Stress-ridden finance and growth losses: does financial development break the link?*

Matias Ossandon Busch[a,b] José Manuel Sánchez-Martínez[a,c]

Anahí Rodríguez-Martínez[a] Ricardo Montañez-Enríquez[a] Serafín Martínez-Jaramillo[a,c]

Manuel Ramos-Francia[a]

Abstract

Does financial development shield countries from the pass-through of financial shocks to real outcomes? We evaluate this question by characterizing the probability density of expected GDP growth conditional on financial stability indicators in a panel of 28 countries. Our robust results unveil a non-linear nexus between financial stability and expected GDP growth, depending on countries' degree of financial development. While both domestic and global financial factors affect expected growth, the effect of global factors is moderated by financial development. This result highlights a previously unexplored channel trough which financial development can break the link between financial (in)stability and GDP growth.

Keywords: economic growth, financial stability, financial development, growth at risk.

JEL Codes: G01, G15, O43, O16

---

*Draft version, please do not circulate or cite without the authors' permission. Corresponding author: Matias Ossandon Busch. Email: mossandon@cemla.org. Disclaimer: Any errors made in this paper are the sole responsibility of the authors. The authors' views do not necessarily reflect those of CEMLA or Banco de México.

[a]Center for Latin American Monetary Studies (CEMLA), Durango 54, Colonia Roma Norte, Alcaldía Cuauhtémoc, 06700 Ciudad de México, Mexico.

[b]Halle Institute for Economic Research, Kleine Märkerstrasse 8, 06180 Halle (Saale), Germany.

[c]Banco de México, Avenida 5 de Mayo 2, Colonia Centro, Alcaldía Cuauhtémoc, 06000 Ciudad de México, Mexico.

1 Introduction

Financial development is considered by academics, practitioners and policymakers an important condition to spur economic growth. Over the last decades, this idea has translated into policy initiatives aiming at supporting growth by means of financial liberalization and global financial integration. Also the introduction of macroprudential regulations has been motivated by the notion that well-functioning financial markets create favorable conditions for growth.

From a macrofinancial perspective, the arguably positive effect of financial development on economic growth reflects that developed financial markets ameliorate market frictions between savers and borrowers, leading to efficiency gains in capital allocation in both cross-sectional and time dimensions. To the extent that this dynamic positively affects countries' saving rates, developed financial markets can reduce external financing constraints that limit real-sector expansion. The stocktake of research in this area shows that the expansion of financial markets creates better cross-sectional and intertemporal risk sharing, inducing portfolio realignments with better risk-return profiles that are important for long-term economic growth (see, e.g., Levine, 2005, Levine and Warusawitharana, 2021).

These positive views on the relationship between financial development and growth contrast with sharp disagreements about the role of the financial sector in economic growth in both public and academic debates, raising the question of whether more finance is necessarily better (Beck et al., 2014). Many concerns have to do with incentives: as financial intermediation expands, further layers between managers and ultimate investors arise, creating incentives for excessive risk taking and undesirable degrees of funding exposure. Moreover, intermediaries' herding behavior and financial interconnectedness can magnify tail risks (see, e.g., Feroli et al., 2014, Ramos-Francia and Garcia-Verdu, 2018). These features of developed financial markets can create a financial sector-induced procyclicality, highlighting a 'dark side' of the finance-economic growth nexus.

Despite sharp debates, little is known about how the bright and dark effects of financial development on growth materialize in periods of financial stress. While efficiency gains driven by financial development could help countries to cope with financial instabilities, a financial sector-induced excessive risk taking could end up leading to the build up of systemic risk, exacerbating the link between financial (in)stability and growth. Previous studies show that financial development can exacerbate the effect of inflation on GDP growth volatility (Beck et al., 2006), while moderating the transmission of terms of trade shocks (Singh et al., 2019). However, the question about whether financial development mediates the effect of financial market conditions on growth has not received, to the best of our knowledge, previous attention in the literature.

This paper fills this gap by asking whether high degrees of financial development affect the relationship between financial stability and economic growth. To this end, we characterize the whole density of expected GDP growth conditional on measures of financial market stress looking to a panel of 28 European countries. We then assess whether the sensibility of the expected GDP growth densities to financial stress varies depending on countries' ex-ante financial development. Importantly, we contrast the effect of domestic and foreign measures of financial stress. This approach allows us to explore possible interactions between financial development and different sources of financial stress that can have an heterogeneous impact across the distribution of countries' GDP growth prospects.

Our approach can be related to previous studies that have investigated the relationship between financial development and economic growth (see, e.g., Aghion et al., 1999, Levine and Warusawitharana, 2021,). While empirical studies provide mixed evidence on the sign and size of this effect (Beck et al., 2014), financial stability conditions have not been considered, to the best of our knowledge, as a factor through which financial development can operate to moderate the volatility of GDP growth. Moreover, by focusing on average effects of financial development on country or sectoral-level outcomes, previous studies have ignored possible differential effects on upside and downside risks of GDP growth.

Addressing our research question comes with strong empirical challenges. Economic growth and financial development are likely to have a reverse causality relationship which can bias the estimation of a potential effect of financial development on growth. Financial development itself can be confounded by other country characteristics, such as financial openness, opening the scope for further measurement errors. Most important for our question is the need to zoom in on how financial development can influence the effect of financial stability on different percentiles of the GDP growth density. This latter challenge is important to quantify the heterogeneous relationship between financial stress and right- vs. left-tails of GDP growth, exploring whether this relationship is similar in periods of economic expansion or recession.

We address these challenges with a research design based on three main building blocks. First, we construct a database on macrofinancial variables for 28 European countries covering the period between 1990 and 2018. These data includes the construction of financial stability indices capturing both domestic and foreign factors that can affect GDP growth forecasts. Second, we estimate the effect of financial stress on GDP growth via panel quantile regressions that identify heterogeneous effects across the GDP growth distribution. Armed with these estimates, we characterize the complete density of expected GDP growth conditional on macrofinancial conditions following the Growth-at-Risk (GaR) approach (Adrian et al., 2019). Finally, after establishing our benchmark findings, we extend the baseline model to explore whether the effect of financial stress on GDP growth varies according to countries' ex-ante degree of financial development.

Our results provide first evidence on how higher degrees of financial development can help to 'break the link' between financial stress and negative GDP growth. As a first step, we confirm previous findings indicating that financial stress has a negative effect on expected GDP growth. This effect is most acute on the left tail of the expected GDP growth density, suggesting that the financial stability - growth nexus materializes the most in downside risk scenarios. Importantly, we find similar results for foreign and domestic financial stress conditions, indicating that the geographical source of financial stability risks has only limited implications for the extent of the transmission of financial shocks to economic growth. These findings are not only statistically significant but also sizable in terms of economic magnitudes: for example, a one standard deviation increase in our measure of domestic financial stress increases the probability of negative GDP growth by roughly 57% one quarter ahead, from 7% to 11%.

Having established these baseline results, we next explore whether our benchmark findings vary according to countries degree of financial development, using information contained in the IMF Financial Development Index. We find that higher degrees of financial development moderate the pass-through of financial instability to economic growth. However, the compensating force exerted by financial development crucially depends on the geographical source of financial distress. When contrasting domestics vs. foreign financial stability shocks, we find that only the effect of the latter factor on GDP growth is moderated by financial development.

To quantify the economic magnitude of this result, consider the case of a country with an average degree of financial development experiencing a foreign financial shock in the form of a one standard deviation increase in our measure of foreign financial stress. This country would face an increase of 146% in the probability of negative GDP growth. As a comparison, a country with a one standard deviation higher financial development facing the same shock would report an increase of 96% in the probability of negative GDP growth. Therefore, our results suggests that increasing financial development by one standard deviation compensates approximately 50 percentage points of the average increase in the probability of negative growth following an adverse financial stability scenario.

What can explain the compensating effect of financial development for the pass-through of foreign financial stress? One explanation can be found in the effect that financial development has on both the stability and the efficient allocation of capital flows. Previous studies have shown that when capital flows are driven by global factors and allocated domestically by imperfect financial markets plagued with market frictions, the risk of capital misallocation increases CGFS (2021). While capital flows can be a relevant instrument to generate gains in investment and productivity, the presence of financial frictions can make these flows more volatile and poorly allocated in terms of efficiency. This argument matches with the fact that smaller financial market frictions have been associated with larger shares of stable FDI flows in contrast to portfolio or banking flows (see, e.g., Blonigen and Piger, 2014, Nguyen and Lee, 2021). Our results are therefore reflecting that accelerating financial development can lead to more stable and efficiently allocated capital flows, which become less sensible to global financial conditions.

We implement a extended set of tests to verify the robustness of our findings. To address the possibility that financial development can have a double-causality relationship with GDP growth, we repeat our exercise fixing financial development in its first value. Financial development can also confound the effect of other country characteristics correlated with financial development. We therefore explore whether similar results emerge when replacing financial development by variables such as countries' GDP per capita, indices of institutional and regulatory quality, or measures of financial openness. Alternatively, we explore whether the results can merely reflect a mechanical relationship between the size of the domestic financial sector and a lower sensitivity to global financial shocks, given (potentially) smaller shares of foreign liabilities as the domestic financial sector expands. These tests confirm that our results are unlikely being explained by the presence of omitted variable bias.

The remainder of the paper proceeds as follows. Section 2 discusses the position of our study in the literature. Section 3 describes our methodological approach including both the construction of financial stability indices and the quantile regression models. Section 4 provides a brief description of our data set and reports summary statistics and preliminary tests. We present our benchmark results in Section 5. In Section 6 we explore the role of financial development in moderating the transmission channel sketched in our benchmark results, discussing the robustness of our main finding. Section 7 concludes.

2 Related literature

This study builds on a large tradition of studies analyzing the link between financial development and economic growth. Early studies already documented how financial development can promote economic growth. King and Levine (1993), for example, found cross-country evidence that financial development is associated with higher rates of economic growth and improvements in the efficiency with which countries employ physical capital. The evidence also points out that productivity improvements associated with financial development can be driven both by well-functioning stock markets and banking sectors (Levine and Zervos, 1998). The positive impact of financial development on economic growth was later confirmed using more advanced panel and instrumental variables' methods (Beck et al., 2000, Beck and Levine, 2004) as well as cross-sectoral data (Rajan and Zingales, 1998). These early studies identified effects robust to biases due to simultaneity and omitted variables.[1]

More recent advances in the literature set a spotlight on identifying non-linear effects of financial development on growth. Beck et al. (2014) shows, for example, that the positive effect of financial development vanishes when, in more advanced stages of financial development, financial markets expand more in non-intermediation financial activities. This vanishing positive impact has been often characterized as an inverted u-shape in the relationship between financial development and growth (see, e.g., Samargandi et al., 2015, Benczúr et al., 2019).

The accumulated empirical evidence further shows that the impact of financial development on growth depends on whether credit, stock markets, or securities lead the expansion of financial markets (Rioja and Valev, 2014), as well as on countries' degree of economic and institutional development (Demirgüç-Kunt et al., 2013).[2] Our paper extends this literature by shifting the focus to the effect of financial development in

[1] See Levine (2005) and Panizza (2013) for summaries of this literature.

[2] Micro-level evidence whos that the positive effect of financial development on growth can be explained by productivity gains (Bai et al., 2018), an improved firm survival (Tsoukas, 2011), and increases in rate of firms' creation (Levchenko et al., 2009).

mitigating the pass-through of financial stress to economic growth.

Closer to our approach are studies exploring the link between financial development and GDP growth volatility, given our focus on the expected density of GDP growth. While several studies associate financial development with a decrease in output volatility (see, e.g., Aghion et al., 1999, Easterly and Stiglitz, 2003), we are unaware of any studies exploring the potential dampening role of financial development in the transmission of financial stress to GDP growth volatility.

From a general perspective, institutional development has being historically associated with lower degrees of output volatility (Acemoglu et al., 2003). Financial development, in particular, exerts an effect on GDP growth volatility by fostering productivity (Levine and Warusawitharana, 2021) and shifting capital allocation towards industries less prone to short-term fluctuations (Manganelli and Popov, 2015). Well-functioning financial markets can also alleviate information asymmetries between borrowers and lenders, mitigating the propagation of shocks when risk-aversion rises (Caballero and Krishnamurthy, 2001). These effects converge on the notion that financial development can both increase firms' growth possibilities and mitigate the negative effects of left-tail events. For example, Iwasaki et al. (2020) show that financial development increases firms' survival rates in a sample of European SMEs.[3]

Despite these findings, different views persist in the debate on the link between finance and growth. Authors' have argue, for instance, that financial development can incentivize risk taking by fueling competition, negatively affecting GDP growth (Murdock et al., 2000). Other studies also suggest being cautious about the positive effects of financial development on output volatility. Beck et al. (2006) suggest that financial development can magnify the transmission of monetary shocks to the real economy, whereas real-sector shocks can be moderated. As mentioned above, the positive effect of financial

[3]Other studies have reached similar conclusions by using sectoral data. For example Braun and Larraín (2005) and Raddatz (2006) find a negative relationship between financial development and output volatility in financially-dependent industries. Such industries are found to react stronger to periods of financial stress in the presence of large financial frictions.

development also decays once financial markets depart from mere intermediation activities (Beck et al., 2014).

In sum, previous findings provide mixed evidence on the effect of financial development on economic growth. While the reduction of financial frictions that comes along with financial development can spur growth at reduce its volatility, this effect may dampen with financial sector-driven procyclicality as financial markets grow.

This paper extends this literature in two dimensions. First, by exploring the effect of financial development across the whole density of expected GDP growth, we can directly observe whether the arguably positive effect on GDP growth is similar across tails. That is, whether it operates both by mitigating negative growth scenarios and spurring economic expansions. Second, our focus on financial stability allows us to quantify the potential moderation in the pass-through of financial stress to GDP growth when financial frictions are alleviated. These two aspects have not been considered, to the best of our knowledge, by previous studies.

Finally, our paper connects to a growing body of literature exploring how macrofinancial conditions affect economic growth by modelling the entire density of GDP growth using the GaR approach. These models originate in seminal contributions by Giglio et al. (2016) and Adrian et al. (2019).[4] Our approach is closer to studies that have used the GaR approach to explore non-linear effects of macrofinancial conditions depending on the stance of macroprudential regulation (see, e.g., Sánchez and Röhn, 2016, Aikman et al., 2019, Franta and Gambacorta, 2020, Eguren-Martin et al., 2020). In a recent application, Galán (2020) finds that macroprudential policies can reduce the downside risk of GDP growth but that this effect depends on the economic cycle and the type of policies implemented. Our approach is different given our focus on financial development as a potential factor affecting the relationship between macrofinancial conditions and GDP growth.

