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Publication date
2016

Document Version
Submitted manuscript

DNB Working Paper

No. 498 / April 2016

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

Working Paper No. 498

April 2016

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Effective macroprudential policy: Cross-sector substitution from price and quantity measures[*]

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21 April 2016

Abstract

Macroprudential policy is increasingly being implemented worldwide. Its effectiveness in influencing bank credit and its substitution effects beyond banking have been a key subject of discussion. Our empirical analysis confirms the expected effects of macroprudential policies on bank credit, both for advanced economies and emerging market economies. Yet we also find evidence of substitution effects towards non-bank credit, especially in advanced economies, reducing the policies' effect on total credit. Quantity restrictions are particularly potent in constraining bank credit but also cause the strongest substitution effects. Policy implications indicate a need to extend macroprudential policy beyond banking, especially in advanced economies.

Keywords: Financial cycle, macroprudential regulation, financial supervision, (shadow) banking.
JEL classifications: E58, G10, G18, G20, G58.

[*] This paper was initiated by Janko Cizel during a secondment at DNB and finalized while at the IMF and ECB. For comments, the authors thank Erlend Nier, Miguel Savastano, Stijn Claessens, Jakob de Haan, Dirk Schoenmaker, Niklas Nordman, Win Monroe, IMF staff at MCM, SPR, and RES, and participants at a workshop of the BIS Committee on the Global Financial System (CGFS), a meeting of the ESRB Instruments Working Group (IWG) and an IMF MCM Policy Forum. We thank Netty Rahajaan, Sonia Echeverri and Adriana Rota for assistance with typesetting. The views expressed in this paper are those of the authors and do not necessarily reflect the position of De Nederlandsche Bank or the IMF. All errors are our own.

I. INTRODUCTION

Macroprudential policy is alive and kicking. It is being used actively both in emerging market economies and – following the global financial crisis – in advanced economies.[1] It includes measures that apply directly to lenders, such as countercyclical capital buffers or capital surcharges, and restrictions that apply to borrowers, such as loan-to-value (LTV) and loan-to-income (LTI) ratio caps. Most macroprudential measures activated around the globe between 2000 and 2013 apply to the banking sector only, including borrower-based measures (IMF, Global Macroprudential Policy Instruments Database, 2013).

The widespread use of macroprudential policy is aimed at reducing systemic risks. Yet the use of national sector-based measures may be subject to a boundary problem, causing substitution flows to less regulated parts of the financial sector (Goodhart, 2008; Aiyar et al., 2014). Specifically, macroprudential policy may have the consequence of shifting activities and risks both to: (*i*) foreign entities (e.g. bank branches and cross-border lending) and (*ii*) non-bank entities (e.g. shadow banking, also referred to as market-based financing). Whereas several papers have estimated intended effects of macroprudential policies (MaPs) on variables such as credit growth and housing prices, and whether measures leak to foreign banks, cross-sector substitution effects have – to the best of our knowledge – not yet been tested empirically.

This paper aims to fill this gap. It investigates whether macroprudential policies lead to substitution from bank-based financial intermediation to non-bank intermediation. In addition, it uses event study methodology to shed light on the timing of the effects of policy measures on bank and non-bank intermediation around activation dates. Moreover, we contribute to the literature by distinguishing between the effects of quantity versus price-based instruments and lender versus borrower-based instruments, given that the effects may differ. We also check whether results differ for advanced economies (AEs) versus emerging market economies (EMEs) and bank versus market-based financial systems.

Our results support the hypothesis that macroprudential policies reduce bank credit growth. In our sample, in the 2 years after the activation of MaPs, bank credit growth falls on average by 7.7 percentage points relative to the counterfactual of no measure. This effect is much stronger in EMEs than in AEs. Beyond this, our results suggests that quantity-based measures have much stronger effects on credit growth than price-based measures, both in advanced and emerging market economies. In cumulative terms, quantity measures slow bank credit growth by 8.7 percentage points over 2 years relative to the counterfactual of no policy change. These results are of the same order of magnitude as those of Morgan et al. (2015), who find that economies with LTV polices (which we classify as a quantity constraint) have experienced residential mortgage loan growth of 6.7% per year, while non-LTV economies have experienced 14.6% per year. For bank credit, our results have the same order of magnitude as those of Cerutti et al. (2015), who find stronger effects in emerging market economies than in advanced economies, just as we do.

