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# Finance, Growth and (Macro)Prudential Policy: European Evidence

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# Finance, Growth and (Macro)Prudential Policy: European Evidence

Martin Hodula and Ngoc Anh Ngo *

## Abstract

This paper examines the interactions between financial development, economic growth and (macro)prudential policy on a sample of euro area countries. Our main takeaway is that active (macro)prudential policy supports the positive finance-growth nexus instead of disrupting it. These benefits are found to be more likely to materialize during tightening of (macro)prudential policy measures and not during easing. This result is conditional on the ability of (macro)prudential policy to curb excess credit growth and mitigate systemic risk, which would otherwise disrupt the market. Moreover, we assert that when analysing the effects of (macro)prudential policy, it is important to account for the direction of (macro)prudential measures, not just for the frequency at which they are implemented.

## Abstrakt

Tento článek zkoumá vzájemné interakce mezi finančním rozvojem, ekonomickým růstem a (makro)obezřetnostní politikou na vzorku zemí eurozóny. Naším hlavním zjištěním je, že aktivní (makro)obezřetnostní politika podporuje pozitivní vztah mezi finančním rozvojem a ekonomickým růstem namísto jeho narušování. Tyto výhody se častěji projevují během zpřísňování (makro)obezřetnostních opatření a nikoliv během jejich uvolňování. Naše zjištění je podmíněno schopností (makro)obezřetnostní politiky omezovat nadměrný růst úvěrové aktivity a zmírňovat systémové riziko, které by jinak narušilo fungování trhu. Dále ukazujeme, že při analýze efektů (makro)obezřetnostní politiky je důležité zohlednit směr působení (makro)obezřetnostních opatření a ne pouze četnost jejich provádění.

**JEL Codes:** G10, G28, O16, O40.
**Keywords:** Development, finance, growth, macroprudential policy, panel analysis.

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# 1. Introduction

Financial development is an important condition for sustainable growth. Improvements in the key functions of the financial sector promote economic growth through capital accumulation and technological progress. Furthermore, they foster productivity, mobilize savings and investment and broaden access to finance in the population. The majority of empirical studies find a positive and statistically sound relationship between financial development and economic growth (see Arestis et al. 2015; Biljsma et al. 2017 and Valickova et al. 2015 for a review of this literature).

However, the finance-growth relationship is much more complex and deserves further exploration. It is now widely recognized that excessive growth in the financial sector might endanger the economy when it results in a financial crisis (Cerra and Saxena, 2008; Abiad et al., 2009; Reinhart and Rogoff, 2008). In this respect, the Global Financial Crisis of 2007–2009 serves as a particularly costly reminder of the destabilizing effects of major fluctuations in the financial sector (Ball, 2014). In response to the crisis, multiple policies have been put forward by academics, central banks, regulators and other policy makers, aimed at preventing systemic risk build-ups and thus reducing the likelihood and impacts of crises on the financial sector and the economy as a whole. In fact, the importance of a sound regulatory framework is expected to grow as financial development progresses.

One of the newly emphasized policies is macroprudential policy, which aims at promoting financial stability. Macroprudential policy measures avert the emergence of financial imbalances and build resilience in the financial sector in good times so that financial intermediation and lending can support the economy in bad times (Smets, 2014; Sánchez and Röhn, 2016). As a relatively new policy, it attracts the attention of researchers, who study its use, effectiveness and interactions with other existing policies to identify its impacts on financial sector development and economic growth.

In this paper, we provide new empirical evidence on the interactions between financial development, (macro)prudential policy and economic growth. We demonstrate that the established finance-growth nexus is affected by active use of (macro)prudential policy measures. We find that economies that have been actively using (macro)prudential policy tend to benefit from financial development more than economies where (macro)prudential policy is less active. Interestingly, this only becomes evident when we consider the direction of (macro)prudential policy measures instead of relying on mere frequency of use in the form of a cumulative index.

There are two other studies (to our knowledge) that empirically assess (macro)prudential policy implications for the finance-growth nexus. Bernier and Plouffe (2019) examine the impact of financial innovation on economic growth using R&D expenditure in the financial services sector and evaluate the influence of macroprudential policy on this relationship. They rely on an unbalanced panel of 23 countries spanning 1996–2014 and do not find any evidence of macroprudential policy influencing the finance-growth nexus. Agénor et al. (2018) use country-level data from 64 advanced and developing economies over the 1990–2014 period and analyse the empirical link between financial openness, prudential policies and economic growth. They find that economies where prudential policy is used to tighten credit conditions tend to benefit from higher growth. At the same time, they discover that higher financial openness tends to offset this positive effect.

Our study differs from the two mentioned above in several important respects. First, we track down the finance-growth nexus while differentiating between the frequency and the direction of (macro)prudential policy measures. To this end, we accommodate two (macro)prudential policy indexes developed by Cerutti et al. (2017a) and Cerutti et al. (2017b). We discover that the initial

choice of (macro)prudential policy index delivers significantly different point estimates as regards the impact on the finance-growth nexus. Second, we extend the period analysed past 2014, when most of the (macro)prudential policy measures took effect. This extension is important, as we record over 150 (macro)prudential policy actions in our sample in the 2014–2017 period alone, as compared to a total of 220 over the whole 2000–2013 period.

The remainder of the paper is organized into four sections. The following section introduces our data and summary statistics. Section 3 describes our baseline specification results. Section 4 subjects our results to a battery of robustness tests. Section 5 concludes.