[4] See Prasad et al. (2019) for a detailed description of GaR applications implemented by the IMF.

3 Methodology

3.1 Identifying domestic and foreign financial stress

We begin by describing our empirical approach to obtain measures of domestic and foreign financial stability conditions in the countries in our sample. These measures will become our variables of interest in the econometric model to obtain conditional estimates of the expected GDP growth densities over time.

To measure domestic financial stress we resort to the Country-Level Index of Financial Stress (CLIFS) methodology developed in Duprey et al. (2017). The CLIFS method was designed to ensure (i) cross-country comparability, and (ii) the comparison of several financial stress events over time by relying on long time series. In general, one can define financial stress as financial turbulence for several markets and asset classes. The elaboration of CLIFS is based on early work by Holló et al. (2012), also known as the Composite Indicator of Systemic Stress (CISS).

The CLIFS index aims to identify periods of financial stress which are reflected by higher uncertainty in market prices, sharp correction in market prices, and a high degree of similarity across sectors, as described by Duprey et al. (2017). In their work, the authors focus on three key elements of financial markets and as for the CISS, they take into account the correlation of stress across several market segments. The three elements are (i) equity markets, represented by the stock market index (STX); (ii) bond markets, represented by the 10 years government yields (R10) and (iii) foreign exchange market, represented by the real effective exchange rate (rEER). Additionally, given that the period of time is long and inflation rates have declined considerably, the authors use real stock prices (rSTX) and real bond yields (rR10). Lower r denotes real term variables.

Nevertheless, the authors recognize that there may be structural breaks on the output volatility. Therefore, before computing the volatility, they divide the data by a 10 years trailing standard deviation. The tilde will denote variables under such standardization.

The detailed formulas are discussed in detail by Duprey et al. (2017).

In the following step, the individual indicators are converted into common units. Here, the authors follow the approach proposed in Holló et al. (2012), which uses the empirical cumulative density function (CDF) calculated over an initial window of 10 years and expands later using new data. The CDF transforms each variable into percentiles by computing at each time the rank of each new observation in the sample of all past data. From here, both the volatility and losses indices are averaged by market segment.

Finally, in the last step each market sub-index is weighted by the cross correlation with the other sub-indices. As a result, the aggregated index reflects the higher risk associated with important co-movements in the different market segments. The authors compute CLIFS as follows: $CLIFS_t = \boldsymbol{I}_t \cdot C_t \cdot \boldsymbol{I}_t'$, where $\boldsymbol{I}_t$ is the 1×3 vector of standardized indices and C_t is the 3×3 time variant cross correlation matrix of the indices. The time variant entries of the matrix are estimated by an exponentially weighted moving average with smoothing parameter $\lambda = 0.85$. Henceforth, we refer to this domestic financial conditions index as FCI. An important advantage of this index is that it increases if conditions tighten in specific sectors (e.g., in stock markets) but also if the correlation between sectors (e.g., between stock markets and interest rate spreads) increases. It therefore captures not only the materialization of financial stress, but also the potentiality of cross-sectoral spillovers in an adverse scenario.

In this work, the case of foreign financial stress is covered by resorting to the Chicago Board Options Exchange Market Volatility Index (VIX Index). Movements in the VIX index are often related to markets' risk-aversion sentiment. Moreover, it has been used as an indicator of the global financial cycle (see, e.g., Rey, 2015), and as proxy of global financial conditions in other related works, including Adrian et al. (2019) and Alessandri et al. (2019). We ortogonalize the global financial conditions with respect to our local financial conditions indicator FCI. This adjustment is done by taking the residuals of a regression of global against local conditions.

3.2 Measuring financial development

There exists an important branch of the literature in economics and finance that investigates on the role of financial development and its impact on economic growth, financial inclusion and economic stability. The ample set of functions which are associated with financial development affect the accumulation of physical and human capital and total productivity, factors that at the end determine economic growth (Svirydzenka, 2016).

The traditional empirical research on financial development essentially relies on two well-known metrics: the credit and the stock market capitalization to GDP ratios. Nevertheless, financial markets and the financial system have evolved into a much more complex apparatus that include the so called shadow banking system as well as many other types of non-bank financial intermediaries and many novel forms of investment and funding. This situation leads to the need of multi-dimensional indices to measure financial development. In this work we rely on the aggregated financial development index described in Svirydzenka (2016) and developed by the IMF. Nevertheless, we also perform exercises using separate sub-indices of this metric focusing on financial institutions and financial markets development separately.

The individual indices for institutions and markets are composed by metrics of depth, access and efficiency. Figure A.1 illustrates how the aggregated index is composed. In terms of the steps followed to compute such an index, the process involves (i) the normalization of variables, ii) the aggregation of the normalized variables into functional sub-indices, and iii) the aggregation of sub-indices into the final index.

The process starts with the creation of six sub-indices, three related to financial institutions and three related to financial markets. Regarding financial institutions, the indices are labeled as FID, FIA and FIE; they correspond respectively to the above mentioned characteristics of depth, access and efficiency. In the case of financial markets the sub-indices are FMD, FMA and FME. Each group of three indices are aggregated to create the FI sub-index for institutions and the FM sub-index for markets. Finally, the final FD index is computed from these two sub indices.

Svirydzenka (2016) provide a detailed description of the treatment of missing data, the treatment of outliers, and the functional form of the aggregation. Once the missing data has been dealt with and the variables are normalized taking into account the outliers, the aggregation process of the corresponding variables into the above mentioned six sub-indices is done via a weighted linear average in which the weights are obtained from Principal Component Analysis (PCA) that reflects the contribution of individual variables to the variation of each sub-index. Once computed, all the six sub-indices are normalized again and the final index is obtained in the same way, i.e. a weighted linear average which will be normalized into a $[0, 1]$ interval.

In Section 4 we provide summary statistics for the IMF Financial Development Index.

3.3 Quantile regression and the GaR approach

Quantile regressions were proposed in Koenker and Bassett (1978). The main intuition behind a quantile regression is to identify heterogeneous effects on the distribution of a variable instead of looking only at the conditional mean. More recently, quantile regressions has become the main statistical tool that supports the GaR methodology.

In general, GaR applications begin by identifying relevant macrofinancial variables that could arguably explain dynamics in GDP growth in a given country (see, e.g., Adrian et al., 2019 or Prasad et al., 2019). Researchers typically rely on a combination of local macroeconomic conditions, local macrofinancial conditions, and international macrofinancial conditions. The selection of specific variables will depend on a country's risk profile, its economic and financial openness, or the characteristics of the financial system.

Having identified relevant macrofinancial risk factors, the next step is to estimate the relationship between these risk factors and GDP growth using a panel quantile regression approach. This method allows characterising the entire probability distribution of GDP growth conditional on the stance of macrofinancial conditions. Therefore, we are not interested in point estimates of expected GDP growth but rather in understanding how macrofinancial conditions affect the distribution of expected GDP growth. Quantile regressions can also inspect heterogeneous responses along the distribution of GDP growth, asking for instance whether the left tail of the distribution (downside risk) experiences a greater impact of financial shocks.

In this work we use quantile regressions to investigate the heterogeneous effects of macrofinancial conditions on future GDP growth. The use of panel data allow us to control for unobserved time-invariant country characteristics, following similar approaches by Adrian et al. (2019) and Galán (2020). We recall that according to Koenker (2005), quantile regressions with fixed effects are estimated on a quantile by quantile fashion, allowing different fixed effects for each quantile.

Equation 1 shows the baseline specification for the quantile regression in our empirical model:

$$\begin{aligned} Q(\Delta GDP_{i,t+h};\tau) =& \alpha_h(\tau) + \beta_{1,h}(\tau)\Delta GDP_{i,t} + \beta_{2,h}(\tau)FCI_{i,t} + \beta_{3,h}(\tau)VIX_t \\ & + \mu_{i,h}(\tau) + \varepsilon_{i,t}(\tau) \end{aligned} \tag{1}$$

where τ represents the quantile level, h is the forecasting time horizon in quarters, $\Delta GDP_{i,t+h}$ is the change on GDP for country i, h quarters ahead and $\alpha_h(\tau) + \mu_{i,h}(\tau)$ represents the unobserved country effects. The coefficients $\beta_{2,h}$ and $\beta_{3,h}$ capture the relationship with the FCI and the VIX h quarters ahead and $\varepsilon_{i,t}$ is the error term. The results for this specification are shown in Figure 3.

While Eq. 1 illustrates our benchmark specification, we are interested in exploring non-linear effects of the macrofinancial variables of interest conditional on the stance of countries' financial development. We therefore adjust Eq. 1 to allow for heterogeneous effects of macrofinancial conditions conditional on countries' ex-ante degree of financial development. This adjusted model takes the following form:

$$
\begin{aligned}
Q(\Delta GDP_{i,t+h};\tau) = & \alpha_h(\tau) + \beta_{1,h}(\tau)\Delta GDP_{i,t} + \beta_{2,h}(\tau)FCI_{i,t} + \beta_{3,h}(\tau)VIX_t \\
& + \beta_{4,h}(\tau)FD_{i,t} + \beta_{5,h}(\tau)(\Delta GDP_{i,t} * FD_{i,t}) \\
& + \beta_{6,h}(\tau)(FCI_{i,t} * FD_{i,t}) + \beta_{7,h}(\tau)(VIX_t * FD_{i,t}) \\
& + \mu_{i,h}(\tau) + \varepsilon_{i,t}(\tau)
\end{aligned} \tag{2}
$$

where the additional terms $\beta_{4,h}$, $\beta_{5,h}$, $\beta_{6,h}$ and $\beta_{7,h}$ capture the relationship of expected growth change with FD, the interaction between FD and growth, the interaction between FD and the FCI and the interaction between FD and the VIX respectively. Throughout the paper we focus our analysis on horizons of one quarter ($h = 1$), that is, we look at the effect of financial conditions on GDP growth one quarter ahead. However, we also explore alternative horizons in Section 5, explicitly exploring the term structure of the estimations.

If financial stress matters to explain future GDP growth, we would expect the coefficients $\beta_{2,h}$ and $\beta_{3,h}$ to report a negative sign, given that our financial indices VIX and FCI increase when financial conditions tighten. If these effects materialize especially during tail events, the coefficients would be statistically significant for the smallest and largest quantiles τ of the GDP growth distribution. The path-dependence of GDP growth documented in previous studies (see, e.g., Galán, 2020) should lead to a positive coefficient on $\beta_{1,h}$. Finally, we would verify an offsetting effect of financial development on the transmission of financial stress if the coefficients $\beta_{6,h}$ or $\beta_{7,h}$ report a positive and statistically significant coefficient, especially in the smaller or larger quantiles τ of the GDP growth distribution.

4 Data and descriptive statistics

This section describes the data used in the empirical analysis. Our sample consists of 28 European countries, of which 27 belong to the European Union plus the UK. For these countries, we collected quarterly data on a set of macrofinancial variables for a time span between 1990Q1 and 2018Q4. Out of these countries, 16 correspond to advanced economies and 12 to emerging economies according to the definitions of the IMF.[5].

Our analysis relies on four main variables of interest. First, collected data on countries' quarterly GDP at current prices in US$, from which we compute the GDP growth series used as dependent variables in Eqs. 1 and 2. We compute quarterly GDP growth as the percentage change in GDP on a year-on-year basis. These series were downloaded from Eurostat databases.

Second, we collected data for the VIX Index — our proxy of global financial conditions — from Yahoo Finance. We computed quarterly averages from the daily closing series of the index, merging this information to our main dataset.

Third, we used data from the European Central Bank Statistical Data Warehouse which reports CLIFS indices for the countries in our sample. We ortogonalize these series with respect to the VIX index to keep only the informational content related to domestic financial conditions. Following Duprey et al. (2017), the CLIFS series capture three dimensions of financial stability that we expect to be relevant for the countries in our sample. A first dimension consists of measures of equity market stress, as captured by the stock market indices of the countries in the sample. A second dimension of analysis considers series of countries' 10-years government bonds interest rates. The respective series for Germany are used as a benchmark to capture tighter conditions in domestic bond markets in other countries. For Germany, Duprey et al. (2017) use the real yield

[5]The countries included in the sample are the following: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

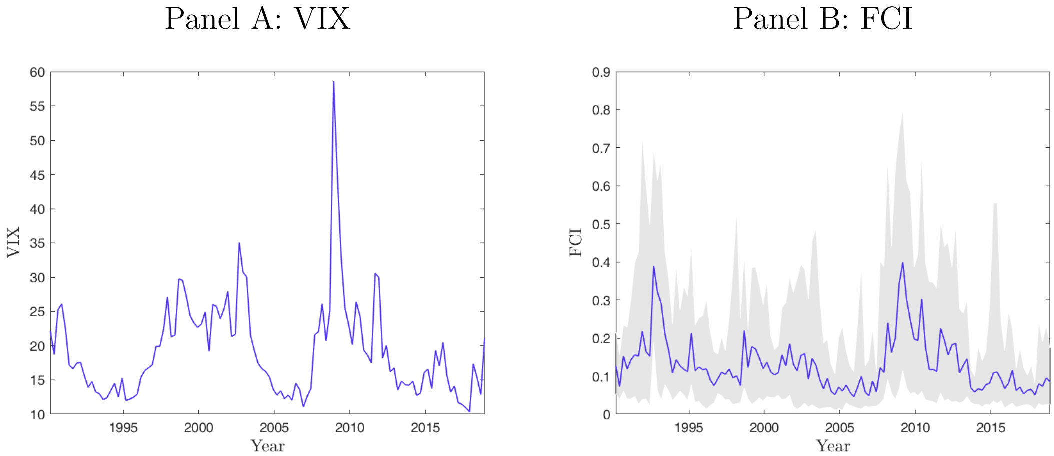


Figure 1 Foreign and Domestic Financial Indicators. This figure illustrates the evolution of the quarterly foreign and domestic financial indicators from 1990 to 2020. Panel A reports quarterly averages of the VIX index used to capture global financial conditions. Panel B reports the average measure of CLIFS (domestic financial conditions, FCI) across the sample. The shadow area marks the minimum and maximum observations for this variable in each period. On both indices tighter financial conditions are represented by an increase in the indices' values.

on 10-year government bonds. Finally, a third dimension of financial stability consists of countries' monetary and currency stress as captured by the respective nominal exchange rates vis-à-vis the US Dollar. We recall from Section 3 that the variables included in the CLIFS are adjusted by inflation using country-level series of consumer price indices.