Our main contribution to the literature relates to substitution effects: we find that the effect of MaPs on bank credit is always substantially higher than the effect on total credit to the private

[1] In the EU, no less than 47 substantive macroprudential measures were adopted in 2014 (ESRB, 2015).

sector. Whereas bank credit growth falls on average by 7.7 percentage points relative to the counterfactual of no measure, total credit growth falls by 4.9 percentage points on average. The reason for this is the increase in non-bank credit growth. We also find significant differences between country groups and instruments. First, substitution effects are stronger in AEs. This is in line with expectations given their more developed financial systems, with a larger role for market-based finance. Second, substitution effects are much stronger in the case of quantity restrictions, which are more constraining than price-based measures. Finally, we find strong and statistically significant effects on specific forms on non-banking financial intermediation, such as investment fund assets.

Our paper builds on a rapidly expanding literature. While the concept of macroprudential policy can be traced back at least to the late 1970's (Clement, 2010), it has become a common part of the policy lexicon in the first decade of this millennium. The global financial crisis has led not only to much more interest in the macroprudential approach, but also to active use of macroprudential instruments around the world. Galati and Moessner (2013, 2014) provide an overview of the literature, emphasizing the objectives, instruments and analytical underpinnings of the macroprudential approach. The ESRB (2014) has released a handbook for operationalizing the macroprudential toolkit and the IMF (2014b) a staff guidance note.

The active use of instruments has spawned a growing empirical literature on the effectiveness of macroprudential policies, in individual country, regional and global settings (Arregui et al., 2013). The most comprehensive study is that of Cerutti et al. (2015), who use an IMF survey to document macroprudential policies in 119 countries over the 2000-13 period. They find that the implementation of such instruments is generally associated with the intended lower impact on credit, but that the effects are weaker in financially more developed and open economies. Bruno and Shin (2014) find that macroprudential policies employed in Korea to deal with the effects of cross-border capital flows – such as the "macroprudential levy" – helped to reduce the sensitivity of capital flows into Korea to global conditions. Krznar and Morsink (2014) establish that recent rounds of macroprudential policy tightening in Canada have reduced mortgage credit growth and house price growth. Lim et al. (2011) show that for 49 countries reviewed, macroprudential instruments helped reduce pro-cyclicality, meaning a reduced sensitivity of credit conditions to GDP growth.

Because of the inherent difficulties in establishing the effects of measures at a macro level, a number of studies have used micro-level data to identify more precisely the behavioral effects of macroprudential policies. For example, by exploiting bank-specific shocks to capital buffers, Jiménez et al. (2012) show that Spain's dynamic provisioning requirements helped smooth cycles in the supply of credit. With Korean data on housing and mortgage activity, Igan and Kang (2011) find that the tightening of DTI and LTV limits have a significant and sizeable impact on transaction activity and house price appreciation.

Yet in addition to its intended effects, macroprudential policy may leak. Aiyar et al. (2014) and Reinhardt and Sowerbutts (2015) find that foreign borrowing increases after home authorities adopt macroprudential measures affecting domestic banks' capital. Similarly, Cerutti et al. (2015) find some evidence of greater cross-border borrowing after macroprudential measures are taken. But macroprudential policy may also increase cross-sector substitution (Goodhart, 2008). A recent study by the IMF (2014a) finds that more stringent capital requirements are associated with stronger growth of shadow banking. Our paper uses both net flow measures and an event study methodology to shed light on the size and timing of cross-sector substitution effects. Our empirical framework builds on work that has sought to explain credit growth, for instance to understand credit rationing and the monetary transmission mechanism (Berger and Udell, 1991; Gertler and Gilchrist, 1992; Kashyap et al., 1993). As done by Frost and van Tilburg (2014), we control for macroeconomic fundamentals to filter out effects of policy on credit growth in a cross-country panel setting.

