribution at different time horizons.

period. Demirgüç-Kunt and Detragiache (2005) use a signals approach and multivariate probability model and their application to studying banking crises in 94 countries from 1980 to 2002.

Reinhart and Rogoff (2009; ReRo thereafter) have compiled a dataset on banking crisis for 81 countries over the period of 1800 to 2014. The construction of the dataset relies heavily on the work of other scholars and they mark a banking crisis by two types of events: (i) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions, and; (ii) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution that marks the start of similar outcomes for other financial institutions. Schularick and Taylor (2012) have assembled a list of financial crises dataset for 14 countries over the period of 1870 to 2008 based on annual coding of financial crisis episodes documented by other scholars. They define financial crises as events during which a country's banking sector experiences bank runs, sharp increases in default rates accompanied by large losses of capital that result in public intervention, bankruptcy, or forced merger of financial institutions.

Finally, Laeven and Valencia (2020; LV thereafter) have compiled the most comprehensive dataset on systemic banking crises for 165 countries over the period of 1970 to 2017. This effort updates the authors' global dataset on systemic banking crises (see, Laeven and Valencia 2008, 2013) which has become the gold standard in the literature on banking crises worldwide.[5] The dataset is based on defining a banking crisis as an event that meets two conditions: (i) significant signs of financial stress in the banking system; and, (ii) significant banking policy intervention measures in response to significant losses in the banking system. As in Laeven and Valencia (2013), the 2020 update on banking crises episodes is further complemented with dates of sovereign debt and currency crises during the same period. In total, 151 banking crises were identified, in addition to 236 currency crises, and 74 sovereign crises.

The second strand in the literature codifies financial stress with continuous rather than binary variables. Jalil (2015) constructs a series documenting banking panics in the US dating 1825 to 1929. This study uses newspapers as its source of narrative analysis and identifies banking panic episodes which were consequential in periods of output decline. Romer and Romer (2017) in their pioneer work used the narrative approach to develop a more comprehensive series of financial stress chronology using semi-annual data for 24 advanced economies for the period 1967 to 2012.

To construct the new measure, RoRo use a single, real-time narrative source—*OECD Economic Outlook*—to classify financial stress on a scale of 0 to 15. To classify financial stress, they start with a keyword search for terms likely to appear in periods of financial stress (e.g., "bank", "financial", "crisis", "rescue", "bailout", "crunch", and "squeeze") to identify which entries to read more closely. However, from December 2007 volume, they read each volume in its entirety (between 600 – 900 words) as the keyword search returned so many matches. Finally, RoRo classifies financial stress on a relatively fine scale and further identifies categories of stress to which they assign episodes that have natural interpretations (e.g., credit disruption, moderate crisis, extreme crisis). One of the key contributions in RoRo is that it convincingly demonstrates how examining narrative sources strengthens the case for a continuous measure compared to a binary measure of financial stress classification.

[5] For over a decade, the Laeven-Valencia dataset has been used in hundreds of applications and received thousands of citations in both academic and policy journals.

Another important study in the second strand of the literature is the work by Baron et al. (2021). They use large bank equity crashes to provide an objective, quantitative, and theoretically motivated measure of banking crises. Specifically, they construct a dataset on bank equity prices and dividends for 46 advanced and emerging economies from 1870 to 2016. They supplement existing bank stock indexes with indexes assembled from new, hand-collected stock price and dividend data from historical newspapers. To validate their approach, they show that bank equity prices are strongly correlated with traditional symptoms of banking crises (e.g., likelihood of government interventions to support banking sector, deposit runs, non-performing loans, and bank failures).

In summary, the first strand of the literature is based on annual coding of financial crisis episodes, treats financial crises as a binary variable, and identifies banking crises grounded on narrative information about events such as bank runs and policy interventions. While these binary chronologies cover a large set of countries across long time periods, they have some drawbacks. Discrete chronologies may in general be too coarse. They may miss milder episodes of financial stress or if calibrated to capture these moderate stress events, they are forced to treat them the same way they treat severe episodes. We contribute to this literature by providing a cross-country consistent continuous measure of financial stress for a large set of countries. As we show in the next section, increases in our measures often precedes the occurrence crisis episodes.

The second strand in the literature uses continuous measures not only to identify episodes of financial crises but also to characterize their intensity. However, this literature so far has covered only a limited set of mostly advanced countries. We contribute to this literature in two ways. First, our index extends the existing country sample significantly by adding about 80 developing economies and emerging markets and increase the frequency of coverage to quarterly data. Second, we make a deliberate effort to address endogeneity concerns by constructing (from the same narrative analysis) an instrumental variable reflecting stress originating outside a country's domestic economy to be used in causality identification exercises.

III. Data Collection and Index Construction

This section discusses the methodology used to construct the FSI, and how it follows the "requirements for rigorous narrative analysis" of Romer and Romer (2023): (i) a reliable narrative source; (ii) a clear idea of what we are looking for in the source; (iii) approach the source dispassionately and consistently; (iv) and document the narrative evidence carefully.

Data Source

The first requirement is to use a reliable narrative source, which is provided in real time, consistent over time, detailed and accurate. Our source is the Economist Intelligence Unit (EIU) country reports.[6]

The EIU, part of The Economist Group, provides insight and analysis of global economic and political developments. As part of its services, the EIU provides country-specific reports covering a large number of countries. Each country report examines and explains the main political and economic developments in the domestic economy. These reports average about 12,000 words in length and are available on a quarterly basis going back to the 1950's. Importantly, these reports provide a real-time

[6] See Ahir, Bloom and Furceri (2022) who also used EIU for constructing an index on economic uncertainty.

detailed assessment of the economic and political developments of an economy and are released timely—typically at the end of the month of the quarter covered in the report.

To prepare the reports, the EIU follows a rigorous process which aims to deliver transparency, accuracy and consistency. In particular, the EIU relies on a comprehensive network of experts based in the field and in its network of offices in key global hubs. Designated country experts prepare a first draft of the report, based on material from experts in the field, public sources and in-house models, and these are then peer-reviewed, subedited and put through data-quality checks to make the reports consistent and standardized. In addition, the format, topics covered, and level of analysis is relatively consistent both across countries and over time.

The use of EIU country reports has several advantages, compared to alternative sources such as, for example, OECD and IMF reports. First, they are published with high frequency (minimum quarterly basis). Second, they are available over an extended time period (current work covers the period from 1967 to 2018). Third, they cover about 180 advanced, emerging markets, and low-income countries.[7] Specifically, in comparison to OECD reports the clear advantage of EIU is that it covers the large majority of developing economies going back to the 1950's. With such wide coverage we can get a picture of global financial stress and also focus on emerging markets which as we show in the next section are the recipients of most financial crises and exhibit a relationship between financial stress and economic activity that differs from that in advanced economies. This would not be possible with the OECD reports which cover mostly advanced economies. In comparison with the IMF Article IV reports, the advantage of EIU reports is that they are available at higher frequency, while IMF reports are available mostly on annual basis and in some cases (especially in earlier years) on a semi-annual basis. [8]

While we do believe that the EIU is a reliable narrative source, one potential shortcoming of any single-source approach is that the resulting index will only be as good as the chosen source (in our case the EIU reports). Put differently, what we gain in tractability and cross-country comparability we may pay in terms of missed information. For this reason, we see single-source narrative-based indexes as a complement rather than a substitute for the more comprehensive zero-one historical efforts such as LV. That said, we are reassured by the fact that a cross-examination of FSI across other prominent measures in the literature (as discussed later on) shows that our EIU-based measure is fairly consistent with previous series.

Constructing the Index

We construct our financial stress index (FSI) for 110 countries for the period 1967-2018 (we restrict the sample to countries with population above 2 million).

What we are looking for. Conceptually, we follow Bernanke (1983) and RoRo and aim at classifying as episodes of financial stress in which an economy experiences an increase in the cost of credit intermediation or disruptions to the credit supply. As described by RoRo, the rise in cost of credit

[7] See the Supplementary Material—Online Appendix Table A1 for country coverage by income level and geographical region.

[8] In our future work we plan to use the EIU availability at the monthly frequency starting in 2008 and covering a smaller sample of (about 70) countries, as well as will include alternative versions of FSI that reflect sub-dimensions of financial stress. See Ahir, Bloom and Furceri (2022) for a similar approach.

intermediation includes both a higher cost of funds for financial institutions relative to a safe interest rate and an increase in other operational costs associated with their lending activities. Put differently, we want to identify episodes in which, for a given level of the expected return on safe assets, the cost (quantity) of credit to the economy increases (decreases). Note that this definition excludes reductions in the supply of credit stemming from increases in interest rates due "normal" cyclical factors such as tighter monetary policy.

Approach. We follow a three-step process to construct the index.

First, similar to RR, we try to narrow down the amount of text in the EIU reports to search for information about financial stress. As RoRo (2017) states: "To narrow the amount of the volumes we need to study closely, we start with a keyword search for terms likely to appear in accounts of financial distress. The most important are bank and financial, but we also search for crisis, rescue, bailout, crunch, and squeeze." They also mention that they experimented with searching for "credit".

We adopt a similar approach and identify paragraphs/lines containing two set of keywords: (i) credit, financial, bank, lending, and fund, and; (ii) crisis, crunch, squeeze, bailout, rescue, tight, contract, and reluctant. The words in the first group (credit, financial, bank, lending, fund) aims at capturing discussion related to the "financial" market, while the words in the second group tries to capture the distress part (e.g., rise in the cost). This approach is very important to limit the volume of pages we need to read for each country-period pair, since we do this process for 110 countries, four times a year (quarterly frequency), and the average length of the report per country is about 30 pages. So, we cover a very high amount of text compared to RoRo (2017). [9]

In the second step, we read the paragraphs extracted in step 1 to confirm that the text is indeed describing developments associated with *contemporaneous* financial stress. The point here is to exclude false positives. An example classified as financial stress related to domestic event is the following: United States (2009Q4): "The administration will also continue to focus on supporting a recovery from the financial and economic crisis and to implement measures that help to avoid a recurrence of such a crisis." To determine whether recovery from a crisis is an actual signal of contemporaneous financial stress, we focus on whether the economy is "under the process of recovery" or "fully recovered from the financial stress". In this case, we read that the government is "supporting a recovery", which indicates that US is still recovering, and the effects of crisis still exist. There is no mention of the stress originating from external causes, therefore, by default, we take "crisis" here as a signal of domestically originated financial stress. At this stage, we also look for text that refers to an increase in the cost of credit intermediation due to developments external to the country (e.g., financial crisis in country A spreading to country B and leads to financial stress in country B). An example classified as financial stress related to external shock is the following: Denmark (2008Q2): "In response to the global credit crunch, the national bank has opened a new seven-day secured lending facility to support liquidity in the money market."

Our search algorithm picks several false positives. For instance, Colombia (2000Q3): "The financial services sector, having contracted by some 10% in 1998-99, continues to consolidate by cutting costs, capitalization and rebuilding reserves." We do not count this event as a contemporaneous financial stress episode. The text does not mention financial stress—that is, the contraction could be simply due to a correction in a previous expansion of the sector—nor the sources causing the contraction in

[9] They follow this process for 24 countries twice a year and the average length of the report per country is about 4 pages.

financial services sector, and it refers to events one-to-two years before the publication of the report. This and other examples show how crucially important was to the data construction process the reading and validation of the text by an expert.[10]

In the last step, we sum the verified signals of financial stress in each period to convert the qualitative classifications to quantitative measure of financial stress. Our working assumption is that as the severity of financial stress increases so will the extent to which it is covered in the EIU country reports. So that higher word counts will correspond to more severe episodes. While this assumption could be questioned, its main advantage is that it improves the transparency and replicability of our approach and reduces the risks of using previous knowledge to focus on certain periods or to quantify the level of financial stress based on ex-post information. We also later verify our assumption by comparing our index to existing financial stress indicators such as RoRo that rely on expert judgement to assess the severity of a stress episode.

An obvious difficulty with these raw counts is that the overall length of country reports varies across time, and across countries. Thus, to make the index comparable across countries, we scale the raw counts by the total number of words in each report and rescaled by multiplying by 1,000.[11] Two factors further help improve the comparability of the index across countries. First, the index is based on a single source. Second, the reports follow a standardized process and structure. In addition, the process to put together the reports described earlier helps to mitigate concerns about the accuracy, ideological bias and consistency of the index.

The resulting index ranges from 0 to 3.15. The index is continuous. But one can use thresholds to "discretize" the index and provide a picture of what "real world" conditions correspond to different index values. As an example, we segment the index values into quintiles. The first quintile (episodes with values above zero but below 0.16), correspond to credit disruptions. The second quintile takes values from 0.16 to 0.25 and correspond to minor crisis. The third quintile takes values from 0.26 to 0.43 and correspond to moderate crisis. The fourth quintile takes values from 0.44 to 0.68 and correspond to major crisis. And the fifth quintile takes values from 0.69 to 3.15 and correspond to extreme crisis. For instance, we could say that the United States experienced a moderate crisis (the index is at 0.27) in the second half of 1990, which is consistent with the classification that RoRo give. Meanwhile, in the first half 2008, we could say that the United States experienced an extreme crisis (the index value is 0.89), while RoRo labels it as a moderate crisis. And in the second half of 2008, the United States continues to experience an extreme crisis (the index value is 1.32), in line with the classification that RoRo give.

Documentation. Table A2 and A3 in the Supplementary Material—Online Appendix report the narrative associated to our episodes of financial stress as well as stemming from financial stress in other economies. Exhibits 1-4 below provide detailed examples on how we classify these episodes based on the original narrative evidence.

[10] In a previous version of the paper, during the review process of the IMF working paper, we also asked IMF country economists to cross-validate the identified signals. IMF economist suggested very minor corrections of the index for few cases (such as Ecuador, Nepal, and Venezuela). In this version of the paper, we decided to do not incorporate these corrections to limit the risk of incorporating ex-post judgment in the construction of the index and improve its replicability for other researchers.

[11] As discussed in Ahir, Bloom and Furceri (2022), while the number of words is on average larger in advanced economies than in emerging and low-income countries, there are no systematic differences across income groups. For example, country reports for countries such as Nigeria or Egypt have a larger number of pages (words) than many advanced economies.

IV. Financial Stress Index (FSI): Global Trends and Country Experiences

Next, we report global, regional, and country-specific financial stress trends and episodes using our newly constructed index. Also, for validation, we compare our index with existing chronologies.

Global Movement

Figure 1 shows that global financial stress as measured by the FSI rose during the Latin America debt crisis in the 1980s (often known as "La Década Perdida," The Lost Decade), the Mexican Peso Crisis in the mid-1990s, the financial crisis in Asia, Russia, and Latin America (also coinciding with the Long-Term Capital Management episode) in the late 1990s, and then rose sharply during the Global Financial Crisis (GFC) and Europe's sovereign debt crisis between 2008-2013. The index then remained relatively stable at least until our last observation in 2018 (an update to current times would likely show some activity during the COVID crisis).

Heterogeneity across Country Income Groups

The magnitude of financial stress varies significantly across income and regional country groups and also across events. Figure 2 shows significant heterogeneity in stress levels across advanced, emerging and low-income economies. For instance, in 2008Q4, the level of the FSI is close to the global average in emerging economies, below it in low-income economies, and about three times it in advanced economies. This is in line with the GFC been described as a crisis of advanced economies.

Averages vs. Episodes

The average level of financial stress over the 1967-2018 period is higher in advanced economies than in emerging economies. Panel A in Figure 3 shows that on average the level of financial stress is 0.033 in advanced economies, followed by 0.025 in emerging economies, and 0.010 in low-income economies. However, the picture changes if we look deeper into the data. If we exclude the period 2008 to 2012 (GFC), the average level of FSI is higher in emerging economies, followed by advanced economies, and low-income economies (Figure 3, Panel B). Moreover, Panel C in Figure 3 shows that the number of quarters with financial stress (normalized by number of countries) is highest in emerging economies (20.7 quarters), followed by advanced economies (15.7 quarters), and low-income economies (13.7 quarters). The low FSI values for low-income economies in all three panels in Figure 3, likely reflect less developed and interconnected financial sectors--a leading explanation as to why these economies survived the GFC better than richer countries.

Regional Heterogeneity

Finally, Figure 4 shows the level FSI across geographical regions. It shows little financial stress in Africa and the Middle-East and Central-Asia—regions characterized by lower levels of income per capita and financial development. In contrast, the Asia-Pacific region shows financial stress during the Asian crisis as well as during the GFC. In the Western Hemisphere, the FSI registers elevated levels during the financial crises in the region in early 1980s, late 1990s and during the GFC. And, for Europe, the FSI captures financial stress during GFC and the European sovereign debt crisis.

Comparison of FSI with Existing Chronologies

Next, we focus on how our new FSI compares with existing measures of financial stress/crises. Table 1 reports key characteristics of our measure and those by RoRo, ReRo, and LV.[12] It shows that the country coverage, frequency, and time coverage varies across measures and that FSI generally compares favorably to other measures along all three dimensions. Table 2 provide simple pairwise correlations between each of the four measures. The correlation between FSI and RoRo in the overlap of observations available to both indices is remarkably high at 0.9 despite the different sources and different approaches at evaluating stress intensity. Similarly, the correlations between the FSI and the two binary indicators are also high—at 0.4 with LV and 0.4 with ReRo—but lower than with respect to RoRo, likely reflecting the fact that our FSI is positive for many zeros recorded in the binary chronologies. And third, the correlation between any two indicators from RoRo, RoRe, and LV, is in the range of 0.5 to 0.7.

To highlight commonalities and differences across measures, Figure 5 compares FSI with the other three selected existing measures of financial stress for a set of 8 countries: the United States, South Korea, Honduras, Argentina, the Philippines, Nigeria, Costa Rica, and Rwanda.[13] Data for LV ends in 2017, for ReRo ends in 2014, and RoRo ends in 2012, so in Figure 5 we restrict our data to match these sample periods. Using these country cases, we can make four noteworthy observations. First, as seen in the case of the US (Panel A) our measure is very closely aligned with that of RoRo. This is indeed the experience in most of the countries for which there is data overlap in the two indices. Compared to the LV and ReRo binary indicators, our indicator, as that of RoRo, captures the severity of the stress more accurately—for instance, the binary indicators are unable to distinguish between the severity of the Savings and Loans crisis against that of the GFC.

Second, the broader country coverage of FSI relative to existing continuous stress measures, allows for a greater examination of heterogeneity in the severity and duration of financial stress across countries and episodes. For example, Panels B, C, and D report comparisons of the three chronologies for Argentina, Philippines and Nigeria, respectively—countries not covered by RoRo. It is clear in all three cases that while the FSI is in broad agreement with LV and ReRo on the timing of financial stress, there exist glaring differences in intensity across these episodes. Take the Argentina case (Panel B): all three indices capture the timing of the Latin America Debt Crisis in the 1980s, the Mexican Peso crisis of the 1990's, and the most severe Argentina crisis of 2001. However, the binary indicators fail to capture differences in severity across these crises, thereby equating what seems to have been a mild financial stress period during the Mexican Peso crisis to the severe Argentine financial crisis of 2001.

Third, there are some cases in which intensity measures do not capture any financial stress episodes, while binary chronologies do, and vice versa. For instance, in the case of Honduras (Panel E) FSI identifies a long period of severe financial stress (1980-1985) related to the broader debt crises in Latin America,[14] while the two binary measures do not pick up any financial stress. And conversely, in the case on Korea (Panel F), ReRo identifies a period from 1985 to 1989 of financial stress that is not

[12] For brevity we focus only on three alternative chronologies. Appendix Table A4 of the Supplementary Material—Online Appendix provides detailed country-by-country coverage comparison of our measure with 8 alternative measures in the literature.

[13] For comparisons between FSI and RoRo, ReRo, and LV chronologies for all 110 countries in our sample see Appendix Figure A1.

[14] According to official documents of June 1983, Honduras had accumulated 75% of GDP in total foreign debt. During the same period 8 other Latin American countries had foreign debt ranging from 75%-134% of GDP. During the 1980s, a period often referred to as "the lost decade", many Latin American countries were unable to service their foreign debt.

identified by FSI. One possible explanation for these two differences is that the definition of financial stress to construct FSI and the definition of banking crisis in ReRo and LV are not identical. In the case of Honduras, we identified narratives such as "liquidity crisis", "credit squeeze" and "financial crisis" from 1980 to 1985, which are clear signs of financial stress to construct the FSI. But neither ReRo nor LV identified such period. In LV's study, two conditions should be met to identify a banking crisis: 1) significant signs of financial stress in the banking system; and 2) significant banking policy intervention measures. In EIU reports, we do not observe any policy intervention, which indicates that the first condition is met, but the second condition is not met—and that could possibly explain why such period is not identified as banking crisis in LV's study. In the case of Korea, the difference in the definition also seems to play a role. ReRo has a rather broad definition of financial stress (banking crisis) compared to the definition of FSI. The large-scale financial liberalization in Korea in the 1980s, and the subsequent increase in the number of banks, is seen as a risk of a banking crisis (Reinhart, 2002; Shin and Hahm, 1998). This case would be barely picked up by our index because we follow a stricter definition of financial stress, which captures a shortage of credit supply. In contrast, in Korea in the 1980s, the credit supply was increasing steadily. This is consistent with the data from LV, whose study finds no systemic banking crisis in mid 1980s, because it follows a rather strict standard to identify systemic banking crisis.

Fourth, in a few country cases, FSI and the binary chronologies simply do not match in identifying financial stress. Panels G and H report such instances for Costa Rica and Rwanda, respectively. For the case of Costa Rica, FSI moves only very little during the 1987 and 1995 crises identified by both LV and RoRe. This case could also be due to the differences in the definition of the measures of financial stress. According to ReRo and LV, the first period of banking crisis from 1987 is identified due to extremely high levels of non-performing loans in the banking system; and the second crisis is led by the closure of the third largest bank in the country. The narratives in the EIU reports of Costa Rica during these two periods, barely mention signals that we use to pick up financial stress. In contrast, FSI spikes in 1967 as the EIU explicitly mentions "economic and financial crisis that now seems endemic in Costa Rica", while ReRo and LV identifies this as debt and currency/external crisis. For Rwanda, FSI identifies two periods of stress that are not identified by LV. From the EIU reports, FSI picks up narratives such as "tight liquidity" in 1985 and "liquidity squeeze" in 2009, which are signals for financial stress. In 1985, "strained treasury and corporate bond is draining liquidity in the banking sector", which causes financial stress. In 2009, the financial stress is due to withdrawals of funds by major depositors, losses on foreign investments, and lower domestic saving, which is possibly associated with the Global Financial Crisis.

Finally, in addition to the explanations above regarding the differences among the three series, there are two additional possible explanations. First, ReRo rely on case reports and other studies, which raises the possibility of omitting important episodes or transferring mistakes from earlier work to their chronology. Second, one of the two necessary criteria of LV for classifying events as a crisis—significant banking policy intervention measures—could be problematic. As Friedman and Schwartz (1963) document, the U.S. government failed to respond significantly to the banking panics of the Great Depression, yet it was still a financial crisis. Therefore, some of these methodological or definitional issues could also explain differences between our work and those of these other studies.

Overall, these discrepancies suggest that these measures are complements rather than substitutes, with costs and benefits on both sides. More generally, while we hope to have demonstrated that our new FSI is able to identify financial stress episodes and overall compares favorably with existing narrative measures, we recognize that it is by no means always the preferred one.

Finally, the FSI is also positively and statistically significantly correlated with statistical measures of financial stress such as the Financial Condition Indices (FCIs) developed by the IMF (2017)—correlation about 0.45—suggesting that the index could also be used as complement to these statistical indicators when they are not available.[15]

V. Empirical Analysis: The Effect of FSI on Economic Activity

In this section, we investigate the economic effect of financial stress using country- and firm-level data. Using country-level information, we proceed in two steps. First, we use the quarterly frequency of the data to estimate the baseline effects of our financial stress indicator on GDP for a panel of 49 countries for which data is available, consider nonlinearities in the relationship between the severity of our index and GDP, and how it varies across country groups—Advanced Economies (AEs) vs. Emerging Market and Developing economies (EMDEs). In a second step, we subject our baseline results to a battery of robustness tests.

These include alternative data samples, specifications, and frequencies—in particular, we use annual data which allows us to increase the county and time dimension of our sample but also to compare the estimates from FSI with those from previous measures. Finally, we construct a novel instrumental variable which we use to deal with simultaneous causality. This is a key contribution of this paper to the existing literature as it provides an identification strategy that does not rely on sectoral data and a diff-in-diff approach and hence allows for an estimation of level effects.

Next, we extend the analysis by using a comprehensive quarterly firm-level dataset for a set of sixty-three AEs and EMDEs over 20 years. This extension makes two important contributions. First, the large coverage of the dataset (over 20,000 firms in our sample) along with the extensive firm heterogeneity makes it possible to estimate the economic effects of financial stress with much more precision than when using country-level data. Second, and more important, it complements our IV approach in dealing with endogeneity. As in previous studies (see for instance, Dell'Ariccia et al., 2008; and Kroszner et al., 2007), we employ a difference-in-differences framework—assigning firms into different groups based on their exposure to financial constraints—which includes country-sector-time fixed effects. The working assumption, based on previous finding of the literature (see, for example, Hoberg and Maksimovic 2015), is that financial stress should have a greater impact on firms that are more financially constrained, while the fixed effects effectively control for domestic macro-economic shocks (such as the policy response in the domestic economy). Evidence of a differential effect across firms, would thereby confirm the presence of causal effect from financial stress to economic activity.

Country-level Analysis

Empirical Methodology

To examine the dynamics of output following changes in financial stress, we follow the local projection method proposed by Jordà (2005), a methodology used also by Auerbach and Gorodnichenko (2013), RoRo, and Alesina et al. (2019) among others. This procedure does not impose the dynamic

[15] The FCI is computed as the principal component of several financial variables such as interest rates, sovereign and corporate debt spreads, equity prices and volatility, exchange rate volatility and real house prices; it covers an unbalanced sample of 43 advanced and emerging market economies from 1996Q1.

restrictions embedded in vector autoregression specifications and is particularly suited to estimating nonlinearities in the dynamic response. The first regression we estimate is:

$$y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=i}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k, \quad (1)$$

where *i* index countries, *t* refers to quarters, and *k* denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is change in the log of output between period *t* and *t+k*; α_i are country fixed effects included to take into account differences in countries' average economic performance; γ_t are time fixed effects, included to control for economic developments facing all countries in a given year; ΔF denotes the change in financial stress.

In the baseline, we estimate Equation (1) for an unbalanced sample of 49 countries for which we have quarterly data from 1996Q1 to 2018Q4. Limited availability for quarterly data dictates the boundaries of this sample. As a robustness check and extension, we investigate the sensitivity of our results to a larger sample of 110 countries, using annual data from 1967 to 2018.

Equation (1) is estimated using ordinary least squares (OLS) for horizon (quarter) $k = 0,\ldots,20$. The coefficient β^k denotes the "impact" of (one standard deviation) changes in FSI on output at a given horizon *k*. Impulse response functions are computed using the estimated coefficients β^k, and the confidence bands associated with the estimated impulse-response functions are obtained using the estimated standard errors—clustered at the country level—of the coefficients β^k.