Fourth, we use the IMF Financial Development Index to measure countries' stance of financial development. This source allows us to explore the main index together with two sub-indices measuring financial markets and financial institutions dimensions of financial development. While the former sub-index focuses on stock and bond markets development, the latter one focuses on the characteristics of the local banking markets as well as on financial infrastructure. Each sub-index is further divided into three indicators measuring variables related to markets' accessibility, efficiency, and depth. The information contained in the index is obtained from multiple sources, including the IMF Financial Access Survey, the BIS debt securities database, and the Dealogic corporate debt database. The index matches our full time span from 1990 to 2018, although only with an annual frequency.

Figure 1 provides a visual inspection of the VIX (left panel) and FCI (right panel) series as they enter the econometric model. While the VIX index is the same for all countries in the sample, the reported FCI index corresponds to the sample average in each quarter. The shadow area marks the minimum and maximum observations in each period. In both series the 2008 global financial crisis represents the main peak in the indices, with financial conditions remaining tight and volatility for approximately three years following the crisis' outbreak. Overall, both series provide a meaningful picture of relevant financial tail events during our sample period including, for example, the events in Europe following the fall of the Berlin wall in the early 1990s or the 2008 global financial crisis.

Table 1 provides descriptive statistics for our sample, including the main variables of interest considered in Eqs. 1 and 2. Overall, our final sample consists in an unbalanced panel containing 2610 observations. The summary statistics depict clear heterogeneities across the GDP growth percentiles. Moreover, the minimum and maximum values are indicative of major tail events during the sample period. These tail events are also reflected in large differences between the average value for our macrofinancial variables of interest and their minimum and maximum observations. Below, we discuss preliminary tests exploring the linear relationship between the macrofinancial variables and GDP growth.

An unbiased estimation of Eq. 2 is challenged by the possibility that financial development may have a double-causality relationship with GDP growth. For example, we could expect financial development to increase as countries enter into a positive trend of economic expansion, difficulting a proper identification of the effect of financial development on future growth. While the lagged structure in Eq. 2 reduces these endogeneity concerns, we provide an alternative estimation in Section 6.3 in which financial development is kept fixed in its first value for each country in the panel. Given our interest in cross-sectional differences in financial development, we are mainly concerned about changes in countries relative position (i.e., rank) in terms of financial development, as such changes could be a result of changing patterns in GDP growth.

Figure A.2 in the Appendix illustrates de evolution of countries' financial development during the sample period. We separate countries according to the median of average financial development and report in Panels A and B countries with an average measure of financial development above and below the median, respectively. These plots suggest that financial development is a rather structural characteristic — in relative terms — for the countries in our sample. That is, those countries reporting and index above or below the median on average maintain their rank relative to the other half of the sample throughout the sample period. The relative stability of countries' rank supports our choice of using time-variant measures of financial development when estimating Eq. 2.

As a preliminary check, we inspect in Figure 2 the linear relationship between global macrofinancial conditions and GDP growth. For this purpose we estimate OLS regression of ΔGDP against the VIX Index (with a one quarter horizon) in country-specific estimations for each of the 28 countries included in the sample. These tests are important to describe the baseline scenario from which we depart to explore non-linearities across the quantiles of the GDP growth density. The exercise is replicated using lagged ΔGDP and our index of domestic financial conditions (FCI) in Figure A.3 in the Appendix. These tests are important to describe the baseline scenario from which we depart to explore non-linearities across the quantiles of the GDP growth density.

Figure 2 illustrates a negative correlation over time between the VIX Index and future GDP growth, in coincidence with the notion that tighter global financial conditions negatively affect GDP growth prospects in the short run. The extended exercises in Figure A.3 in the Appendix show a similar effect of the FCI Index (Panel A), whereas Panel B shows that lagged GDP growth is positively correlated with current GDP growth in all countries in the sample, suggesting a path-dependence trend in line with previous studies (see, e.g., Adrian et al., 2019).

Together, these statistically significant results show that our macrofinancial conditions of interests matter for explaining future GDP growth, opening the scope to explore non-linearities across GDP growth quantiles using the full structure of Eq. 1.

	Mean	S.d.	Min.	Max.	p5	p25	p50	p75	p95
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
Variable:									
ΔGDP	2.34	4.06	-21.72	29.09	-4.71	0.90	2.63	4.35	8.03
Financial Cond. Index (FCI)	0.12	0.10	0.01	0.80	0.03	0.05	0.09	0.16	0.33
VIX Index	19.47	7.20	10.30	58.59	12.04	13.94	17.39	23.23	30.72
Financial Dev. Index	0.53	0.20	0.01	0.95	0.20	0.36	0.54	0.71	0.83

Table 1 Descriptive statistics. This table reports the summary statistics for the working sample. Cols. I to IV report the mean, the standard deviation (S.d.), the minimum, and the maximum value for each variable for the entire sample period. Cols. V to IX report the percentiles for each variable.

We also extended our dataset with further country-level variables to implement robustness tests discussed in detail in Section 6.3. First, we merged to our main dataset annual data on GDP per capita at constant 2010 US$ from the World Bank. Second, collected annual data of the Regulatory Quality Index reported by the Worldwide Governance Indicators of the World Bank (see Kaufmann et al., 2010). Third, we collected data on capital inflows represented by portfolio and foreign direct investment foreign liabilities for the countries in our sample. These annual data come from the IMF Balance of Payment database. Fourth, we included in the sample a measure countries' degree of capital account openness as accounted by the Chinn-Ito index, computed using information from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (see Chinn and Ito, 2006). Fourth, we collected annual data on countries' credit-to-GDP ratio from the World Bank database. Finally, we complemented our sample with data on the VSTOXX index obtained from Yahoo Finance and Bloomberg. This index reflects market expectations of future volatility in the main European markets, providing a measure of foreign financial stress that is geographically closer to the European countries in our sample.

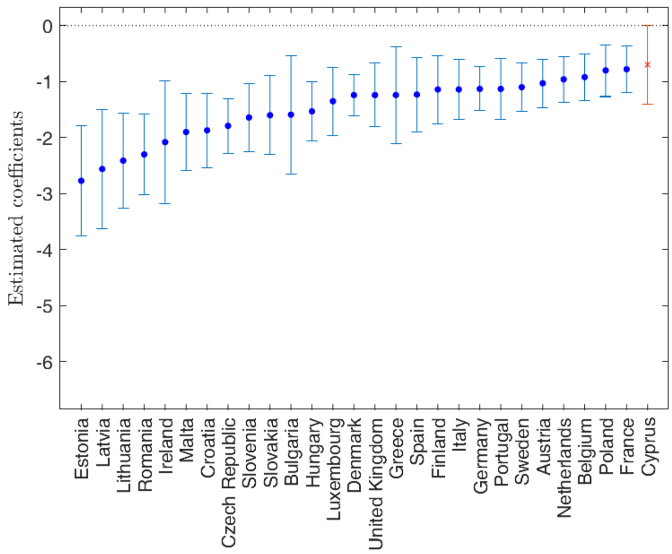


Figure 2 Linear effect of the VIX Index on GDP growth. This figure illustrates the linear average effect of global financial conditions on GDP growth over a one quarter horizon. The estimations are based on a simplified version of Eq. 1 obtained from OLS estimates at the individual country level. The estimation is run separately for each of the 28 countries in the sample considering the full time-span in the sample from 1990 to 2018. Global financial conditions are measured with the VIX index. The blue dots represent the respective point estimates, whereas the whiskers represent the corresponding 95 percent confidence intervals for each estimation. This exercise is extended to the FCI Index and GDP growth as explanatory variables in Figure A.3 in the Appendix.

5 Benchmark results

Our benchmark results based on the panel quantile regression model in Eq. 1 are reported in Figure 3, using country fixed-effects μ_i. Each panel represents the estimated coefficients for our variable of interests, including the lagged value of ΔGDP, the domestic financial conditions index (FCI) and the VIX index as our measure of foreign financial conditions. To ease the interpretation, we recall that given the quantile regression estimation, the estimated coefficients represent the effect of a unit change in macrofinancial conditions on the expected percentile τ of the GDP growth density. The coefficients represented by the blue dots on Figure 3 are reported along their confidence intervals (blue brackets) at a 95% confidence level.

Tighter financial conditions, either domestic or foreign, are negatively associated with future GDP growth, in line with the preliminary findings from Figure 2. However, this effect varies considerably depending on the percentiles τ of the conditional GDP growth

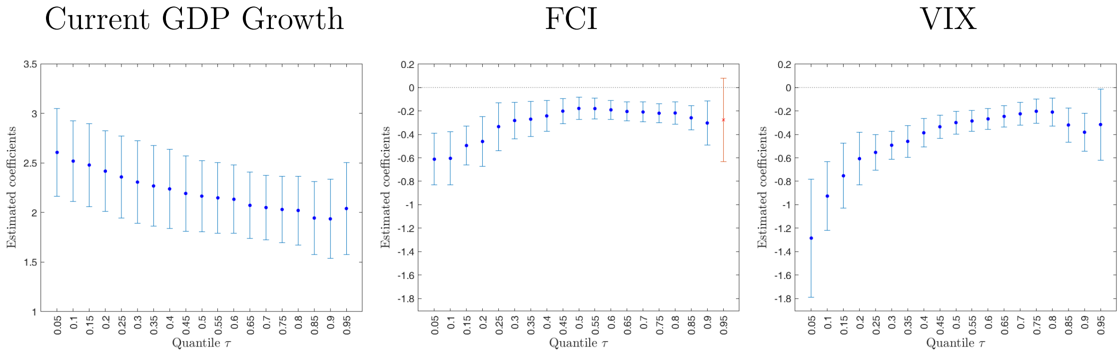


Figure 3 **Benchmark results.** This panel reports the results from estimating Eq. 1 using a panel quantile regression approach. The blue dots represent the respective point estimates, whereas the whiskers represent the corresponding 95 percent confidence intervals for each estimation. These whiskers are plotted in blue when representing a statistically significant estimation (and in red otherwise). The left-side chart shows the effect of current GDP growth on the individual percentiles of the expected GDP growth density one quarter ahead ($h = 1$). The center chart reports the results for our measure of domestic financial conditions (FCI), whereas the right-side chart reports the estimated coefficients for our measure of global financial conditions (VIX). The confidence intervals are based on bootstrap methods. The panel includes 28 European countries and spans from 1990 to 2018 with a quarterly frequency. See Table A.1 in the Appendix for a detailed definition of the variables of interest used in the analysis.

density being considered. The effect is the largest on the left tails of the density, suggesting that tighter financial market conditions are associated with a higher probability of realizing large drops in GDP over a one quarter horizon. On the contrary, the negative effect of financial stress on upper percentiles of the GDP growth density is smaller, implying that the documented relationships are moderated in periods of economic expansion. While loose financial conditions help to support economic growth, the effect is smaller and does not offset the negative consequences of financial stress. We also find evidence of a path dependence in GDP growth given the homogeneous and positive effect of lagged ΔGDP shown in the first panel of Figure 3, also coincident with Figure 2.

The left-tail effects are more pronounced for foreign than domestic financial conditions. For example, a one-standard deviation increase in the VIX index (7.2 points) is associated with a left-shift of approximately 1.2 percentage points in the 5th percentile of the GDP growth density. In contrast, a similar increase in the (residuals of the) FCI index by one standard deviation (0.08 points in CLIFS units) leads to a left-shift in the same percentile of only 0.6 percentage points. These statistically significant results imply that the left tail of the expected GDP growth density becomes much fatter following a shock on VIX compared to a shock on FCI.

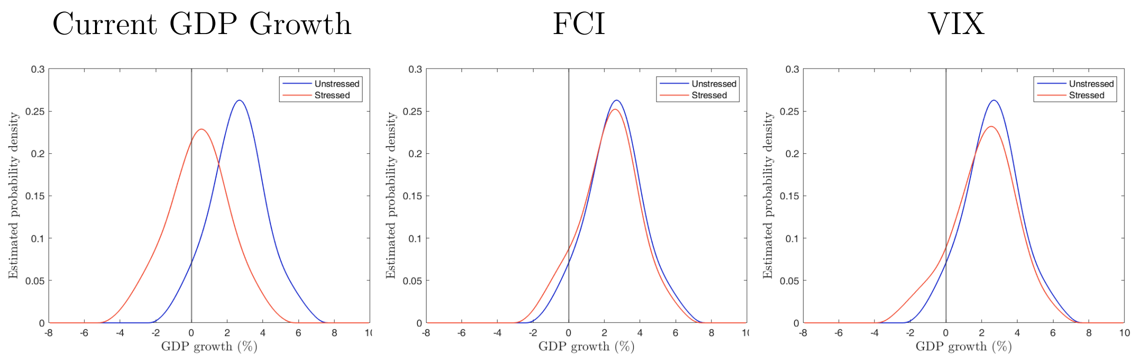


Figure 4 Scenario analyzes. This panel reports a scenario analysis based on the estimates reported in Figure 3. Each exercise shows the result of a one-standard deviation left-shift in one of our macrofinancial variables of interest on future GDP growth, one quarter ahead. The blue lines represent the baseline expected GDP growth density using the estimates from Figure 3. The orange line shows the alternative expected GDP growth density after the left-shift in the respective variable. The left-side chart shows the results for current GDP growth. The center chart reports the exercise for domestic financial conditions (FCI). The right-side chart depicts the results for our measure of global financial conditions (VIX). The panel includes 28 European countries and spans from 1990 to 2018 with a quarterly frequency. See Table A.1 in the Appendix for a detailed definition of the variables of interest used in the analysis.

To provide a sense check of the magnitudes implied by our benchmark regressions, Figure 4 reports scenario analyzes for our variables of interest. The panels depict the estimated changes in the GDP growth densities in the face of tighter macrofinancial conditions, as represented by a one standard deviation shift in the respective macrofinancial variable. The first panel shows that following an adverse GDP growth scenario, the density of expected GDP growth shifts sharply to the right, increasing the probability of negative growth. In line with our findings from Figure 3, we find that the effect of a negative shock on the FCI and VIX indices is smaller in size and concentrates in lower percentiles of the GDP growth density, as evidenced by the fatter tails in the post-shock densities (orange lines).