## 2. Data

We base our econometric analysis on annual data collected from a variety of sources. Our dataset is a balanced panel of twelve euro area countries spanning 1980–2017. Table A1 presents a data overview and summary statistics. In a monetary union such as the euro area, country-specific imbalances cannot be offset by the uniform monetary policy and are hard to correct using the institutionally constrained fiscal policy. (Macro)prudential policy provides countries with a set of tools that can be tailored to specific risks on the national level, tools which have shorter implementation lags than other public policies to offset divergences in national financial cycles and promote sustainable growth.

Our first set of variables aims to capture economic performance. For this purpose, we rely on the three indicators most commonly found in the empirical literature: gross domestic product (GDP), GDP per capita (GDPPC) and gross value added (GVA) in nominal terms. The data on all the variables are seasonally adjusted and transformed into annual growth rates.[1]

Our second indicator of interest is the Financial Development Index (FDI) taken from the IMF database and described in Svirydzenka (2016). The FDI ranges from 0 to 1; the higher the number, the more financially developed the country. To improve the interpretation value of the indicator, we multiply the raw data values by 100. Hasan et al. (2018) state that the most common indicators of financial development depict the depth, efficiency and stability of the banking sector and the depth and efficiency of stock markets. All of these aspects are covered in the FDI.

Our third indicator captures the effects of (macro)prudential policy measures. We rely on two indexes: the Macroprudential Policy Index constructed by Cerutti et al. (2017a) and the Prudential Policy Index from Cerutti et al. (2017b). Since the ready-to-use data start in 2000 and end in 2014, we extend the datasets using data from Budnik and Kleibl (2018) and ESRB (2020) following the methodology of the original indexes. Altogether, these different data sources allow us to produce two indexes of (macro)prudential policy measures over the period 2000–2017. Since there is less consensus on data related to prudential regulation compared to data on economic growth and financial development, we explain in more detail how these data were originally compiled and treated in the following paragraphs.

The Macroprudential Policy Index (MPI) contains twelve macroprudential policy instruments as simple binary variables. The macroprudential instruments covered are the general countercyclical capital buffer/requirement, the leverage ratio for banks, time-varying/dynamic loan-loss provisioning,

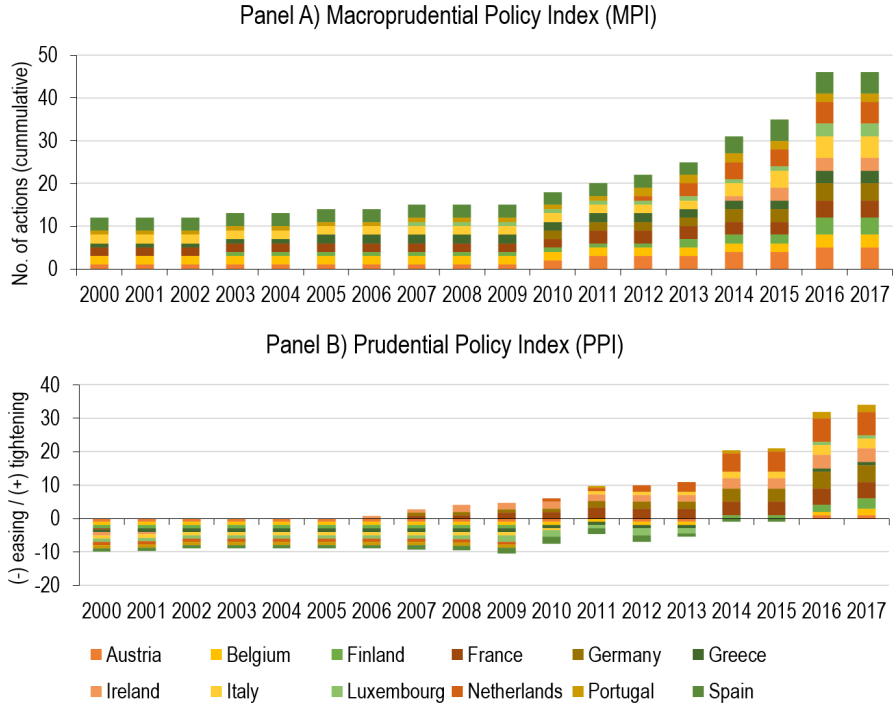
[1] Bekaert and Popov (2019) argue in favour of using rolling windows to compute average GDP growth over a given period (typically five years). This is to correct for relative heterogeneity of sample countries. Given that our sample is a relatively homogeneous monetary union, we pursue our analysis using annual growth rates.

caps on the loan-to-value ratio and the debt-to-income ratio, limits on domestic currency loans, limits on foreign currency loans, reserve requirement ratios in foreign currency, a levy/tax on financial institutions, capital surcharges on systemically important financial institutions, limits on interbank exposures and concentration limits. The index for each of the instruments employed takes the value of 1 if it is active and 0 if it is inactive. An overall macroprudential index is calculated as the simple sum of the scores for all instruments (Figure 1, panel A). The MPI does not take into account the direction of the instruments (whether the policy is tightening or loosening).