Our results do not allow us to assess whether substitution effects reduce or increase systemic risks. A lowering of systemic risks may be expected, as risks may shift to institutions that are less leveraged and less subject to maturity mismatch. But this need not be the case, as market failures and systemic risks may also arise outside the regulated banking sector. Specifically, non-bank financial institutions may contribute to procyclical leverage (Adrian and Shin, 2009, 2010); may amplify the impact of price changes and flows (Feroli et. al., 2014), and may be subject to misaligned incentives that influence the overall risk in the system (Rajan, 2006). A proper macroprudential approach should aim to address these systemic risks in a broad, consistent manner (Adrian, 2014; FSB, 2014; IMF, 2014b). Overall, our findings underline the relevance of such a broad approach to monitoring and addressing systemic risks, especially for advanced economies. Earlier findings on cross-border leakages indicate that macroprudential policy should not take a narrow national perspective, as this would fail to internalize cross-border substitution effects. Our results on cross sector substitution complement these findings, and suggest that macroprudential policy should not take a narrow sectoral perspective. The results support proposals like that by Schoenmaker and Wierts (2015) for an integrated approach for highly leveraged entities and activities across the financial system. A similar approach can be envisaged for maturity and liquidity mismatches, interconnectedness and misaligned incentives related to too-big-to fail (ESRB, 2013).

The rest of the paper is organized as follows. Section II describes the data. Section III investigates the degree of substitution between bank and non-bank credit in a larger sample of countries by estimating whether macroprudential measures affect the flows of bank and non-bank credit as a percentage of total credit. Section IV provides a complementary approach, by estimating the effect of macroprudential policies on both variables (and other balance sheet data on non-bank entities) directly with an event study methodology. It also distinguishes between different types of macroprudential measures (price versus quantity-based, and borrower versus lender-based) and different country groups. Robustness checks are presented in section V. Section VI concludes.

II. DATA

The empirical analysis in this paper is based on three types of country-level data: (A) information on bank and non-bank credit, (B) dates and types of macroprudential policy measures adopted in the sample countries, and (C) indicators of macroeconomic fundamentals. The dataset is available in the online appendix of this paper.[2]

[2] The online appendix can be found at http://www.jankocizel.com/research/macroprud/.

A. Private credit to the non-financial sector

Our measures of bank and non-bank credit come from the BIS database on private non-financial sector credit (Dembiermont et al., 2013). The database contains quarterly series of private credit data for 40 economies for a period covering the last 40 years. The measure of private credit covers all loans and debt securities to non-financial corporations, households and non-profit institutions serving households. Bank credit is defined as all loans and debt securities held by domestic and foreign banks (subsidiaries and branches). Non-bank credit encompasses loans and debt securities held by all other sectors of the economy (e.g. insurers, pension funds, investment funds, other firms, households, etc.) and, for some countries, direct cross-border lending by foreign banks. The presence of direct cross-border lending in the non-bank credit measure may hamper the cross-sectoral focus of this study because it may conflate loans by domestic non-banks and foreign banks abroad. In the online appendix we show, however, that the direct cross-border lending amount to less than 5% of non-bank credit for the aggregate sample of BIS reporting countries. For this reason, movements in the non-bank credit series are expected to primarily reflect the changes in the provision of credit by non-bank financial institutions, rather than by foreign banks.

A shortcoming of the BIS database is its limited geographic coverage of only 40 (mostly advanced) economies. In addition, the database provides no information on the breakdown of non-bank credit providers. We thus complement the private credit data from the BIS with information on the size of the balance sheets of banks and of various types of non-bank financial institutions, which we obtain from the World Bank's Financial Development Database (Cihak et al., 2012). The cross-section coverage of the database ranges from about 80 countries in the case of investment and pension funds, to over 100 countries in the case of banks and insurance companies. The database covers the period 1980-2012 for different series.[3]

To put our results into context, Panel A of Table 1 provides summary statistics on bank and non-bank credit and financial institutions' assets in AEs and EMEs for the period 1997-2014 (1997-2012). Banks are an important source of credit in both AEs, where it represents 85% of GDP, and in EMEs (60% of GDP). Non-bank credit, on the other hand, is much more important in AEs, at 56% of GDP, compared to just 9% of GDP in EMEs. We also note a relatively high reliance of AEs on financing provided by investment funds (IFs): IF assets in these countries represent close to a third of GDP, about five times the size as in EMEs. Nominal credit growth, measured by year-to-year percentage changes in the nominal stock of sectoral credit, is on average higher in EMEs than in AEs. In EMEs, bank and non-bank credit grew by 10.5% and 11.6%, whereas in AEs they grew by 6.5% and 7.4%. Total credit grew at an average annual rate of 6.7% in AEs and 9.8% in EMEs.