In the baseline, we do not take a stance on the drivers of financial stress—that is, we do not distinguish between changes in financial stress stemming from other countries and that can therefore be considered "more exogenous" to domestic economic activity, from endogenous ones that arise from domestic conditions. Later on, we investigate the sensitivity of our results to exogenous changes in financial stress, either using these foreign-originated changes as an instrument for overall changes in financial stress or directly as regressors.

Data Sources

The quarterly and annual macroeconomic series for GDP, employment, labor productivity (defined as the ratio of GDP to employment), unemployment, policy rates and cyclically adjusted balance are taken from the IMF World Economic Outlook. The classification of countries in income groups (advanced vs. emerging markets and developing economies) and regions (Africa, Asia-Pacific, Europe, Middle-East and North Africa (MENA) and Americas) follows that of the IMF World Economic Outlook. Data for uncertainty are taken from Ahir, Bloom and Furceri (2022). Data on stock returns and return volatility are taken from Baker, Bloom and Terry (2021).

Baseline Results

Table A1 presents the results obtained estimating Equation (1) for each horizon (quarter) *k*, from 0 to 20. The lagged output coefficient, as expected, is close to 1, suggesting that the level of GDP is non-stationary and that the country fixed effects capture average GDP growth rates.[16] The country

[16] Panel cointegration tests reject the null hypothesis that the estimated residual of Equation (1) is non-stationary.

fixed effects are jointly statistically significant, as are the time fixed effects, reflecting the importance of global shocks.

Figure 6 presents the evolution of (log) output following a one-standard deviation increase in FSI (this is equivalent to 0.1 changes in the index). Time is indicated on the x-axis; the solid line displays the average estimated response, shaded areas denote 90 percent confidence bands. The results suggest increases in financial stress are associated with sizeable and persistent reductions in the level of output, and transitory ones in the growth rate of the economy. In particular, we find that a one standard deviation increase in FSI (such as that experienced by Germany in the third quarter of 2011) is associated with a reduction in the level of output by 0.35 percent one year after the increase in financial stress and by 0.2 percent 5 years after. This result is highly statistically significant, economically sizeable, and appears reasonable. To put it in perspective, the results suggest that the peak increase in financial stress observed in the United States during the GFC (1.7 in the fourth quarter of 2008) would have been associated with a reduction in US GDP by about 6 percent in 2009—an estimate in line with the range found in the literature (e.g., RoRo).

Heterogeneity: Advanced vs. Developing Economies

Several studies using binary chronologies of crises suggest that the economic effects of banking crises tend to be larger in EMDEs than in AEs (see e.g., Cerra and Saxena 2008; Gourinchas and Obstfeld 2012; and Claessens et al. 2009, 2014). To corroborate this evidence, we re-estimate the following equation:

$$y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^{kAE} D \cdot \Delta F_{i,t} + \beta_0^{kEMDE}(1-D) \cdot \Delta F_{i,t} + \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k, \quad (2)$$

where *D* is a dummy variable which takes value 1 for AEs, and zero otherwise. The coefficients β^{kAE} and β^{kEMDE} capture the relationship between output and financial stress for AEs and EMDEs, respectively.

The results reported in Figure 7 show that the response of GDP to an equal increase in financial stress, is more than twice larger in EMDEs than in AEs. This result is consistent with some existing literature based on the binary indicators which points to the greater economic severity of financial crises in EMs. However, the novelty of our results is that, thanks to the FSI intensity dimension, we are able to highlight that what drives the heterogeneity in the output response across AEs vs EMDEs is not the different severity of financial stress (since we are comparing the responses to the same increase in financial stress) but rather the differences in economic resilience, including the ability and space of fiscal and monetary policies to respond to financial stress.

Nonlinearities: Severity of Financial Stress

To investigate the possibility that more severe stress levels are disproportionately more detrimental to output than moderate levels, we estimate variants of our baseline specification that relax the assumption that the relationship between output and financial stress is independent of the level of financial stress. In particular, we modify Equation (1) as follows:

$$y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^{kG} I[F_{it} \in G\,] \cdot \Delta F_{i,t} + \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k, \quad (3)$$

where *I* is an indicator function which assumes value 1 when the level of financial stress belongs to a specific bin (terciles) of the distribution, which we refer to as group *G*. The coefficients β_0^{kG} capture the relationship between output and financial stress at horizon *k* for each "group" of financial stress. The main benefit of this specification is that it does not impose any functional form to capture non-linearity in the way the effect of financial stress on output varies across groups (low, medium and high) of financial stress.

The estimates reported in Figure 8 Panel A suggests nonlinearities in the response of the economy to financial stress: the effect of financial stress on output is small and not statically significantly different from zero for lower levels of financial stress, while is precisely estimated and larger than the baseline estimates of Figure 6 for medium-to-high levels of financial stress. The differences in the response between low vs. medium financial stress and low vs. high financial stress are statistically significant up to *k*=11. However, they become insignificant in the medium-term because of the large confidence bands associated with the medium-term point estimates for the low-financial stress regime (Table A2). Overall, these results are consistent with Baron et al. (2021), that find non-linear effects of bank equity returns on output and bank credit. A potential reason of why financial stress has larger marginal impact on the economy when is high could be a lower fiscal (monetary) response to offset the lager shock.

Next, we examine whether the extent of non-linearity in the relation between financial stress and output vary between AEs and EMDEs. To do so, we estimate a variant of Equation (3):

$$y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^{kGAE} I[F_{it} \in G\,] \cdot D \cdot \Delta F_{i,t} + \beta_0^{kGEMDE} I[F_{it} \in G\,] \cdot (1-D) \cdot \Delta F_{i,t} +$$

$$+ \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k. \qquad (4)$$

The results reported in Figure A2 show that for both group of countries, the output responses are not statistically significant for low levels of financial stress but become larger and more precisely estimated for medium-to-high levels of financial stress. Notably, the non-linearity is more pronounced and significant in EMDEs than AEs (where it is significant only at high levels of stress).

These results are robust to alternative specifications to capture non-linearity in the relation between financial stress and output. As a first alternative, we consider a variation of equation (2) in which *D* takes value 1 if the level of financial stress is above the median of the distribution, and zero otherwise. In a second alternative specification, we replace *D* with a smooth transition function of the level of financial stress. The results reported in Figure A3 confirm non-linearity: the response of the economy following an increase of a given size in financial stress is large and statistically significantly when the initial level of stress is already high, while being small and typically not statistically significant when the level of financial stress is initially low.[17]

Robustness Checks

To check the robustness of these results, we performed several sensitivity tests across alternative samples and specifications.

[17] The differences in the responses in these two approaches is statistically significant only in the short term but not in the medium term because of the large confidence bands associated with the medium-term point estimates for the low-financial stress regime. In addition, differences are more noticeable for EMDEs than AEs (see Figure A2). Finally, and consistent with Romer and Romer (2017), we do not find evidence that the effect of financial stress output depends *linearly* on the level of financial stress.

Alternative samples. We considered samples dropping the following sets of observations: a) Outliers (those observations corresponding to the residuals in the output regression in the bottom and top percentiles of the distribution); b) High inflation episodes (inflation above 20 percent); c) Observations from the Americas; d) Asian and Sub-Saharan African economies; e) Drop small countries; f) Episodes of large changes in financial stress episodes (those corresponding to the 99th percentile of the distribution); g) Observations pertaining to the period following the GFC (after the third quarter of 2008).[18] The results are shown to be robust to all these perturbations as reported in Figure A4.

Alternative specifications and control variables. We considered two main modifications to Equation (1). First, we restrict the change in the financial stress indicator to enter Equation (1) only with a lag—that is, we do not estimate the contemporaneous effect of financial stress on GDP. This is equivalent to estimate, for k>1, the GDP effect of changes in financial stress that are orthogonal to contemporaneous changes in economic activity. Second, we add a set of control variables that may be related to financial stress and affect output—such as changes in monetary policy rates, changes in cyclically adjusted budget balance, stock market growth and volatility, and economic uncertainty. The results reported in Figure A5 are not statistically different from those reported in the baseline.

Alternative data frequency. We also re-estimate Equation (1) using annual data for an unbalanced panel of 110 countries over the period 1950-2018. Table A3 presents the results obtained for each horizon (quarter) k, from 0 to 5, and Panel A in Figure A6 presents the evolution of (log) output following a one-standard deviation increase in the financial stress indicator (this is equivalent to 0.1 changes in the index). The results confirm that increases in financial stress are associated with sizeable and persistent reductions in the level of output, and transitory ones in the growth rate of the economy. In particular, we find that a one-standard deviation increase in the financial stress indicator is associated with a reduction in the level of output by 0.8 percent one year after the increase in financial stress and by 0.6 percent 5 years after. This estimate is highly statistically significant, and even larger than the one obtained using quarterly data. To check whether this larger estimate is the result of a larger sample, we repeated the analysis constraining the sample to be the same as the one used for the quarterly data. The results confirm the larger estimate obtained using annual data (Figure A6 Panel B). A possibility for this larger estimate is that reverse causality tends to be larger using annual data. This suggests that analysis on the effect of financial crises and stress using annual data are likely to overestimate the macroeconomic effect of financial stress.

Comparison with other Chronologies

Next, we compare the relationship between FSI and output using annual frequency (to allow comparisons across all measures) to those obtained using other measures. To do so, we re-estimate Equation (1) using the measures of: (i) RoRo (annualized); (ii) LV; and (iii) ReRo—aiming at maximizing the overlap of the estimation sample as well as the number of episodes of financial stress. We report the results in Figure 9. For each alternative measure, we report their output response as well as the output responses obtained using our index over the same sample. In particular, in the left panels we report the estimates for FSI over the samples for which RoRo, LV and ReRo are available. In the right panels, we show the responses of the financial stress together with the other chronologies.

[18] Similar results are obtained when excluding the period after the fourth quarter of 2007, or after 2009.

The results point to two main findings. First, the responses reported in the left panels confirm the robustness of the estimates for FSI over alternative samples. Second, the magnitude of the estimates varies across chronologies. While the output effects of a one standard deviation increase in our index are in the same ballpark than that those associated with a of a one standard deviation increase in RoRo index, they are about one-tenth smaller than those associated with the financial crises identified in LV and ReRo. This result provides strong support for the evidence reported previously suggesting that the relationship between financial stress and economic activity is non-linear and steepens with the intensity of the financial stress—a dimension binary measures do not capture.

Addressing Endogeneity

To address endogeneity concerns, we carefully examine the narrative in the EIU reports describing the episodes of financial stress and identify those stemming from financial stress originating outside each country.[19] Arguably these episodes are less driven by domestic economic conditions and can be treated as exogenous to GDP. Indeed, estimates of these changes on their own lags and contemporaneous and lagged GDP confirm that this is the case (Table A4).

Once these episodes are identified we use them as instruments for the overall changes in FSI. In particular, our IV strategy reads as:

$$y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^k \widehat{\Delta F_{i,t}} + \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k,$$

and

$$\Delta F_{i,t} = \pi_i^{\square} + \tau_t^{\square} + \vartheta \Delta EF_{i,t} + \sum_{j=1}^{2} \rho_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \sigma_j^k y_{i,t-j} + \mu_t^{\square}, \quad (5)$$

where $EF_{i,t}$ is the indicator of external financial stress. The first stage estimates suggest that the instrument is "strong" and statistically significant. The Kleibergen–Paap rk Wald F statistic—which is equivalent to the F-effective statistic for non-homoskedastic errors in case of one endogenous variable and one instrument (Andrews et al., 2019)—is about 1200, about 75 times the associated Stock-Yogo critical value (16.38).

Our IV results support the findings obtained with OLS: the baseline IV result indicates a significant negative and persistent effect of financial stress (Figure A7). However, the magnitude of the IV coefficient estimates is smaller in absolute value than the OLS estimate, which suggests that OLS estimates are downward biased and should be considered an upper bound of the negative effect of financial stress on economic activity. This is consistent with the evidence that some financial stress is a consequence of declines in economic activity. We also re-estimate Equation (1) using external financial stress directly as the main regressor, instead of as instrument for overall financial stress. The results are qualitatively unchanged.

To test the validity of our instruments, we run several checks. First, we test whether the instruments have a direct effect on economic activity by including them as additional controls in the baseline model (Table A5). If the coefficients turned out to be negative and significant, one could argue that the

[19] See Table A3 of the Supplementary Material—Online Appendix. for the list of episodes and the associated narrative. Based on Table A3, we find that about 35 percent of our observations with financial distress are foreign-originated; of which 67 percent relates to Great Financial Crisis, 26 percent relates to a combination of Great Financial Crisis and Euro Debt Crisis, and 7 percent relates to other crisis (Mexico's Tequila crisis, Asian crisis, Russian crisis, and other).

instrument is part of the error term and thus does not satisfy the exclusion restriction. The results suggest that this is not the case. Second, we test directly the association of the baseline residuals and the instrument. The results suggest that the relationship is indistinguishable from zero (Table A6), which supports the validity of our instruments.

Additionally, we exclude from the analysis, once at the time, the United States and other G7 economies as domestic economic conditions in these larger economies are more likely to generate financial spillovers in other countries, which could then spill back home. Also in this case, the results confirm the validity of our instruments (Figure A8). We also consider the possibility that external financial stress transmits not only through the financial channel (therefore, leading to an increase in financial stress in the domestic economy) but also through trade. To control for this possibility, we expand the regression to include trading partners weighted GDP growth, where the weights are given by the share of each trading partner in the country's total trade. Also in this case, the results corroborate the validity of our instruments (Figure A9).

Another potential concern is that a large part of episodes of foreign-driven financial stress relates to the Global Financial Crisis (GFC).[20] While it seems reasonable to argue that many countries would not have experienced domestic financial stress if the crisis would not have originated in a key global financial center, an interesting question is whether the results would remain robust when we exclude this influential observation. To check for this, we re-estimate equation (1) by limiting our sample at the end of 2006. The results reported in Figure A10 confirm a negative and persistent effect of financial stress, while the instrument remains sufficiently strong (the F-test of the first stage now is reduced to about 66 but is well above the associated Stock-Yogo critical value of 16.38).

Finally, we re-estimate Equation (2) using annual data (Figure A11) and also re-estimate Equation (2) and (3) with an IV approach. Similarly, to what was found above, the results, although smaller in magnitude, are qualitatively consistent with the OLS results.[21]

Channels

We finish the cross-country analysis by making a first attempt at exploring channels through which financial stress may affect output. We do so by re-estimating Equation (1) using potential drivers of output as alternative dependent variables as follows: (i) labor productivity; (ii) employment; (iii) unemployment; (iv) the growth rate of stock market returns; (v) stock market volatility; and (vii) economic and policy uncertainty (World Uncertainty Index by Ahir, Bloom and Furceri, 2022). The results reported in Figure 10 suggest that a key channel is the statistically and economically significant decrease in labor productivity, which declines by about 2 percent after one year following a one-standard deviation increase in financial stress. Increases in financial stress have also negative effects in the labor market by reducing employment about 1 year after the shock and increase the unemployment rate by about 0.1 percentage point, 1 year after the shock. Finally, the results corroborate existing evidence that increase in financial stress is associated with a short-term decline in stock market growth, and short-lived increase in stock market volatility and uncertainty (e.g., Caggiano et al., 2021 and references therein). Similar results are obtained when using the IV approach (Figure 11).

[20] Note that given that our empirical specification controls for time fixed effects, variation in the instrument mostly comes from different timing in which the GFC spread across countries.

[21] The results are available upon request.

Firm-level Analysis

In this section, we complement our cross-country analysis with firm-level analysis. The extensive firm coverage and heterogeneity helps with identification and allows for further testing causality through a difference-in-differences approach.

Data

Our main source is S&P Capital IQ (CIQ), which provides extensive firm balance sheet and income statement information. The main advantage of this dataset compared to other leading corporate data providers such as Orbis or Worldscope is that data are available at the quarterly frequency, which is more suited to identify the firm-level responses to high frequency shocks—such as financial stress episodes.

The dataset covers 150 countries from 1950Q1 to 2021Q2. In order to reduce significant gaps in the time series, we restrict the sample to 2001Q1 onwards, and to 75 advanced and emerging market economies. Details regarding the sample of countries used in the analysis, by geographic region, are available in Table A5 of the Supplementary Material—Online Appendix. The data is restricted to non-financial corporations and was cleaned to remove firms which had negative values for assets or debt in any year, and observations with the incorrect sign for revenue, capital expenditure, cash, tangible assets, and interest expenditure were set to missing—see Kim et al. (2020) and Arbatli-Saxegaard et al. (2022) for details. We further restrict the sample to exclude real estate and insurance companies. Tables A6 and A7 (the Supplementary Material—Online Appendix) display the number of firms across countries and 20 economic sectors.

We make use of a set of balance sheet and cash-flow statement indicators from S&P Capital IQ to investigate the response of firm-level investment to financial stress, and its heterogeneity depending on firms' characteristics. As for our investment measure, we use capital expenditures (IQ_CAPEX-2021). This variable refers to funds used by firms to acquire assets—such as property, plant, or equipment—and generally used to undertake new investments.

Empirical Methodology

Our empirical approach to quantify the effect of financial stress at the firm-level proceeds in two steps. In the first step, we estimate the average (unconditional) effect of financial stress on firm investment using Jordà's (2005) local projections. Specifically, we estimate the following specification:

$$y_{n,i,t+k} = \alpha_{isq}^{k} + \gamma_{n}^{k} + \sum_{j=0}^{4} \beta_{j}^{k} \Delta F_{i,t-j} + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}, \quad (6)$$

where dependent variable, $y_{n,i,t+k}$, is the change in investment ratio between period (quarter) t and $t+k$ in firm n of country i; $\Delta F_{i,t}$ denotes the change in the financial stress indicator at time t; γ_{n}^{k} indicate firm fixed effects to control for unobservable time-unvarying firm characteristics and α_{isq}^{k} are country-sector-quarters dummies to account for cross-sector variations across countries as well as seasonality in the data.

In the second step, we expand equation (6), to estimate how the effect of financial stress varies across firms. We apply a difference-in-differences approach based on the identifying assumption that financial stress has larger effects on firms that are less profitable (characterized by lower profits,

revenues and ROA) and that are more financially constrained (characterized by higher debt-to-asset ratios and being smaller and younger). In particular, we estimate the following specification:

$$y_{n,i,t+k} = \alpha_{ist}^{k} + \gamma_{nq}^{k} + \sum_{j=0}^{4} \mu_j^k \Delta F_{i,t-j} * D_n + \sum_{j=1}^{4} \theta_j^k y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}, \quad (7)$$

where *D* is a dummy which is equal to one if the firm country characteristics is below (above) the median of the country value.[22] We use the average profitability over the entire sample to define this dummy to reduce endogeneity due to the potential time-varying response of corporate debt to recessions. α_{ist}^{k} are country-sector-time fixed effects to account for macro-economic shocks and their differential effect across sectors (such as the differential effect of financial stress) as well as sector-specific shocks at the country level (such as changes in country regulations affecting a given sector). γ_{nq}^{k} are firms-quarter dummy to account for firms' characteristics as well as seasonality in the data. μ_j^k indicates the marginal (additional) response of investment to financial stress in quarter k for firms with a low (below-median) level of profitability relative to those with high levels of profitability. Equations (4)-(5) are estimated using OLS (and IV) and standard errors are two-way clustered on firm and country-time.

Results

Figure 12 presents the response of (log) investment to an increase in financial stress. Time (quarter) is indicated on the x-axis; the solid line displays the average estimated response, dashed areas denote 90 confidence bands, respectively. Consistent with previous findings in the literature (e.g. Duchin et al. 2010), the results suggest increases in financial stress are associated with persistent effects on the level of investment. In particular, we find that a one-standard deviation increase in financial stress is associated with an average reduction in the level of firms' investment of about 6 percent after 7 quarters. The effect is persistent at about 4 percent after 12 quarters. In addition, as for the country-level analysis, the effect is larger emerging markets and developing economies than for advanced economies.

Figure 14 reports the differential response of investment to financial stress between a firm with relatively low profitability/high financial constraints and firms with relatively high profitability/low financial constraints. The results show that the differential investment loss for a firm with low profitability/high financial constraint is statistically significant and precisely estimated across all variables and most of the horizon considered, with the peak effect being economically sizeable at about 10 percent. These results are robust when estimating Equation (7) with the IV approach using the external financial stress indicator as the instrument (Figure 14).[23]

VI. Conclusions

This paper uses text analysis to construct a continuous financial stress index (FSI) for 110 countries quarterly over the period 1967-2018. The new indicator has a larger country and time coverage and higher frequency than similar measures focusing on advanced economies (RoRo) and it complements binary indicators with broad country coverage and extends the work on banking crisis to 81 countries

[22] Similar results are obtained when we consider the median of the sector, and the median of the sector within each country.

[23] The role of various firms' characteristics in shaping the effect of financial stress on investment is not statistically different between advanced economies and emerging markets and developing economies. For the latter, the effects are more precisely estimated for ROA and age than for other firms' variables.

over the period of 1800 to 2014 (Laeven and Valencia 2013, 2014, and 2020; and Reinhart and Rogoff, 2009) by providing a continuous measure of financial stress intensity. Further, since FSI relies primarily on a computer algorithm, it is easy to maintain and update.

We use our new indicator to revisit a set of key questions in the literature: What is the effect of financial stress on output? Can we establish a causal effect between financial stress and output loss? Is this loss temporary or persistent? Does the severity of financial stress affect its relationship with output? And is the relationship different in advanced economies, emerging markets, and developing countries?

We confirm the existence of an economically significant and persistent relationship between financial stress and output. Further, using our newly constructed series of "foreign-originated" stress we provide evidence of a causal effect of financial stress on output, but also suggest that OLS estimates will tend to overestimate such effect. Our IV approach contributes to the literature by providing novel "simultaneous-causality-proof" level estimates of the effect. Yet, we also use firm-level and a diff-in-diff approach to further confirm the direction of causality in the relationship between financial stress and economic activity.

We exploit the broad country coverage and continuous nature of our index to explore the cross-country heterogeneity of the relationship between financial stress and output. We confirm evidence that crises tend to be more disruptive in EMDCs than in AEs. But we also show that this is not due solely to the fact that less advanced economies are exposed to larger shocks. Rather, even for comparable levels of financial stress, the effects on output tend to be larger in EMDCs, suggesting that greater fiscal and monetary policy space and stronger institutional frameworks are likely to play a role. Finally, especially for EMDEs, we find evidence of nonlinearities in the relationship between financial stress and economic activity, with the effect being typically not significant for low levels of financial stress.

This paper opens important questions for future research. First, across all 110 covered countries, we observe that generally FSI tend to pick up the start date of stress earlier than the binary measures and this is especially true for developing economies. Future research could investigate whether and under what conditions an early rise in FSI could serve as a warning indicator for more severe financial crises. Second, what are the mechanisms through which financial stress impacts output? Our initial attempt points to labor productivity and unemployment as promising areas of future research. Second, further work using text analysis would certainly contribute to the frequency of observations and depth of the narrative around each observation. Third, extending the empirical exercises in this paper using emerging sources of firm-level data across different sectors and countries seems also an exciting venue of research.

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Exhibits

Exhibit 1—United States in 2009

Date	Financial Stress Detected?	Source of Financial Stress
2009Q1	Yes	Domestic
2009Q2	Yes	Domestic
2009Q3	Yes	Domestic
2009Q4	Yes	Domestic

Notes: Examples of the actual text for each of the quarters in 2009:

- **2009Q1:** "Real GDP is forecast to contract by 3.1% in 2009 as the **financial crisis** and the housing downturn take their toll on domestic demand. Slowing growth in the developed world will also curb US export growth in 2009."
- **2009Q2:** "Consumer expenditure is depressed by the sharp decline in employment and weakening wage growth. Households are also hit by **tightening financial** conditions for new loans, a particular concern because much of the earlier spending binge had been debt-financed. The collapse of stock markets and housing prices has also undermined consumer wealth, with household net **financial** and tangible assets down by 154% of annual disposable income (to 484%) between the peak at the end of the third quarter of 2007 and the end of the fourth quarter of 2008."
- **2009Q3:** "The decline in residential investment is showing signs of abating given that the earlier falls had been truly dramatic. We now expect housing investment to start expanding again in 2010, albeit at a subdued pace, and US house prices to find a firmer footing in 2010 and to have stabilised by late 2010 or early 2011. Weaker domestic and foreign demand, increased uncertainty and **tight credit** conditions will lead to a hefty 19% decline in private non-residential investment in 2009, and this will be only gradually offset by stronger public investments as a result of the stimulus package."
- **2009Q4:** "The administration will also continue to focus on supporting a recovery from the **financial** and economic **crisis** and to implement measures that help to avoid a recurrence of such a crisis. The effects of the stimulus package worth US$787bn signed into law in February 2009 will gradually fade in 2010, and the debate will shift to whether there will be need for further measures. We expect some measures to be extended (as has already occurred for a home-buyers **credit**, which was due to expire in November 2009). However, the scale of fiscal support will decline dramatically in 2011 and fiscal consolidation will gain in importance."

Exhibit 2—Denmark in 2008

Date	Financial Stress Detected?	Source of Financial Stress
2008Q1	Yes	Foreign
2008Q2	Yes	Foreign
2008Q3	Yes	Foreign
2008Q4	Yes	Foreign

Notes: Examples of the actual text for each of the quarters in 2008:

- **2008Q1:** "The headline consumer confidence index slipped further from a net balance of -1.1 in January to -2.5 in February, the lowest level since 2003. Whereas the survey respondents adopted only a slightly more negative view of their own personal finances, their expectations regarding the Danish economy have altered radically. The constant barrage of negative news regarding the global **credit crisis**, recession in the US, inflation and asset price falls may be largely to blame. Hence, consumer spending may not slow as much as the confidence readings suggest. Signs of economic slowdown are nonetheless evident in the latest bankruptcy statistics, which show a 22% year-on-year increase in business failures in January 2008 (to a total of 232)."
- **2008Q2:** "In response to the global **credit crunch**, the National **Bank** has opened a new seven-day secured **lending** facility to support liquidity in the money market."
- **2008Q3:** "Private consumption growth will be much weaker than in recent years, as a result of a number of factors. First, high interest rates (partly stemming from the increase in **banks** own financing costs as a result of the **credit crunch**) will curb **credit** growth, as well as eroding the disposable income of heavily indebted Danish households. Second, inflation has risen and will fall back only gradually from the end of 2008. Even though nominal wage growth should continue to outpace the rise in prices, real wage growth will be substantially lower than in recent years. Third, although we expect continued employment growth in 2008 (following a surprisingly strong start to the year), conditions in the labour market are likely to become less favourable by 2009."
- **2008Q4:** "Following a strong cyclical upswing in 2004-06, the Danish economy is heading for its most severe contraction since the 1970s. With businesses and consumer confidence at extremely low levels, and external demand weakening, we expect real GDP growth to contract by 0.8% in 2008 and a further 1.6% in 2009, before stabilising in 2010. A correction in the overvalued housing sector and developments in international **financial** markets also mean that there remain significant risks to our forecast. The Danish **banking** system is generally sound, but **banks** are weaker than they should be relative to the stage in the economic cycle as a result of the global **credit crunch**. Rising defaults at home and/or persistent turmoil in international **financial** markets could trigger an even sharper **restriction** of **credit** to the economy than is currently envisaged, which would have severe implications for economic growth."