The Prudential Policy Index (PPI) comprises actions of a (micro- and macro-)prudential nature and records changes and their effect. It covers nine types of prudential instruments: general capital requirements, real estate credit-related specific capital buffers, consumer credit-related specific capital buffers, other specific capital buffers, domestic currency capital requirements, foreign currency capital requirements, interbank exposure limits, concentration limits and loan-to-value (LTV) ratio limits. The instrument has a 1 or -1 entry depending on whether the prudential tool was tightened or loosened in the given period. The index equals 0 in those years when no change occurs (Figure 1, panel B).[2]

Visual inspection of the two indexes in Figure 1 shows that the frequency of use of (macro)prudential policy instruments is growing over time. Furthermore, the nature of the policies shifted from loosening at the beginning of the sample to tightening at the end of the sample. As of 2017, all instruments implemented in the panel of countries analysed were of a tightening nature. Moreover, the data point to a large degree of heterogeneity across the countries analysed. The heterogeneity does not appear to be explained simply by country size, degree of openness, regional or other specific factors. For this reason, we decided to employ a dynamic panel data analysis as described in the next section, which allows us to exploit the cross-sectional variability in the sample.

***Figure 1: (Macro)Prudential Policy Indexes***




***Source:*** Cerutti et al. (2017a), Cerutti et al. (2017b), own elaboration.

[2] Note that for both indexes, we assign the same weights to the different measures. This allows us to investigate the overall effectiveness of (macro)prudential tools.

## 3. Finance-Growth Nexus and (Macro)Prudential Policy

To study the effect of (macro)prudential policy measures on the finance-growth nexus, we run a series of panel regressions in which ($\Delta y_{i,t}$) is economic growth. We begin with a baseline specification in which ($\Delta y_{i,t}$) is regressed on the financial development index ($FDI_{i,t}$):

$$\Delta y_{i,t} = \alpha_i + \beta_1 \Delta y_{i,t-1} + \beta^{'} X_{i,t} + \gamma FDI_{i,t} + \varepsilon_{i,t} \tag{1}$$

The $\gamma$ coefficient measures the strength of the finance-growth nexus. We employ country-fixed effects ($\alpha_i$) to control for unobserved factors across countries. The model is estimated using the Blundell and Bond (1998) System-GMM (Generalized Method of Moments) with Instrumental Variables to mitigate the reverse causality problem.[3] Motivated by the finance-growth literature, we employ a wide range of controls[4] stacked in vector $X_{i,t}$ that include: labour productivity growth ($labour_{i,t}$), trade openness ($open_{i,t}$), the inflation rate ($inf_{i,t}$), the ECB monetary policy conditions index ($MCI_{i,t-1}$),[5] and a financial crisis dummy ($crisis_{i,t}$).[6]

The results of the baseline model specification are shown in Table 1. We confirm the existence of the finance-growth nexus for our sample countries using the 1980–2017 data as well as in the shortened sample period (2000–2017), for which we have collected data on (macro)prudential policy actions. More specifically, a one-point increase in the $FDI_{i,t}$ is associated with about a 0.24 pp increase in GDP growth. This estimate is fairly standard and places us close to the mean of the estimates of other studies surveyed in Arestis et al. (2015) and Valickova et al. (2015). The estimate is robust across different model specifications. Our control variables have the expected sign.

### 3.1 How Robust is the Finance-Growth Nexus to (Macro)Prudential Policy Actions?

In this section, we test whether the established finance-growth nexus would be affected in any way by active (macro)prudential policy. To this end, we consider a set of extended regressions where (in line with our earlier discussion) we allow the effect of financial development on economic growth to depend on the frequency and the direction of (macro)prudential policy measures ($MPP_{i,t}$). We augment eq. (1) with the following interaction term:

$$\Delta y_{i,t} = \alpha_i + \beta_1 \Delta y_{i,t-1} + \beta^{'} X_{i,t} + \gamma FDI_{i,t} + \delta MPP_{i,t} + \zeta FDI_{i,t} \times MPP_{i,t} + \varepsilon_{i,t} \tag{2}$$

where in $MPP_{i,t}$ we gradually consider changes to the Macroprudential Policy Index ($MPI_{i,t}$), which measures the frequency of macroprudential policy actions, and to the Prudential Policy Index ($PPI_{i,t}$), which measures the direction of such actions. The $\zeta$ coefficient reflects the joint impact of financial development and active (macro)prudential policy on economic growth.[7]

[3] The instruments used in the System-GMM regression are lagged levels (two periods) of the dependent variable. For the level equation the instruments are the lagged differences (one period). The exogenous covariates and the crisis dummy are instrumented by themselves in the differenced and level equations.

[4] The control variables were chosen in line with previous studies on the finance-growth nexus. For a detailed overview of the use of control variables in such studies, please refer to the dataset of the meta-analysis by Biljsma et al. (2017).