These scenario analyses help to further illustrate the magnitude of the effects captured by our estimation. For FCI, a negative shock is associated with a 57% increase in the probability of experiencing a negative GDP growth rate one quarter ahead, whereas a similar shock to VIX can be connected with an increase of 108% in this probability. It should be noted that the documented effect could be alternatively attributed to a few countries in which trading-intensive financial markets create a pro-cyclical relationship between our financial stability indices and GDP growth, as it has been discussed by

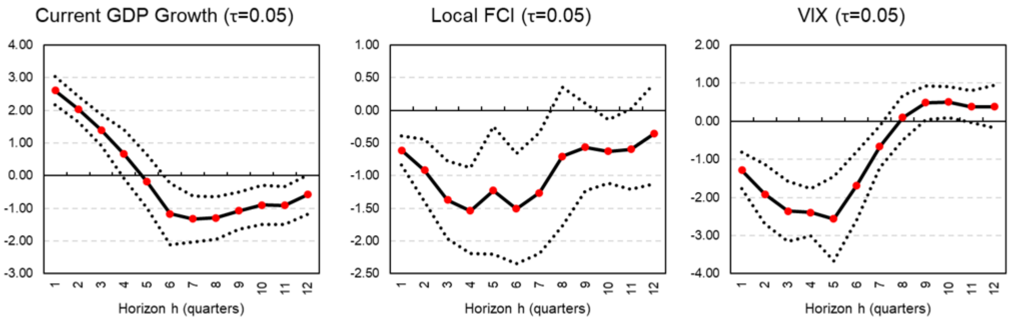


Figure 5 Term structure of the results. This panel depicts the results from replicating our benchmark exercise reported in Figure 3 for alternative horizons, following the same structure as in Eq. 1. Each point estimate (red circles) represents the effect of one of our macrofinancial variables of interest on the 5th percentile of the expected GDP growth density. The dotted area represents the estimated 95 percent confidence intervals for each estimation obtained with bootstrap. Each estimation is repeated separately for horizons ranging from 1 to 12 quarters ahead of the explanatory variables. The left-side chart shows the results for current GDP growth; the center chart reports the results for our measure of domestic financial conditions (FCI); the right-side chart reports the results for our measure of global financial conditions (VIX). The panel includes 28 European countries and spans from 1990 to 2018 with a quarterly frequency. See Table A.1 in the Appendix for a detailed definition of the variables of interest used in the analysis.

Beck et al. (2014). However, the fixed-effect structure in Eq. 1 mitigates concerns that such unobserved country-specific factors could introduce a bias in our findings by absorbing time-invariant country characteristics. Despite this advantage, we are cautious about interpreting the findings in a causal way, considering the lack of a measure of true (exogenous) shocks to financial stability.

Our benchmark findings consider a 1-quarter horizon in the relationship between macrofinancial conditions and GDP growth. To provide a more detailed account of the term structure of the estimated effects over alternative horizons, Figure 5 depicts the effect of macrofinancial conditions on the 5th percentile ($\tau = 5$) of future GDP growth replicating our baseline estimation for multiple horizons ranging from 1 to 12 quarters ahead. This extension is important to shed light on the informational content of current financial stability in terms of long-term trends in GDP growth. We focus on $\tau = 5$ given the evidence documented above on a larger effect of financial stress on the left-tails of the estimated GDP growth densities.

Figure 5 shows that the negative effect of financial stress on the 5th percentile of GDP growth materializes on impact (1-quarter ahead) but also remains in place for up to 6 to 7 quarters ahead. This finding further highlights the economic significance of our results.

The identified effect fades entirely after 2 years, becoming then statistically insignificant.

A few interesting conclusions can be drawn when comparing the effect of FCI (center chart) vs. the effect of VIX (right-side chart). First, this comparison reinforces our finding that foreign events captured in the VIX index have a seemingly larger effect on GDP growth, being also estimated with a higher precision. We recall that the FCI index capturing domestic financial conditions is orthogonalized with respect to the VIX index. Therefore, the results for FCI suggest that locally sourced financial stress scenarios do matter to explain short- and mid-term developments in GDP growth, albeit to a smaller extent when compared to the VIX index. We also find some evidence of a sign reversal of the effect at longer horizons for the VIX index, reflecting a recovery phase in the economy and coinciding with previous evidence in this direction in the literature (Adrian et al., 2019).

As a final note, we note that the right-hand side chart on Figure 5 depicts a clear changing pattern of the GDP growth trend effect over time. Over 4 to 5 quarters ahead, the 5th percentile of GDP growth follows closely its lagged value, albeit a diminishing effect over time. From 7 quarters onwards, the effect changes its sign and becomes negative and statistically significant, reflecting the recovery effect mentioned above.

Summarizing our findings, we conclude that both domestic and foreign financial conditions exert a statistically significant effect on future GDP growth. These effects are persistent over a mid-term horizon and capture countries' recovery following periods of economic downturn. Important for the following analysis is the fact that we find the effects to be stronger on the left-tail of GDP growth, with global financial conditions captured by the VIX index dominating over domestic financial conditions in terms of the economic magnitude of the effects.

6 Zooming-in: the role of financial development

6.1 Non-linear effects conditional on financial development

Having established our benchmark findings, we turn next to our main research question and exploit the model to investigate the possibility that our effects vary in either direction depending on countries' ex-ante degree of financial development. As highlighted in Section 2, the literature provides mixed results on the relationship between financial development and the volatility of GDP growth. We would expect, for example, that the effects depicted in Figure 3 could be offset if financial development is associated with a more efficient allocation of capital that shields more productive firms from the negative consequences of shocks. This hypothesis is supported by recent findings showing that financial development may come along with a reallocation of capital towards industries less prone to suffer from short-term volatilities, stabilizing output volatility in periods of financial distress (Levine and Warusawitharana, 2021).

To address this hypothesis we estimate the model in Eq. 2 adding interaction terms between the macrofinancial variables of interest and the lagged measure of the IMF Financial Development Index. The coverage and time span of this source make it an ideal input to our empirical approach.[6]

In Eq. 2 financial development enters the model both as a stand-alone variable and in interaction with the three macrofinancial variables considered in the previous analysis. Given that the IMF Financial Development Index only provides information on an annual basis, we use the same value for the index over the four quarters of a given year. To keep consistency and mitigate reverse-causality concerns, the variable enters the model lagged in one year.

Our main results are reported in Figure 6. Each panel corresponds to the quantile

[6]The index has also received increasing attention in the literature. Recent applications include, for example, studies by Araujo et al. (2017), Ogrokhina and Rodriguez (2019), Altunbaş and Thornton (2019), and Sobiech (2019).

effect of financial development as a single variable and the interaction effects with macro-financial conditions. The dots in this figure represent point estimates for a given quantile that are statistically significant (blue) or insignificant (red) at a 5 percent confidence level. The corresponding whiskers represent the confidence intervals at this confidence level. Throughout the text we keep the same notation to interpret our findings.

The interaction terms of interest show mixed results regarding the impact of financial development. Three main conclusion can be drawn. First, the negative interaction term with lagged GDP growth implies that higher degrees of financial development moderate the path-dependence of GDP growth, making it less sensible to past observations. This result is similar across the GDP growth density but it is estimated with less precision for lower quantiles, becoming statistically insignificant for the percentile $\tau = 0.05$. This results implies that higher degrees of financial development are less effective in offsetting the negative trend of GDP growth in periods of economic downturn. On the contrary, financial development is seemingly more effective at curbing quarter-to-quarter trends in periods of economic expansion, probably moderating episodes of economic overheating.[7]

A second conclusion relates to the lack of explanatory power of the interaction term between financial development and domestic financial conditions, as captured by the FCI index. Across the density of GDP growth, we observe that the relevant interaction term remains statistically insignificant. We interpret this result as suggesting that the negative effect of FCI on the left tail of the GDP growth density captured in Figure 3 does not vary at higher or lower levels of financial development. This finding is indicative that the expansion of financial markets does not come necessarily along with a pro-cyclical output volatility, as higher quantiles of the GDP growth density tend to decrease with countries' financial development.

Finally, an interesting result emerges when looking at the interaction term with the

[7]It should be noted that the stand-alone coefficient for financial development represents the intercept when the interaction macrofinancial variables are at their minimum. This intercept tends to be negative and statistically significant for larger percentiles of GDP growth, implying that these upper percentiles become smaller for higher degrees of financial development.

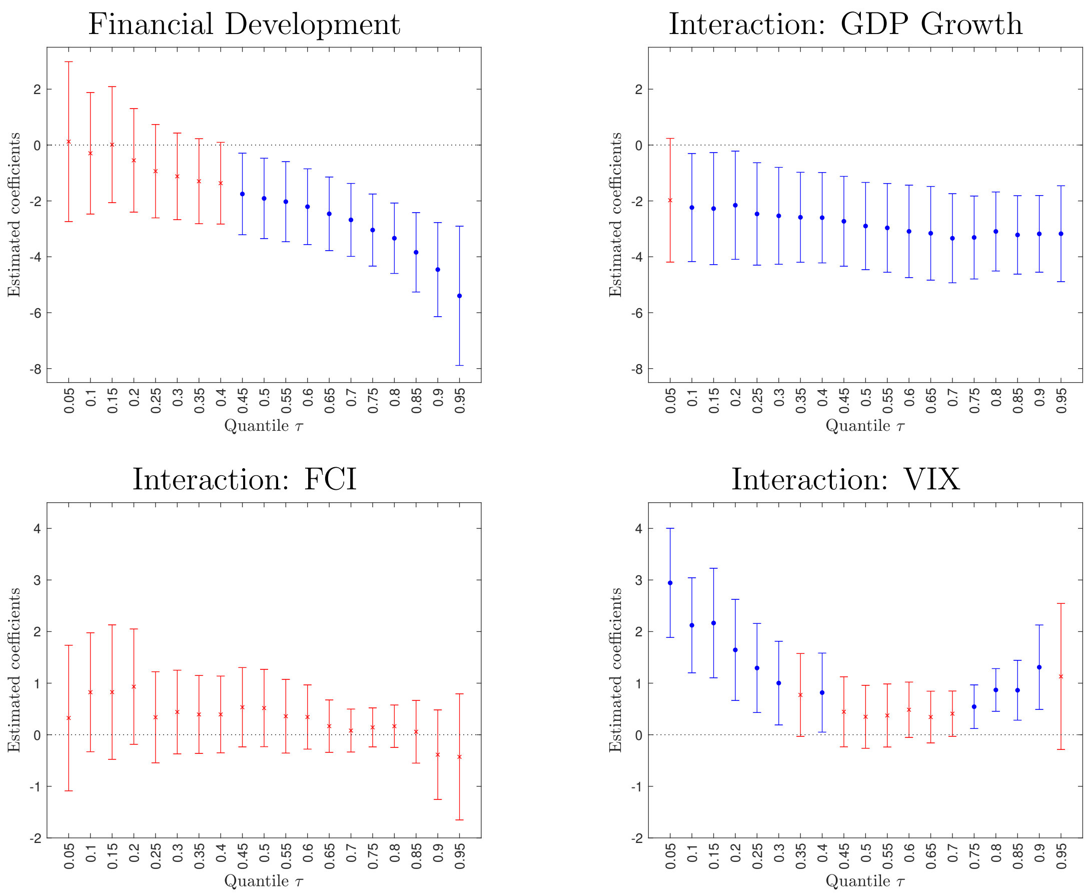


Figure 6 Effects conditional on financial development. This panel reports the results of estimating Eq. 2 (with a one quarter horizon, $h = 1$), focusing on the interaction terms between our macrofinancial variables of interest and a measure of financial development, using the IMF Financial Development Index. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). The upper-left chart reports the result for the stand-alone coefficient for financial development in Eq. 2. The upper-right chart reports the interaction coefficient between current GDP growth and financial development. The bottom-left chart reports the interaction coefficients between domestic financial conditions (FCI) and financial development. The bottom-right chart shows the estimated coefficients for the interaction term between global financial conditions (VIX) and financial development. The panel includes 28 European countries and spans from 1990 to 2018 with a quarterly frequency. See Table A.1 in the Appendix for a detailed definition of the variables of interest used in the analysis.

VIX index. The pass-through of global financial conditions to GDP growth observed in Figure 3 is ameliorated by financial development in both tails, as represented by the positive and statistically significant coefficients in the bottom-right panel of Figure 6. This result illustrates a shielding effect of financial development, leading to a loss of sensitivity of GDP growth with respect to the ex-ante evolution of global financial conditions. Recall that this offsetting effect is expected to be economically more important in the left-tail, considering that the benchmark effect of VIX on Figure 3 is larger for lower quantiles of

GDP growth.[8]

To visualize the economic magnitude of this finding, consider that a country with an average degree of financial development facing a shock represented by a one standard deviation increase in the VIX index, would experience an increase in 146% in the probability of negative GDP growth. This probability would increase by 50 percentage points less in the case of a country with a one standard deviation higher degree of financial development. In this example, the higher degree of financial development reduces by roughly 52% the increase in the probability of negative growth.

A natural question is whether the heterogeneous effects by financial development are similar across different components of the IMF Financial Development Index. We address this question by replicating the main exercise for the sub-indices of financial institutions and financial markets separately. Recall that the financial institutions sub-index aggregates measures of financial institutions' size and liquidity, including, e.g., measures of credit to GDP, the number of bank offices and ATMs, and measures of the size of pension and mutual funds as proxies for market liquidity. On the contrary, the financial markets sub-index focuses mostly on the relative size of stock and securities' (bonds) markets beyond a purely bank-based financial market environment.

The instituions sub-index would dominate our findings if, for example, the increase in market liquidity that comes along with financial development moderates the occurrence of credit crunches in periods of financial stress, as lenders could be less exposed to rising risk aversion given the wide availability of funds. An alternative hypothesis could suggest that is not liquidity per se what matters, but rather the availability of multiple marketplaces as represented by banks, stock markets, and bond markets. This 'diversification story' would imply that our results are better explained by the financial markets sub-index, which reflects the availability to firms of multiple well-functioning funding markets that can compensate for lacking liquidity strains in periods of stress.

[8] In unreported results we confirmed that our findings can be replicated when estimating Eq. 2 separately for each macrofinancial variable of interest, an approach that does not alter the conclusions drawn from Figure 6. These results are available upon request.

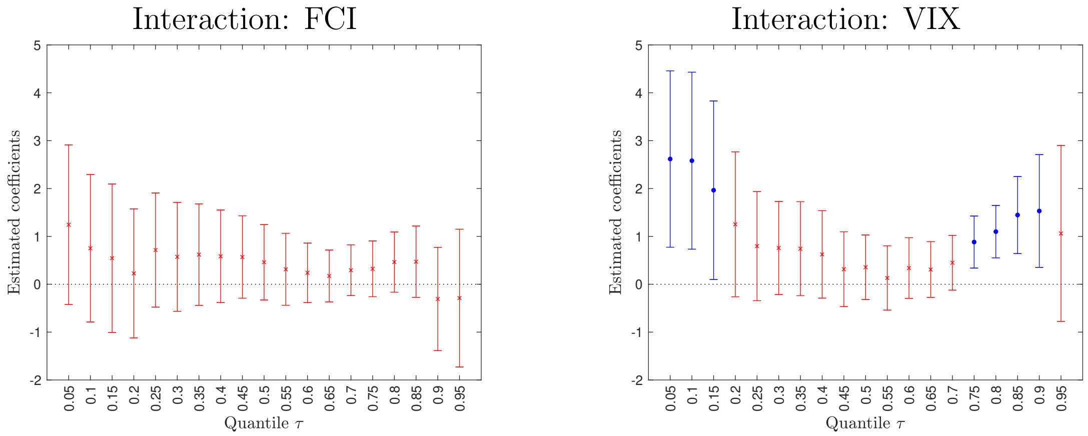


Figure 7 Effects conditional on financial development - Financial institutions. This panel reports the results of estimating Eq. 2 (with a one quarter horizon, $h = 1$), focusing on the interaction terms between our macrofinancial variables of interest and a measure of financial development, using the IMF Financial Development Index defined by its sub-index of financial institutions development.Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). The left-side chart reports the interaction coefficients between domestic financial conditions (FCI) and financial development. The bottom-side chart shows the estimated coefficients for the interaction term between global financial conditions (VIX) and financial development. All other interaction and single terms from Eq. 2 are also included in the regressions. The panel includes 28 European countries and spans from 1990 to 2018 with a quarterly frequency. See Table A.1 in the Appendix for a detailed definition of the variables of interest used in the analysis.