Exhibit 3—Colombia in 2000

Date	Financial Stress Detected?	Source of Financial Stress
2000Q1	Yes	Domestic
2000Q2	Yes	Domestic
2000Q3	No	None
2000Q4	No	None

Notes: Examples of the actual text for each of the quarters in 2000:

- **2000Q1:** "In the short term the process of narrowing the overall fiscal (combined public- sector) deficit has been hampered by the burden of providing support for the **financial** sector. Legislation approved by Congress in October will oblige the private sector to contribute to the recapitalisation of mortgage **lenders** through compulsory bond purchases. Further state support will be required before the **financial** sector **crisis** has passed, as most of the **banks** in difficulties are state owned. The cost of the emergency operation for the **banking** sector is estimated at between 4% and 6% of GDP, with 60% needed for capitalisation of publicly owned **banks**. In order to help finance this, on January 7th the government extended the 0.2% tax on **banking** transactions, which had first been introduced as a temporary measure in November 1998, to 2002. The tax, which initially covered only withdrawals, was amended to cover all transfers. By widening the scope of the tax the government hopes to add at least $540m a year to revenue."
- **2000Q2:** "Both the World **Bank** and the Inter-American Development **Bank** (IDB) approve of the Fogafin strategy, but domestic private-sector **banks** are not as supportive. They hold that the conditions on Fogafin support (that a **bank** be on the verge of collapse) result in private **banks** being heavily penalised by a nervous public. Consequently, some private **banks** may delay recapitalisation rather than subject themselves to the Fogafin scheme (which could further aggravate the **crisis**), or, as the government might hope, private **banks** may simply look for other sources of financing and use Fogafin as a **lender** of last resort."
- **2000Q3:** "The **financial** services sector, having **contracted** by some 10% in 1998-99, continues to consolidate by cutting costs, capitalisation and rebuilding reserves.
- **2000Q4:** "The president, Andrés Pastrana, faces serious political challenges. He needs to win approval for reforms required by the IMF, but further delays are likely as he lacks a majority in Congress and has faced setbacks to the peace process against a backdrop of escalating violence. In this context Mr Pastrana's prospects rest heavily on international support. The EIU expects the backing of the IMF and the US to hold firm, while the EU is moving towards agreement on an aid package. Higher than expected oil revenue has helped to restore the economy to growth in 2000, but political uncertainty, a weakened **financial** system and reduced oil production will **restrain** growth in 2001-02."

Exhibit 4—Sri Lanka in 1998

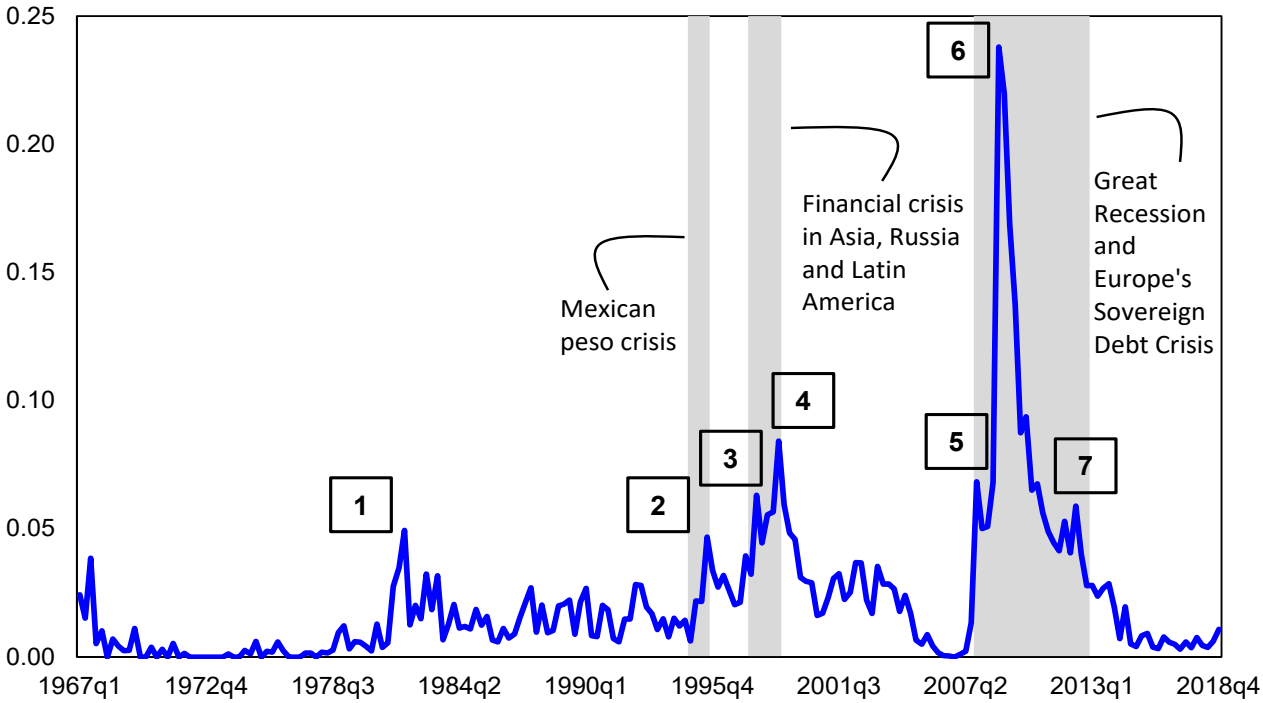
Date	Financial Stress Detected?	Source of Financial Stress
1998Q1	No	None
1998Q2	No	None
1998Q3	No	None
1998Q4	Yes	Foreign

Notes: Examples of the actual text for each of the quarters in 1998:

- **1998Q1:** "On December 8th Sri Lanka's first build-own-operate thermal power plant was formally commissioned at Sapugaskanda. The 22.5-mw power plant, the third thermal power project to come into operation in 1997, is a joint venture between Lanka Transformers, Asea Brown Boveri Kraft of Norway and Wartsila Diesel of Finland. The project, which will cost an estimated SLRs1bn ($16m), was **funded** primarily by a consortium of local commercial and development **banks**. Following the power **crisis** that occurred in 1996 (2nd quarter 1997, page 21), Sri Lanka added nearly 180 mw of power to the national grid in 1997."
- **1998Q2:** "Export growth picked up in the second half of 1997, rising by 13.7% year on year compared with a 12.3% annual increase in the first half. A rapid expansion in industrial exports, which grew by 14.1% in 1997, continued to underpin overall export expansion. Exports of textiles and garments rose by a robust 19.6% to $2.3bn in 1997 from $1.9bn in 1996. Their share in total exports increased to 49% in 1997 from 46.4% in 1996, while their share of industrial exports increased by 3 percentage points to 66%. Among other industrial exports, leather and rubber goods performed strongly, growing by nearly 16%. The **financial crises** in Asian economies had a negative impact on exports of gems and jewellery. Minerals exports contracted by 6.3% in 1997. After growing by 6.2% in the first half of 1997, exports of minerals (of which gems constitute a large proportion) **contracted** by 17.6% in dollar terms in July-December, reflecting a contraction in demand in Asian markets."
- **1998Q3:** "The fallout from the Asian **financial crisis** was most pronounced in the rubber sector, as prices plunged; coupled with a 46% decline in export volumes, earnings halved to $17.8m. The value of coconut exports also fell sharply during the same period."
- **1998Q4:** "Interest rates have remained fairly stable, with the weighted average prime **lending** rate remaining between 14.6% and 15% in recent months. However, they are expected to rise in the coming months, as a likely increase in the number of non-performing assets may prompt **banks** to raise interest rates to compensate for losses incurred on interest income. Outstanding export bills resulting from the Russian **crisis** have also **tightened** the liquidity position of several commercial **banks**."

Figures

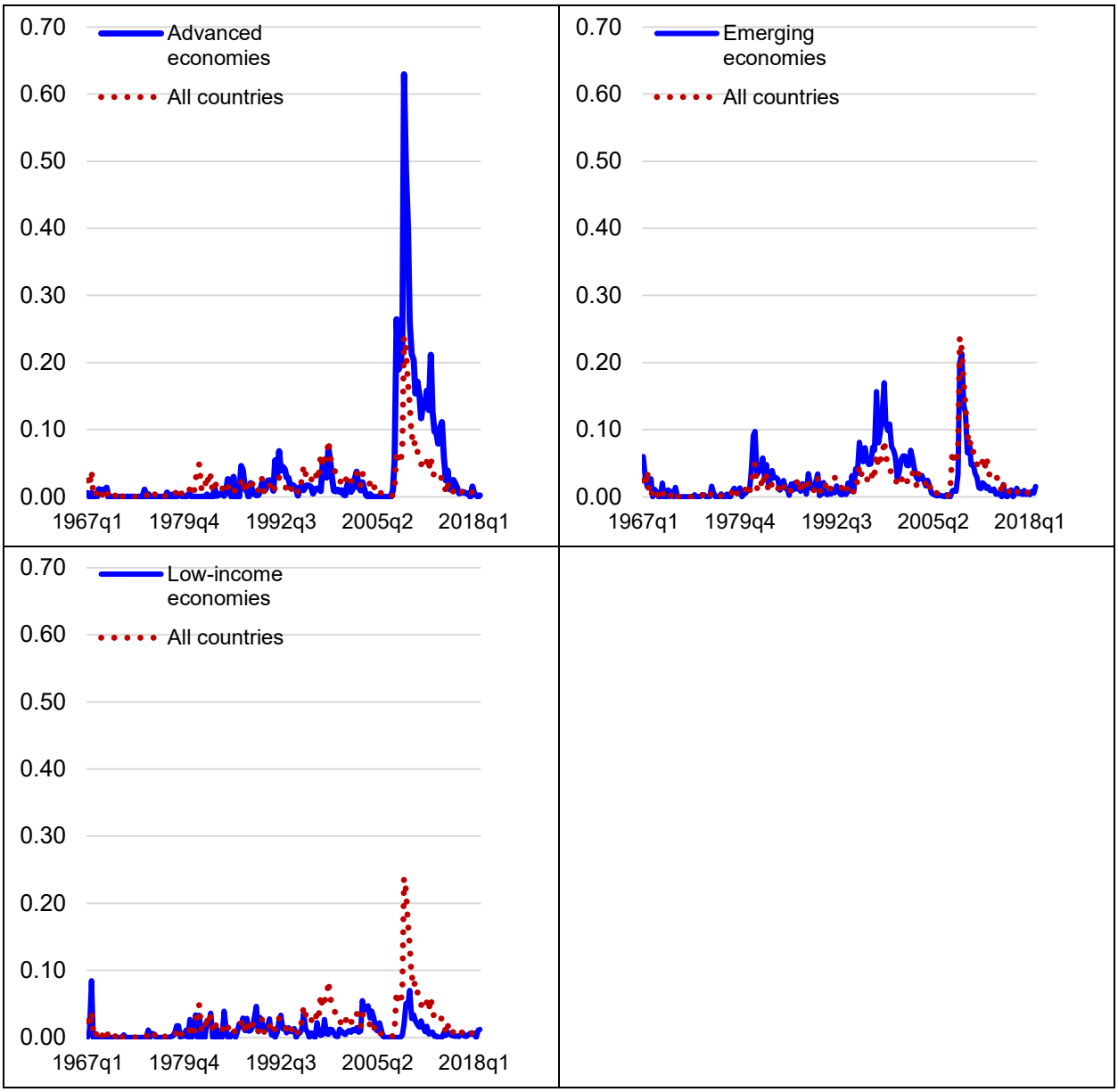
Figure 1. Financial Stress Index (FSI) over Time



Notes: The Financial Stress Index (FSI) is summing the number of keywords identified with financial stress in EIU country reports. The index is then normalized by total number of words and rescaled by multiplying by 1,000. A higher number means higher financial stress and vice versa. The figure above is an average across 110 countries and covers 1967 to 2018 at a quarterly frequency.

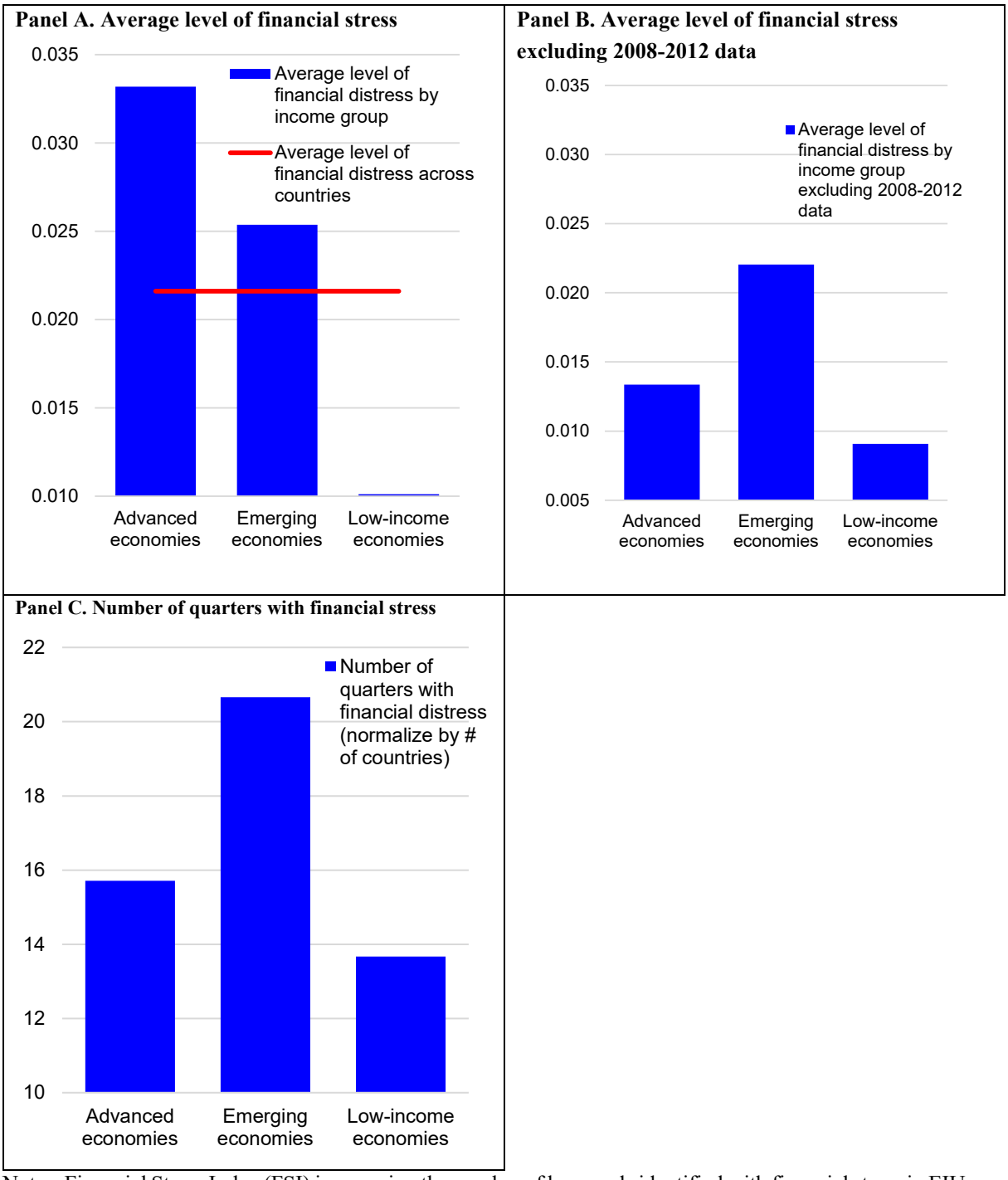
1. Financial stress in 1981Q4 in 6 countries: Argentina, Chile, Costa Rica, Ecuador, Guatemala, and Honduras.
2. Financial stress in 1995Q3 in 11 countries: Alergia, Argentina, Bolivia, Bulgaria, Cameroon, Jamaica, Japan, Liberia, Mexico, Niger, and Paraguay.
3. Financial stress in 1997Q4 in 15 countries: Brazil, Bulgaria, Hong Kong SAR, India, Indonesia, Jamaica, Japan, Korea, Malaysia, Mexico, Paraguay, Philippines, Thailand, Venezuela, and Vietnam.
4. Financial stress in 1998Q4 in 23 countries: Argentina, Brazil, Colombia, Ecuador, Egypt, Hong Kong SAR, India, Indonesia, Jamaica, Japan, Kenya, Korea, Malaysia, Panama, Paraguay, Peru, Philippines, Russia, South Africa, Sri Lanka, Thailand, United States, and Vietnam.
5. Financial stress in 2007Q4 in 19 countries: Austria, Belgium, Brazil, Canada, Denmark, El Salvador, Finland, France, Germany, Iceland, Italy, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom, and United States.
6. Financial stress in 2008Q4 in 55 countries: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Cameroon, Canada, China, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, El Salvador, Finland, France, Gabon, Germany, Greece, Guatemala, Haiti, Honduras, Hong Kong SAR, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Lebanon, Libya, Netherlands, New Zealand, Norway, Pakistan, Panama, Paraguay, Peru, Portugal, Russia, Singapore, Spain, Sweden, Switzerland, Taiwan Province of China, Thailand, Turkey, United Kingdom, United States, Uruguay, and Vietnam.
7. Financial stress in 2012Q2 in 16 countries: Austria, Belgium, Denmark, France, Germany, Greece, Haiti, Hungary, Ireland, Italy, Netherlands, Nigeria, Pakistan, Portugal, Spain, and United Kingdom.

Figure 2. FSI over Time by Country Income Group



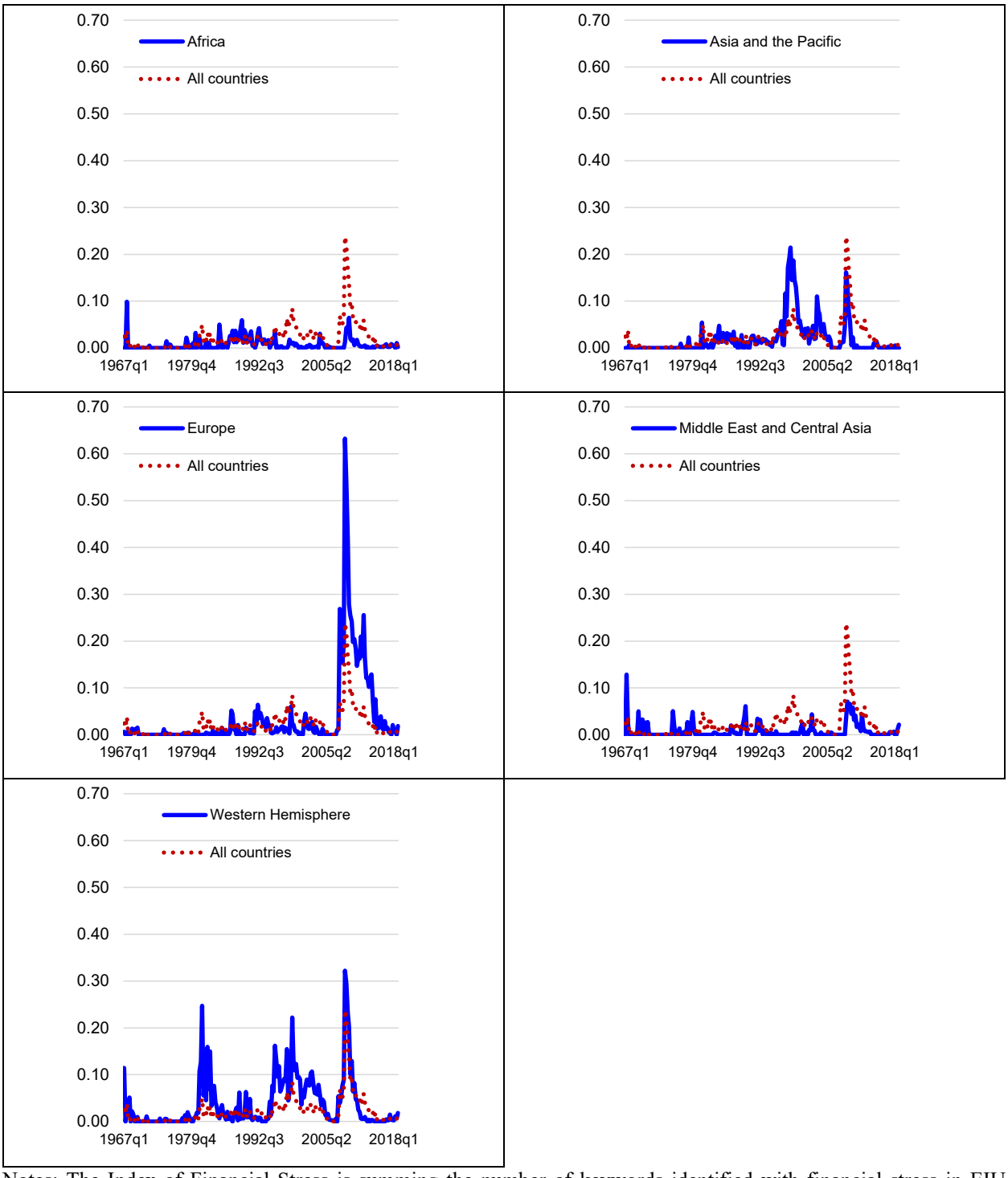
Notes: Financial Stress Index (FSI) is summing the number of keywords identified with financial stress in EIU country reports. The index is then normalized by total number of words and rescaled by multiplying by 1,000. A higher number means higher financial stress and vice versa. For the list of countries in each income group, see Table 1. The figure above is an average of three country income levels and covers 1967 to 2018 period at a quarterly frequency.

Figure 3. FSI: Average Level vs. Number of Episodes



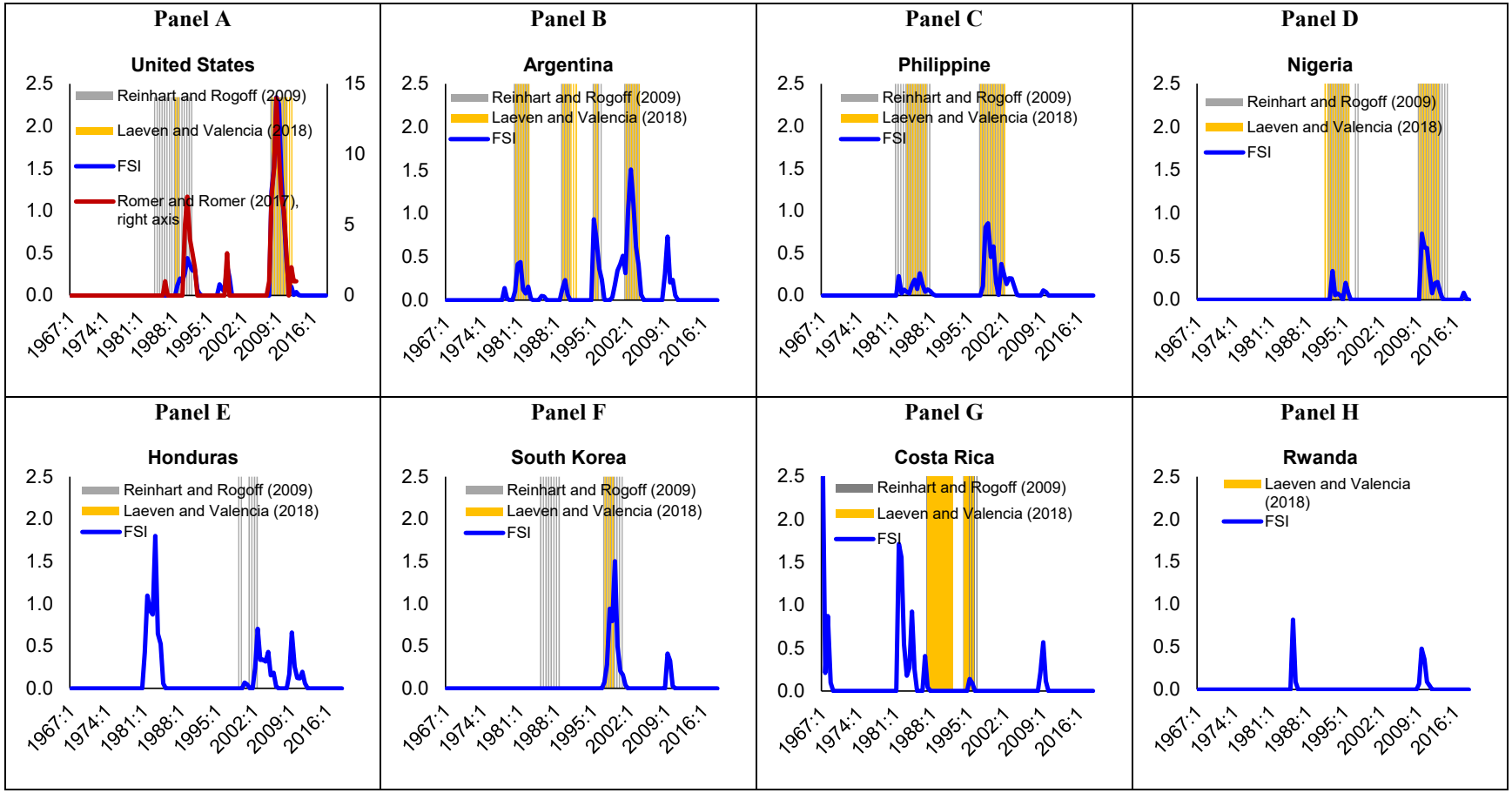
Notes: Financial Stress Index (FSI) is summing the number of keywords identified with financial stress in EIU country reports. The index is then normalized by total number of words and rescaled by multiplying by 1,000. A higher number means higher financial stress and vice versa. For the list of countries in each income group, see Table 1. The figure above presents FSI averages across income groups and financial stress episodes over the period 1967 to 2018 at a quarterly frequency.

Figure 4. FSI over Time by Geographical Region



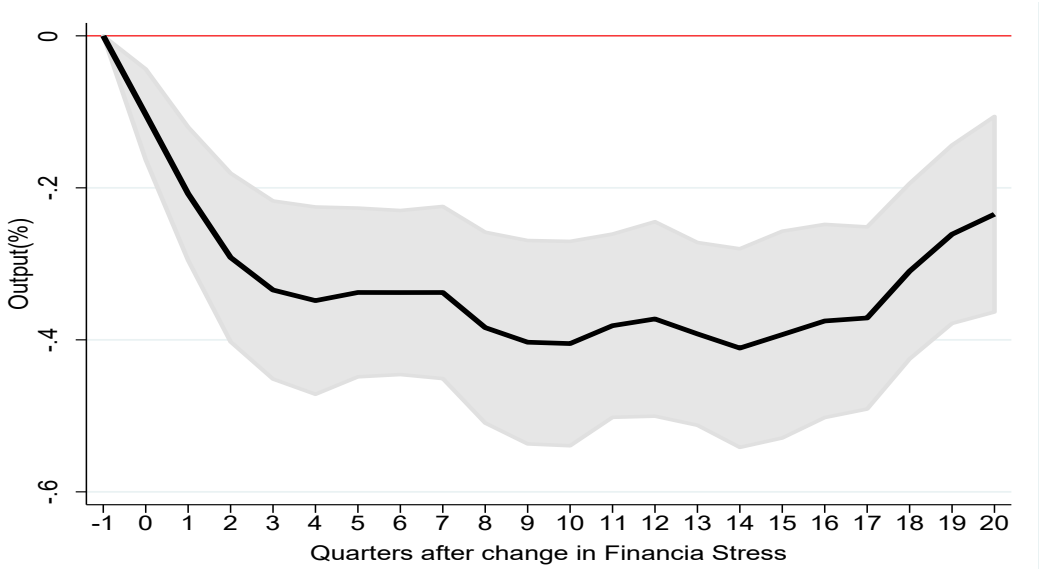
Notes: The Index of Financial Stress is summing the number of keywords identified with financial stress in EIU country reports. The index is then normalized by total number of words and rescaled by multiplying by 1,000. A higher number means higher financial stress and vice versa. For the list of countries in each region, see Table 1. The figure above is an average over five geographical regions and covers 1967 to 2018 period at a quarterly frequency.