[5] The MCI combines 14 different variables in four categories, namely interest rates, monetary aggregates, balance sheet items and the exchange rate. This enables us to capture the effects of both conventional and unconventional

***Table 1: Financial Development and Economic Growth***

| | 1980–2017 | | | 2000–2017 | | |
|---|---|---|---|---|---|---|
| | GDP growth | GDPPC growth | GVA growth | GDP growth | GDPPC growth | GVA growth |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $y_{i,t-1}$ | 0.422*** | 0.424*** | 0.298*** | 0.323*** | 0.318*** | 0.297*** |
| | (0.037) | (0.035) | (0.064) | (0.073) | (0.063) | (0.073) |
| $FDI_{i,t}$ | 0.235*** | 0.227*** | 0.325*** | 0.227*** | 0.195*** | 0.075 |
| | (0.028) | (0.030) | (0.068) | (0.045) | (0.044) | (0.057) |
| $labour_{i,t}$ | 0.606*** | 0.606*** | 0.574*** | 0.967*** | 0.969*** | 0.943*** |
| | (0.115) | (0.115) | (0.139) | (0.071) | (0.061) | (0.055) |
| $open_{i,t}$ | 0.011*** | 0.005*** | 0.013*** | 0.010*** | 0.004** | 0.009*** |
| | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) |
| $inf_{i,t}$ | 0.087* | 0.058 | 0.384* | 0.180 | 0.074 | 0.296 |
| | (0.052) | (0.051) | (0.225) | (0.193) | (0.153) | (0.233) |
| $MCI_{i,t-1}$ | -0.104*** | -0.090** | -0.309*** | -0.234** | -0.180* | -0.282** |
| | (0.035) | (0.040) | (0.101) | (0.111) | (0.094) | (0.137) |
| $crisis_{i,t}$ | -1.077*** | -0.972*** | -1.164*** | -1.280* | -1.534** | -1.757*** |
| | (0.302) | (0.275) | (0.406) | (0.726) | (0.730) | (0.567) |
| Observations | 381 | 381 | 252 | 204 | 204 | 204 |
| Hansen | 0.513 | 0.284 | 0.358 | 0.208 | 0.105 | 0.189 |
| AR (2) | 0.369 | 0.106 | 0.151 | 0.137 | 0.078 | 0.101 |

***Note:*** Robust standard errors are in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by ***, ** and * respectively.

The results of the augmented model are summarized in Table 2. We find that accounting for the frequency of macroprudential policy measures tends to offset the positive effects of financial development on economic growth (columns 1, 2 and 3). Since macroprudential policy is of a preventive nature, it may be overly limiting in terms of its influence on bank lending, thus lowering economic growth.[8] Sánchez and Röhn (2016), who also employ $MPI_{i,t}$ to investigate the link between macroprudential policy and GDP growth, argue that more frequent use of macroprudential policy measures may be associated with lower economic growth.

However, the appropriateness of employing a cumulative macroprudential policy index such as $MPI_{i,t}$ should be discussed. One possible caveat is associated with the reverse causality problem, which is impossible to control for in full. Specifically, countries may choose to implement certain (macro)prudential policies in response to output growth conditions. Another issue is the danger of recording a spurious regression. Trying to explain economic growth by the mere number of new policy instruments might by tricky for several reasons. First, one cannot distinguish between tools that are meant to tighten market conditions and those that are intended to loosen them.[9] Second,

monetary policies, which is essential in the post-crisis period. For details on the calculation of the MCI, please refer to Malovana and Frait (2017).

[6] The financial crisis dummy is created on the basis of the ESRB financial crisis database. It takes the value of 1 if there was a crisis and 0 otherwise. For further information regarding the database, please refer to Lo Duca et al. (2017).

[7] In this case, a reverse causality would imply a situation where faster economic growth would lead to greater use of (macro)prudential policies. In fact, it also motivates the use of GVA growth side by side with GDP and GDPPC growth. GVA corrects for excess growth just on account of increased tax collection due to better compliance/coverage.

[8] Estimates of the impact of capital-based regulation on bank lending can be found in Aiyar et al. (2014), Deli and Hasan (2017) and Kolcunová and Malovaná (2019).

[9] This is likely to be an issue, since Boar et al. (2017), who also estimated the impact of prudential policy measures on economic performance, found the exact opposite as Sánchez and Röhn (2016). This is because Boar et al. (2017) apply $PPI_{i,t}$, accounting for the direction of MPP measures.

several tools can be set to a non-zero value without affecting the market.[10] Third, the estimation period might just be too short on active macroprudential measures for the estimate to be robust, as most of the macroprudential policy measures took effect only after the adoption of the Basel III accord in 2010.[11]

Interestingly, when we account for the direction of the (macro)prudential policy measures by applying $PPI_{i,t}$, the offsetting effect disappears (columns 4, 5 and 6). Carefully employed and targeted (macro)prudential policy measures have the potential to generate benefits for the economy by reducing systemic risk and lowering the probability of crises, thus improving financial stability. Since financial stability is a prerequisite for sustainable growth, the growing role of (macro)prudential policy is expected to contribute to faster economic growth, rather than diminishing it. Multiple estimates of the interaction term ($FDI_{i,t} \times MPP_{i,t}$) suggest that in an economy with active (macro)prudential policy, the growth effect of financial development advances tends to be double or more the effect that can be expected in an economy with inactive (macro) prudential policy.