We explore these contradictory hypotheses in Figures 7 and 8, which replicate our main findings by focusing on the respective sub-indices. While our main conclusions can be verified in both exercises, the higher precision of the estimates on Figure 8 suggests that the 'diversification story' is more likely to explain our findings.

In Figure 8 the heterogeneous effect of the VIX index conditional on financial development becomes clearer (see bottom-right panel), at least in terms of the precision of the econometric result. The same exercise reports a larger point estimate in Figure 7 for the 5th percentile of the density (2.8 against 1.8, respectively), but the results is estimated also with a much larger confidence interval. While both hypotheses outlined above seem to be in place, the evidence also points out that the possibility of accessing different types of well-functioning financial markets matters more than the size and geographical spread of banking markets in explaining our findings. Overall, these exercises confirm that our main results remain in place regardless the definition of financial development being considered. In Section 6.2 below we provide an extended discussion of the moderating effect of financial development on the pass-through of global financial stress to GDP growth.

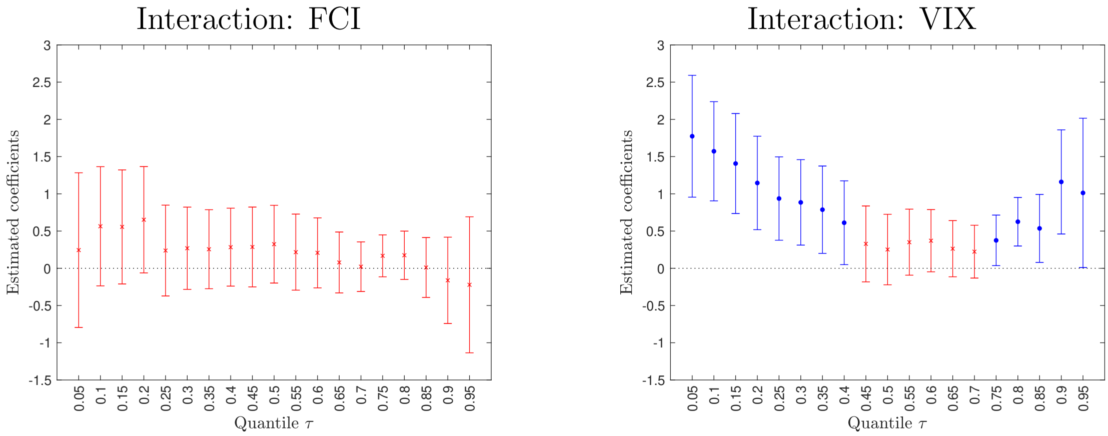


Figure 8 Effects conditional on financial development - Financial markets. This panel reports the results of estimating Eq. 2, focusing on the interaction terms between our macrofinancial variables of interest and a measure of financial development, using the IMF Financial Development Index defined by its sub-index of financial markets development. The dots represent the respective point estimates (with a one quarter horizon, $h = 1$), whereas the whiskers represent the corresponding 95 percent confidence intervals for each estimation. These whiskers (and their corresponding point estimates) are plotted in blue when representing a statistically significant estimation (and in red otherwise). The left-side chart reports the interaction coefficients between domestic financial conditions (FCI) and financial development. The right-side chart shows the estimated coefficients for the interaction term between global financial conditions (VIX) and financial development. All other interaction and single terms from Eq. 2 are also included in the regressions. The panel includes 28 European countries and spans from 1990 to 2018 with a quarterly frequency. See Table A.1 in the Appendix for a detailed definition of the variables of interest used in the analysis.

Relating these results to the literature is not straightforward considering the mixed evidence on the effect of financial development on GDP growth volatility described in Section 2. While a body of literature suggests indeed that financial development can attenuate output volatility (e.g., Bacchetta and Caminal, 2000, Beck et al., 2006, Levine and Warusawitharana, 2021), previous studies do not ask whether this effect operates via a more nuanced transmission of financial stability shocks – either domestic or foreign – to GDP growth. Moreover, previous studies focus on average estimates of GDP growth or sectoral output, providing little guidance on the expected differential effect of financial development on the tails of the GDP growth density.

The interaction results for lagged GDP growth on Figure 6 can be related to previous findings by Beck et al. (2006) or more recently by Singh et al. (2019), who find that larger credit markets relative to GDP help to curbe the transmission of terms of trade shocks to economic growth. This finding can be connected to the idea that imperfect capital markets are detrimental for countries' economic performance (Bernanke and Gertler, 1990). Beck et al. (2006) also find that financial development can exacerbate the effect of monetary (i.e., inflation) shocks. Discussions about different samples and estimation approaches aside, these studies do not provide evidence on whether financial development can moderate the pass-through of financial stability shocks to economic growth, and under which conditions this moderating effect can take place. Neither do previous studies provide insights on whether this hypothesis could hold similarly for upper and lower tails of the GDP growth density. Finally, most studies focus on narrow definitions of financial development as accounted by the ratio of credit to GDP. This limitation implies that little can be said about whether different sources of financial development play a similar role in shaping the transmission of real- or financial-sector shocks to economic growth.[9]

6.2 Discussion: possible underlying drivers

Our main results suggest that developed financial markets contribute to a higher resilience against global financial shocks. Despite ample discussions in the literature regarding the benefits and costs of developed financial markets, our findings provide a rationale that frames previous evidence suggesting a negative relationship between financial development and output volatility. However, the question remains about why financial development may interact with global financial factors — in contrast to domestic ones — in buffering against the real effects of financial shocks. In what follows we discuss a few possible explanations connected with previous evidence in the literature.

A first possible explanation relates to the role of capital flows for financial stability. The effect of the VIX index — our measure of global financial stress — on GDP growth is likely capturing the effect of capital flows' booms and busts that react to global financial

[9] One prominent exception is the study by Singh et al. (2019), who do report a few exercises comparing the effect of banking vs. stock market development in moderating the transmission of terms of trade shocks to output volatility. However, the study focuses on a sample of developing economies and does not look at financial stability as a source of output volatility. Interestingly, the authors find that only banking sector development matters for mitigating the effect of terms of trade shocks, in opposite to our findings that both financial institutions and financial markets development do play a role in mitigating the transmission of global financial stress to the density of expected domestic GDP growth, albeit more precise estimates for the financial markets definition.

factors. It is well known that changes in global financial factors such as the price of the US Dollar create large shifts in capital flows (see, e.g., Bruno and Shin, 2015, Ivashina et al., 2015), a dynamic that is affected by both domestic (push) and foreign (pull) factors (Eguren-Martin et al., 2020).

As mentioned in the discussion above, higher degrees of financial development are associated with investment diversification possibilities. As financial markets expand and the enforcement of contracts and hedging opportunities improve, foreign investors will find it easier to identify investments for which appropriate collateral can be obtained (Martin and Taddei, 2008). Three main consequences derive from this dynamic. First, foreign investors will have a more diversified portfolio in the destination countries, cushioning against large individual exposures. Second, the availability of a diversified portfolio of investments will likely incentivize more foreign actors to enter into a market, diversifying countries' international liabilities (Eichengreen and Leblang, 2003). Third, a wider availability of domestic liquidity and the ease of financial frictions provides foreign investors larger liquidity pools in the destination countries. This latter fact is important considering the relevance of domestic liquidity for foreign investors (Desai et al., 2021). Together, these arguments underscore the idea that well-functioning financial markets allow for a more diversified exposure to capital flows.

A second but — closely related — explanation concerns the impact of financial development on the share of foreign direct investment (FDI) in total capital flows. Even though multinational companies can rely on more liquid home-country markets, they also closely interact with host countries' financial markets in search for financing (Kinoshita and Campos, 2008). Again, easing capital market imperfections and expanding liquidity creates favorable conditions that can tip the balance in favor of FDI against other forms of arms' length foreign investment (Desai et al., 2021). This argument has been confirmed by empirical evidence linking financial development with increasing FDI flows (see, e.g., Blonigen and Piger, 2014, Nguyen and Lee, 2021). Given the evidence on the stability of FDI flows compared to other forms of capital flows (see, e.g., Montiel and Reinhart, 1999, Broner et al., 2014), financial development could lead to a re-balancing of capital flows allowing for a larger share of more stable FDI flows.

This effect could explain the lack of sensibility to global financial factors that comes along with high financial development in our results. This interpretation is in line with the findings by Eguren-Martin et al. (2020), who show that global financial conditions do not affect the prospects of future FDI flows, in contrast to a significant effect on portfolio and banking flows.[10]

Finally, a third line of argument is that financial development could mechanically moderate the relative importance of portfolio and banking flows for economic growth. As the domestic financial sector expands, capital flows may end up representing a smaller fraction of GDP, making the economy less sensible to global factors that affect the stability of capital flows. We do not believe, however, that this argument is a valid interpretation of our findings. First, the evidence suggests that the share of capital flows in countries' GDP tends to expand with financial and economic development, as countries become more integrated globally (Vermeulen and de Haan, 2014). Second, this argument would mostly apply to larger economies able to generate large liquidity pools as the economy expands. Given that we control for country characteristics in our model, factors such as countries' size should not be a relevant factor when interpreting our results. Robustness tests discuss below further confirm that this explanation is unlikely driving our findings.[11]

[10]We recall that our results from Figure 6 indicate a statistically significant interaction between financial development and global financial factors in both tails of the expected GDP growth density. Therefore, if a changing pattern in capital flow could explain our findings, the mechanism would likely operate both by mitigating capital outflows in times of stress, as well as by curbing large (short term) capital inflows in periods of economic expansion.

[11]A different but complementary question is why our results for domestic financial conditions (FCI) remain unaltered for different degrees of financial development. Putting together previous findings, one can speculate that domestic financial conditions matter for GDP growth for different stances of financial development, albeit for reasons that differ as financial markets evolve. Low degrees of financial development imply that little alternatives exist to diversify firms' funding structures, magnifying negative financial shocks (Levine and Warusawitharana, 2021). On the contrary, high degrees of financial development may come along with an expansion of financial markets in areas beyond financial intermediation, triggering a financial sector-induced procyclicality, as it has been shown by Beck et al. (2014). These dynamics may explain the lack of explanatory power of the interaction term between FCI and financial development in our main results.

6.3 Robustness tests

Our results survive an extensive set of robustness checks, reducing concerns of our findings being driven by measurement errors or an omitted variable bias. We report these robustness tests in the Appendix A.2.

In a first set of tests, we replace our measure of financial development in Eq. 2 by variables that capture country characteristics that could be arguably correlated with countries' degree of financial development. We report these results in Figure A.4. We first check in Panel A whether our results can be explained by countries overall degree of economic development (as measured by GDP per capita), considering that developed economies could be better equipped to mitigate the transmission of foreign financial shocks. Second, we evaluate in Panel B whether countries' regulatory quality could explain our findings, given the importance of prudential regulations in mitigating the build up of systemic risk. Finally, we check whether the share of portfolio and FDI flows to GDP explains our results. If the increase in capital flows in an economy is correlated with a larger diversification of foreign liabilities, the sensibility to global financial shocks could be moderated even if domestic financial frictions remain in place.

These tests show that the interaction terms of interest between the VIX index and these competing variables are largely statistically insignificant across the future GDP growth quantiles. We do find, however, some evidence that the effect of domestic financial stress (FCI) varies according to countries' economic development and also depending on countries' regulatory quality, as measured by the Worldwide Governance Indicators of the World Bank (Kaufmann et al., 2010). Even though the interaction of FCI and these latter variables is statistically insignificant in the tails, the result suggests that — as long as domestic financial conditions are not 'too' tight — developed economies with well-designed regulatory frameworks benefit from a moderated finance-driven procyclicality.[12]

[12] Alternatively, we also run a similar test replacing financial development by the Chinn-Ito Index of financial openness (Chinn and Ito, 2006). One could argue that as countries' capital account becomes more globally integrated, diversification effects may lead to a milder effect of foreign financial shocks. However, the results reported in Figure A.5 show that the coefficients for the interaction term between the Chinn-Ito and the VIX indices are largely statistically insignificant. If anything, financial openness

Our results could also be affected by a reverse causality error given the possibility that financial development could be increasing as countries enter into positive trends in GDP growth. To address this concern we replicate our main estimation by fixing each countries' measure in the IMF Financial Development Index in the first year in which all countries report a non-missing observation in the database (i.e., 1993). That is, financial development keeps a pre-existent fixed value throughout the time series. The intuition of this test is that if reverse causality dynamics explain our findings, the results should vanish once a pre-existent fixed value of financial development is used in the estimation. The results of this test are reported in Figure A.6, confirming that our results remain unaltered when using ex-ante fixed measures of financial development. If anything, the effect of VIX on a few right-tail quantiles becomes statistically insignificant.[13]

We also test the robustness of our results to more mechanical modifications of our empirical setup. For example, our results can be replicated when replacing the VIX index by a geographically closer European measure of market volatility as represented by the VSTOXX index (see Figure A.8).[14] The fact that this alternative measure doesn't change our results confirms that foreign financial stress is driving the non-linear effect of financial development on GDP growth.

We discussed in the previous section that our results could also be arguably explained by the mere increase in the size of domestic financial markets, irrespective of the alleviation of financial frictions that we expect to come along with financial development. This line of argument could suggest that larger financial markets relative to the economy can 'mechanically' reduce the sensibility to foreign financial shocks as foreign capital becomes relatively less important as a liquidity source. We explore this hypothesis by estimating

is connected to a stronger effect of global conditions for a few central quantiles in the distribution.

[13]We also consider a test in which we exclude countries that, during the sample period, changed their sample rank in terms of the IMF Financial Development Index the most. These results are reported in Figure A.7. In this test, we exclude countries with a standard deviation in the year-specific rank above the 75th percentile. This test confirms our findings for the downside risk of GDP growth. We also find that some moderating effects of the VIX index in the right-tail of GDP densities becomes statistically insignificant. However, we are cautions about interpreting this result as the sample exclusion penalizes countries with longer time series in the IMF Financial Development Index.