Figure 5. FSI vs. other Measures: country examples



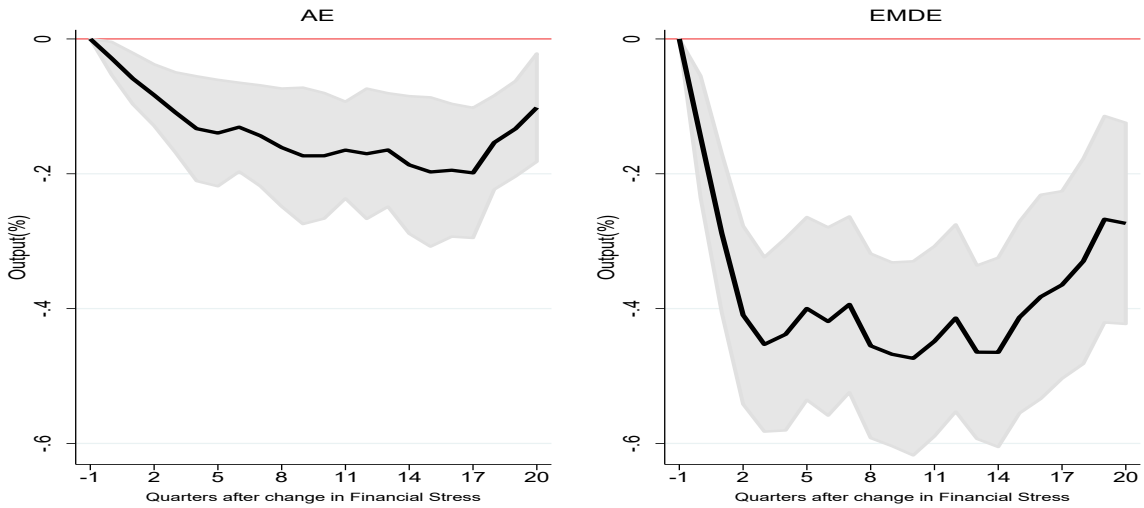
Notes: Financial Stress Index is summing the number of keywords identified with financial stress in EIU country reports. The index is then normalized by total number of words, rescaled by multiplying by 1,000 and calculated using a moving average method. A higher number means higher financial stress and vice versa. The data plotted is semi-annual and run from 1967 until 2018, except RoRo until 2012, ReRo until 2014 and LV until 2017.

Figure 6. Impact of Change in FSI on Output (quarterly data)



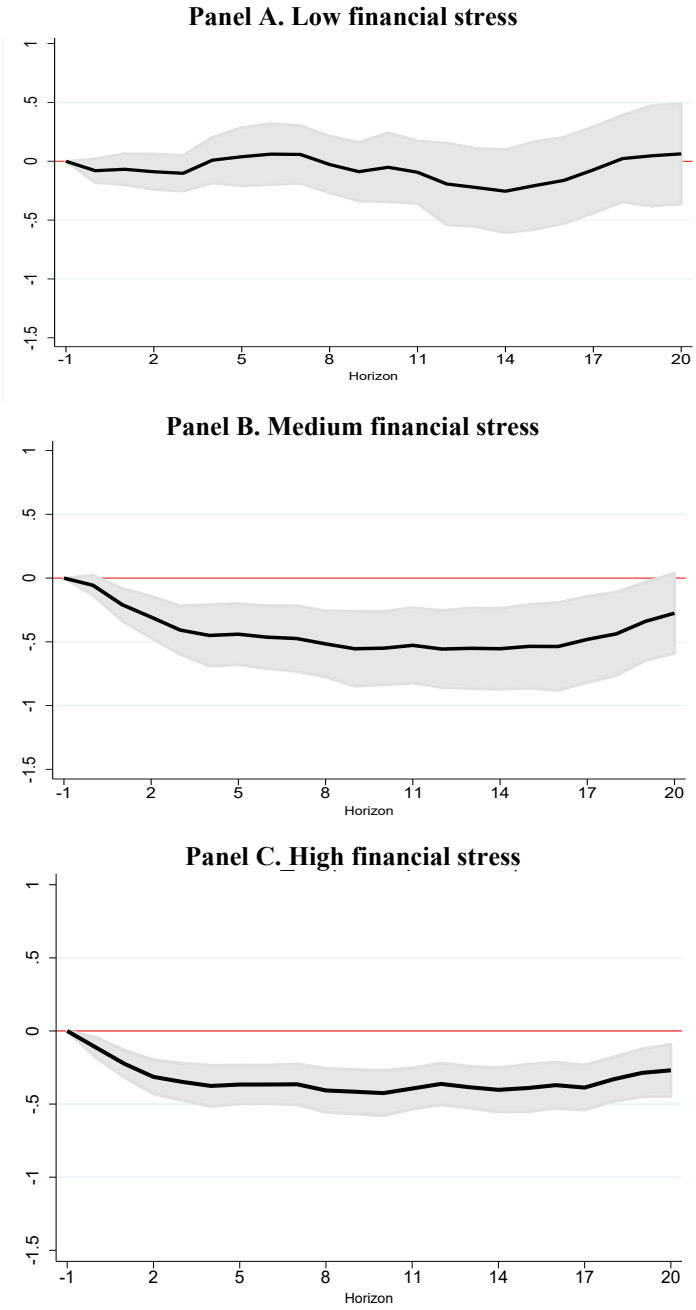
Notes: The graph shows the dynamic response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$ where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI.

Figure 7. Impact of Change in FSI on Output—Advanced Economies (AE) vs. Emerging Markets and Developing Economies (EMDE)



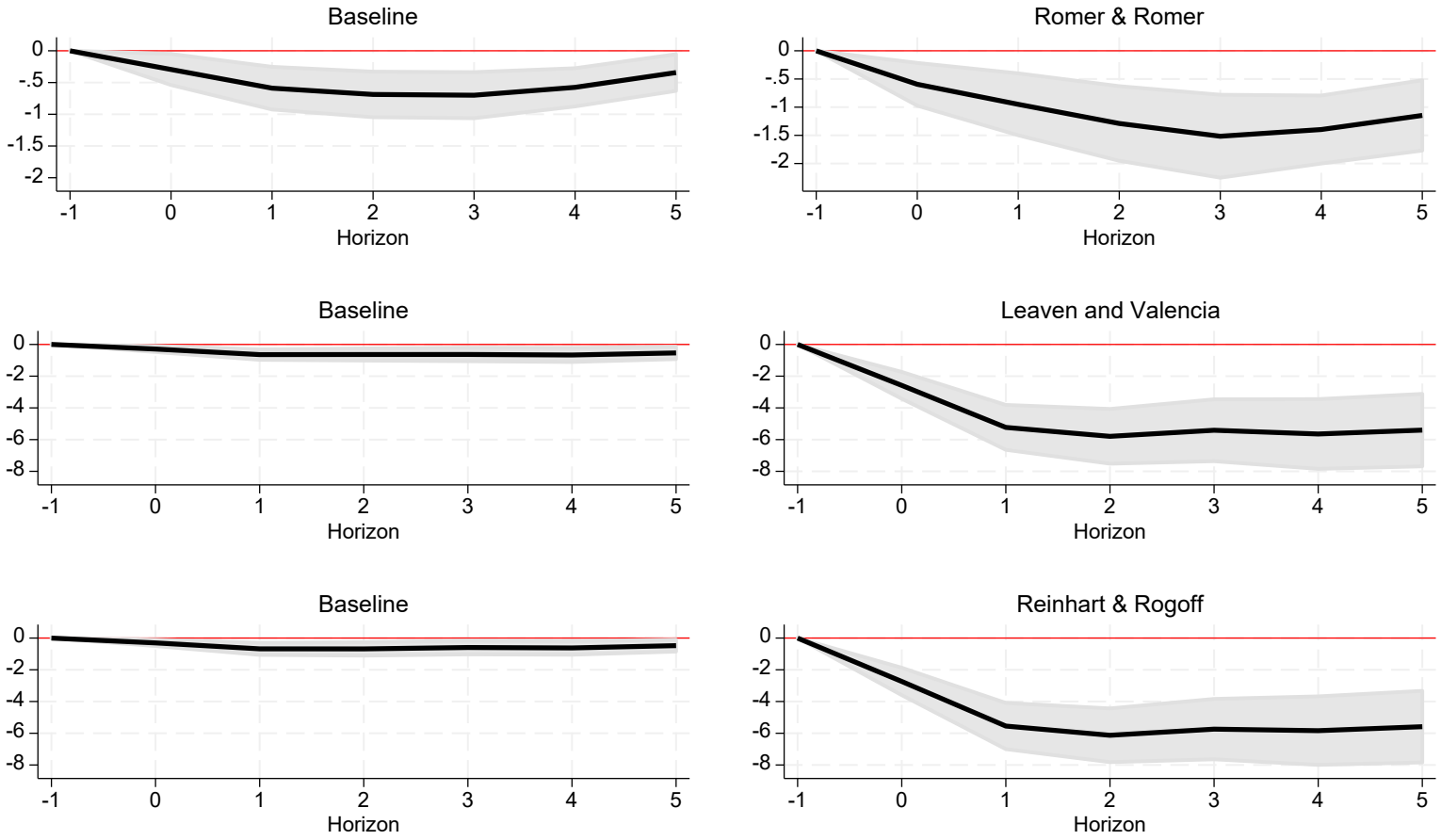
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4, and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta AE_{i,t-j} + \sum_{j=0}^{2} \partial_j^k \Delta EMDE_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔAE denotes the change in FSI in Advanced Economies (AE) and $\Delta EMDE$ denotes the change in FSI in Emerging Markets and Developing Economies (EMDE).

Figure 8. Impact of Change in FSI on Output—Non-linear Effects



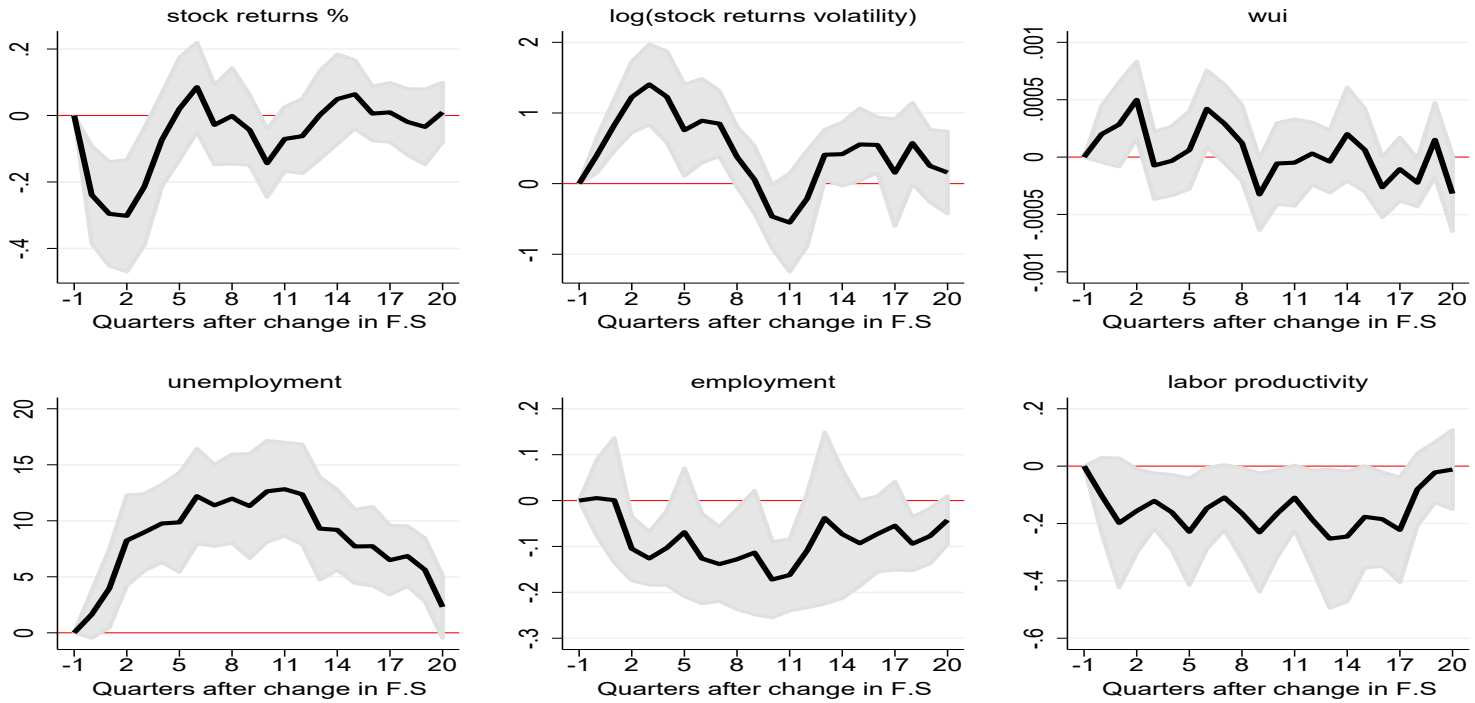
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4, based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^{kG} I[F_{it} \in G\ ] \cdot \Delta F_{i,t} + \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where I is an indicator function which assumes value 1 when the level of financial stress belongs to a specific bin (terciles) of the distribution, which we refer to as group G.

Figure 9. Impact of Change in FSI and Alternative Chronologies



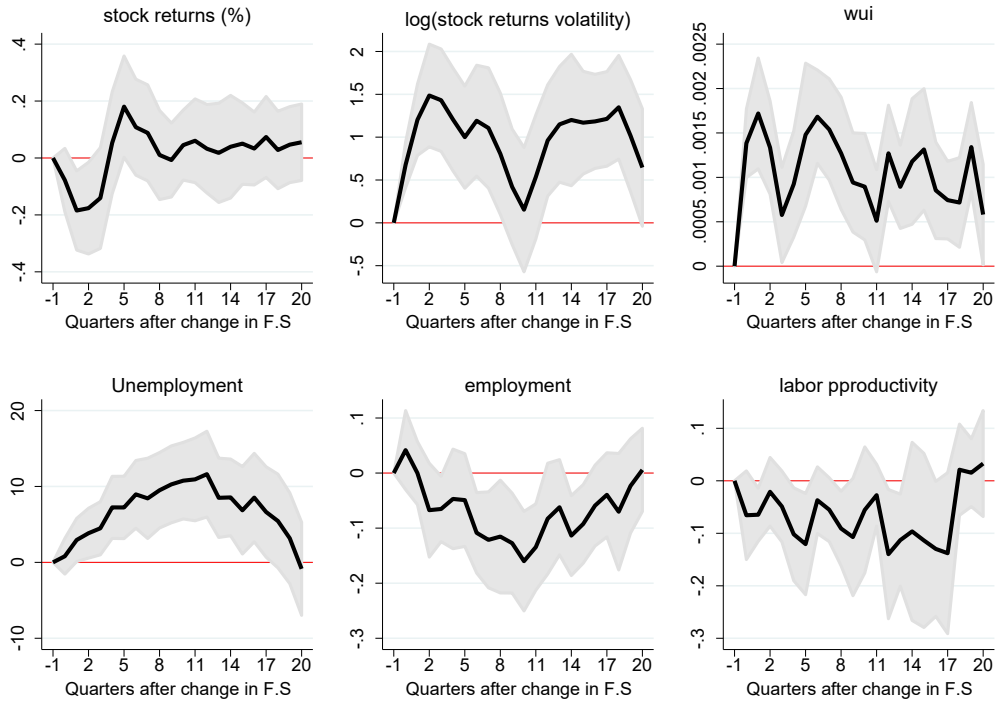
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates of baseline are obtained using a sample of 25 countries for the analysis based on the Romer&Romer sample, and of 105 countries for the others analysis over the period 1967-2018, and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$ where i index countries, t refers to quarters, and k denotes the horizon (the years after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI.

Figure 10. Impact of Change in FSI on other Macroeconomic Variables



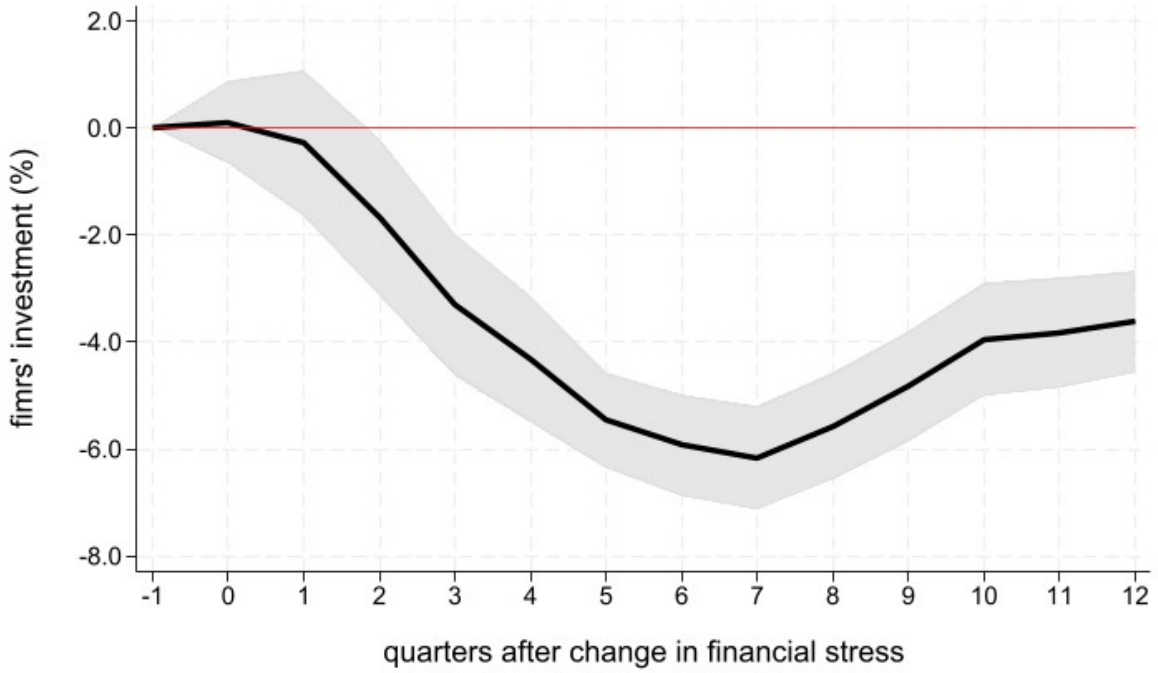
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4, and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is: (i) stock returns %; (ii) log (stock returns volatility); (iii) World Uncertainty Index (wui); (iv) unemployment; (v) employment; and (vi) labor productivity; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI.

Figure 11. Impact of Change in FSI on other Macroeconomic Variables—IV Results



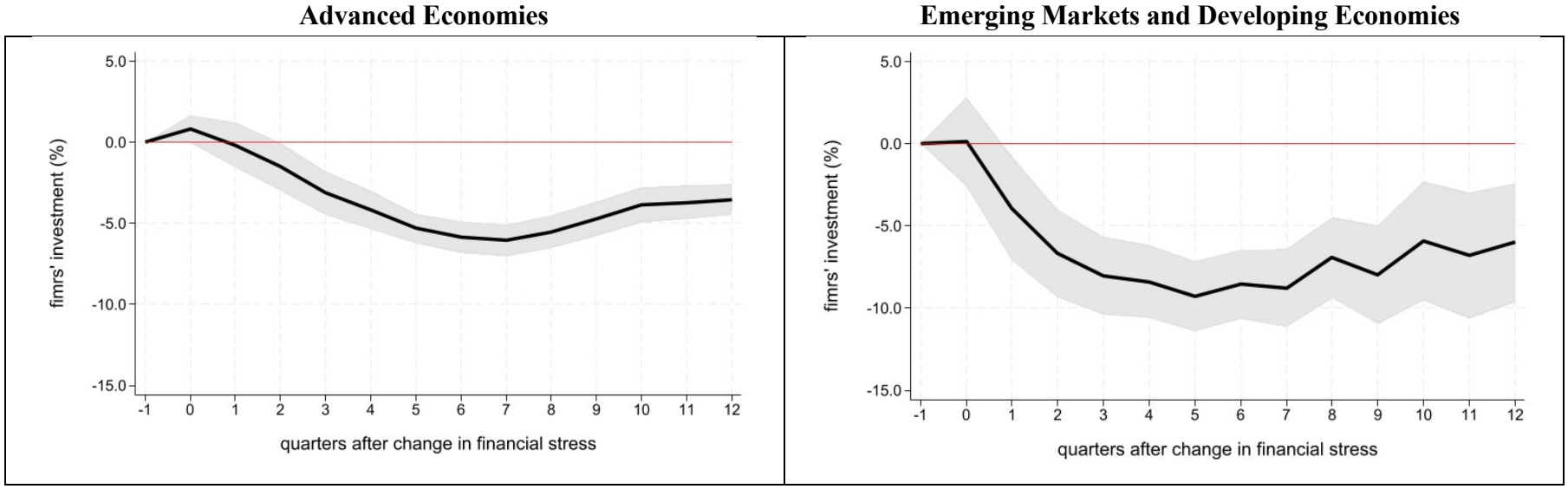
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4, and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is: (i) stock returns %; (ii) log (stock returns volatility); (iii) World Uncertainty Index (wui); (iv) unemployment; (v) employment; and (vi) labor productivity; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI.

Figure 12. Impact of Change in FSI on Firm Investment



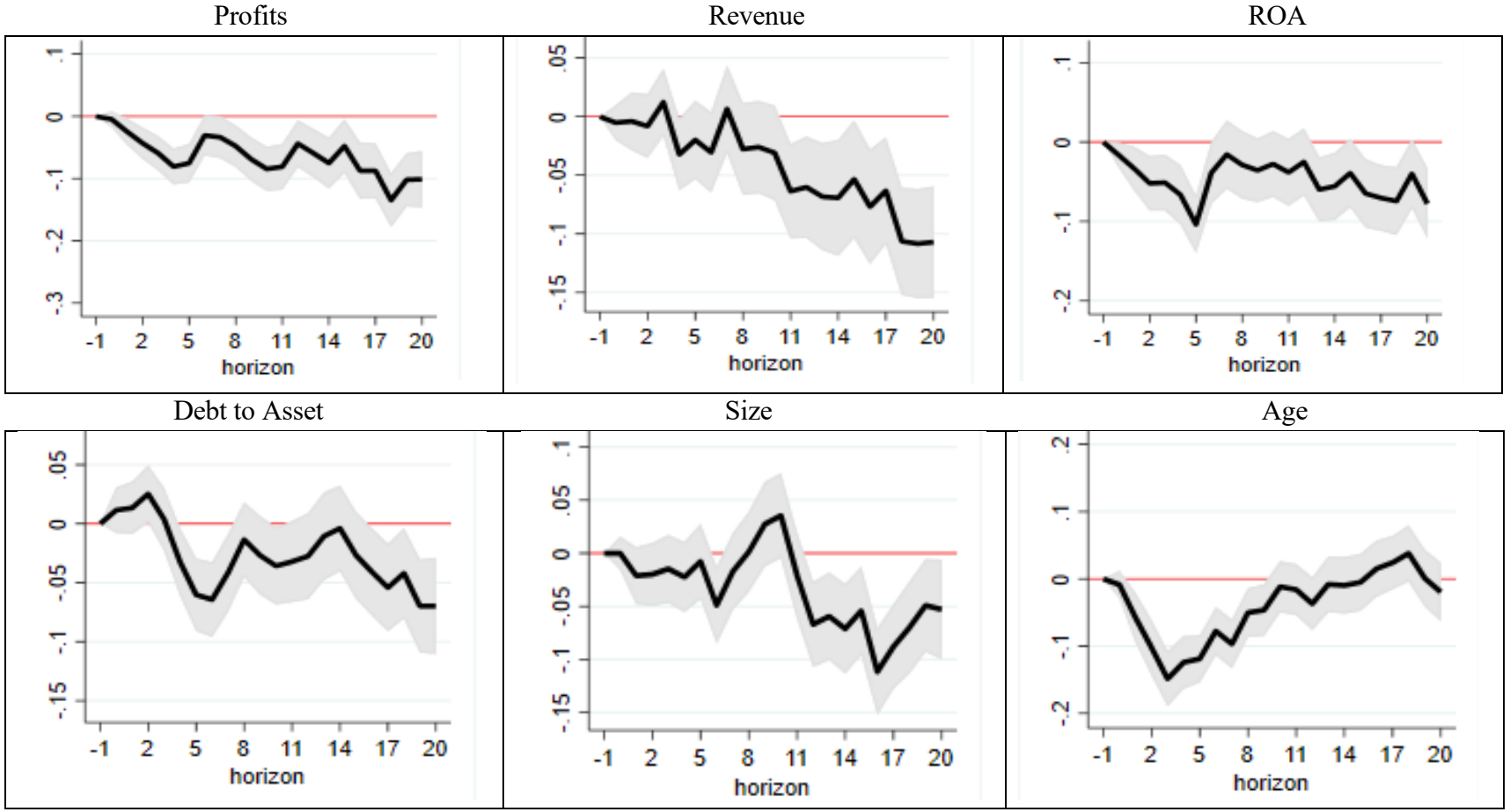
Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha_{is}^{k} + \gamma_{nq}^{k} + \sum_{j=0}^{4} \beta_{j}^{k} \Delta F_{i,t-j} + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $\Delta F_{i,t-j}$ is the change in FSI, γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimates separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_{0}^{k} for different horizons k, while shaded areas denote 90 percent confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Figure 12. Impact of Change in FSI on Firm Investment—Advanced Economies (AE) vs. Emerging Markets and Developing Economies (EMDE)