***Table 2: Finance-Growth Nexus with (Macro)Prudential Policy***

| | *Frequency of MPP* | | | *Direction of MPP* | | |
|---|---|---|---|---|---|---|
| | GDP growth | GDPPC growth | GVA growth | GDP growth | GDPPC growth | GVA growth |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $y_{i,t-1}$ | 0.408*** | 0.425*** | 0.328*** | 0.355*** | 0.349*** | 0.304*** |
| | (0.103) | (0.105) | (0.060) | (0.101) | (0.090) | (0.078) |
| $FDI_{i,t}$ | 0.241*** | 0.214*** | 0.118 | 0.132*** | 0.111** | 0.313** |
| | (0.070) | (0.052) | (0.085) | (0.047) | (0.046) | (0.129) |
| $MPI_{i,t}$ | -0.703 | -0.199 | -0.849 | | | |
| | (0.525) | (0.311) | (0.516) | | | |
| $FDI_{i,t} \times MPI_{i,t}$ | -0.411*** | -0.324*** | -0.333*** | | | |
| | (0.143) | (0.099) | (0.106) | | | |
| $PPI_{i,t}$ | | | | 0.109 | 0.325 | 0.246 |
| | | | | (0.257) | (0.314) | (0.329) |
| $FDI_{i,t} \times PPI_{i,t}$ | | | | 0.527* | 0.533* | 0.616*** |
| | | | | (0.306) | (0.298) | (0.188) |
| $labour_{i,t}$ | 0.980*** | 0.971*** | 0.934*** | 0.969*** | 0.967*** | 0.991*** |
| | (0.103) | (0.081) | (0.071) | (0.065) | (0.060) | (0.053) |
| $open_{i,t}$ | -0.018** | -0.024*** | -0.019* | 0.009*** | 0.003** | 0.009*** |
| | (0.009) | (0.008) | (0.011) | (0.001) | (0.001) | (0.001) |
| $inf_{i,t}$ | 0.009 | -0.093 | 0.111 | 0.211 | 0.109 | 0.412 |
| | (0.229) | (0.198) | (0.215) | (0.161) | (0.125) | (0.269) |
| $MCI_{i,t-1}$ | -0.305*** | -0.271*** | -0.317*** | -0.257*** | -0.202** | -0.356*** |
| | (0.108) | (0.068) | (0.104) | (0.086) | (0.085) | (0.128) |
| $crisis_{i,t}$ | -2.004** | -2.067** | -3.087*** | -1.392*** | -1.546** | -0.792 |
| | (0.887) | (0.814) | (0.734) | (0.535) | (0.623) | (0.770) |
| Observations | 192 | 192 | 192 | 204 | 204 | 192 |
| Hansen | 0.476 | 0.646 | 0.320 | 0.823 | 0.844 | 0.527 |
| AR (2) | 0.142 | 0.101 | 0.190 | 0.361 | 0.261 | 0.072 |

***Note:*** Robust standard errors are in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by ***, ** and * respectively.

[10] For example, several countries argue that the countercyclical capital buffer should be set to a non-zero value for a normal risk environment (ESRB, 2016).

[11] The original macroprudential policy index of Cerutti et al. (2017b) ends in 2014.

### 3.2 Asymmetric Effects of (Macro)Prudential Policy Measures

Finally, we estimate the augmented model while accounting for the extent to which (macro)prudential policy measures are tightening or loosening over the period analysed. In this exercise, we use information from $PPI_{i,t}$, which captures the direction of the (macro)prudential policy changes. This helps us to verify whether tightening or loosening (macro)prudential policy might affect economic growth and the finance-growth nexus in an asymmetric fashion. The results are summarized in Table 3. Two main conclusions can be drawn from these additional estimates.

First, (macro)prudential policy aimed at tightening the financial sector is found to increase economic growth. $PPI_{i,t}$ consistently enter significantly with a positive sign at the 1% confidence level. Within our sample, a one standard deviation increase in $PPI_{i,t}$ would be associated with a 0.5 pp increase in economic growth when averaging different estimates from columns 1, 2 and 3. This shows that active (macro)prudential policy is good for the economy if it succeeds in limiting excess credit growth and mitigating systemic risk. Therefore, it should be actively implemented to restrict possible disruptions in the financial sector. Compared with other public policies, (macro)prudential measures benefit from smaller implementation lags and the possibility to tailor the policy instruments to specific risks without causing a generalized reduction in economic growth and limiting the costs of policy intervention. In turn, (macro)prudential policy easing is found to have no statistically significant effect on economic growth.[12]

Second, the amplification effects of active (macro)prudential policy on the finance-growth nexus are found to be driven by tightening and not easing. This shows that the positive relationship between finance and growth is stronger in economies where (macro)prudential policy is actively used to curb excess credit growth and mitigate systemic risk.

## 4. Robustness Check

In this section, we demonstrate that our base results that (macro)prudential policy significantly affects the finance-growth nexus are quite robust. First, we show that they are largely robust to a wide variety of sample perturbations (Table B1). For each sample perturbation, we report the point estimate for the coefficient of interest, the interaction term ($FDI_{i,t} \times MPP_{i,t}$), for the six specifications of the augmented model in Table 2. As is apparent, the point estimate is robust to a large proportion of the permutations, but not to all of them. First, we drop the control variables one at a time. It can be seen that our results remain largely unchanged following the removal of the controls. If anything, we report stronger estimates following the removal of $MCI_{i,t-1}$, which is reassuring, as it indicates that monetary policy actions are not driving our results. We next drop outlier observations, which are identified as those with residuals more than two standard deviations above or below the average. Last, we drop Luxembourg and Ireland from the sample. Luxembourg, despite its geographical size, is a European financial centre and forms an outlier of its own in most of the variable categories. Ireland's GDP data was subject to many unusual factors over the 2015–2017 period, making it a natural candidate for our sensitivity exercise (FitzGerald, 2015). Our results for both sample perturbations remain significant at least at the 10% level.

[12] Our findings are in line with Agénor et al. (2018), who also find a positive effect of (macro)prudential tightening on economic growth of around 0.7 pp.