[Table 1 here]

[3] In what follows, advanced and emerging market economies are defined according to the most recent IMF WEO classification. Market-based financial systems have a share of non-bank credit in total credit is above the sample-wide median. For more analysis on market versus bank-based systems, see Gambacorta et al. (2014).

Figures 1A and 1B depict the behavior of (average) bank and non-bank credit flows, both in AEs and EMEs. While the series show a large degree of co-movement, there is nonetheless a more cyclical pattern for bank credit than for non-bank credit.

[Figures 1A and 1B here]

We measure the substitution of credit between banks and non-banks as the quarterly net sectoral credit flow, defined as the difference between the quarterly change in bank credit and the quarterly change in non-bank credit, scaled by total credit:

$$[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$$

Positive values of the measure indicate that growth in bank credit outpaces growth in non-bank credit, while negative values indicate a faster growth in credit by non-banks.[4] The nominal net flows in credit (the numerator) are scaled by the previous years' stock of total credit (the denominator). For the whole sample period, the measure is positive both in AEs and EMEs, but is higher in EMEs (Table 1, Panel A). This is as expected given that the numerator of our measure contains level changes, and the share of bank credit in total credit is much higher in EMEs than in AEs.

Figure 1C provides further insight into the dynamics of the measure both for AEs and EMEs. It shows a cyclical pattern in net sectoral credit flows. Figure 2 provides a histogram of the net credit flow measure. The distribution of the measure is positively skewed, with the mean and the mode slightly above 0.

[Figure 2 here]

To limit the influence of outliers, we winsorize all credit-related variables, i.e. replace outliers with a value corresponding to the 1% level for each tail of their distribution. We also exclude the observations for Argentina, which experienced a prolonged sovereign distress episode covering much of our sample period.

B. Macroprudential Policy Events

The information on the use of macroprudential policies (MaPs) across countries and over time comes from Cerutti et al. (2015), who select indicator variables to measure the use of various

[4] A drawback of measuring the relative shift between bank and non-bank credit is that this does not indicate whether the shift is driven by one of these components or both. We therefore complement this analysis with estimates of the direct effect of MaPs on bank and non-bank credit.

MaPs in 120 countries on an annual basis over the period of 2000-13. Their database is constructed from responses to the IMF's Global Macroprudential Policy Instruments (GMPI) survey, provided by the participating countries' financial authorities (IMF, 2013). The analysis covers 12 categories of MaPs, listed in Table 2. This yields 12 dummy variables, which take on a value of 1 in each year that a certain measure is used, and 0 if it is not used in that country and year. Cerutti et al. (2015) classify these as lender-based or borrower-based. Lender-based policies are those aimed at financial institutions' assets or liabilities and include, for example, loan-loss provisioning practices, leverage, and capital buffers. Borrower-based measures are those aimed at borrowers' leverage and financial positions, and cover LTV and LTI caps. Limits on foreign currency and domestic currency loans and reserve requirements have been most common in EMEs, whereas leverage ratios and limits on interbank exposures are most frequently applied in AEs. Overall, the most popular lender-based MaPs in both AEs and EMEs are concentration limits, which restrict the fraction of bank assets tied to a particular type of borrowers.

[Table 2 here]

Inspection of the underlying qualitative answers in the IMF GMPI database indicates that all MaPs are primarily aimed at depository institutions (banks), including the borrower-based measures. Our hypotheses on substitution effects between bank and non-bank credit can therefore be tested by including all MaPs simultaneously.

The effect of MaPs on credit activity will be somewhat different depending on whether a measure acts as a quantity constraint on credit, which limits the volume of a particular activity, or as a price constraint, which affects the average cost of engaging in this activity. We thus categorize MaPs in the dataset into price and quantity-based measures and perform all empirical analyses both for an aggregate measure, and treating both groups separately. Table 2 also provides this classification. Examples of price-based policies include dynamic provisioning requirements and taxes on financial institutions. Examples of quantity-based measures are limits on interbank and foreign currency exposures, both of which act as a cap on the balance sheet exposures to the particular asset classes. The distinction between quantity and price classifications is admittedly fuzzy in some cases. For example, assuming that the supply of bank capital is constrained, we classify the leverage ratio as a quantity measure, since it effectively caps the balance sheet size of the affected entity. A leverage ratio cap could however also be seen as a price-based measure, since the bank could in principle expand its balance sheet by raising new capital, which would affect the average cost of funding. As a robustness check, we perform the analyses with alternative price/quantity classifications; the corresponding results are reported in the online appendix.