[14]The VSTOXX index is computed based on the EURO STOXX 50 real time options prices and reflects market expectations of future volatility in the main European markets.

a model in which financial development is replaced by a measure of countries' credit-to-GDP ratio. The results for the interaction terms of interest are reported in Figure A.9. Even though the credit-to-GDP ratio is included as an input in the IMF Financial Development Index, we find that this variable cannot explain by itself — beyond a single quantile — the documented interaction between the VIX index and financial development.

A further concern is the possibility that our results may be driven exclusively by the 2008 global financial crisis or other periods in which global financial conditions experienced a peak. To explore this possibility, we run simple tests in which we drop the observations corresponding to the year 2008 or to the years 2003, 2008, and 2012 and re-estimate our model. The results, reported in Figures A.10 and A.11, show that even when excluding the largest peaks in the VIX Index during the sample period our results remain unaltered. These findings corroborate that the moderating effect of financial development applies both to crisis and non-crisis periods, underscoring the policy relevance of our findings.

7 Conclusion

In this paper we provide first evidence on the moderating effect of financial development on the pass-through of financial stability shocks to GDP growth. Using a panel quantile regression approach, we characterize the complete density of expected GDP growth one quarter ahead of periods of domestic and global financial stress. Focusing on a sample of 28 European countries for the period between 1990 to 2018, we find that financial stress, either foreign or domestic, is negatively associated with expected GDP growth, an effect that is stronger in the left tails of the expected GDP growth densities.

Our main result shows that this baseline effect diminishes with countries' degree of financial development, albeit only for scenarios of global financial stress. Our results are also more clearly identified when defining financial development as an expansion in bond and stock markets, in contrast to an increase in the size of the banking sector relative to the economy. While previous literature has found mixed evidence on the relationship between financial development and GDP growth, our results show that particularly via moderating the sensibility of GDP growth to global financial stress, financial development can help countries to build resilience against foreign financial shocks. This conclusion extends the literature on financial development and growth volatility by unveiling a previously unexplored mechanism through which financial development can reduce the volatility of GDP growth.

Our findings suggest a changing pattern in countries' sensibility to global financial factors as financial development increases. This idea is likely reflecting that alleviating capital market imperfections and expanding investment opportunities creates incentives to diversify countries' international liabilities. Well-functioning financial markets have been also associated with an increase in more stable FDI flows in contrast to portfolio and banking capital flows. These two forces offer an explanation to the ameliorated sensitivity to global financial factors as domestic financial markets develop. Future research could shed light on these underlying explanations, exploring how the contribution of global capital flows to domestic financial stability varies in the presence of frictions in domestic financial markets.

References

Acemoglu, D., Johnson, S., Robinson, J., Thaicharoen, Y., 2003. Institutional causes, macroeconomic symptoms: volatility, crises and growth. Journal of Monetary Economics 50(1), 49–123.

Adrian, T., Boyarchenko, N., Giannone, D., 2019. Vulnerable growth. American Economic Review, American Economic Association 109, 1263–1289.

Aghion, P., Banerjee, A., Piketty, T., 1999. Dualism and macroeconomic volatility. The Quarterly Journal of Economics, Oxford University Press 114(4), 1359–1397.

Aikman, D., Bridges, J., Hacioglu Hoke, S., O'Neill, C., Raja, A., 2019. Credit, capital and crises: a gdp-at-risk approach. Bank of England working papers 824 Bank of England.

Alessandri, P., Vecchio, L.D., Miglietta, A., 2019. Financial conditions and growth at risk in Italy. Working paer 1242. Banca d'Italia.

Altunbaş, Y., Thornton, J., 2019. The impact of financial development on income inequality: A quantile regression approach. Economics Letters, Elsevier 175, 51–56.

Araujo, J.D., David, A.C., van Hombeeck, C., Papageorgiou, C., 2017. Procyclicality of private capital inflows in lower income developing economies. Journal of International Money and Finance, Elsevier 70, 157–182.

Bacchetta, P., Caminal, R., 2000. Do capital market imperfections exacerbate output fluctuations? European Economic Review 44, 449–468.

Bai, J.J., Carvalho, D., Phillips, G.M., 2018. The impact of bank credit on labor reallocation and aggregate industry productivity. Journal of Finance, American Finance Association 73(6), 2787–2836.

Beck, T., Degryse, H., Kneer, C., 2014. Is more finance better? disentangling intermediation and size effects of financial systems. Journal of Financial Stability 10(C), 50–64.

Beck, T., Levine, R., 2004. Stock markets , banks, and growth: Panel evidence. Journal of Banking & Finance 28(3), 423–442.

Beck, T., Levine, R., Loayza, N., 2000. Finance and the sources of growth. Journal of Financial Economics 58(1-2), 261–300.

Beck, T., Lundberg, M., Majnoni, G., 2006. Financial intermediary development and growth volatility: Do intermediaries dampen or magnify shocks? Journal of International Money and Finance 25(7), 1146–1167.

Benczúr, P., Karagiannis, S., Kvedaras, V., 2019. Finance and economic growth: Financing structure and non-linear impact. Journal of Macroeconomics 62(C).

Bernanke, B.S., Gertler, M., 1990. Financial fragility and economic performance. Quarterly Journal of Economics 105, 87–114.

Blonigen, B.A., Piger, J., 2014. Determinants of foreign direct investment. Canadian Journal of Economics, Canadian Economics Association 47(3), 775–812.

Braun, M., Larraín, B., 2005. Finance and the business cycle: International, inter-industry evidence. Journal of Finance, American Finance Association 60(3), 1097–1128.

Broner, F., Didier, T., Erce, A., Schmukler, S.L., 2014. Gross capital fows: Dynamics and crises. Journal of Monetary Economics 60, 113–133.

Bruno, V., Shin, H.S., 2015. Cross-border banking and global liquidity. Review of Economic Studies, Oxford University Press 82(2), 535–564.

Caballero, R.J., Krishnamurthy, A., 2001. International and domestic collateral constraints in a model of emerging market crises. Journal of Monetary Economics 48, 513–548.

CGFS, 2021. Changing patterns of capital flows. CGFS Papers 66, Committee on the Global Financial System (CGFS).

Chinn, M.D., Ito, H., 2006. What matters for financial development? capital controls, institutions, and interactions. Journal of Development Economics 81(1), 163–192.

Demirgüç-Kunt, A., Feyen, E., Levine, R., 2013. The evolving importance of banks and securities markets. World Bank Economic Review, World Bank Group 27(3), 476–490.

Desai, M.A., Foley, C.F., Hines, J.R., 2021. Capital controls, liberalizations, and foreign direct investment. Review of Financial Studies, Oxford University Press 19(4), 1433–1464.

Duprey, T., Klaus, B., Peltonen, T., 2017. Dating systemic financial stress episodes in the eu countries. Journal of Financial Stability 32(C), 30–56.

Easterly, W., Stiglitz, J., 2003. Shaken and stirred: Explaining growth volatility. Annual World Bank Conference on Development Economics 191.

Eguren-Martin, F., O'Neill, C., Sokol, A., von dem Berge, L., 2020. Capital flows-at-risk: push, pull and the role of policy. Bank of England working papers 881 Bank of England.

Eichengreen, B., Leblang, D., 2003. Capital account liberalization and growth: was mr. mahathir right? International Journal of Finance & Economics, John Wiley & Sons, Ltd. 8(3), 205–224.

Feroli, M., Kashyap, A.K., Schoenholtz, K.L., Shin, H.S., 2014. Market tantrums and monetary policy. Chicago Booth Research Paper, Chicago Booth School of Business 14-09.

Franta, M., Gambacorta, L., 2020. On the effects of macroprudential policies on growth-at-risk. Economics Letters 196(C).

Galán, J.E., 2020. The benefits are at the tail: uncovering the impact of macroprudential policy on growth-at-risk. Journal of Financial Stability .

Giglio, S., Kelly, B., Pruitt, S., 2016. Systemic risk and the macroeconomy: An empirical evaluation. Journal of Financial Economics 119(3), 457–471.

Holló, D., Kremer, M., Lo Duca, M., 2012. Ciss - a composite indicator of systemic stress in the financial system. IMF Working Papers 2012/1426 International Monetary Fund.

Ivashina, V., Scharfstein, D.S., Stein, J.C., 2015. Dollar funding and the lending behavior of global banks. Quarterly Journal of Economics 130(3), 1241–1281.

Iwasaki, I., Kocenda, E., Shida, Y., 2020. Institutions, financial development, and small business survival: Evidence from european emerging markets. CESifo Working Paper Series 8641 CESifo.

Kaufmann, D., Kraay, A., Mastruzzi, M., 2010. The worldwide governance indicators : methodology and analytical issues. Policy Research Working Paper Series 5430, The World Bank .

King, R.G., Levine, R., 1993. Finance and growth: Schumpeter might be right. The Quarterly Journal of Economics, Oxford University Press 108(3), 717–737.

Kinoshita, Y., Campos, N.F., 2008. Foreign direct investment and structural reforms: Evidence from eastern europe and latin america. IMF Working Papers, International Monetary Fund 2008/026.

Koenker, R., 2005. Quantile Regression. Econometric Society Monographs, Cambridge University Press. doi:10.1017/CBO9780511754098.

Koenker, R., Bassett, G., 1978. Regression quantiles. Econometrica 46, 33–50.

Levchenko, A.A., Rancière, R., Thoenig, M., 2009. Growth and risk at the industry level: The real effects of financial liberalization. Journal of Development Economics 89(2), 210–222.

Levine, O., Warusawitharana, M., 2021. Finance and productivity growth: Firm-level evidence. Journal of Monetary Economics 117(C), 91–107.

Levine, R., 2005. Finance and growth: Theory and evidence. Handbook of Economic Growth, P. Aghion & Durlauf, S., ed. Ch.12, Elsevier.

Levine, R., Zervos, S., 1998. Stock markets, banks, and economic growth. American Economic Review, American Economic Association 88(3), 537–558.

Manganelli, S., Popov, A., 2015. Financial development, sectoral reallocation, and volatility: International evidence. Journal of International Economics 96(2), 323–337.

Martin, A., Taddei, F., 2008. International capital flows and credit market imperfections: A tale of two frictions. Journal of International Economics 89(2), 441–452.

Montiel, P., Reinhart, C.M., 1999. Do capital controls and macroeconomic policies influence the volume and composition of capital flows? evidence from the 1990s. Journal of International Money and Finance 18, 619–635.

Murdock, K.C., Hellmann, T.F., Stiglitz, J.E., 2000. Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? American Economic Review, American Economic Association 90, 147–165.

Nguyen, C.P., Lee, G.S., 2021. Uncertainty, financial development, and fdi inflows: Global evidence. Economic Modelling 99, 105473.

Ogrokhina, O., Rodriguez, C.M., 2019. The effect of inflation targeting and financial openness on currency composition of sovereign international debt. Journal of International Money and Finance, Elsevier 97, 1–18.

Panizza, U., 2013. Guest workers: Financial development and economic growth: Known knowns, known unknowns, and unknown unknowns. IHEID Working Papers 13-2013.

Prasad, A., Elekdag, S., Jeasakul, P., Lafarguette, R., Alter, A., Feng, A.X., Wang, C., 2019. Growth at risk: Concept and application in imf country surveillance. IMF Working Papers 2019/036 International Monetary Fund.

Raddatz, C., 2006. Liquidity needs and vulnerability to financial underdevelopment. Journal of Financial Economics 80(3), 677–722.

Rajan, R., Zingales, L., 1998. Financial dependence and growth. American Economic Review 88, 559–586.

Ramos-Francia, M., Garcia-Verdu, S., 2018. Is trouble brewing for emerging market economies? an empirical analysis of emerging market economies' bond flows. Journal of Financial Stability 35, 172–191.

Rey, H., 2015. Dilemma not trilemma: the global financial cycle and monetary policy independence. Technical Report. National Bureau of Economic Research.

Rioja, F., Valev, N., 2014. Stock markets, banks and the sources of economic growth in low and high income countries. Journal of Economics and Finance, Springer 38(2), 302–320.

Samargandi, N., Fidrmuc, J., Ghosh, S., 2015. Is the relationship between financial development and economic growth monotonic? evidence from a sample of middle-income countries. World Development 68(C), 66–81.

Sánchez, A.C., Röhn, O., 2016. How do policies influence gdp tail risks? OECD Economics Department Working Papers 1339 OECD Publishing.

Singh, R.J., Kpodar, K.R., Le Goff, M., 2019. Financial deepening, terms of trade shocks, and growth volatility in low-income countries. IMF Working Papers 2019/068.

Sobiech, I., 2019. Remittances, finance and growth: Does financial development foster the impact of remittances on economic growth? World Development, Elsevier 113, 44–59.

Svirydzenka, K., 2016. Introducing a new broad-based index of financial development. IMF Working Papers, International Monetary Fund 2016.

Tsoukas, S., 2011. Firm survival and financial development: Evidence from a panel of emerging asian economies. Journal of Banking & Finance 35(7), 1736–1752.

Vermeulen, R., de Haan, J., 2014. Net foreign asset (com)position: Does financial development matter? Journal of International Money and Finance, Elsevier 43(C), 88–106.

A Appendix

A.1 Variables Definitions

Variable	Definition	Unit and Sources
ΔGDP	Change in quarterly GDP (year-on-year) computed from the quarterly series of GDP and its main components based on chain linked volumes (2010=100) at market prices.	Growth rate (ECB).
FCI	Financial condition index based on the CLIFS methodology (end of period) obtained from the ECB Statistical Data Warehouse. The index measures domestic financial conditions and is based on the index proposed by Duprey et al. (2017).	Index unit. End of period (ECB Statistical Data Warehouse).
VIX	Chicago Board Options Exchange's CBOE Volatility Index. It measures the stock market's volatility expectation based on S&P 500 index options.	Index unit (Yahoo Finance).
FDI	Financial Development Index. It measures the development of financial markets and financial institutions with respect to the depth, access and efficiency (see Svirydzenka, 2016).	Index unit (IMF database).
GDP per capita	GDP per capita (constant 2010 US$)	US$ (World Bank).
Regulatory quality	Index computed by the Worldwide Governance Indicators of the World Bank (see Kaufmann et al., 2010).	Index unit (World Bank).
Capital flows	Sum of net inflows of portfolio, equity and foreign direct flows.	Millions of US$ (Balance of Payments database, IMF).
Chinn-Ito Index	Index measuring countries' degree of capital account openness (see Chinn and Ito, 2006).	Index unit (IMF's Annual Report on Exchange Arrangements and Exchange Restrictions).
Credit-to-GDP ratio	Ratio of domestic credit (to private sector) to GDP	% of GDP (World Bank database).
VSTOXX	EURO STOXX 50 Index. It reflects market expectations of future volatility in the main European markets.	Index unit (Bloomberg and Yahoo Finance).