***Table 3: Finance-Growth Nexus with (Macro)prudential Policy: Asymmetric Effects***

| | *Tightening* | | | *Loosening* | | |
|---|---|---|---|---|---|---|
| | GDP growth | GDPPC growth | GVA growth | GDP growth | GDPPC growth | GVA growth |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $y_{i,t-1}$ | 0.471*** | 0.493*** | 0.421*** | 0.287*** | 0.284*** | 0.253*** |
| | (0.128) | (0.115) | (0.153) | (0.072) | (0.067) | (0.067) |
| $FDI_{i,t}$ | 0.177*** | 0.131** | 0.108 | 0.384*** | 0.371*** | 0.192 |
| | (0.059) | (0.053) | (0.076) | (0.084) | (0.101) | (0.140) |
| $PPI_{i,t}$ | 0.422*** | 0.357*** | 0.508*** | -0.562 | -0.496 | -0.978* |
| | (0.140) | (0.117) | (0.170) | (0.545) | (0.381) | (0.499) |
| $FDI_{i,t} \times PPI_{i,t}$ | 0.085** | 0.081** | 0.131*** | -0.201* | -0.227 | -0.123 |
| | (0.036) | (0.036) | (0.049) | (0.122) | (0.153) | (0.162) |
| $labour_{i,t}$ | 1.060*** | 1.061*** | 1.013*** | 0.969*** | 0.978*** | 0.922*** |
| | (0.063) | (0.055) | (0.057) | (0.096) | (0.084) | (0.061) |
| $open_{i,t}$ | -0.007 | -0.013 | 0.002 | 0.010*** | 0.003 | 0.009*** |
| | (0.037) | (0.034) | (0.043) | (0.003) | (0.003) | (0.003) |
| $inf_{i,t}$ | 0.199 | 0.042 | 0.321 | 0.214 | 0.121 | 0.243 |
| | (0.233) | (0.207) | (0.216) | (0.247) | (0.210) | (0.226) |
| $MCI_{i,t-1}$ | -1.368*** | -1.156*** | -1.521*** | -0.204 | -0.182 | -0.047 |
| | (0.302) | (0.275) | (0.287) | (0.139) | (0.118) | (0.104) |
| $crisis_{i,t}$ | -2.307** | -2.375*** | -3.245*** | -0.786 | -0.790 | -1.968** |
| | (0.917) | (0.831) | (1.021) | (0.756) | (0.848) | (0.826) |
| Observations | 180 | 180 | 180 | 192 | 192 | 192 |
| Hansen | 0.706 | 0.611 | 0.370 | 0.152 | 0.233 | 0.306 |
| AR (2) | 0.447 | 0.287 | 0.102 | 0.434 | 0.373 | 0.107 |

***Note:*** Robust standard errors are in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by ***, ** and * respectively.

Second, we test the robustness of our results to a change in estimator. While the system-GMM estimator has been used extensively in the literature, it may produce biased estimates in panels where the time period is large relative to the sample size. Roodman (2009) shows that the substantial number of instruments produced in such panels may render the system-GMM estimator invalid even though the individual instruments may be valid. In our case, the data sample consists of 12 countries and 17 time periods, which could in principle leave room for a minor bias. To demonstrate that we need not be concerned in our analysis, we re-estimate the augmented baseline model from Table 2 using the bootstrap-based bias-corrected (BBBC) estimator proposed by De Vos et al. (2015). This is to verify that the instrumental variable technique does not lead to poor small-sample properties (Kiviet, 1995; Bun and Windmeijer, 2010). The results are shown in Table B2. Based on the estimated coefficients, it seems safe to say that our findings are not prone to the weak instrument problem.

Lastly, one might be concerned about the medium-term effects of (macro)prudential policy measures, as our model is contemporaneous, looking at the immediate effect. Part of this concern might be mitigated by the fact that we use annual data. We are hesitant to compute non-overlapping multi-period averages as in Agénor et al. (2018) due to the limited number of observations arising from our focus on the euro area. Instead, we conduct another sensitivity exercise to address this potential issue. Specifically, we introduce a richer lag structure into the regression specification. We employ up to 5 lags of the interaction term ($FDI \times MPP$) and its components. The results are displayed in Table B3. Allowing for a richer lag structure delivers estimates that are not statistically different from zero, showing that our original contemporaneous model is appropriate.

## 5. Conclusion

We document that the finance-growth nexus is significantly affected by active use of various (macro)prudential policy measures. We find that (macro)prudential policies support the positive finance-growth nexus instead of disrupting it. In other words, economies with (macro)prudential policy that is actively used to prevent the occurrence of a credit boom and to limit systemic risk tend to benefit from financial development more than economies where (macro)prudential policy is inactive. This only becomes evident when we consider the direction of (macro)prudential policy measures instead of relying on mere frequency of use in the form of a cumulative index.

The reported evidence echoes the research implying that there is a non-monotone (inverted U-shape) relationship between financial development and economic performance. Empirical studies find that more finance is only good up to a certain point, after which it starts to worsen the socio-economic outcomes (Cecchetti and Kharroubi, 2015; Čihák and Sahay, 2020). This is linked to the growing body of literature doubting the usefulness of the financial sector. Several studies point to the increasing costs of financial intermediation (French, 2008; Philippon and Reshef, 2012; Bivens and Mishel, 2013), while others warn against the ever rising riskiness of the financial sector (Bai et al., 2016; Bell and Hindmoor, 2018) and the growing costs of financial imbalances (Jordà et al., 2011). Yet, (macro)prudential policy and its pre-emptive nature is rarely discussed or considered in the theoretical model setups or empirical frameworks even though it has the potential to limit the costs associated with a growing financial sector. In this regard, we offer one of the first empirical estimates of how (macro)prudential policy can affect the finance-growth nexus.