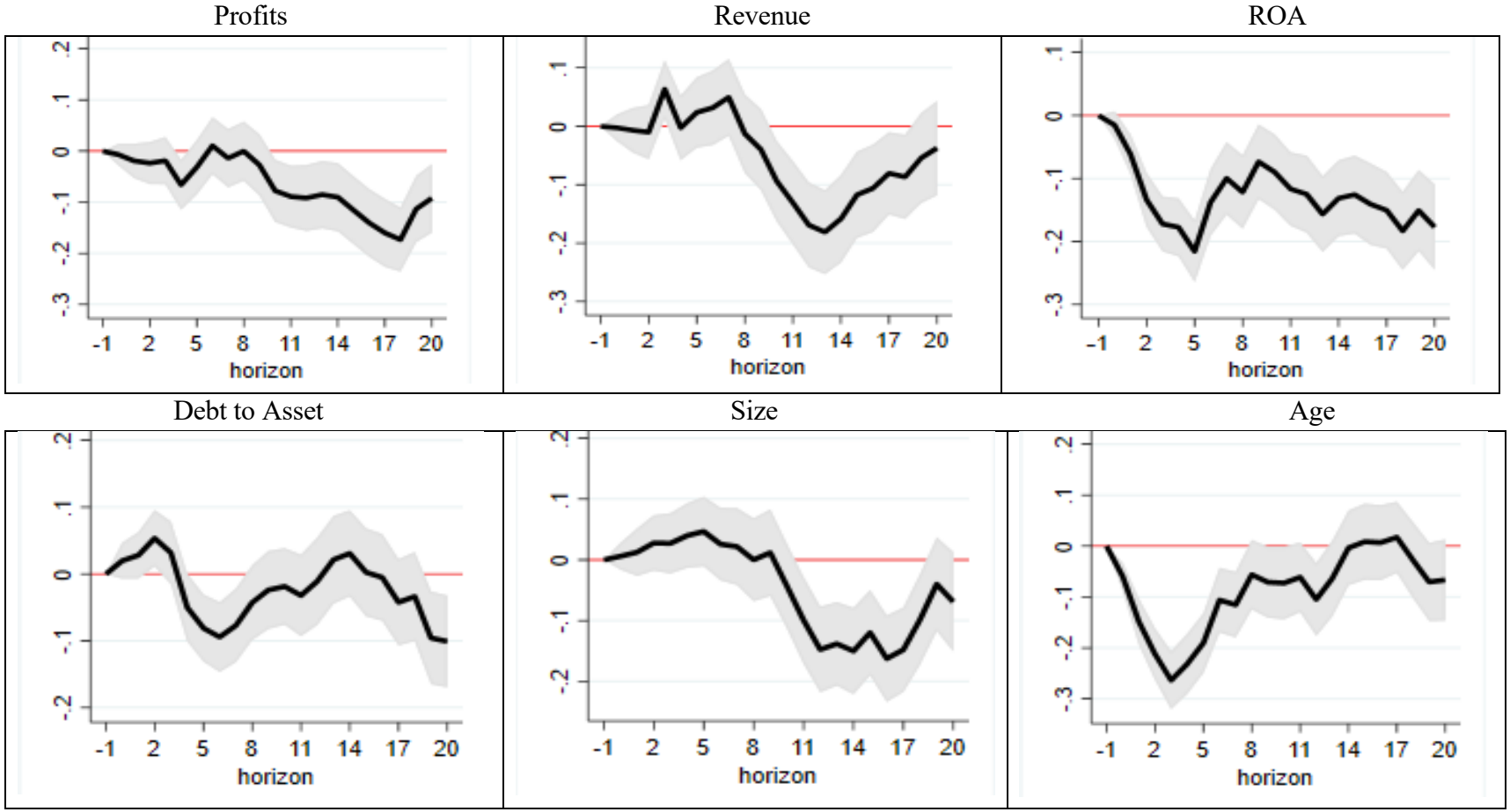
Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha_{is}^{k} + \gamma_{nq}^{k} + \sum_{j=0}^{4} \beta_{j}^{k} \Delta F_{i,t-j} + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $\Delta F_{i,t-j}$ is the change in FSI, γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimates separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_{0}^{k} for different horizons k, while shaded areas denote 90 percent confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Figure 13. Impact of Change in FSI on Firm Investment—the Role of Firm Characteristics



Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates based on the regression $y_{n,i,t+k} = \alpha_{ist}^{k} + \gamma_{nq}^{k} + \sum_{j=-k}^{4} \mu_j^k \Delta F_{i,t-j} * D_n + \sum_{j=1}^{4} \theta_j^k y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $\Delta F_{i,t-j}$ is the change in FSI, γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimates separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_0^k for different horizons k, while shaded areas denote 90 percent confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Figure 14: Impact of Change in FSI on Firm Investment—the Role of Firm characteristics (IV)



Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates are based on the regression $y_{n,i,t+k} = \alpha_{ist}^{k} + \gamma_{nq}^{k} + \sum_{j=-k}^{4} \mu_j^k \Delta F_{i,t-j} * D_n + \sum_{j=1}^{4} \theta_j^k y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $\Delta F_{i,t-j}$ is the change in FSI, γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimates separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_0^k for different horizons k, while shaded areas denote 90 percent confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Tables

Table 1. Data Coverage: FSI vs. other Chronologies

	Romer&Romer (RoRo)	Reinhart&Rogoff (ReRo)	Laeven&Valencia (LV)	FSI
Variable Type	Numeric (0-15)	Binary (0, 1)	Binary (0, 1)	Numeric
Country Coverage	24 OCED economies	81 economies	165 economies	110 economies
Time Horizon	1967-2012	1800s to 2014 (updated)	1970 to 2017	1967-2018
Source	OECD reports	Historical Events	Historical Events	EIU reports
Definition & Method	Narrative Approach over paragraphs with key words (Intensity is identified subjectively)	1) Bank runs leading to government intervention;or 2) Government intervention	1) Signs of financial stress 2) Banking policy intervention	Narrative Approach over paragraphs (Intensity determined by frequencies of keywords)

Notes: The table reports country and time coverage across 4 financial stress indicators. It also provides the definition and method used to arrive at the financial stress variable constructed.

Table 2. Pair-wise Correlations between Chronologies

	FSI	Romer&Romer (RoRo)	Reinhart&Rogoff (ReRo)	Laeven&Valencia (LV)
FSI	1.0			
Romer&Romer (RoRo)	0.9	1.0		
Reinhart&Rogoff (ReRo)	0.4	0.5	1.0	
Laeven&Valencia (LV)	0.4	0.7	0.6	1.0

Notes: The table reports correlations for each pair of the 4 financial stress indicators.

Annex

Table A1. Impact of Change in FSI on Output (quarterly data)

	k=0	k=5	k=10	k=15	k=20
$F_{i,t}$	-0.103***	-0.338***	-0.405***	-0.393***	-0.235***
	(0.0363)	(0.0675)	(0.0818)	(0.0827)	(0.0782)
$F_{i,t-1}$	-0.126***	-0.358***	-0.437***	-0.409***	-0.200*
	(0.0352)	(0.0841)	(0.101)	(0.107)	(0.107)
$F_{i,t-2}$	-0.102***	-0.246***	-0.300***	-0.306***	-0.144*
	(0.0285)	(0.0695)	(0.0828)	(0.0928)	(0.0801)
$y_{i,t-1}$	0.0193	0.0860	0.172	0.332*	0.102
	(0.0683)	(0.306)	(0.360)	(0.187)	(0.203)
$y_{i,t-2}$	-0.0182	-0.0932	-0.219	-0.441**	-0.278
	(0.0662)	(0.302)	(0.362)	(0.187)	(0.189)
Observations	4,211	3,966	3,721	3,476	3,231
R-squared	0.197	0.433	0.514	0.586	0.654

Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on: $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=0}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where *i* index countries, *t* refers to quarters, and *k* denotes the horizon (the quarter after the change in FSI) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI.

Table A2. Impact of Change in FSI on Output—Non-linear Effects. P-value differences in responses

	K=0	K=1	K=2	K=3	K=4	K=5	K=6	K=7	K=8	K=9	K=10
Low vs. medium	0.612	0.0524	0.0157	0.0190	0.00730	0.0295	0.0201	0.0155	0.0241	0.0524	0.0622
Low vs. high	0.708	0.139	0.0782	0.0349	0.0266	0.0281	0.0159	0.0175	0.0238	0.0380	0.0362
Medium vs. high	0.333	0.815	0.921	0.556	0.606	0.619	0.552	0.534	0.529	0.461	0.496
	K=11	K=12	K=13	K=14	K=15	K=16	K=17	K=18	K=19	K=20	
Low vs. medium	0.0804	0.412	0.441	0.490	0.402	0.353	0.178	0.144	0.252	0.274	
Low vs. high	0.0651	0.147	0.183	0.249	0.236	0.165	0.149	0.0940	0.216	0.283	
Medium vs. high	0.492	0.345	0.450	0.488	0.538	0.507	0.700	0.659	0.822	0.979	

Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4, based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^{kG} I[F_{it} \in G\,] \cdot \Delta F_{i,t} + \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where I is an indicator function which assumes value 1 when the level of financial stress belongs to a specific bin (terciles) of the distribution, which we refer to as group G.

Table A3. Impact of change in FSI on Output (annual data)

	K=0	K=1	K=2	K=3	K=4	K=5
$F_{i,t}$	-0.473***	-0.830***	-0.788***	-0.794***	-0.829***	-0.763***
	(0.154)	(0.203)	(0.192)	(0.196)	(0.190)	(0.159)
$F_{i,t-1}$	-0.340***	-0.309**	-0.315**	-0.354**	-0.275**	-0.259**
	(0.0938)	(0.125)	(0.128)	(0.137)	(0.130)	(0.130)
$F_{i,t-2}$	-0.000464	-0.0755	-0.131	-0.0741	-0.110	-0.187
	(0.0667)	(0.0821)	(0.0939)	(0.0917)	(0.120)	(0.131)
$y_{i,t-1}$	0.109	0.115	0.145	0.106	0.0705	0.107
	(0.0775)	(0.0910)	(0.108)	(0.121)	(0.148)	(0.127)
$y_{i,t-2}$	-0.135*	-0.171*	-0.228**	-0.226*	-0.223	-0.296**
	(0.0777)	(0.0892)	(0.106)	(0.117)	(0.138)	(0.117)
Observations	5,058	5,058	5,058	4,949	4,840	4,731
R-squared	0.150	0.213	0.276	0.321	0.365	0.411

Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1,5 and 10 percent, respectively. Estimates are obtained using a sample of 110 countries over the period 1967-2018 and based on: $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to years, and k denotes the horizon (the year after the change in FSI) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI.

Table A4. Foreign Shocks—Reverse Causality

	K=0	k=5	k=10	k=15	k=20
$EF_{i,t-1}$	-1.470***	-0.976***	-0.963***	-1.035***	-1.011***
	(0.0376)	(0.0367)	(0.0204)	(0.0127)	(0.0106)
$EF_{i,t-2}$	-0.245***	-0.0257	-0.00119	-0.00200	-0.00848
	(0.0467)	(0.0363)	(0.0276)	(0.0145)	(0.0111)
$\Delta lngdp_{i,t}$	-0.0973	0.115	0.0851	-0.0908	-0.0784
	(0.0770)	(0.0935)	(0.0590)	(0.0721)	(0.124)
$\Delta lngdp_{i,t-1}$	-0.0917	-0.0143	-0.0617	-0.0168	0.218
	(0.0638)	(0.0710)	(0.0389)	(0.0588)	(0.177)
$\Delta lngdp_{i,t-2}$	0.0368	-0.0586	-0.0902	-0.142	-0.138
	(0.0633)	(0.0484)	(0.108)	(0.106)	(0.0908)
Observations	4,203	3,958	3,713	3,468	3,223
R-squared	0.741	0.575	0.569	0.597	0.585

Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $EF_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=1}^{2} \beta_j^k EF_{i,t-j} + \sum_{j=1}^{2} \beta_j^k \Delta lngdp_{i,t-j} + \varepsilon_t^k$, where *i* index countries, *t* refers to quarters, and *k* denotes the horizon (the quarter after the change in the financial stress indicator) being considered. *EF* is the foreign shock; α_i are country fixed effects; γ_t are time fixed effects; and $\Delta lngdp$ is the change in the log of output.

Table A5. Adding the Instrument as a Control Variable

	k=0	k=5	k=10	k=15	k=20
$EF_{i,t}$	0.00896	0.0140	0.0148	0.00851	0.0108
	(0.00673)	(0.00989)	(0.0104)	(0.00995)	(0.00899)
Observations	4,211	3,966	3,721	3,476	3,231
R-squared	0.198	0.433	0.514	0.586	0.654

Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=0}^{2} \theta_j^k y_{i,t-j} + \partial_j^k EF_{i,t} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI, and $EF_{i,t}$ refers to the instrumental variable. Controls included but not reported.

Table A6. Validity of the Instrument

(Regressing instrument on residuals of baseline)

	k=0	k=5	k=10	k=15	k=20
$resid_{i,t}$	0.00319	0.00494	0.00520	0.00299	0.00382
	(0.00226)	(0.00595)	(0.00833)	(0.0102)	(0.0116)
Observations	4,211	3,966	3,721	3,476	3,231

Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI. Subsequently, by taking the residual from the baseline and checking the validity of the instrumental variable, estimates are obtained based on $resid_{i,t+k} = \alpha_i^k + \beta_j^k \Delta EF_{i,t} + \varepsilon_t^k$, where $resid$ is the residual obtained from the baseline and $EF_{i,t}$ is the indicator of external financial stress used as an instrument.