Table A.1 Variables definitions. This table provides a description of the main variables used for the empirical analysis reported in the paper. Sources are reported in parentheses.

A.2 Further tables and figures

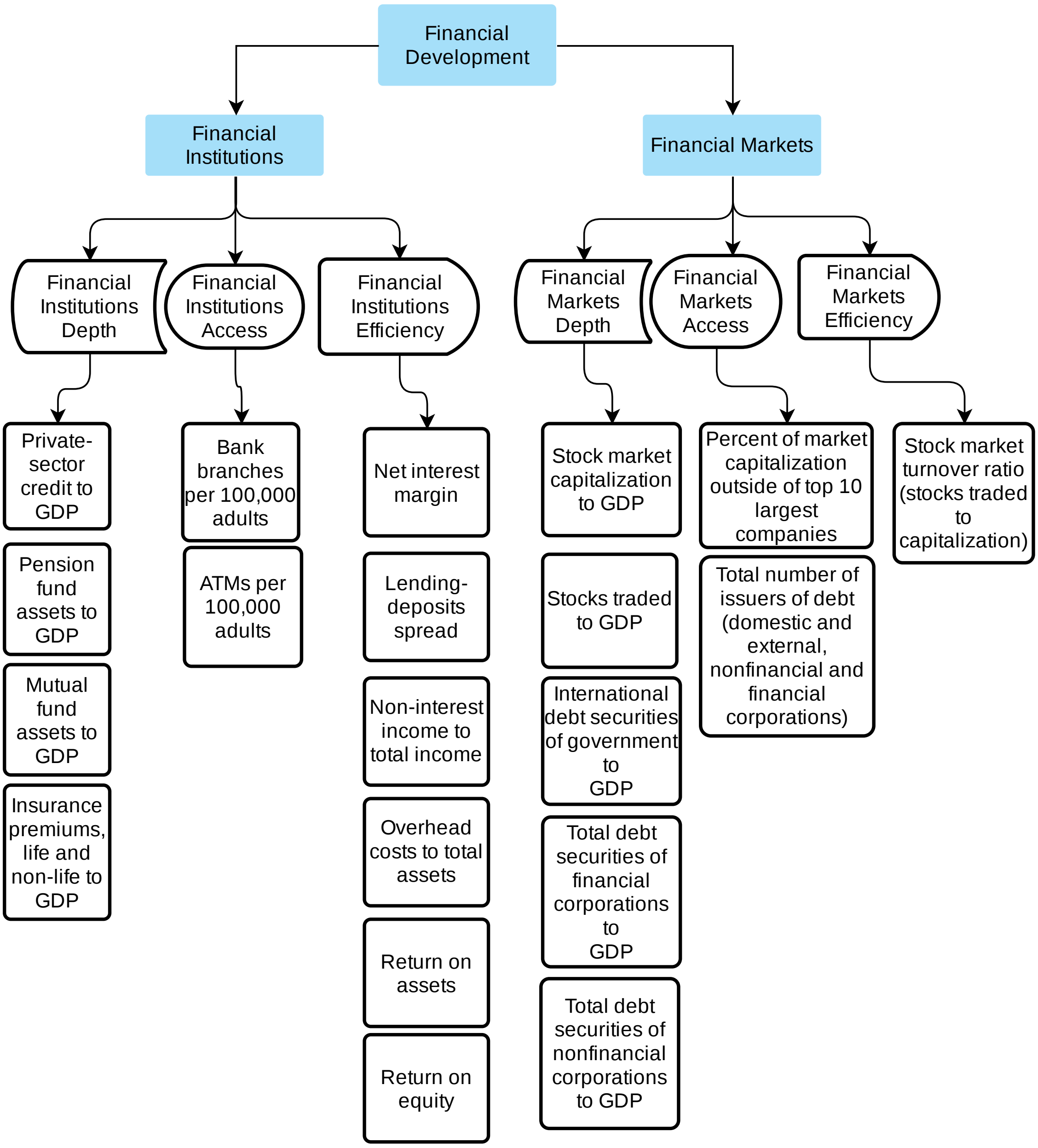


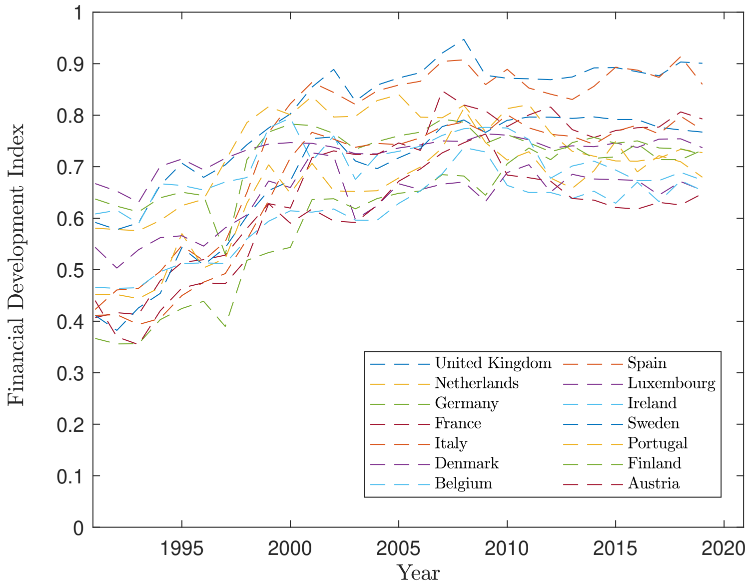
Figure A.1 Financial Development Index conceptual approach This diagram provides a description of the main indicators used to defining the Financial Development Index. It mainly uses data from FinStats 2015, IMF Financial Access Survey, BIS debt securities database and Dealogic corporate debt database. Own elaboration with information from Svirydzenka (2016).

Table A.2 LIST OF COUNTRIES IN THE SAMPLE

Advanced economies	
Austria	Italy
Belgium	Luxembourg
Germany	Netherlands
Denmark	Poland
Finland	Portugal
France	Spain
Greece	Sweden
Ireland	United Kingdom
Emerging economies	
Bulgaria	Latvia
Cyprus	Lithuania
Czech Republic	Malta
Croatia	Romania
Estonia	Slovenia
Hungary	Slovakia

NOTES: This table lists the jurisdictions included in our main empirical analysis. 28 European countries including 16 advanced economies and 12 emerging economies. The selection of these countries is based on the European Union country list and the UK.

Panel A: 14 highest FDI



Panel B: 14 lowest FDI

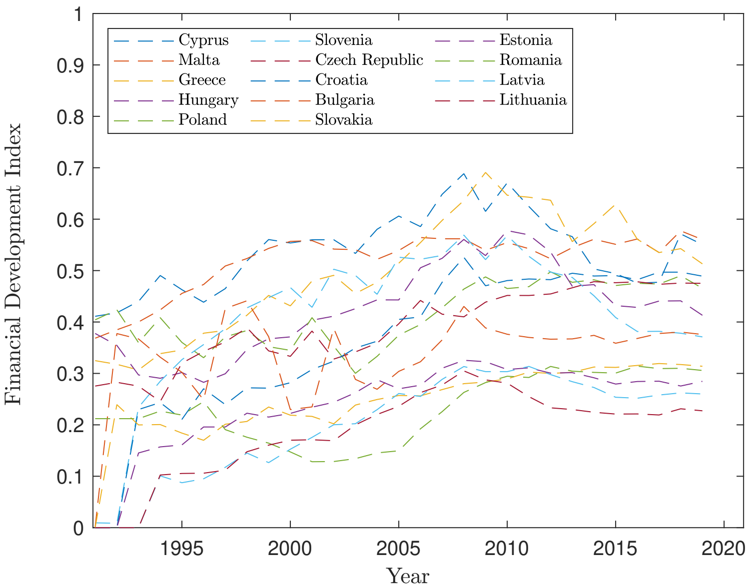


Figure A.2 Financial Development Index Ranking. This figure illustrates the evolution of the annual financial development index used in the empirical analysis from 1990 to 2018. Panel A includes the top 14 countries with the highest index value on average. Panel B reports estimates for the 14 countries with a the lowest index value, on average. Both panels show a steady behavior of the index which is important for the robustness of the analysis.

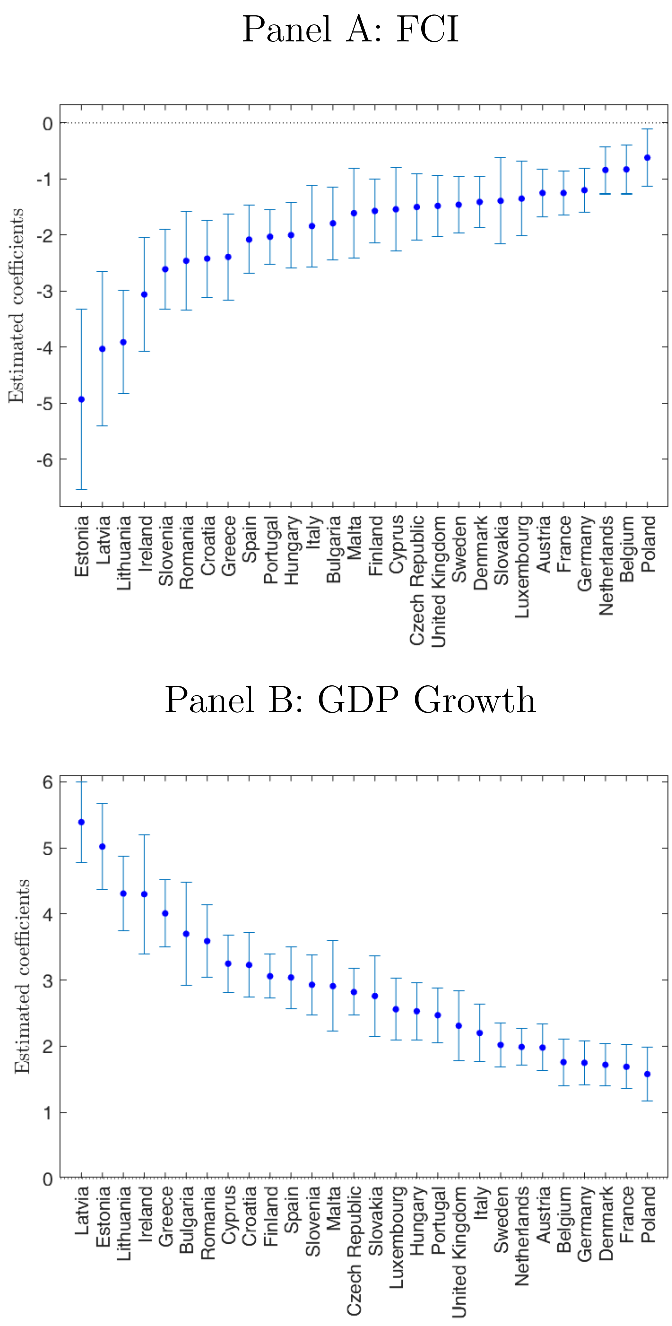


Figure A.3 Linear effects on GDP growth. This figure illustrates the linear average effect of macrofinancial conditions on GDP growth over a one quarter horizon. The estimations are based on a simplified version of Eq. 1 obtained from OLS estimates at the individual country level. The estimation is run separately for each of the 28 countries in the sample considering the full time-span in the sample from 1990 to 2018. Panel A reports the coefficient estimates for the regression of current GDP growth on future GDP growth. Panel B reports reports the coefficient estimates for the regression of current domestic financial conditions (FCI) on future GDP growth. The results for the VIX Index are reported in Figure 2 in the article. The dots represent the respective point estimates, whereas the whiskers represent the corresponding 95 percent confidence intervals for each estimation.

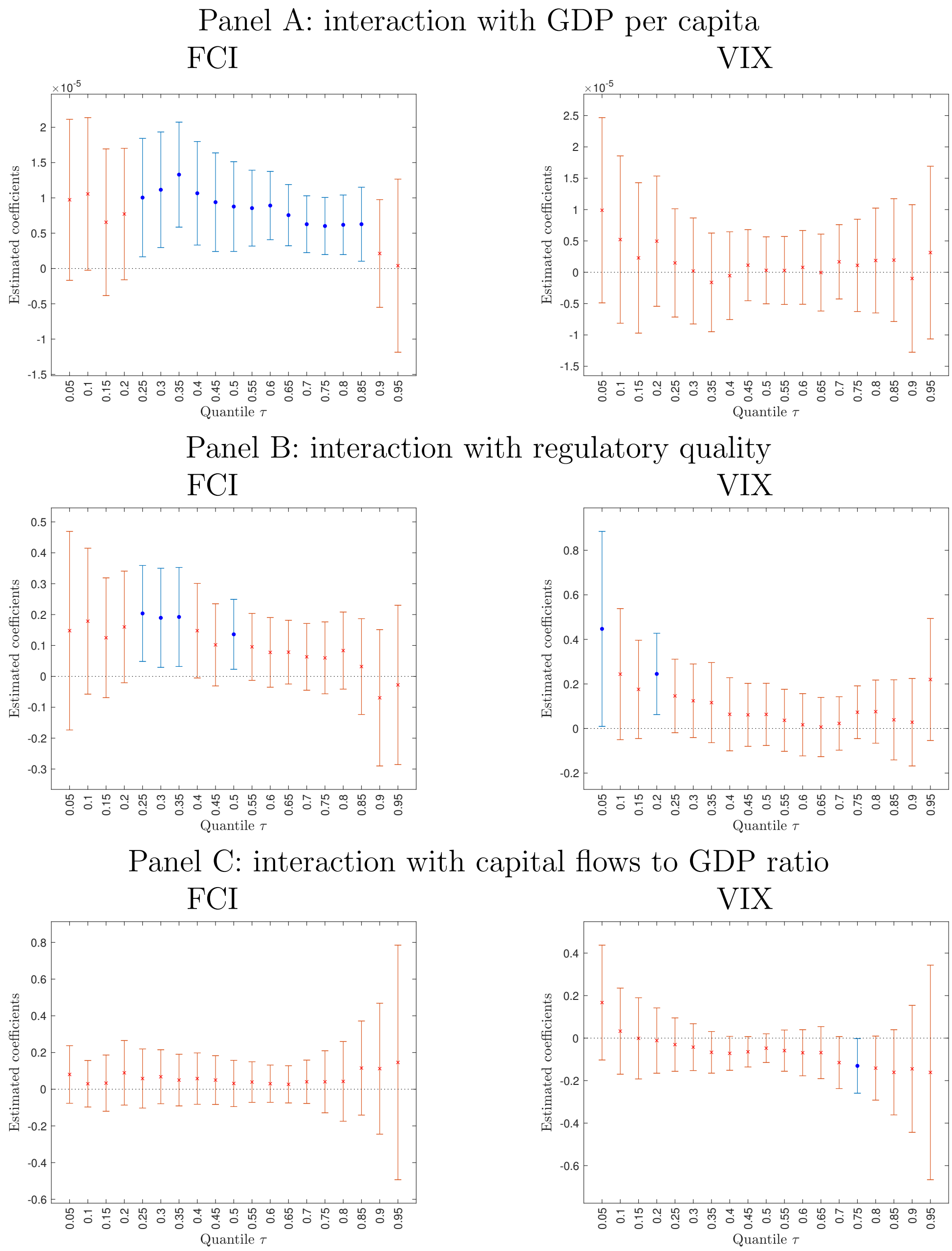


Figure A.4 Interaction models with competing variables. This figure reports the results of estimating alternative versions of Eq. 1 in which financial development is replaced by alternative country characteristics. Each panel reports only the estimated coefficients for the interaction term between the FCI and VIX indices and the respective competing variable. Panel A interacts these variables with countries' GDP per capita; Panel B includes interaction terms with an index of regulatory quality from the World Bank Governance Indicators; Panel C includes and interaction term with countries' capital flows to GDP ratio. Capital flows are computed as the sum of portfolio and FDI flows reported in the IMF Balance of Payments Statistics. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.