We also contribute to the literature that argues that it is not "*too much finance*" but rather "*quantity versus quality of finance*" that matters. This literature finds that while quality of finance is conducive to economic growth, the effect of quantity of finance on growth is indeterminable, ranging from positive to negative or zero (Koetter and Wedow, 2010; Hasan et al., 2018). We contribute to this strand of literature by showing that (macro)prudential policy improves the quality of finance, as it promotes financial stability, which in turn improves economic growth.

What remains unclear is the effect of advances in non-bank financial intermediation on the finance-growth nexus. This is where the role of (macro)prudential policy in fostering benefits from finance to economic growth might be limited. This is because so-called shadow entities are typically less regulated than their bank counterparts (Plantin, 2015; Hodula et al., 2020). From a policy perspective, it may be important to examine the extent to which the growing importance of shadow banking activities might weaken the effectiveness of the regulatory activities of central banks and national regulators, at both national and international level.

As a final note, let us briefly discuss the caveats associated with the analysis of the (macro)prudential policy effects. First, while we control extensively for reverse causality, we might not have been completely successful. This would imply that countries experiencing faster economic growth react by adopting (macro)prudential policies more frequently. If this is the case, our parameter estimates could be overvalued. Second, while we did account for the direction of the (macro)prudential policy measures, we did not account for their intensity. This particular caveat is inherently associated with the existing data limitations and constitutes a promising avenue for future research in this area.

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# Appendix A: Data

***Table A1: Summary Statistics***

| Mnemonic | Variable | N | Mean | Std. Dev. | Min | Max | Units | Source |
|---|---|---|---|---|---|---|---|---|
| *GDP* | GDP growth | 456 | 2.21 | 2.64 | -9.13 | 10.90 | % | WB |
| *GDPPC* | GDP per capita growth | 456 | 1.71 | 2.57 | -9.00 | 9.80 | % | WB |
| *GVA* | GVA growth | 264 | 1.97 | 2.79 | -9.69 | 10.22 | % | WB |
| *FDI* | Financial development index | 456 | 0.60 | 0.16 | 0.25 | 0.91 | index | IMF |
| *LABOUR* | Labour productivity growth | 436 | 1.72 | 2.13 | -5.81 | 19.87 | % | OECD |
| *OPEN* | Trade openness | 456 | 47.79 | 36.20 | 14.05 | 221.20 | % | WB |
| *INF* | Inflation | 456 | 4.07 | 4.79 | -4.48 | 28.38 | % | WB |
| *MCI* | Monetary Conditions Index | 399 | 5.02 | 4.54 | -1.41 | 20.05 | index | Malovana and Frait (2017) |
| *MPI* | Macroprudential Policy Index | 216 | 1.75 | 1.33 | 0.00 | 5.00 | index | Cerutti et al. (2017b) |
| *PPI* | Prudential Policy Index | 216 | 0.17 | 1.76 | -2.00 | 7.00 | index | Cerutti et al. (2017a) |
| $PPI^{ease}$ | Prudential Policy Index (only loosening) | 216 | -0.28 | 0.79 | -2.00 | 3.00 | index | Cerutti et al. (2017a) |
| $PPI^{tight}$ | Prudential Policy Index (only tightening) | 216 | 0.72 | 1.40 | 0.00 | 7.00 | index | Cerutti et al. (2017a) |

# Appendix B: Additional Estimates

***Table B1: Sample Sensitivity***

| | *Frequency of MPP ($MPI_{i,t}$)* | | | *Direction of MPP ($PPI_{i,t}$)* | | |
|---|---|---|---|---|---|---|
| | GDP growth | GDPPC growth | GVA growth | GDP growth | GDPPC growth | GVA growth |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $FDI \times MPP(t)$ *base* | -0.411*** | -0.324*** | -0.333*** | 0.527* | 0.533* | 0.616*** |
| | (0.143) | (0.099) | (0.106) | (0.306) | (0.298) | (0.188) |
| *Drop crisis*$_{i,t}$ | -0.376*** | -0.291*** | -0.270*** | 0.599* | 0.627** | 0.664*** |
| | (0.135) | (0.103) | (0.092) | (0.341) | (0.301) | (0.202) |
| *Drop labour*$_{i,t}$ | -0.355*** | -0.381*** | -0.320*** | 0.170 | 0.184 | 0.345* |
| | (0.089) | (0.097) | (0.068) | (0.244) | (0.242) | (0.181) |
| *Drop open*$_{i,t}$ | -0.442*** | -0.368*** | -0.363*** | 0.584* | 0.546* | 0.607*** |
| | (0.143) | (0.102) | (0.104) | (0.323) | (0.303) | (0.210) |
| *Drop inf*$_{i,t}$ | -0.421*** | -0.313** | -0.362** | 0.497* | 0.514 * | 0.517*** |
| | (0.181) | (0.129) | (0.148) | (0.298) | (0.305) | (0.167) |
| *Drop* $MCI_{i,t-1}$ | -0.569** | -0.434** | -0.514*** | 0.389* | 0.417* | 0.631*** |
| | (0.269) | (0.178) | (0.188) | (0.202) | (0.230) | (0.158) |
| *Drop outliers* | -0.456* | -0.405** | -0.481* | 0.503** | 0.535** | 0.518*** |
| | (0.221) | (0.200) | (0.305) | (0.251) | (0.248) | (0.184) |
| *Drop Luxembourg* | -0.435*** | -0.354*** | -0.305*** | 0.486* | 0.503* | 0.489*** |
| | (0.120) | (0.102) | (0.094) | (0.268) | (0.275) | (0.105) |
| *Drop Ireland* | -0.402*** | -0.320*** | -0.328*** | 0.520* | 0.498** | 0.478** |
| | (0.107) | (0.080) | (0.089) | (0.299) | (0.248) | (0.243) |
| Rest of the controls | Yes | Yes | Yes | Yes | Yes | Yes |