Figure A1. Financial Stress Index vs. Other Measures

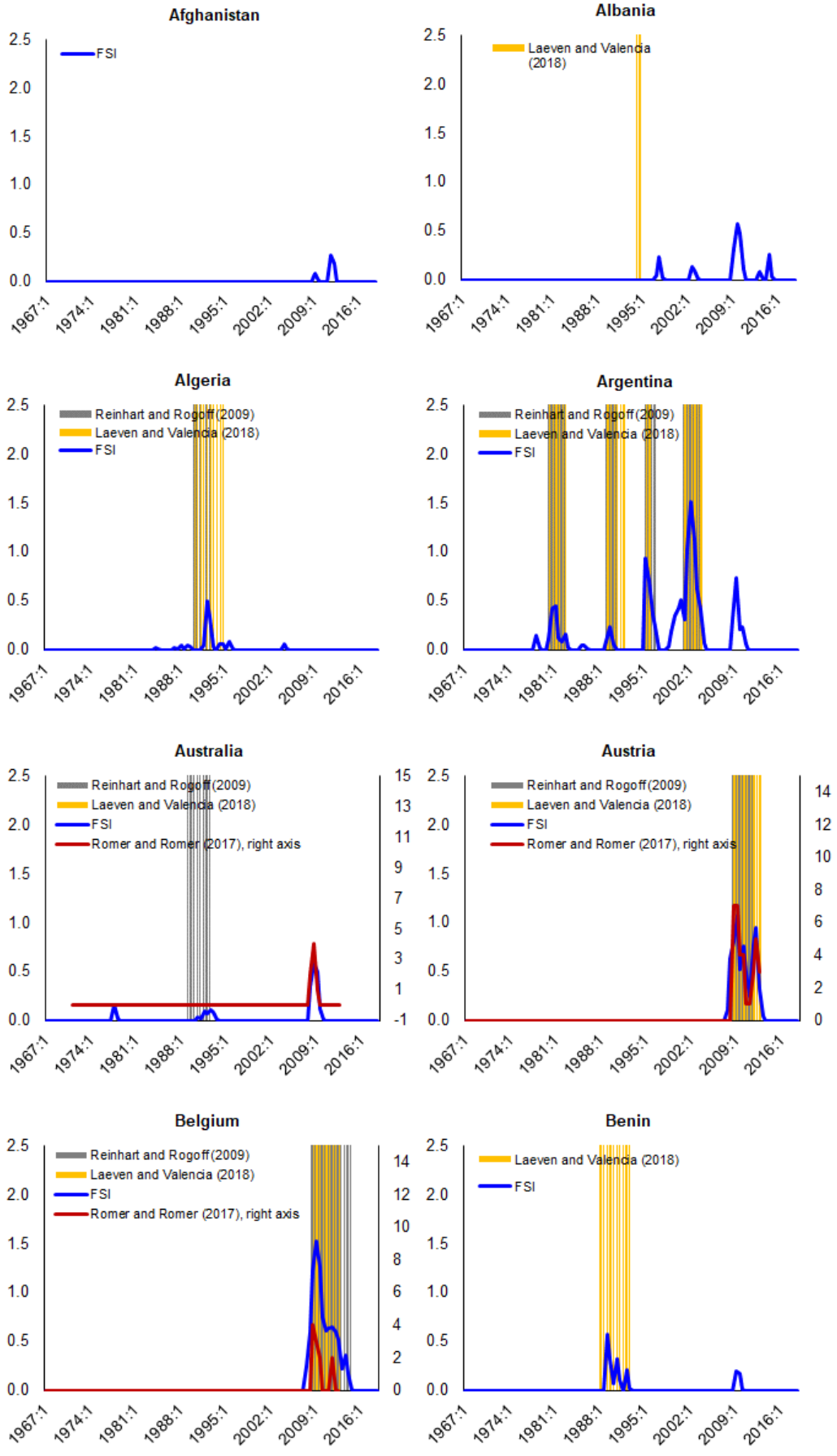


Figure A1 – Continued

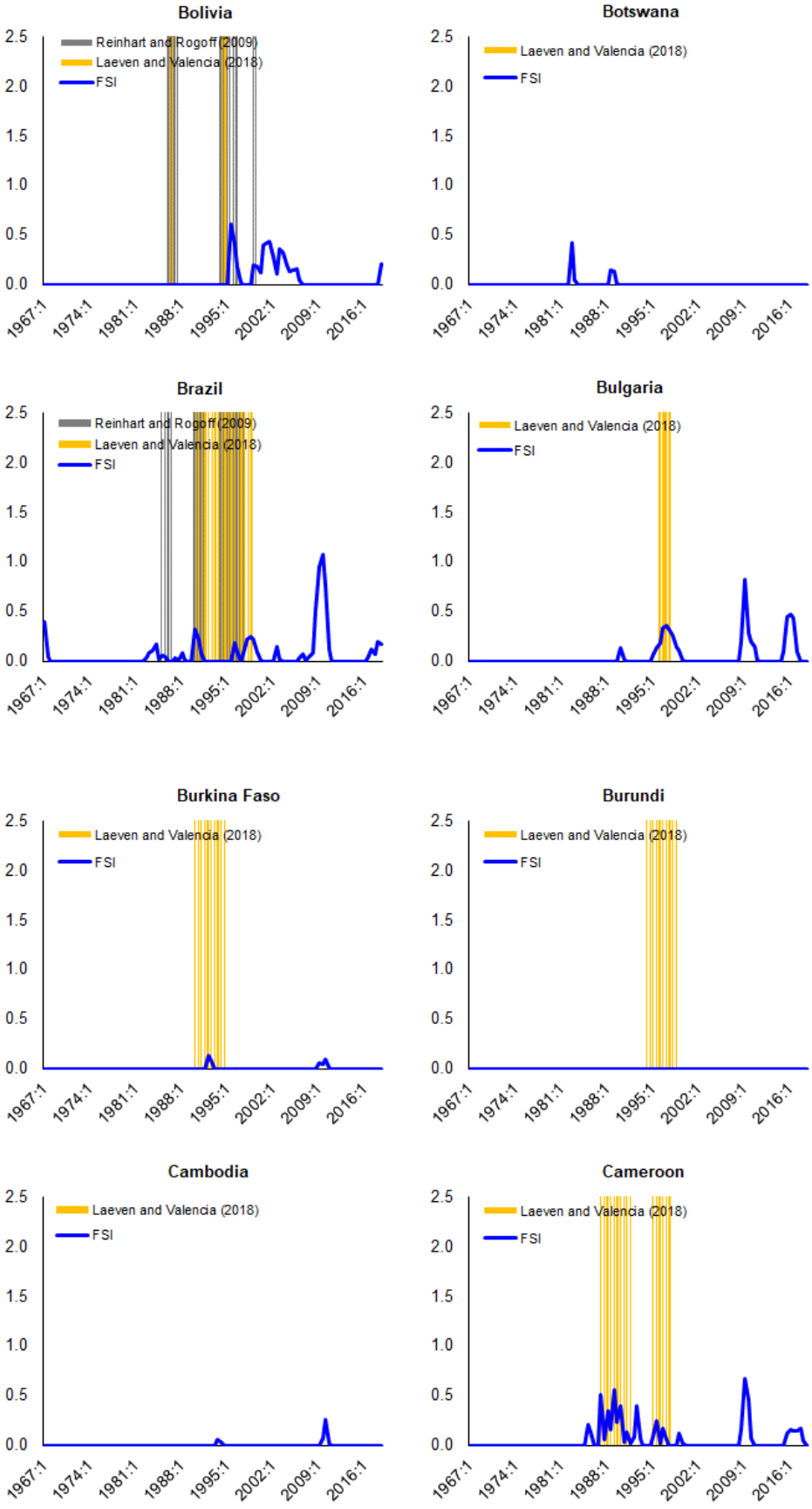


Figure A1 – Continued

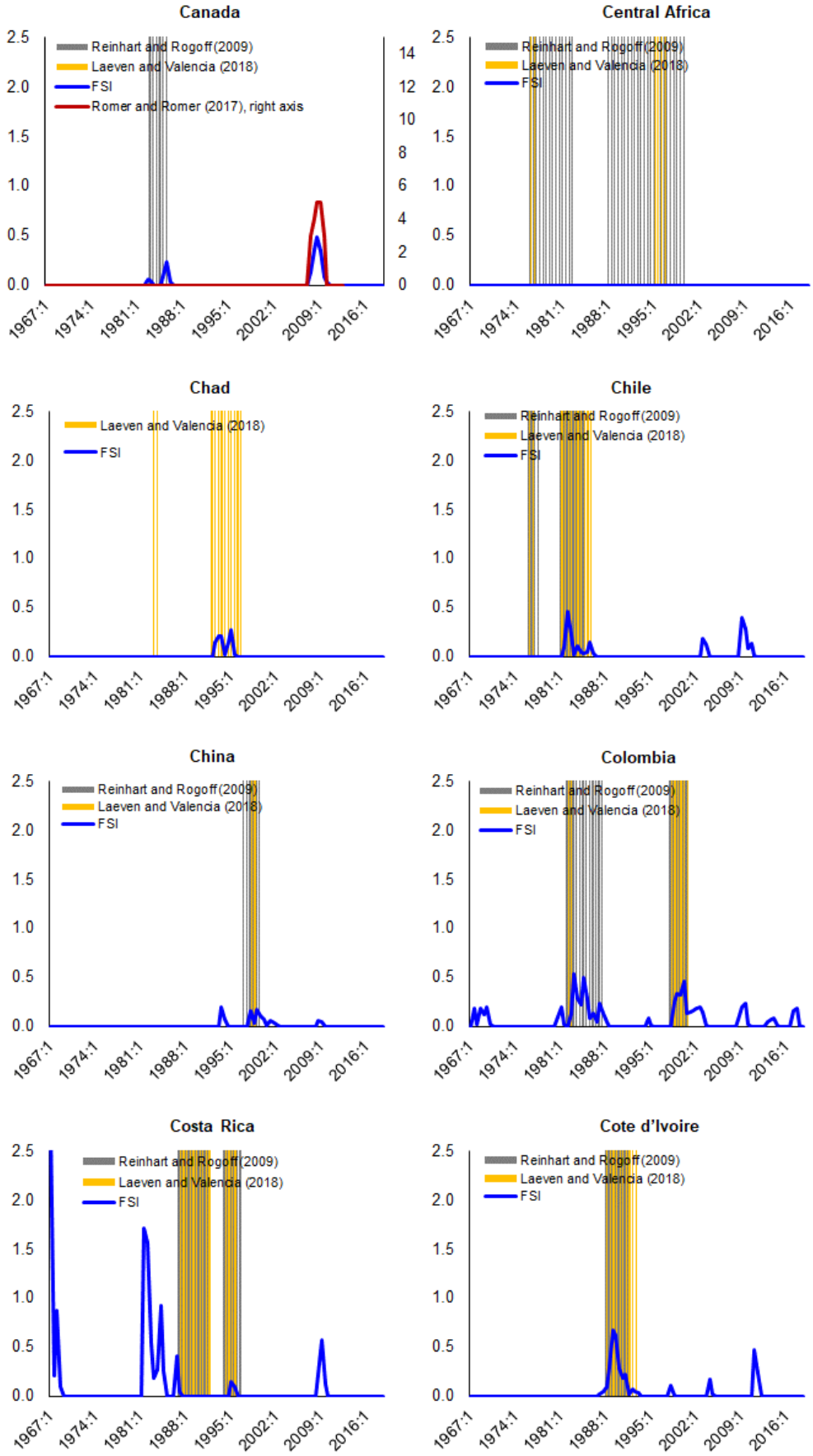


Figure A1 – Continued

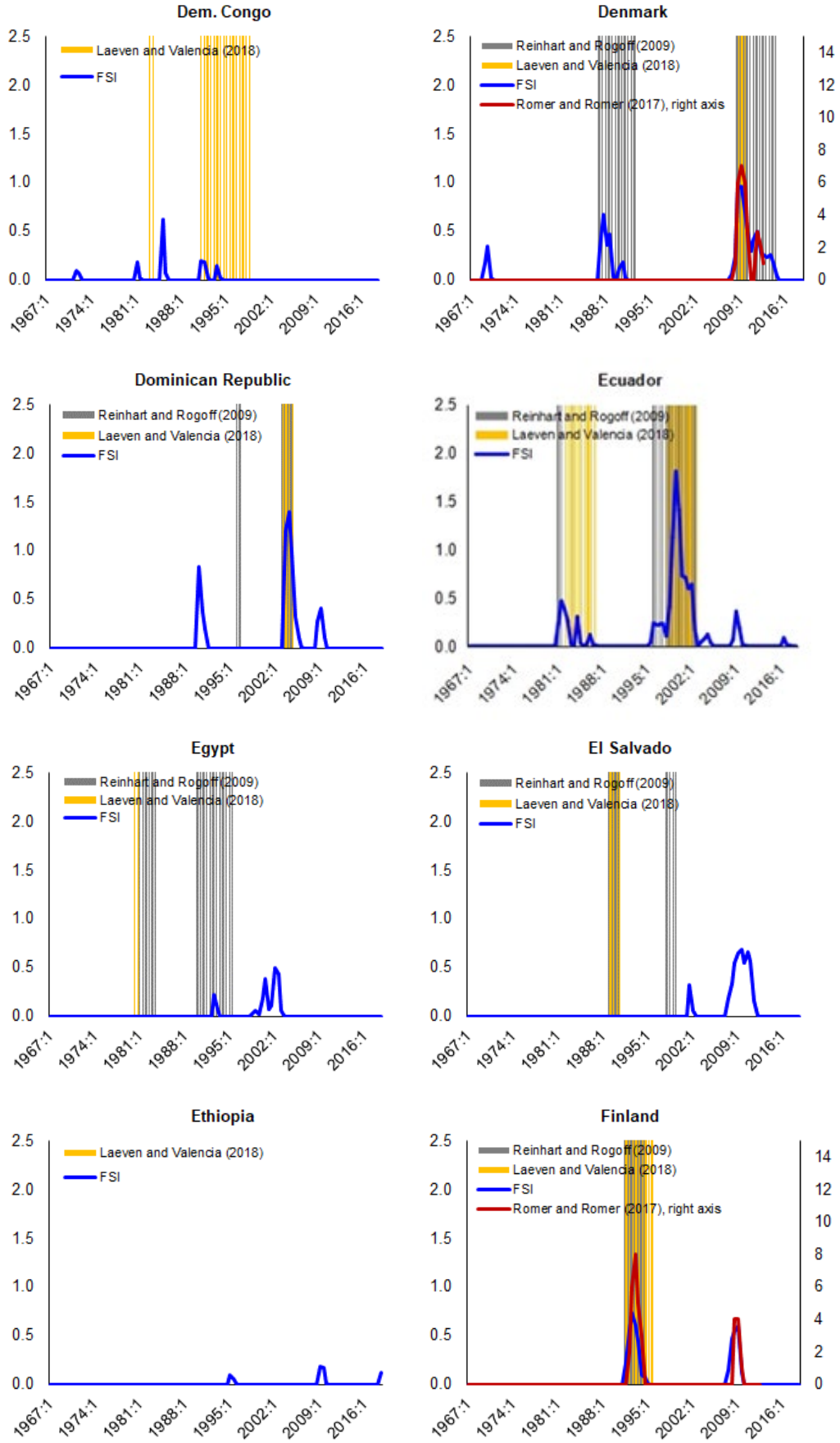


Figure A1 – Continued

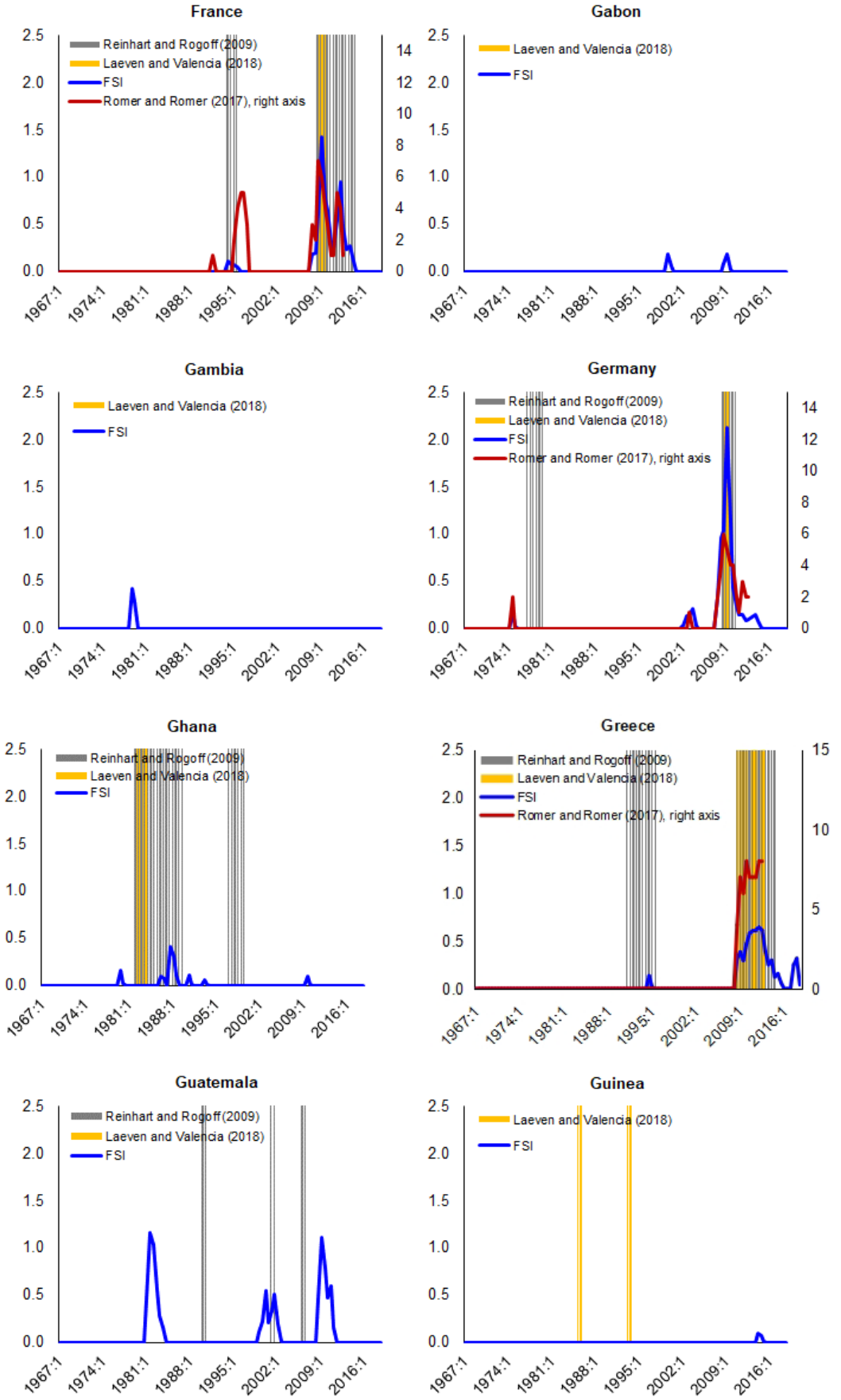


Figure A1 – Continued

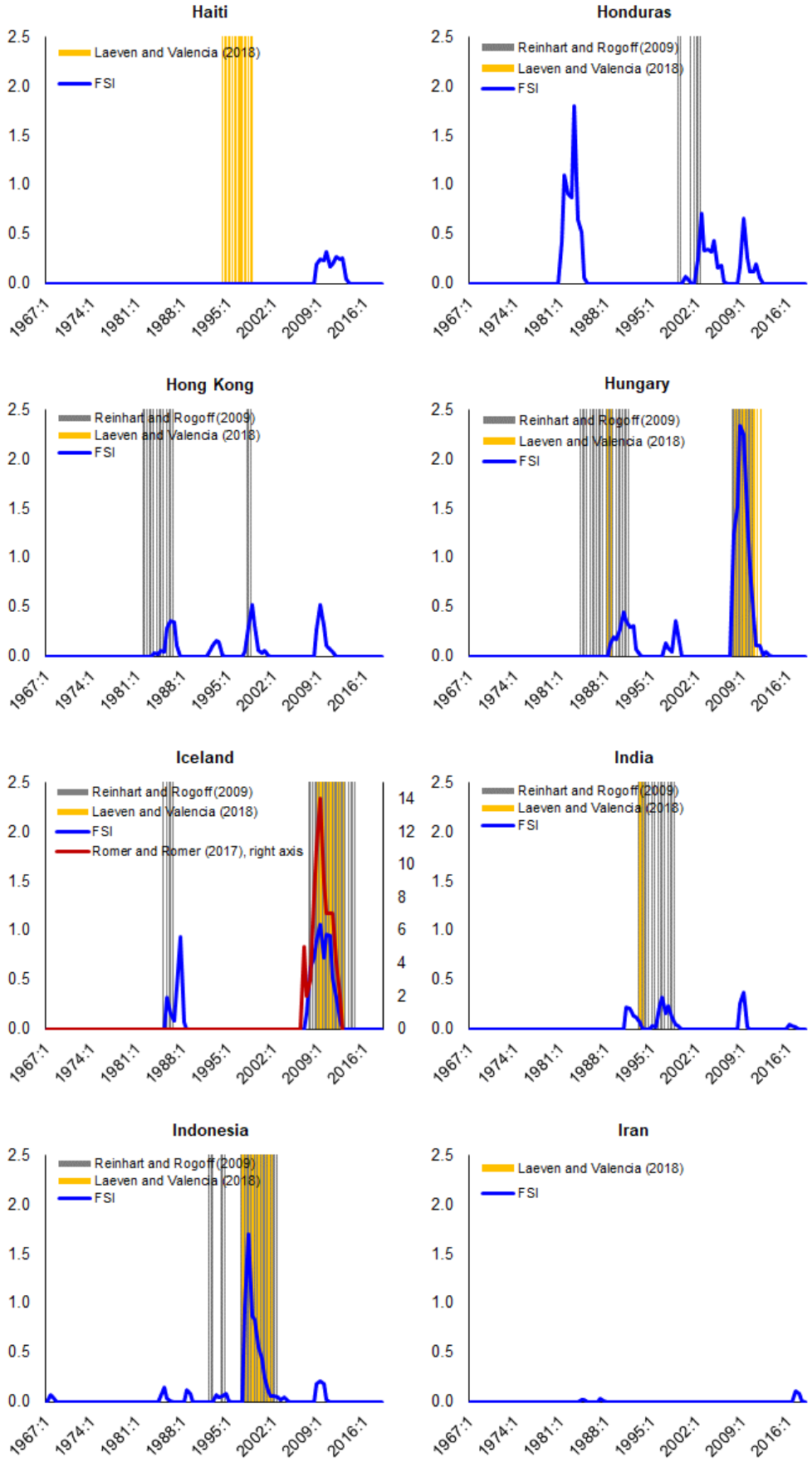


Figure A1 – Continued

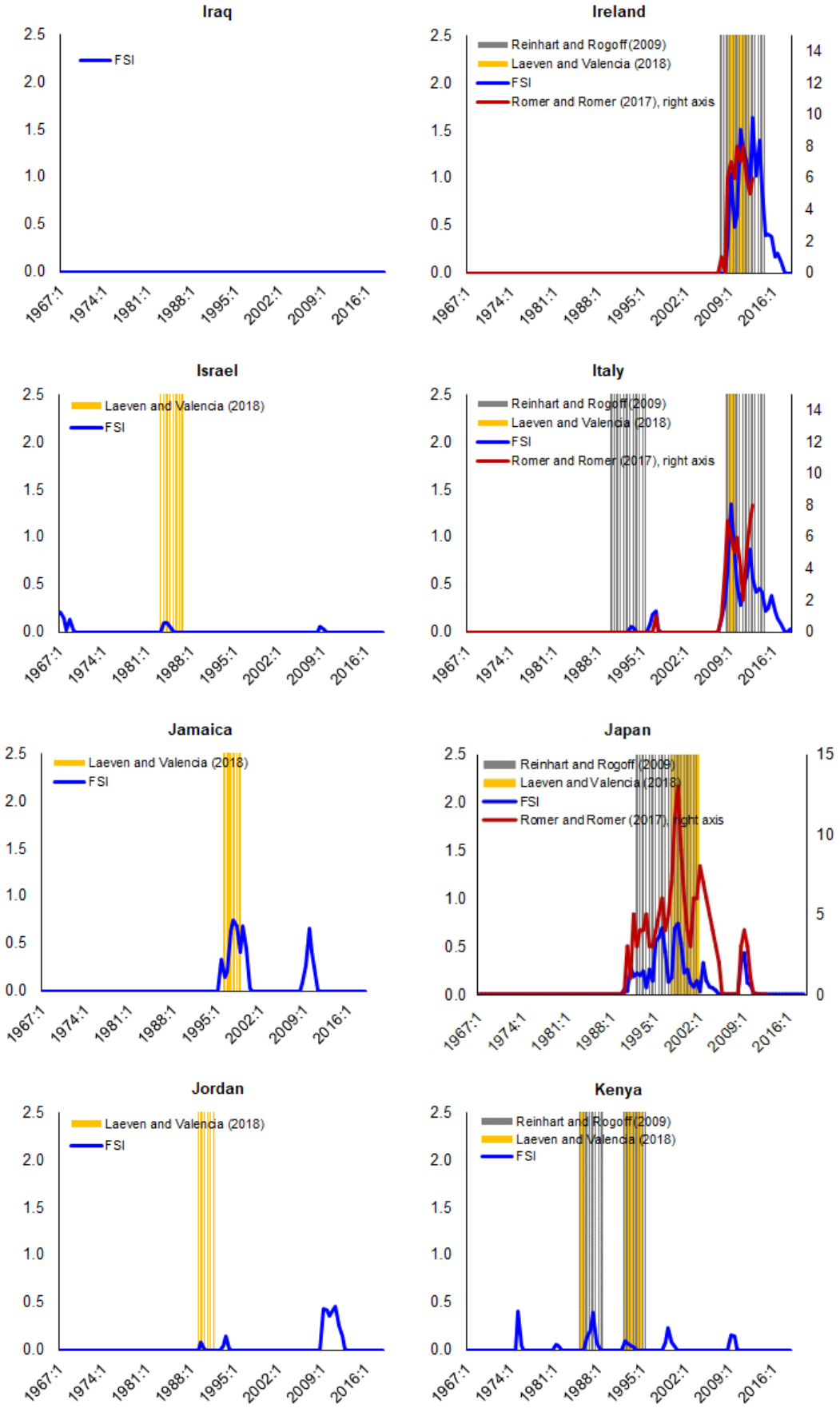


Figure A1 – Continued

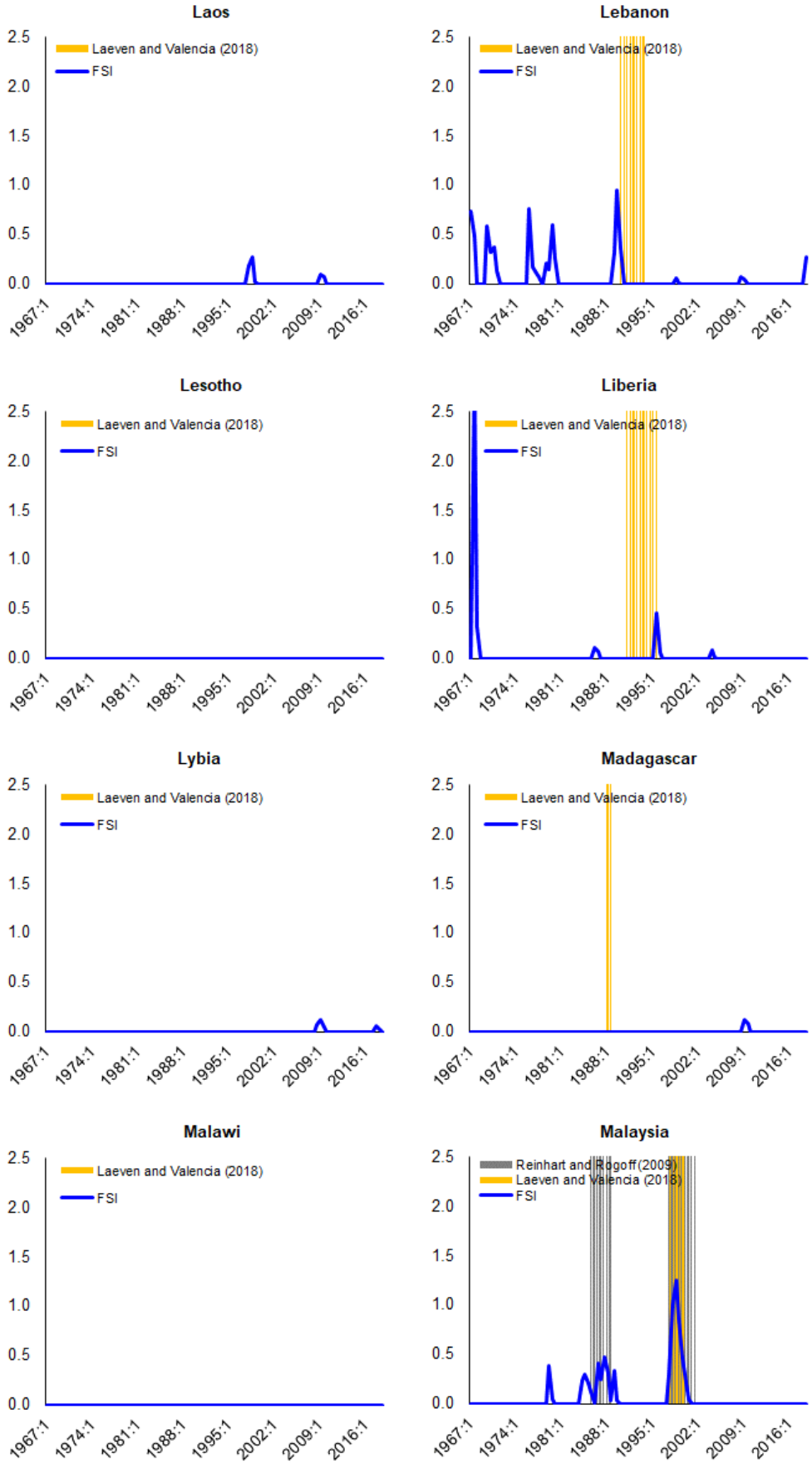


Figure A1 – Continued

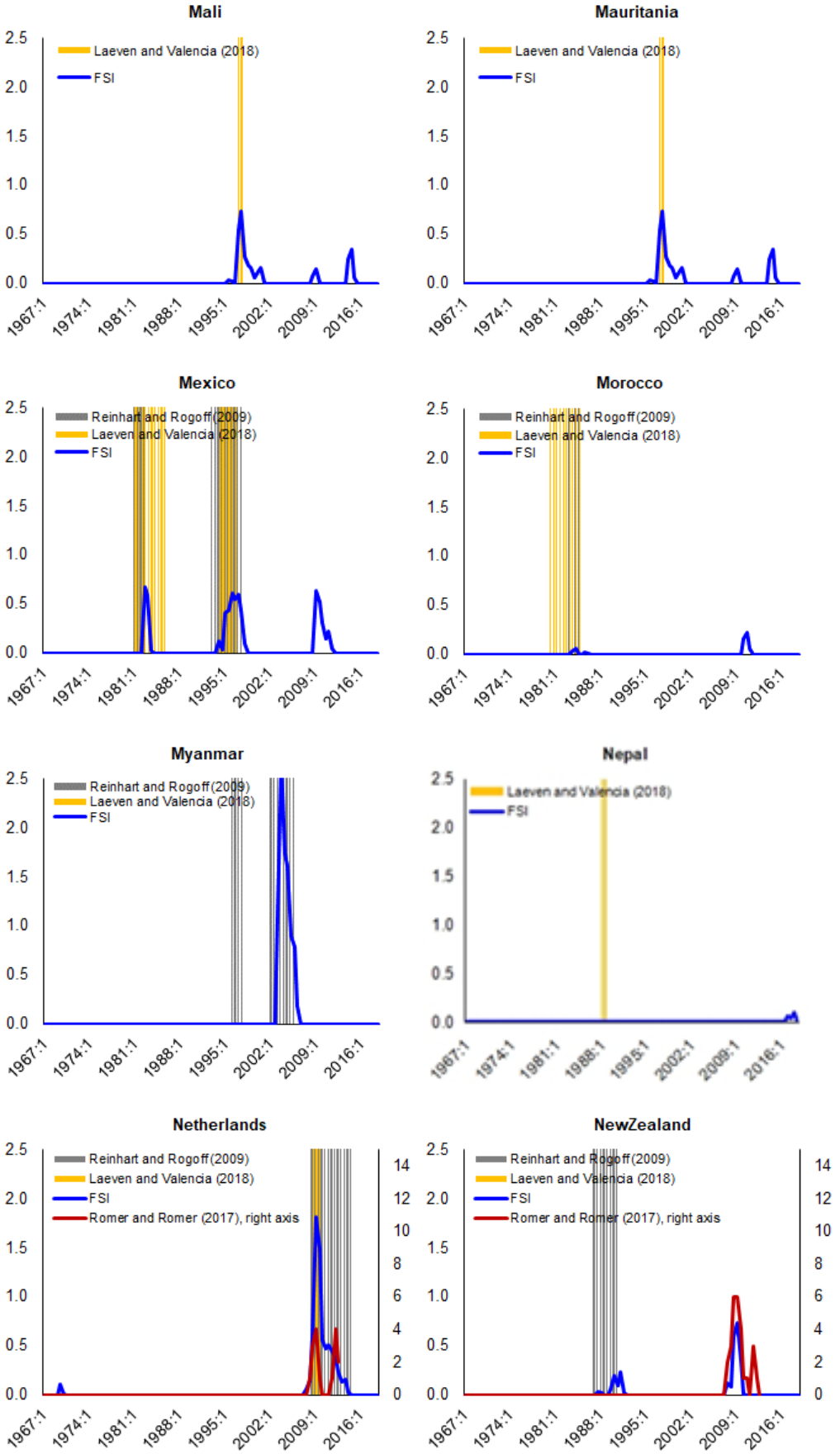


Figure A1 – Continued

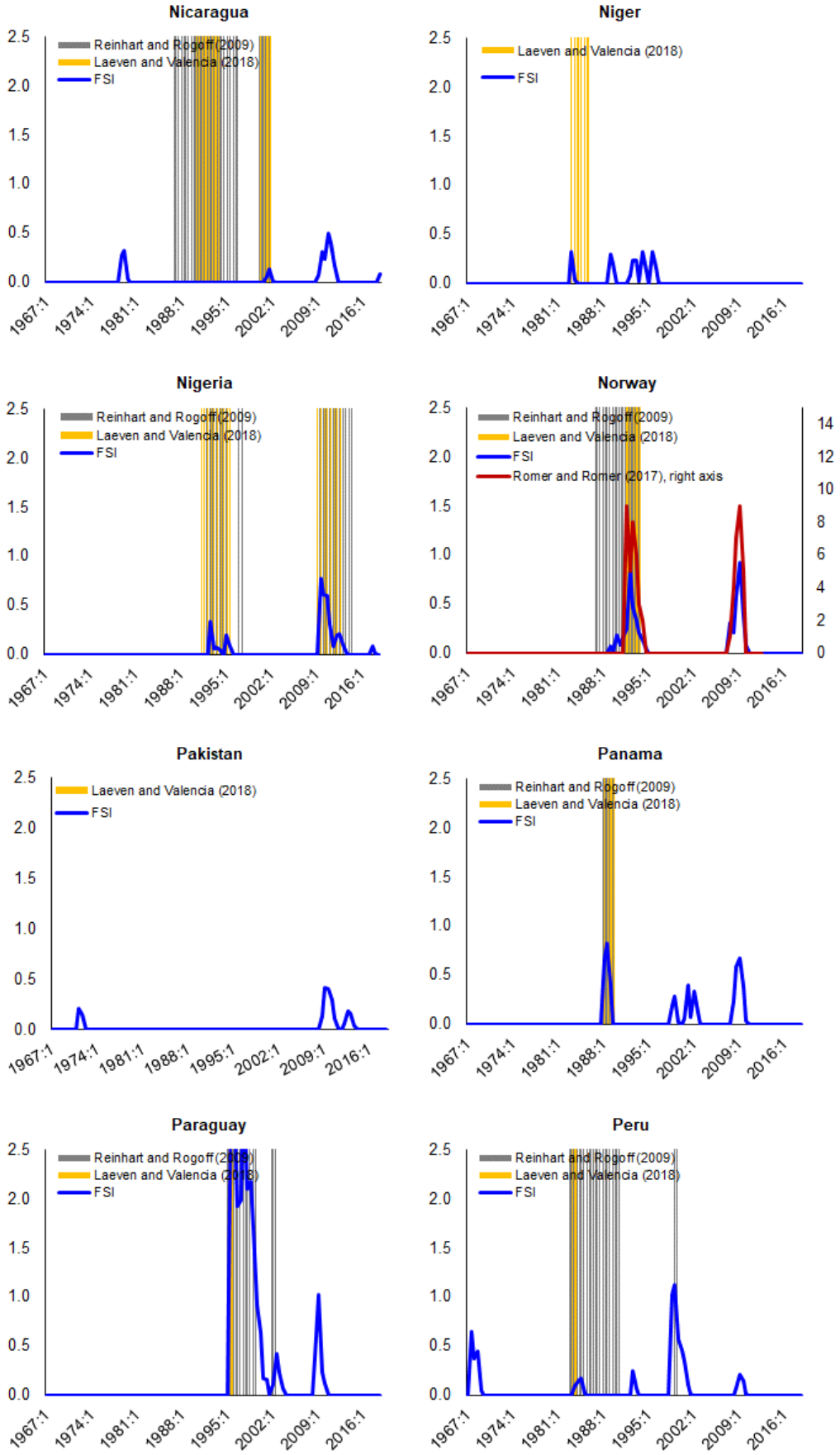


Figure A1 – Continued

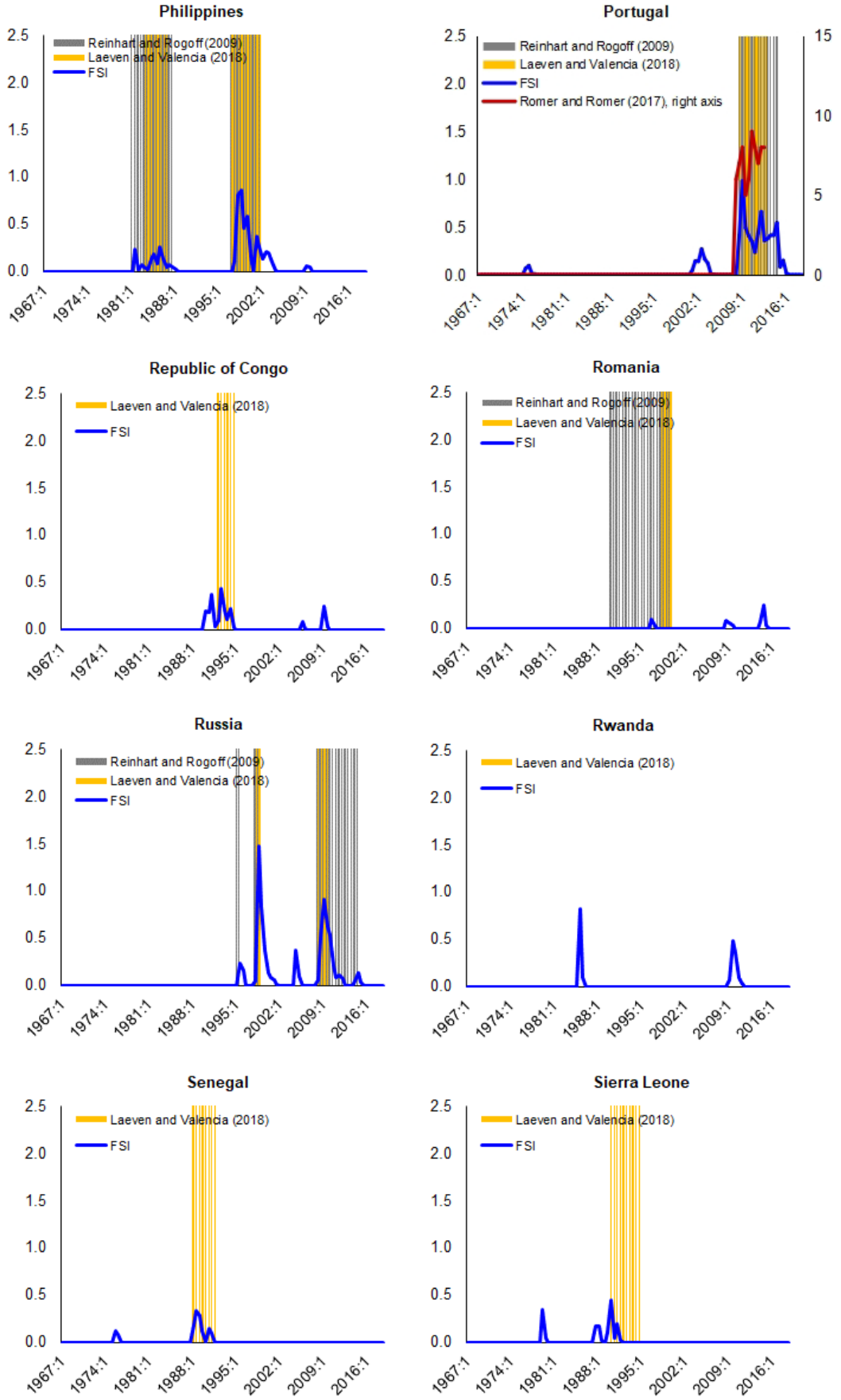


Figure A1 – Continued

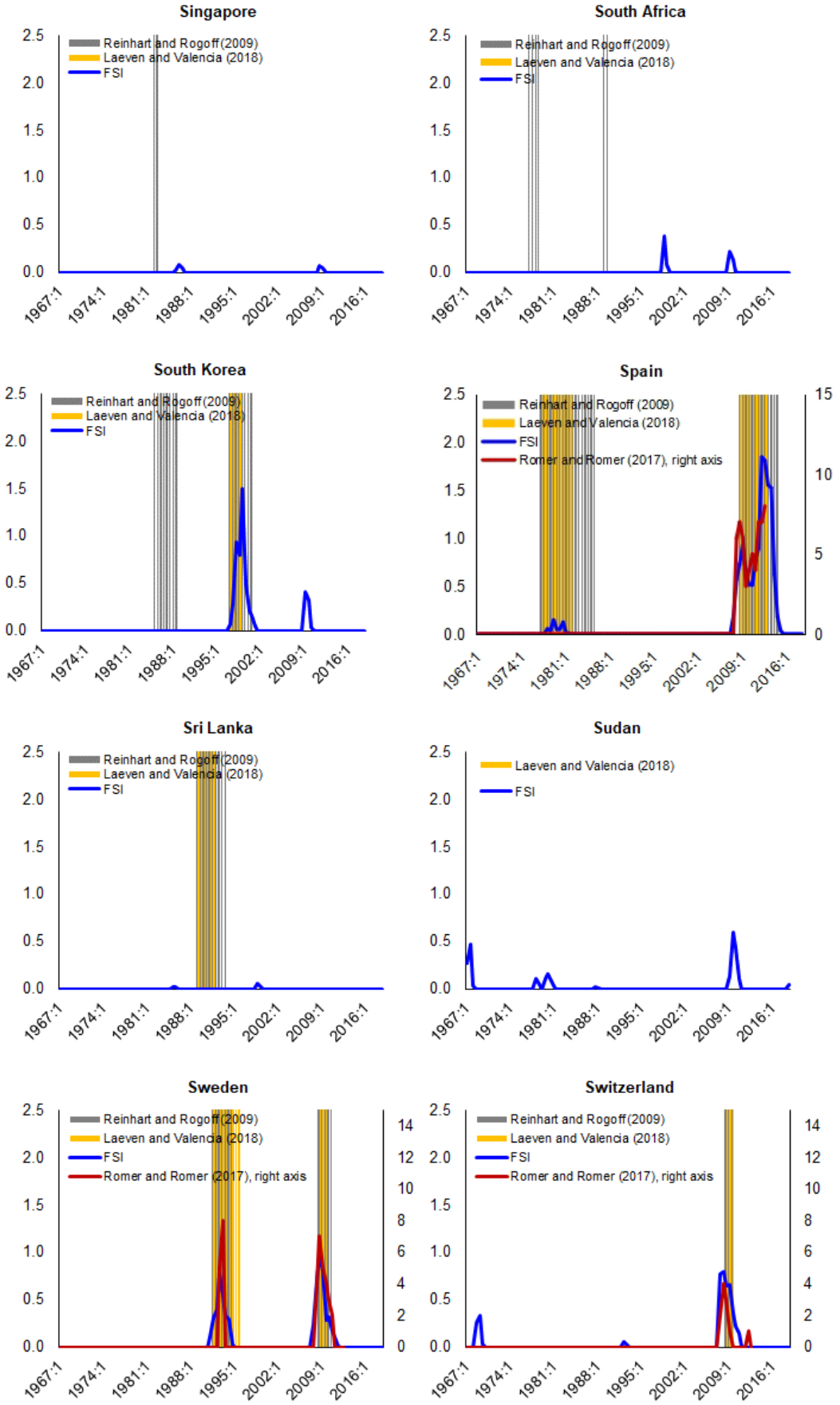


Figure A1 – Continued

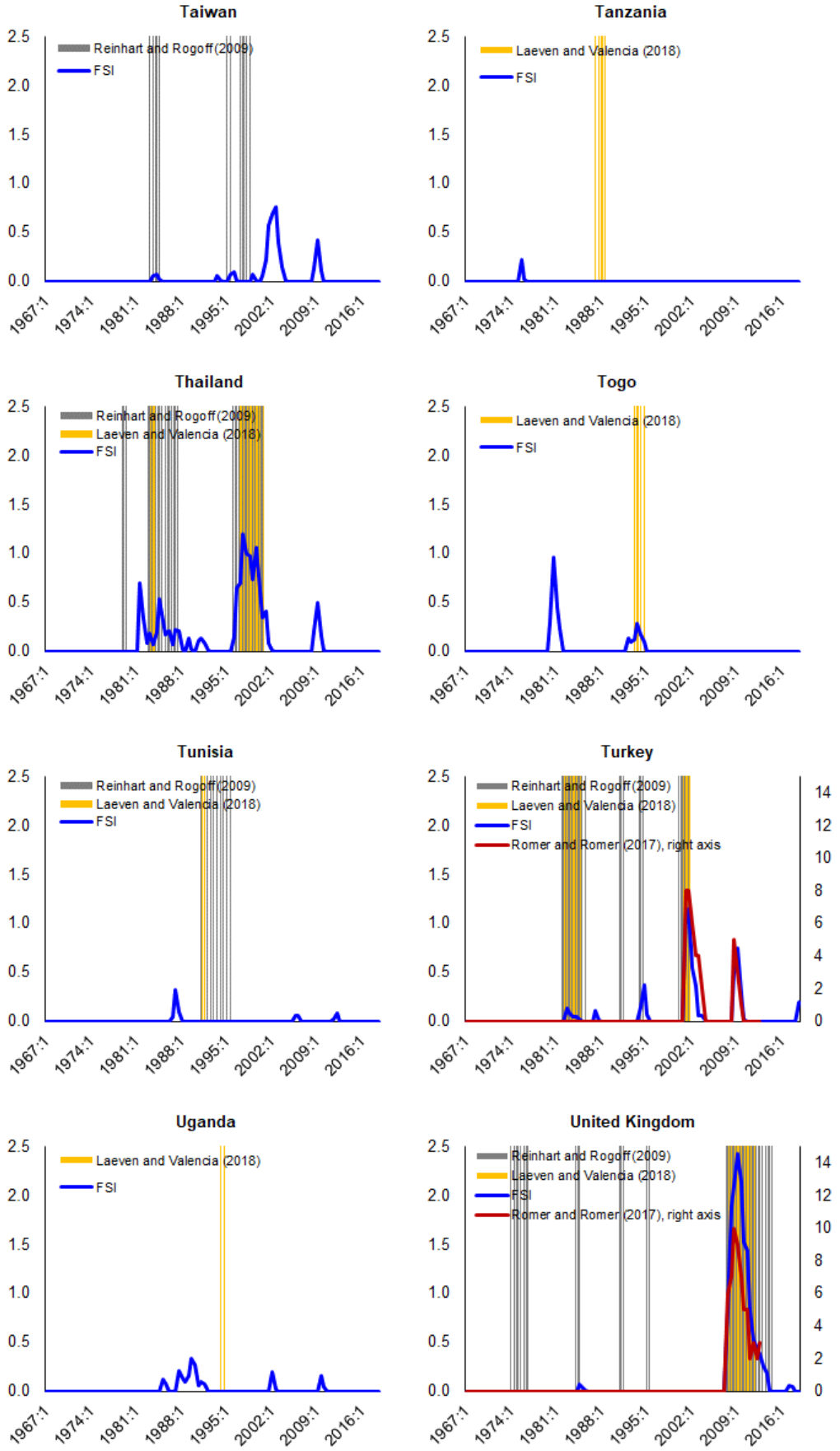
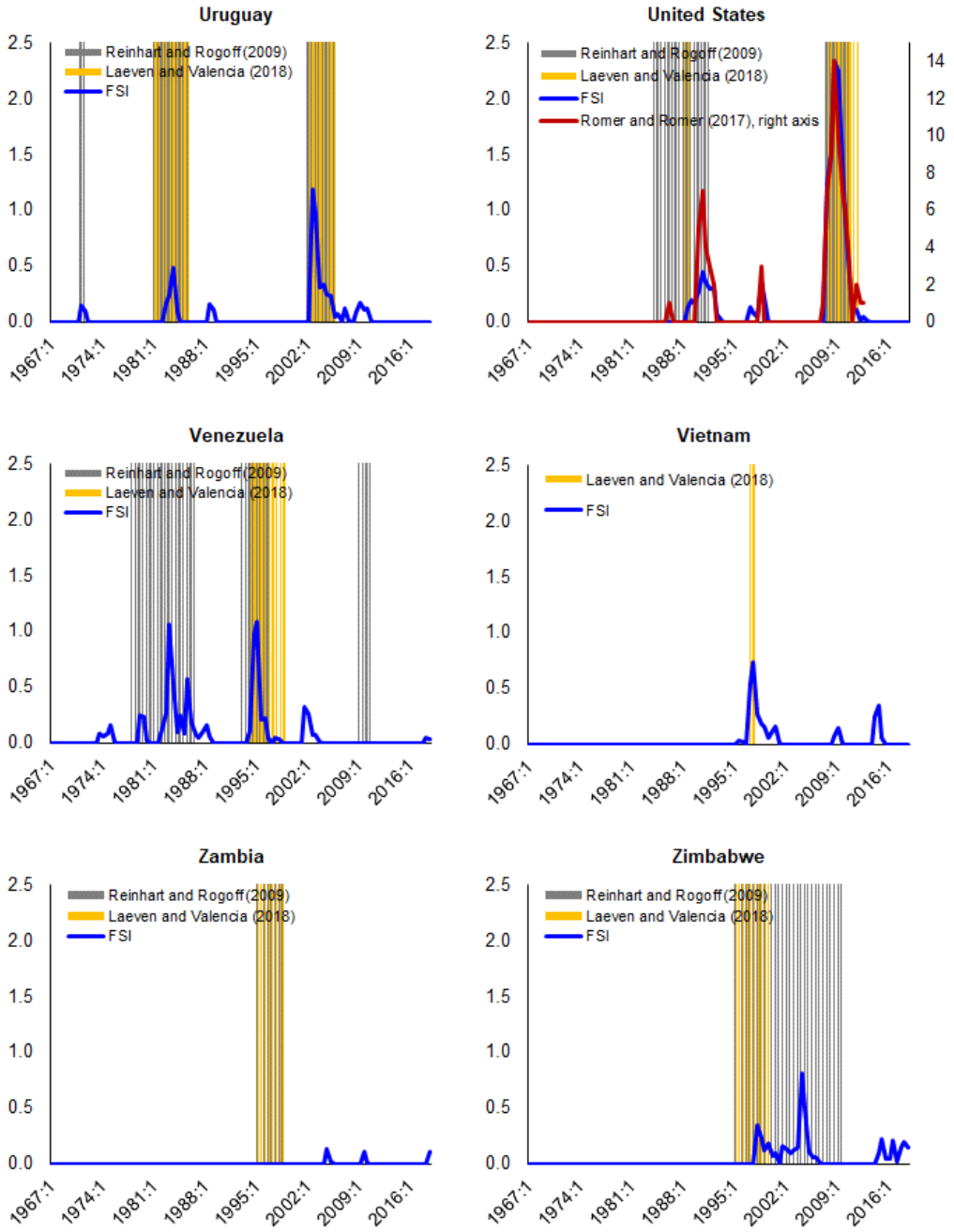
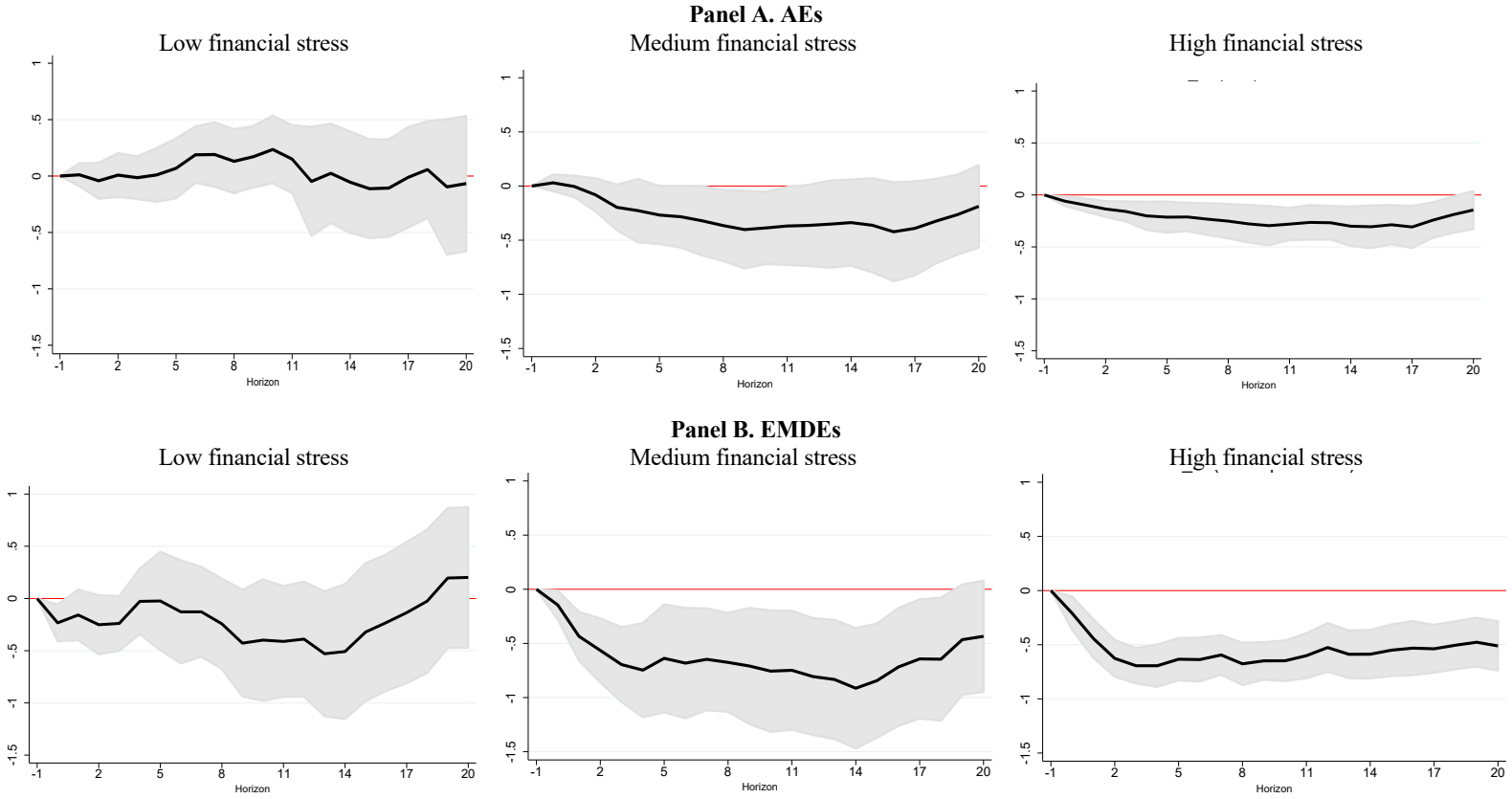


Figure A1 – Continued



Notes: Financial Stress Index is summing the number of keywords identified with financial stress in EIU country reports. The index is then normalized by total number of words, rescaled by multiplying by 1,000 and calculated using a moving average method. A higher number means higher financial stress and vice versa. The data plotted is semi-annual and run from 1967 until 2018, except RoRo RR until 2012, ReRo until 2014 and LV until 2017.

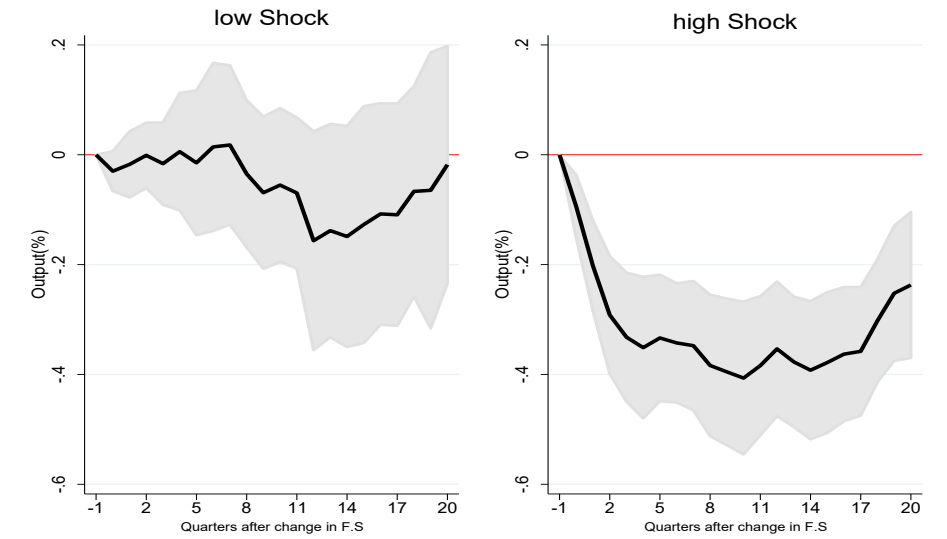
Figure A2. Impact of Change in FSI on Output—Non-linear Effects



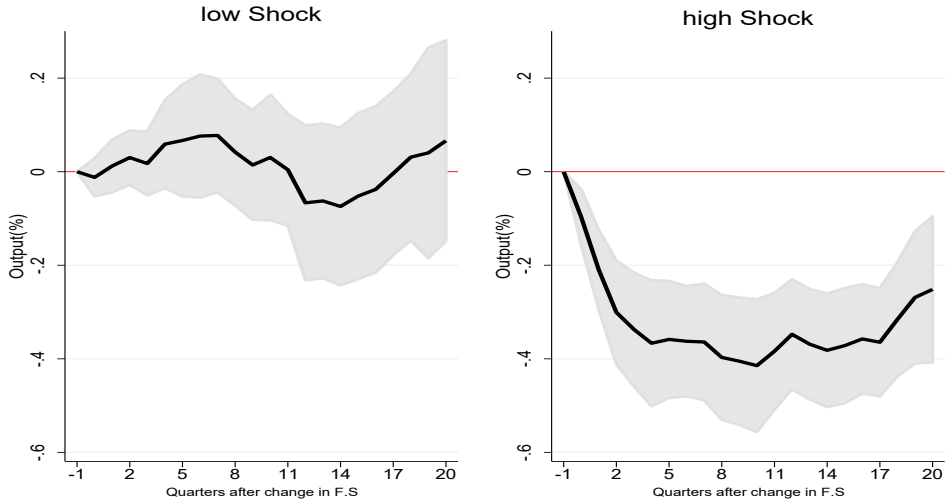