Panel B of Table 1 provides summary statistics for the MaP indices. The indices are the sum of MaPs of a given classification used by a country in a given period. On average, AEs and EMEs have 1.6 and 2 MaPs in place in a given year, respectively.

We define MaP events as the adoption of a new measure – i.e. a policy tightening.[5] Figure 3 provides an overview of MaP events across countries in the dataset. Circles in the graph mark the periods of the adoption of MaPs. The circle size corresponds to the number MaPs activated by a country in that year. The color of circles denotes the percentage of quantity-based MaPs. In total there are 171 MaPs in the dataset, 77% of which are quantity-based. Most events, in particular in AEs, are clustered during the period 2007-13. Prior to that MaPs were activated mostly in EMEs.

[Figure 3 here]

C. Macroeconomic Fundamentals

In the empirical analysis, we try to explain the baseline growth rates of credit, using a number of macroeconomic variables as controls. While it is inherently difficult to distinguish between factors influencing the demand and supply for credit, we expect that higher GDP growth would be associated with higher demand for credit by firms and households. We also expect that credit supply would be positively related to foreign capital inflows (into the banking sector and capital markets), and negatively related to inflation (which makes lenders wary of committing to nominal claims) and higher government borrowing (due to crowding out effects). The sources of these variables are the IMF's World Economic Outlook and International Financial Statistics databases. Panel C of Table 1 provides the summary statistics for the macroeconomic indicators used in the regressions.

III. Cross-Sectoral Substitution Due to Macroprudential Measures

A. Methodology

This section studies the cross-sector leakages of MaPs in the provision of credit to the private sector. In line with the "boundary hypothesis," the activation of a MaP directed at banks is expected to shift the relative provision of credit towards unregulated or less regulated credit providers, i.e. non-banks.[6]

We measure the substitution of credit with the net sectoral credit flow measure defined in the previous section. To the extent that MaPs increase the relative cost of bank credit, we expect them to prompt a decline in the net sectoral credit flow measure, which indicates a *relative* shift from bank to non-bank credit. (Section IV also estimates the direct effect of MaPs on different credit categories.)

Trying to estimate the relationship between cross-sector credit substitution and MaPs raises identification issues. For example, cross-sector shifts in credit supply may be the outcome of

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[5] The database of Cerutti et al. (2015) records the number of MaPs of a particular type used by a country at a given point in time. Macroprudential policy events occur when any measure goes from 0 to 1.

[6] Conceptually, the flow of finance between bank and non-bank sectors should depend on the expected risk-adjusted rate of return to investors in the two sectors. A shock that reduces the expected returns in one sector should shift the supply of credit towards the (relatively) unaffected sector.

other factors asymmetrically impacting the cost of capital or expected investment returns of different credit providers. If such factors move in tandem with MaP activation this creates an identification problem.

Two factors in particular may tend to create a spurious correlation between our net sectoral credit flow measure and MaPs. The first are banking crises. As noted above, most MaPs in AEs were used during and after the global financial crisis (GFC), which was particularly detrimental to the balance sheets of banks. Indeed, the severity of the GFC for banks may have resulted in cross-sector shifts in credit provision even in the absence of MaPs. Moreover, authorities in many countries responded to the GFC with a set of expansionary monetary and fiscal policies, aimed *inter alia* at restoring the viability of and confidence in the banking sector. To the extent that these policies coincided with the adoption of MaPs, their separate impact would be difficult to identify.

Second, changes in monetary policy – through policy rates and unconventional measures – may have asymmetric effects on different categories of credit providers, in a direction that is not clear *a priori*. For example, periods of low policy interest rates may directly benefit bank credit, but may also motivate banks to "search for yield," by investing in alternative high-yield and high-risk investments (see Buch et al., 2014 for banks; see Azis and Shin, 2015 for debt market issuance and asset managers). Likewise, the changes in central bank balance sheets stemming from unconventional monetary policy may reflect either direct funding to banks, or changes in holdings of publically traded securities or non-bank debt.