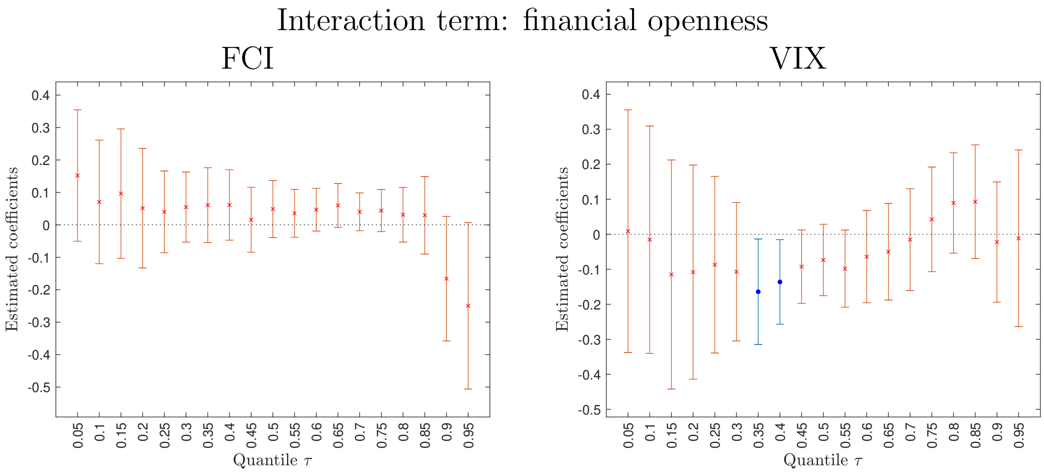


Figure A.5 Interaction model with financial openness. This figure reports the results of estimating an alternative version of Eq. 1 in which we replace financial development by the Chinn-Ito Index of financial openness (Chinn and Ito, 2006). This index measures countries' degree of capital account openness an is updated until 2018, allowing us to cover the full time span of our sample from 1990 to 2018. The index measures restrictions in cross-border financial transactions as reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. The panel reports the coefficients for the interaction term between the FCI (left) and VIX (right) indices and the Chinn-Ito Index. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.

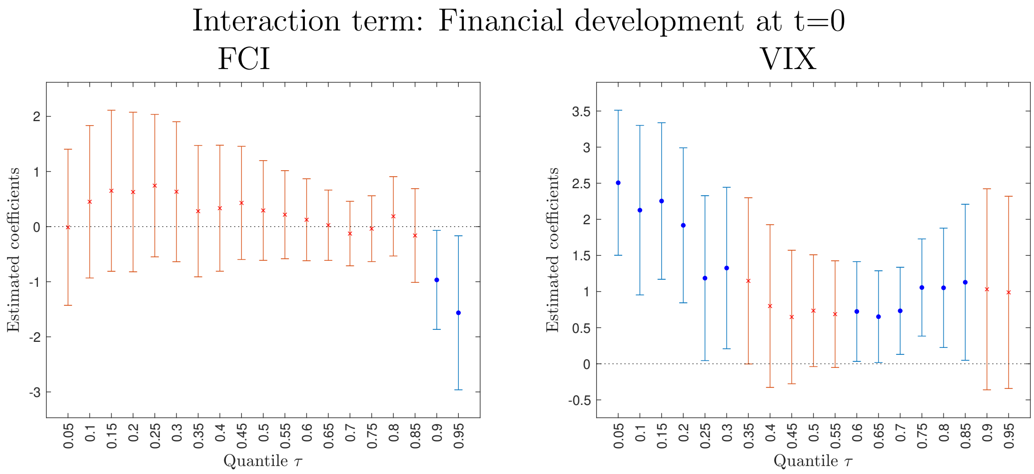


Figure A.6 Fixing financial development over time. This figure reports the results of estimating Eq. 1 with financial development entering the model fixed with its value representing the first observation available for all countries in the sample. This observation is kept fixed throughout the sample period. The panel reports the coefficients for the interaction term between the FCI (left) and VIX (right) indices and our measure of financial development. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.

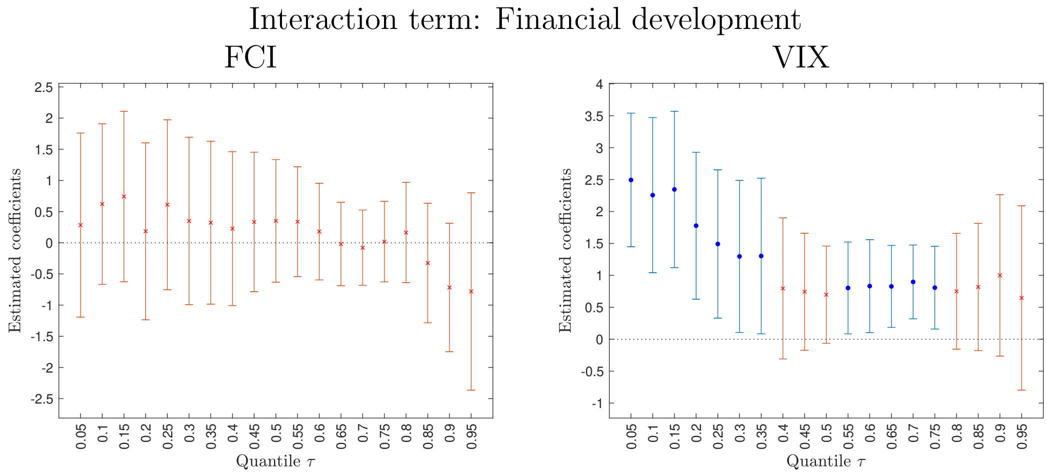


Figure A.7 Excluding countries with large changes in financial development rank. This figure reports the results of estimating an alternative version of Eq. 1 in which we exclude countries that changed by most their financial development rank during the sample period. In this exercise we first compute each country's rank in the IMF Financial Development Index within our sample per year. Next, we compute the country-specific standard deviation in this rank variable between 1990 and 2018. Finally, we identify countries with a standard deviation above the 75th percentile of the sample's distribution, excluding them from the sample. These countries correspond to Austria, Spain, France, Greece, Italy, Sweden, and Slovenia. The panel reports the coefficients for the interaction term between the FCI (left) and VIX (right) indices and financial development. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.

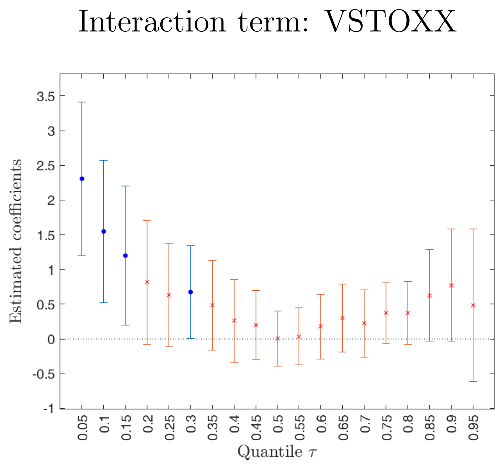


Figure A.8 Replacing the VIX by the VSTOXX index. This figure reports the estimated coefficients for the interaction term between financial development and the VIX index in Eq. 1 when the VIX index is replaced by the VSTOXX index. The VSTOXX reflects market expectations of future volatility as captured by the variance across all options at a given time in the main European markets. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.

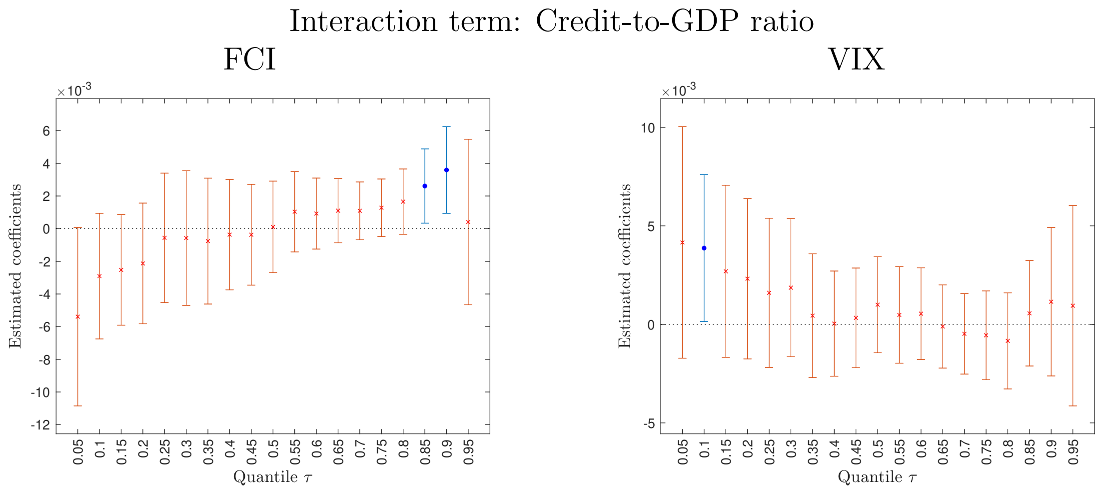


Figure A.9 Interaction effect with the credit-to-gdp ratio. This figure reports the results of estimating Eq. 1 by replacing financial development by countries' credit-to-gdp ratio. The panel reports the coefficients for the interaction term between the FCI (left) and VIX (right) indices and our measure of financial development.Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.

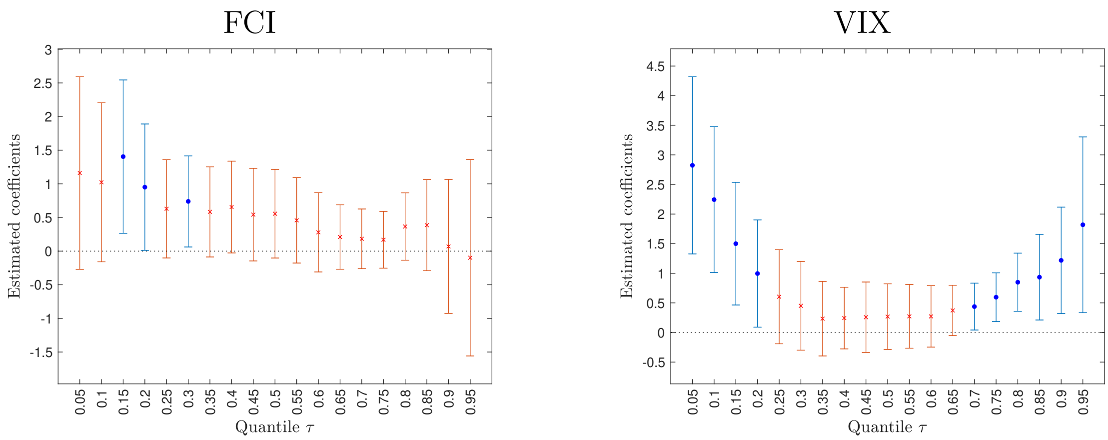
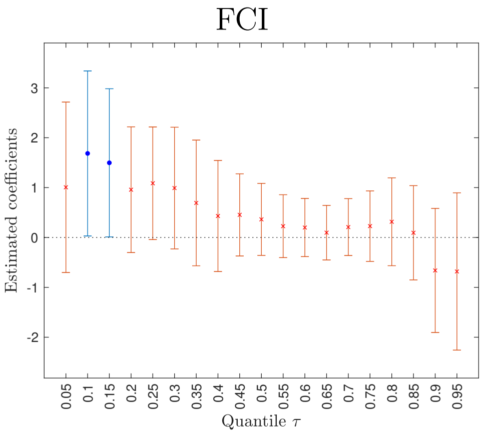


Figure A.10 Dropping 2008 from the sample. This figure reports the results of estimating an alternative version of Eq. 1 in which we drop the observations corresponding to the year 2008 from the sample. The panel reports the coefficients for the interaction term between the FCI (left) and VIX (right) indices and our measure of financial development. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.



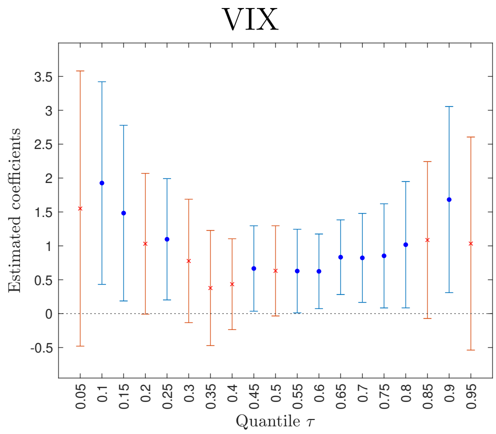


Figure A.11 Dropping peaks in financial conditions. This figure reports the results of estimating Eq. 1 when dropping the observations corresponding to the years 2003, 2008, and 2012 from the sample. The panel reports the coefficients for the interaction term between the FCI (left) and VIX (right) indices and our measure of financial development. Statistically significant estimates with their corresponding confidence intervals a 5 percent confidence level are reported in blue (and in red otherwise). All relevant interaction and single terms are included in the regressions but not reported. The sample period spans from 1990 to 2018. The variables are described in detail in Table A.1.