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4, based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^{kG} I[F_{it} \in G\,] \cdot \Delta F_{i,t} + \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where *I* is an indicator function which assumes value 1 when the level of financial stress belongs to a specific bin (terciles) of the distribution, which we refer to as group G.

Figure A3. Impact of Change in FSI on Output—Non-linear Effects

Panel A. Dummy variable

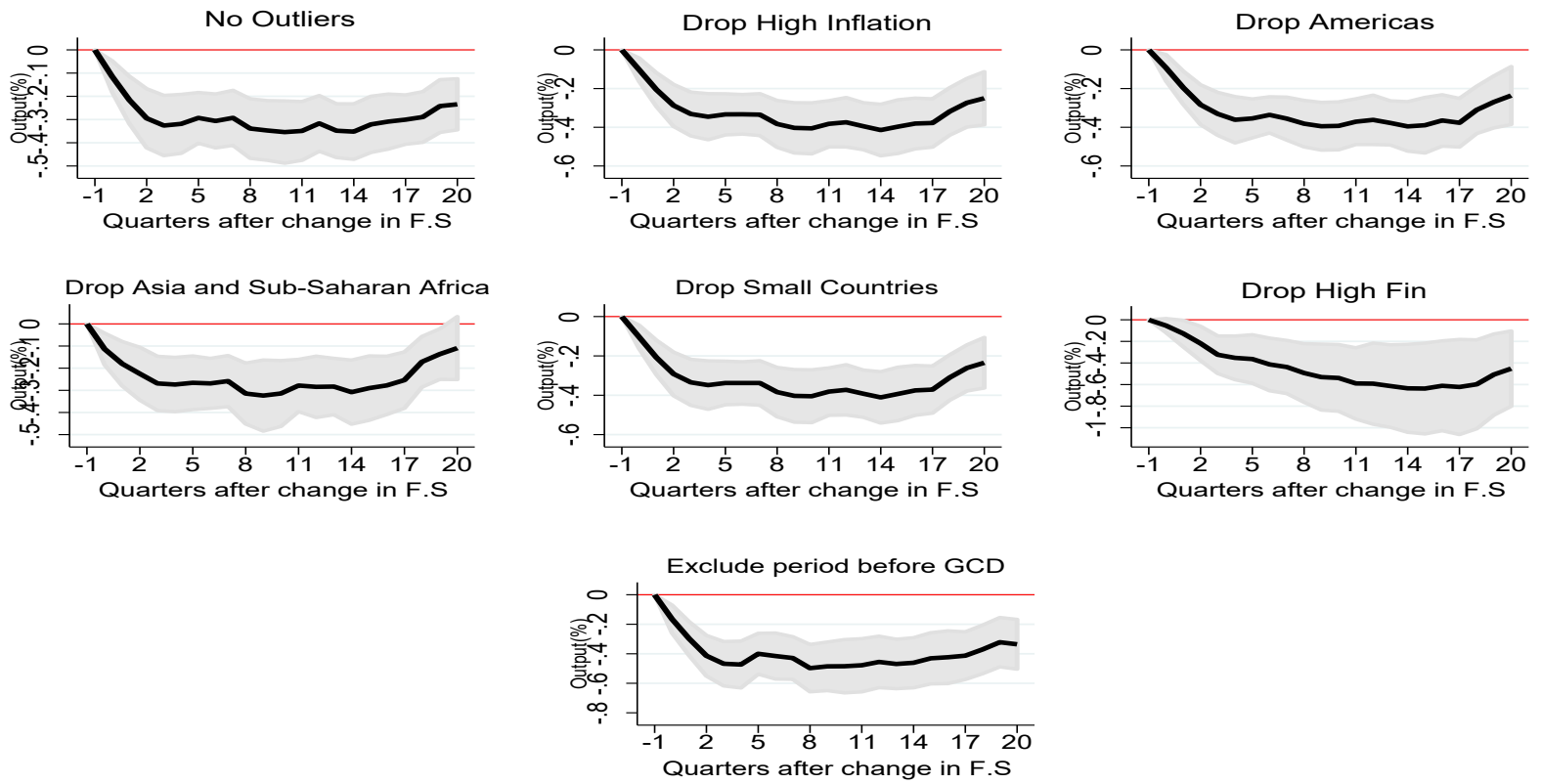


Panel B. Smooth transition function



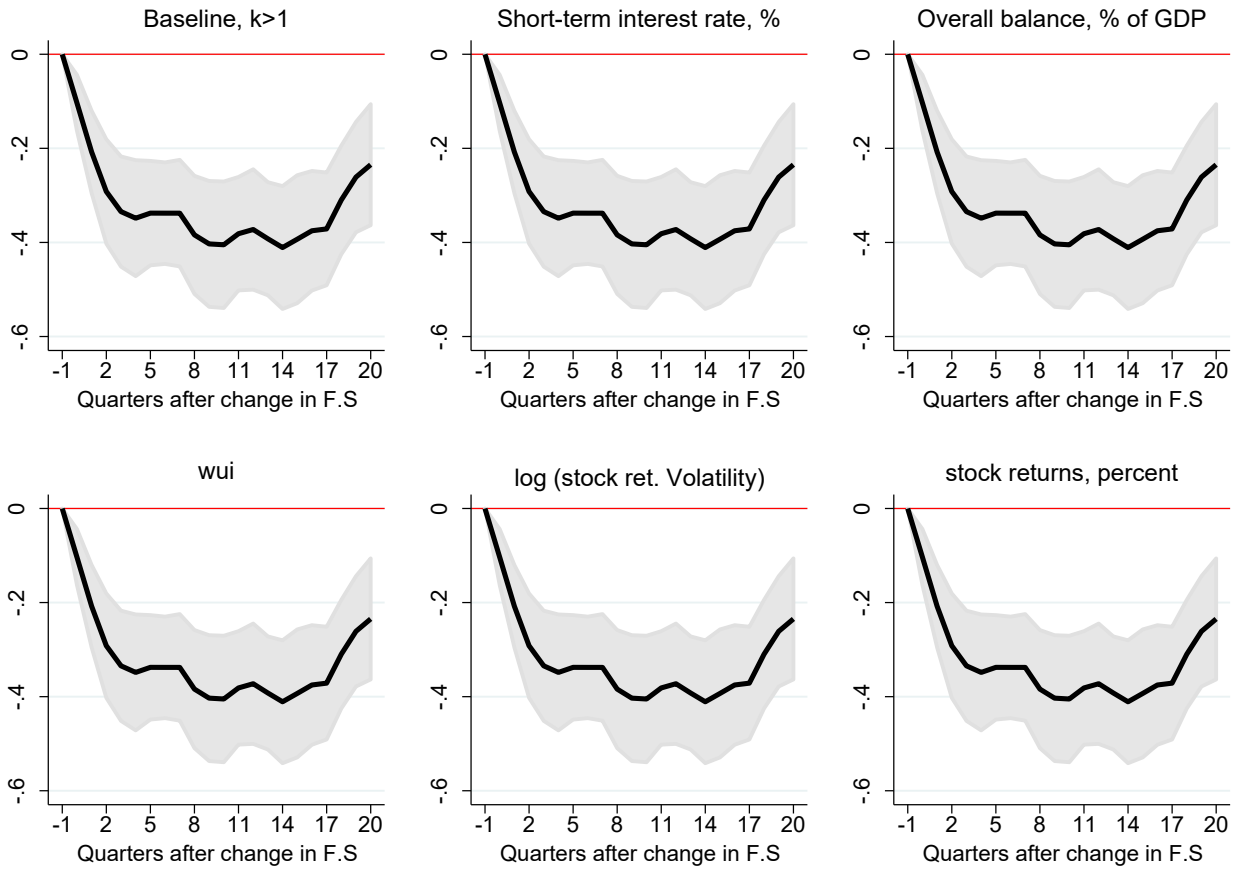
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4. Panel A is based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \beta_0^{kH} D \cdot \Delta F_{i,t} + \beta_0^{kL}(1-D) \cdot \Delta F_{i,t-j} \sum_{j=1}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=0}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in financial stress. D is a dummy variable which takes value 1 if the level of FSI is above the median of the distribution, and zero otherwise. The coefficients β^{kH} and β^{kL} capture the output impact of financial stress at horizon k in cases of low levels of FSI and high levels of FSI, respectively. An alternative specification is in Panel B based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + F(z_{it})[\beta_0^{kH} \Delta F_{i,t}] + (1 - F(z_{it}))\left[\beta_0^{kL} \Delta F_{i,t-j}\right] + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, with $F(z_{it}) = \frac{exp^{-\gamma zit}}{1+exp^{-\gamma zit}}$ where $\gamma = 1.5$.