To address the above identification challenges, we take the following steps. First, we control for banking crises by including the banking crisis indicator of Laeven and Valencia (2013) as a control variable in all subsequent empirical specifications. The crisis indicator flags those country-quarter observations during which a country experienced a systemic banking crisis. Since banking crises in Laeven and Valencia (2013) are defined by the application of various crisis management tools, such as deposit guarantees and government recapitalizations of failed banks, the inclusion of this indicator deals with the concern that the coefficient on MaPs might be picking up the effects of those other policies.

Second, we control for changes in monetary policy in two ways. First, our empirical specifications include year-on-year changes in the monetary policy rate as an explanatory variable. Second, we control for unconventional monetary policies by including a variable that measures year-to-year changes in central banks' balance sheet size relative to GDP (see Pattipeilohy et al., 2013).

With these considerations in mind, we estimate the following specification:

$$NetFlow_{c,t} = \alpha_c + \beta_t + \theta_1 BankCrisis_{c,t} + \theta_2 \Delta MonetaryPolicy_{c,t} + \theta_3 \Delta MaP_{c,t} + \epsilon_{c,t}$$

where $NetFlow_{c,t}$ is the net sectoral credit flow (defined in Section II) for country c and year t and α and β are country and time dummies. $BankCrisis$ is a dummy variable capturing systemic banking crises. In line with the above discussion, its expected sign is negative.

$\Delta MonetaryPolicy$ indicates changes in the central bank policy rate and the central bank balance sheet size. The expected sign of the coefficient is ambiguous for both. We estimate the coefficients in the above specification using the within panel estimator and we cluster the standard errors by country to allow for serial correlation in residuals. ΔMaP indicates the adoption of macroprudential policies, as previously defined. We expect that MaP events will lead to higher cross-sectoral leakages and thus lower values of the net sectoral credit flow. As discussed in section II, we also distinguish between quantity and price-based measures.

B. Results

Table 3 reports estimation results on the impact of the overall changes in macroprudential policies. In line with the boundary hypothesis, MaP coefficients are negative across all regressions, indicating that net sectoral credit flows move in favor of non-banks following the adoption of macroprudential policies directed at banks. The magnitude of the coefficient for the overall sample is -0.26, implying that during the first year following MaP activation the net sectoral credit flows move by about 1 percentage point (hereafter pp) of total credit in favor of non-banks.[7] The coefficient is statistically significant in most regressions, except for the sample of EMEs.

[Table 3 here]

As expected, the estimated coefficients for the banking crisis indicator are negative and statistically significant. Banking crises thus appear to hit bank credit to a much larger extent than non-bank credit – likely through credit supply. The impact of banking crises is large: on average they reduce net credit flows from banks by about 5pp of total credit per annum. The effect is particularly strong in EMEs, where it amounts to about 10pp per annum.

The relationship between net credit flows and central bank interest rates is ambiguous: while it is positive in AEs, it is negative in EMEs and insignificant in the pooled sample. Expansion in central bank balance sheets is negatively related to net credit flows in most specifications. In the overall sample, a 1% increase in central bank assets is associated with 2pp per annum shift in net credit flows originating from banks. That is: increases in central bank balance sheets appear to stimulate a relative shift from bank to non-bank credit. The association is particularly strong in AEs and in bank-based financial systems.

Table 4 reports the results for the specifications that distinguish between quantity and price-based MaP measures. The estimated coefficients are negative and statistically significant for quantity measures, and positive but not statistically significant for price measures. In the overall sample, the effect of quantity measures suggests a 2pp relative shift in the provision of credit towards non-banks during the first year after a Map is adopted. The effect is particularly strong in market-based economies (3pp).

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[7] Since the net sectoral credit flow is measured on a quarterly basis, the regression coefficient for $\Delta^{YtY} MaP$ measures the average *quarterly* increase in the net flow measure during the first year after the policy activation. To obtain the *annual* increase in the measure during the first year after the activation, one has to multiply the coefficient by four.

[Table 4 here]

Taken together, the results in this section provide evidence broadly consistent with the boundary hypothesis: the adoption of macroprudential policies results in a relative shift in the provision of credit from banks to non-banks. The substitution effect is especially pronounced for quantity-based MaP measures directed at banks and is not detectable for price measures.