***Note:*** Robust standard errors are in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by ***, ** and * respectively.

***Table B2: Finance-Growth Nexus with (Macro)Prudential Policy Estimated via BBBC Estimator***

| | *Frequency of MPP* | | | *Direction of MPP* | | |
|---|---|---|---|---|---|---|
| | GDP growth | GDPPC growth | GVA growth | GDP growth | GDPPC growth | GVA growth |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $y_{i,t-1}$ | 0.370*** | 0.374*** | 0.342*** | 0.380*** | 0.384*** | 0.353*** |
| | (0.074) | (0.071) | (0.076) | (0.086) | (0.087) | (0.089) |
| $FDI_{i,t}$ | 0.105*** | 0.094*** | 0.064** | 0.163** | 0.154*** | 0.123** |
| | (0.034) | (0.031) | (0.027) | (0.035) | (0.038) | (0.027) |
| $MPI_{i,t}$ | -0.223 | -0.238 | -0.150 | | | |
| | (0.333) | (0.338) | (0.397) | | | |
| $FDI_{i,t} \times MPI_{i,t}$ | -0.386** | -0.374** | -0.365*** | | | |
| | (0.117) | (0.126) | (0.137) | | | |
| $PPI_{i,t}$ | | | | 0.281* | 0.287* | 0.308* |
| | | | | (0.165) | (0.149) | (0.164) |
| $FDI_{i,t} \times PPI_{i,t}$ | | | | 0.214** | 0.207** | 0.218*** |
| | | | | (0.101) | (0.104) | (0.081) |
| $labour_{i,t}$ | 1.087*** | 1.092*** | 1.068*** | 1.110*** | 1.114*** | 1.085*** |
| | (0.056) | (0.055) | (0.064) | (0.060) | (0.046) | (0.038) |
| $open_{i,t}$ | -0.013 | -0.015 | -0.006 | -0.015 | -0.017 | -0.009 |
| | (0.026) | (0.024) | (0.022) | (0.019) | (0.028) | (0.017) |
| $inf_{i,t}$ | 0.323 | 0.207 | 0.421 | 0.348* | 0.231 | 0.453* |
| | (0.239) | (0.197) | (0.259) | (0.190) | (0.210) | (0.260) |
| $MCI_{i,t}$ | -0.294** | -0.269** | -0.249** | -0.315** | -0.289** | -0.266*** |
| | (0.142) | (0.124) | (0.106) | (0.126) | (0.131) | (0.097) |
| Observations | 204 | 204 | 204 | 204 | 204 | 204 |

***Note:*** Bootstrapped standard errors are in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by ***, ** and * respectively.

***Table B3: Richer Lag Structure of the Interaction Term***

| | *Frequency of MPP ($MPI_{i,t}$)* | | | *Direction of MPP ($PPI_{i,t}$)* | | |
|---|---|---|---|---|---|---|
| | GDP growth | GDPPC growth | GVA growth | GDP growth | GDPPC growth | GVA growth |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $FDI \times MPP(t)$ *base* | -0.411*** | -0.324*** | -0.333*** | 0.527* | 0.533* | 0.616*** |
| | (0.004) | (0.001) | (0.002) | (0.305) | (0.298) | (0.188) |
| $FDI \times MPP(t-1)$ | 0.175 | 0.171 | -0.195 | -0.098 | -0.064 | -0.137 |
| | (0.214) | (0.246) | (0.194) | (0.207) | (0.177) | (0.189) |
| $FDI \times MPP(t-2)$ | -0.889 | -0.724 | -0.802 | 0.042 | 0.022 | 0.061 |
| | (1.091) | (0.954) | (1.179) | (0.161) | (0.161) | (0.124) |
| $FDI \times MPP(t-3)$ | -0.453 | -0.471 | -0.652 | 0.041 | 0.180 | -0.053 |
| | (0.761) | (1.041) | (1.201) | (0.180) | (0.171) | (0.287) |
| $FDI \times MPP(t-4)$ | 0.359 | -0.144 | -0.031 | 0.157 | 0.281 | 0.121 |
| | (1.052) | (0.872) | (0.819) | (0.351) | (0.356) | (0.416) |
| $FDI \times MPP(t-5)$ | -0.552 | -0.595 | -0.851 | 0.453 | 0.220 | 0.798 *** |
| | (0.861) | (0.961) | (0.882) | (0.340) | (0.342) | (0.248) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |

***Note:*** Robust standard errors are in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by ***, ** and * respectively.

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