Figure A4. Robustness Checks—Alternative Samples



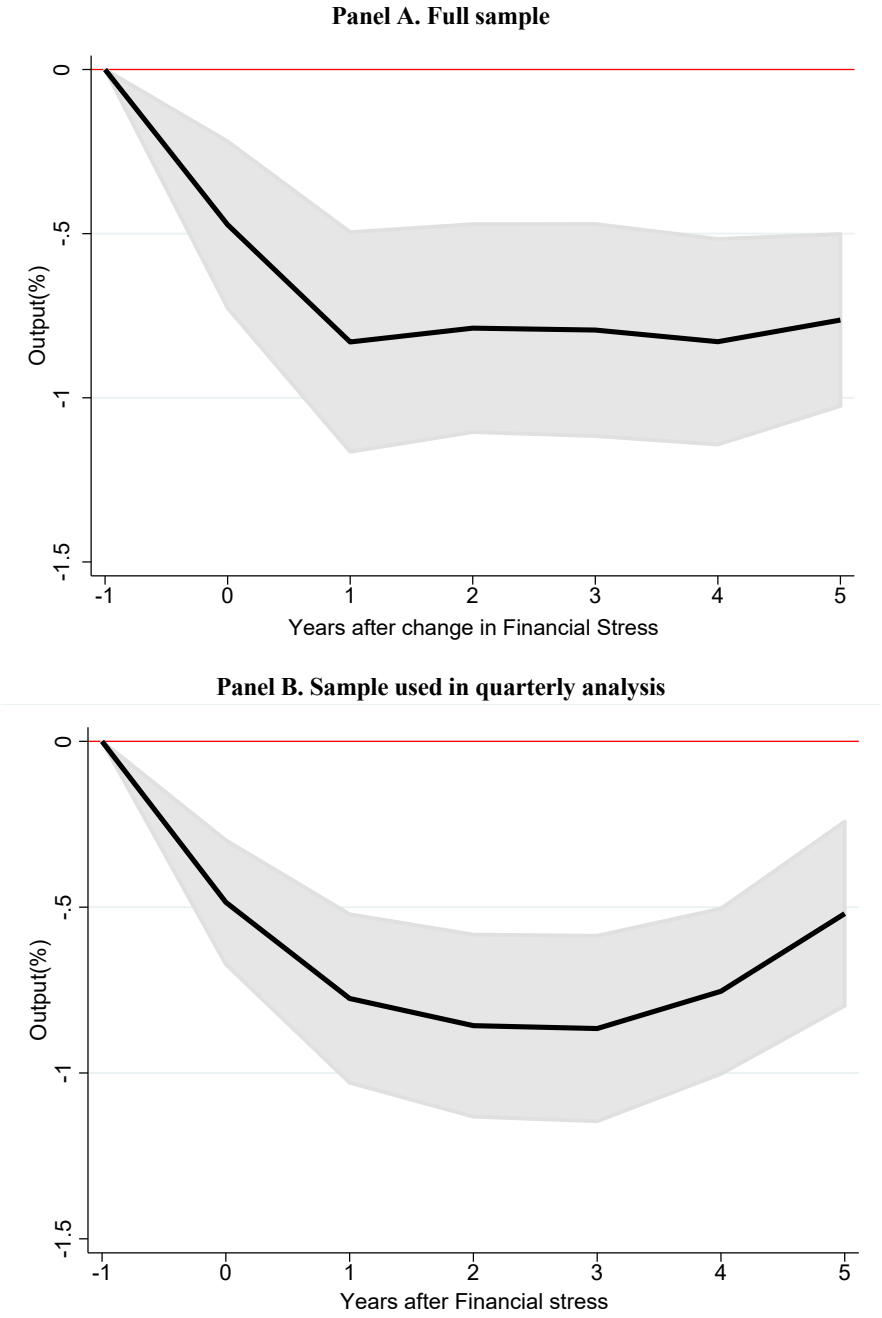
Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI. The plots above consider dropping: a) outliers (those observations corresponding to the residuals in the output regression at the bottom and top percentiles of the distribution); b) high inflation episodes (inflation above 20 percent); c) observations from the Americas; d) Asian and Sub-Saharan African economies; e) small economies (with population below two millions); f) episodes of large changes in financial stress episodes (those corresponding to the 99th percentile of the distribution); and g) excluding the period following the Global Financial Crisis (after the third quarter of 2008).

Figure A5: **Robustness Checks—Alternative Sets of Control Variables**



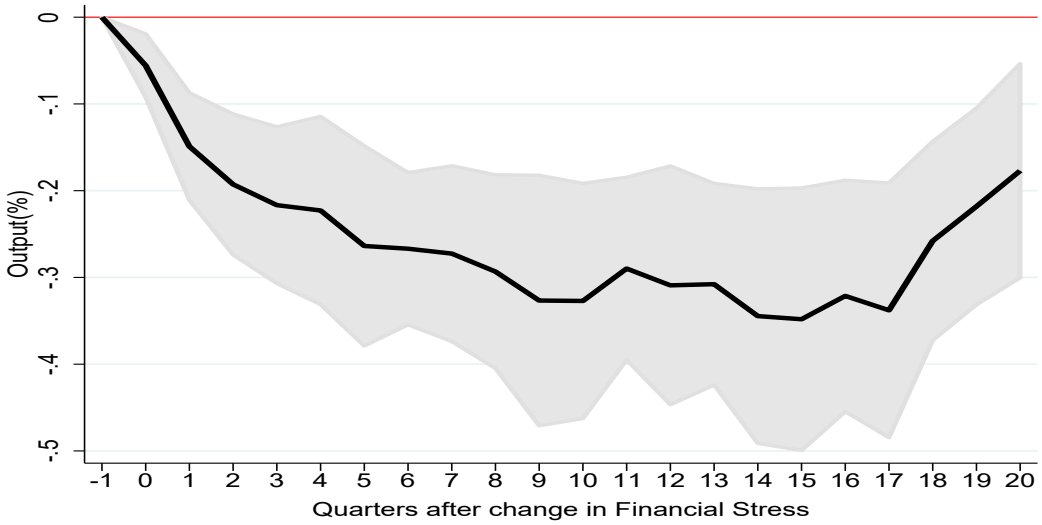
Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \sum_{j=0}^{2} \theta_j^k X_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; ΔF denotes the change in FSI; and X is a set of controls as follows: i) without lag of FSI; ii) overall balance (% of GDP); iii) short-term interest rate (%); iv) uncertainty; v) log stock return volatility; and vi) stock return (%).

Figure A6. Impact of Change in FSI on Output (annual data)



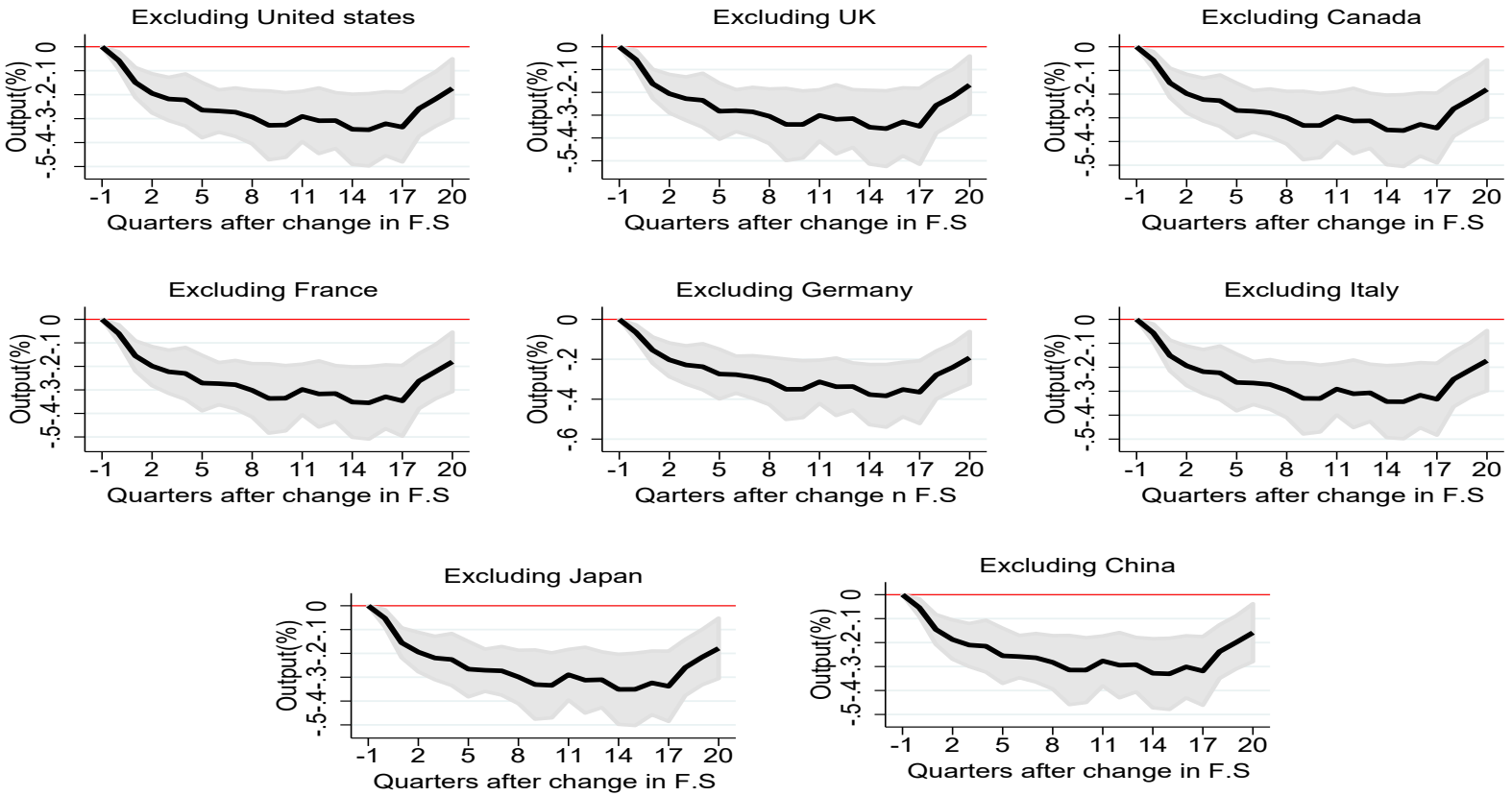
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using the full sample of 110 countries over the period 1967-2018 (Panel A), and the sample used for the quarterly data baseline equation (Panel B). Both panels are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$ where i index countries, t refers to years, and k denotes the horizon (the year after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI.

Figure A7. Impact of Change in FSI on Output—IV results



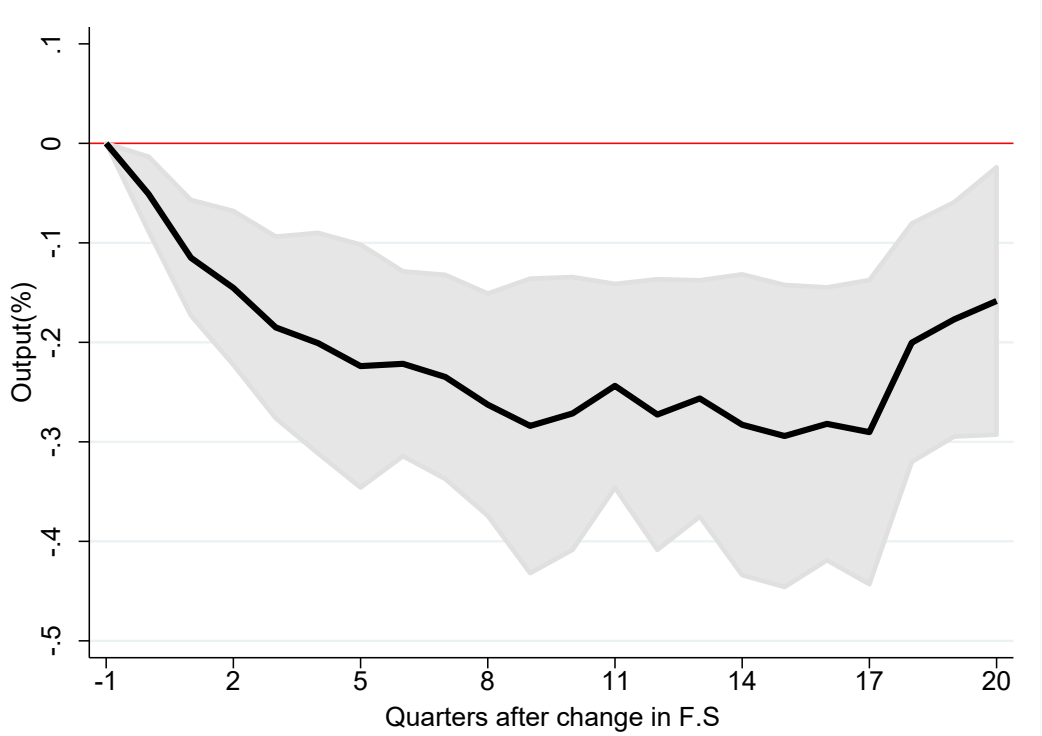
Notes: The graph shows the response and shaded areas denote 90 percent confidence bands. Time is indicated on the x-axis. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4, and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where *i* index countries, *t* refers to quarters, and *k* denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in financial stress. The instrumental variable (IV) approach consist of $\Delta F_{i,t} = \pi_i^{\square} + \tau_t^{\square} + \vartheta \Delta EF_{i,t} + \sum_{j=1}^{2} \rho_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \sigma_j^k y_{i,t-j} + \mu_t^{\square}$, whereas $EF_{i,t}$ is the indicator of external financial stress produced using the information on episodes of external financial stress.

Figure A8. IV Results—Excluding G7 Economies and China



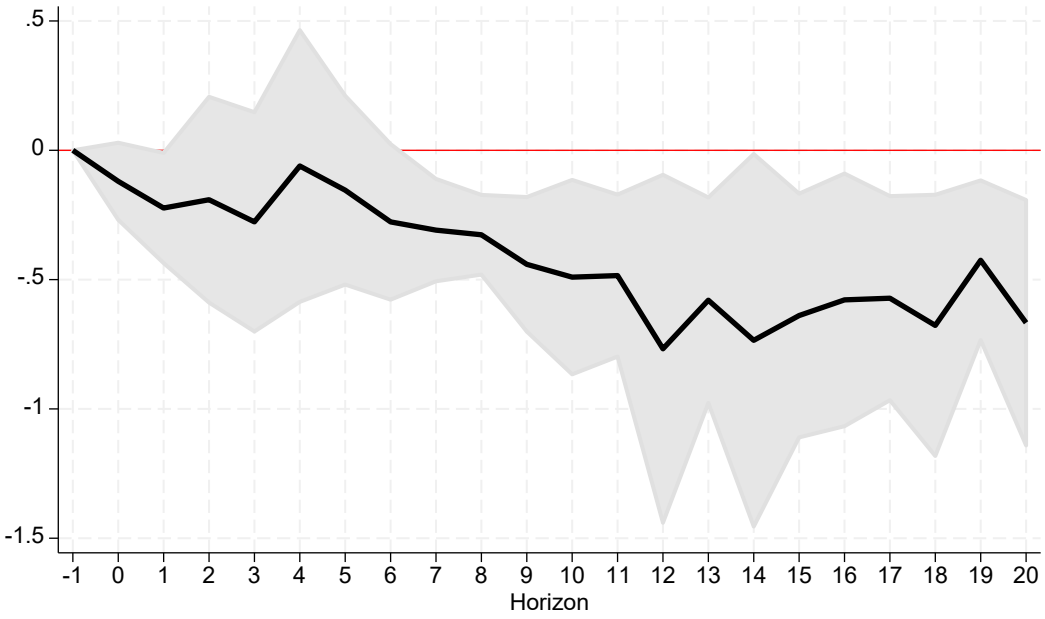
Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI. The instrumental variable (IV) approach consist of $\Delta F_{i,t} = \pi_i^{\square} + \tau_t^{\square} + \vartheta \Delta EF_{i,t} + \sum_{j=1}^{2} \rho_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \sigma_j^k y_{i,t-j} + \mu_t^{\square}$, where $EF_{i,t}$ is the indicator of external financial stress. Excluding the G7 countries and China one at a time

Figure A9. IV Results—Controlling for Growth in Major Trading Partners



Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2018q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=0}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI. The instrumental variable (IV) approach consist of $\Delta F_{i,t} = \pi_i^{\square} + \tau_t^{\square} + \vartheta \Delta EF_{i,t} + \sum_{j=1}^{2} \rho_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \sigma_j^k y_{i,t-j} + \sum_{j=0}^{2} \theta_j^k foreign\_g_{i,t-j} + \mu_t^{\square}$, where $EF_{i,t}$ is the indicator of external financial stress, $and\ foreign\_g_{i,t-j}$ is the growth in major trading partners.

Figure A10. IV Results—Before GFC

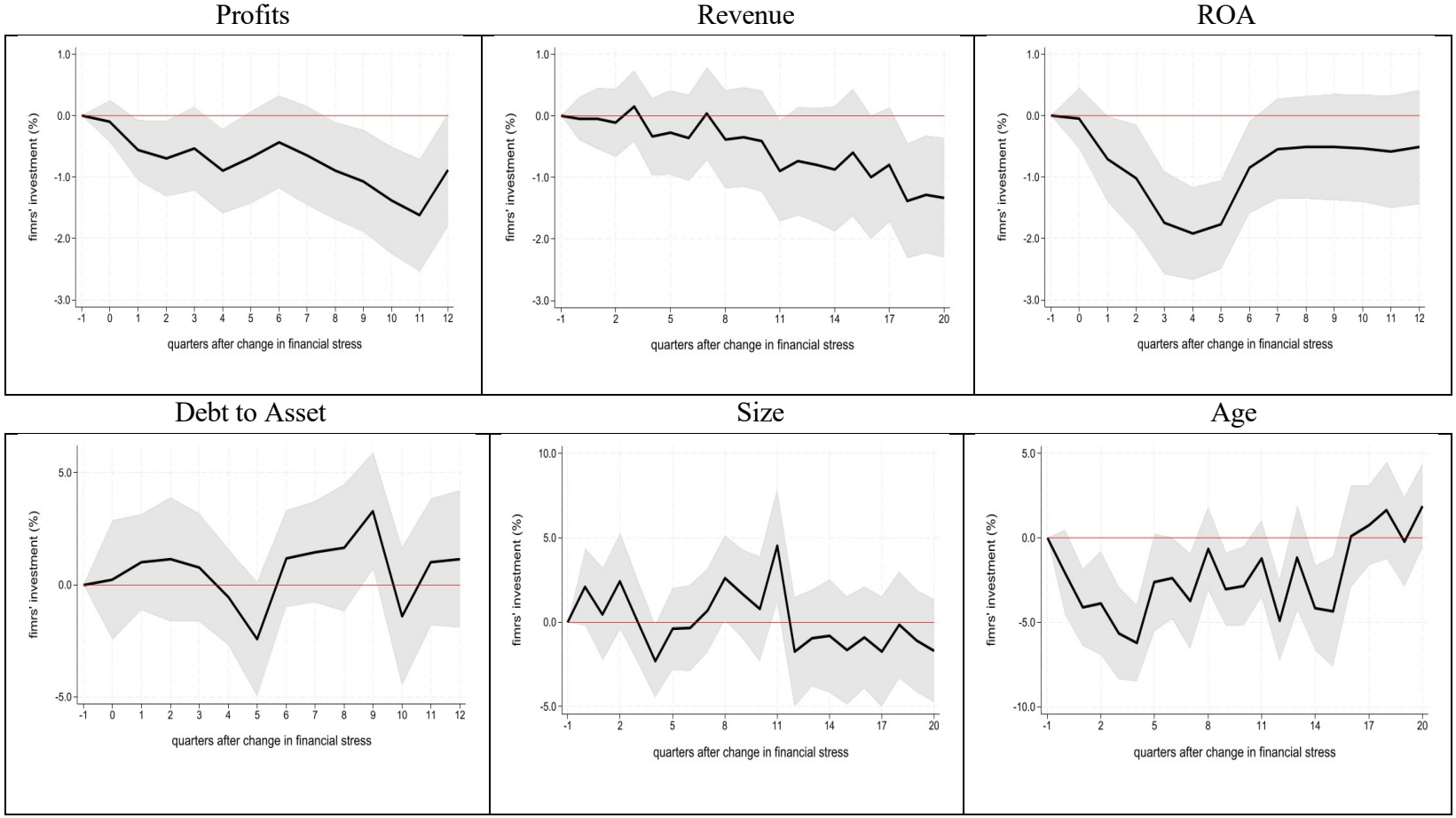


Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 49 countries over the period 1996q1-2016q4 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=0}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where i index countries, t refers to quarters, and k denotes the horizon (the quarter after the change in the financial stress indicator) being considered. y is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI. The instrumental variable (IV) approach consist of $\Delta F_{i,t} = \pi_i^{\square} + \tau_t^{\square} + \vartheta \Delta EF_{i,t} + \sum_{j=1}^{2} \rho_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \sigma_j^k y_{i,t-j} + \sum_{j=0}^{2} \theta_j^k foreign\_g_{i,t-j} + \mu_t^{\square}$, where $EF_{i,t}$ is the indicator of external financial stress, $and\ foreign\_g_{i,t-j}$ is the growth in major trading partners.

Figure A11. IV Results—Annual Data

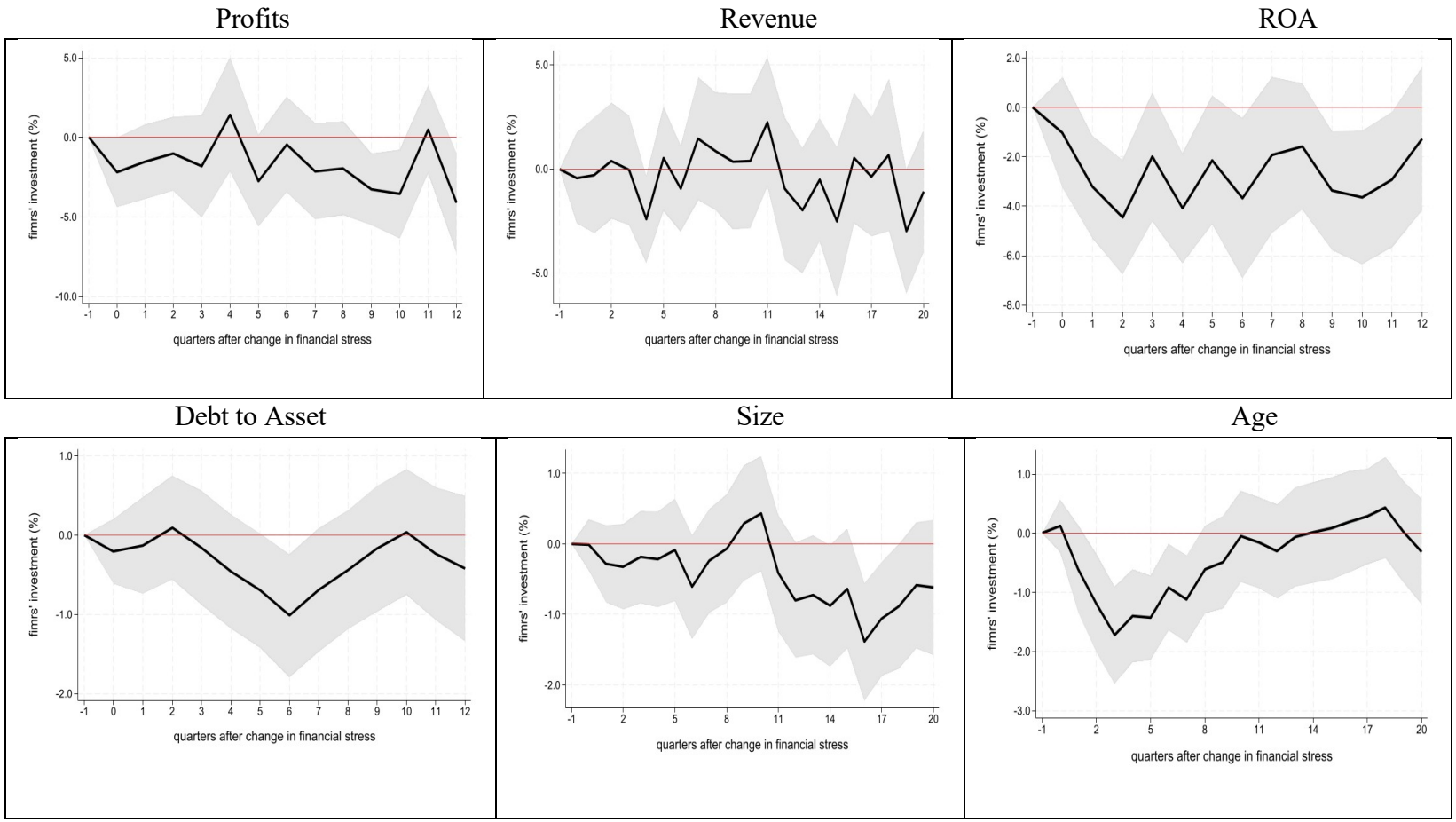
Notes: Standard errors clustered at the country-level in parenthesis. ***, **, * denote statistical significance at 1, 5 and 10 percent, respectively. Estimates are obtained using a sample of 110 countries over the period 1967-2018 and are based on $y_{i,t+k} = \alpha_i^k + \gamma_t^k + \sum_{j=0}^{2} \beta_j^k \Delta F_{i,t-j} + \sum_{j=0}^{2} \theta_j^k y_{i,t-j} + \varepsilon_t^k$, where *i* index countries, *t* refers to years, and *k* denotes the horizon (the year after the change in the financial stress indicator) being considered. *y* is the log of output; α_i are country fixed effects; γ_t are time fixed effects; and ΔF denotes the change in FSI. The instrumental variable (IV) approach consist of $\Delta F_{i,t} = \pi_i^{\square} + \tau_t^{\square} + \vartheta \Delta EF_{i,t} + \sum_{j=1}^{2} \rho_j^k \Delta F_{i,t-j} + \sum_{j=1}^{2} \sigma_j^k y_{i,t-j} + \mu_t^{\square}$, whereas $EF_{i,t}$ is the indicator of external FSI.

Figure A12. Impact of Change in FSI on Firm Investment—the Role of Firm characteristics, AEs



Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates are based on the regression $y_{n,i,t+k} = \alpha_{ist}^{k} + \gamma_{nq}^{k} + \sum_{j=-k}^{4} \mu_{j}^{k} \Delta F_{i,t-j} * D_n + \sum_{j=1}^{4} \theta_{j}^{k} y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $\Delta F_{i,t-j}$ is the change in FSI, γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimates separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_0^k for different horizons k, while shaded areas denote 90 percent confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.

Figure A13. Impact of Change in FSI on Firm Investment—the Role of Firm characteristics, EMDEs



Note: Impulse response functions based on local projection methods following Jordà (2005) using firm-level quarterly data from 75 countries for the period 2001Q1 to 2020Q4. Estimates are based on the regression $y_{n,i,t+k} = \alpha_{ist}^{k} + \gamma_{nq}^{k} + \sum_{j=-k}^{4} \mu_j^k \Delta F_{i,t-j} * D_n + \sum_{j=1}^{4} \theta_j^k y_{n,i,t-j} + \varepsilon_{n,i,t}^{k}$ for different horizons 'k', where $y_{n,i,t+k}$ is the log change in capital expenditure of firm n in country i at time t over the next k quarters, $\Delta F_{i,t-j}$ is the change in FSI, γ_{nq}^{k} are firm-quarters fixed effects, and α_{is}^{k} are country-sector fixed effects. The regression is estimates separately for different horizons k (for up to 12 quarters). The solid line shows the point estimate for β_0^k for different horizons k, while shaded areas denote 90 percent confidence intervals. Standard errors are clustered at two-way at the firm and country-time level.