IV. Event Study of Macroprudential Policy Interventions

A. Methodology

This section further examines the effects of MaPs by studying the behavior of bank credit, non-bank credit, total credit, and net sectoral credit flows, before and after the activation of MaPs. Concentrating on the timing of the effects is important given that market participants may react to measures that have been announced but that have not yet taken effect. Moreover, authorities may respond to periods of high or low credit growth by tightening or easing MaPs. To account for these effects we adopt a leads-and-lags model (Atatanasov and Black, 2015), which is suitable to check pre-treatment and post-treatment trends relative to control groups of entities (in our case countries). Intuitively, pre-treatment trends that are found to be statistically different from 0 may be indicative of endogeneity problems, as the occurrence of the event (in our cast the activation of MaP measures) may then be explained by the abnormal movements in the dependent variable (in our case credit) during the pre-event period.

As discussed in Section II, MaP events are defined as the year in which a country activates a macroprudential tool. To isolate the movements in credit flows that can be attributed to MaPs, we adjust the actual credit growth by a counterfactual rate of credit growth that would have prevailed in absence of a MaP. We then use event study methodology to examine the divergence between the resulting adjusted and actual growth rates around MaPs.

Let $y^s{}_{c,t}$ denote credit growth by sector s in country c at time t. The excess growth rate $\hat{y}^s_{c,t}$ is defined as:

$$\hat{y}^s_{c,t} = y^s_{c,t} - E[y^s_{c,t}]$$

We assume that the expected rate of growth, $E[y^s{}_{c,t}]$ is a linear function of a covariate vector x, which controls for macroeconomic conditions within a country. We also allow for country-specific time-invariant determinants of credit/asset growth, μ_c, as well as for common shocks, α_t. The resulting specification for the expected credit/asset growth in sector s is then:

$$E[y^s_{c,t}] = \alpha^s_t + \mu^s_c + x'_{c,t}\beta^s$$

where β^s denotes a vector of coefficients of the covariate vector x. There is currently no consensus on the set of economic variables that determine the "normal" or expected rate of credit growth for banks and non-banks. As a result, theory offers only limited guidance on the composition of the covariate vector x. Our choice of the covariate vector x thus draws on the existing empirical literature that explores the determinants of total credit (e.g. Frost and van Tilburg, 2014) and bank credit (e.g. Berger and Udell, 1991; Gertler and Gilchrist, 1991; Kashyap et al., 1993); we are not aware of comparable studies explaining non-bank credit or net sectoral credit flows. Specifically, we control for the presence of systemic banking crises, GDP growth, the current account balance, gross capital inflows, central bank interest rates and the growth in central bank assets.

Next, let τ denote a time at which a MaP event takes place, and define an indicator function I_τ that equals 1 if a MaP event occurs between i and $i+1$ time units from time t, and zero otherwise:

$$I_{\tau\epsilon(t+i,t+i+1)} = \begin{cases} 1, \text{ if } \tau\epsilon(t+i, t+i+1) \\ 0, \quad\quad\quad\quad \text{otherwise} \end{cases}$$

A set of excessive growth rates around MaP events can then be obtained by estimating the following expected growth rate (EGR) specification:

$$y_{c,t}^{s} = \alpha_t^s + \mu_c^s + x_{c,t}'\beta^s + \sum_i \phi_i^s \mathbf{1}_{\tau\in(t+i,t+i+1]} + \epsilon_{c,t}^s .$$

In the above specification, ϕ_i measures the excessive growth in sector s of country c, i periods before (for negative values of i) or after (for positive values of i) the MaP event. We estimate the coefficients in the above specification using the within panel estimator and we cluster the standard errors by country to allow for serial correlation in residuals. We lag all variables in the covariate vector x by one year, to mitigate concerns of endogeneity.

The main remaining identification assumption required for this procedure, after controlling for the set of observables in x, is the that the authorities' decision on the activation of MaPs is independent from any additional factors that might jointly determine the growth of the bank and non-bank sectors. To the extent that this assumption holds, any systematic movements in the excess growth rates of credit following the activation MaP measures may be interpreted as being causally related to these MaPs.

We study the effect of MaPs on credit growth in the bank and non-bank sectors by examining the cumulative behavior of excessive growth rates starting three years prior to the activation of a MaP and tracing its path until three years after. Specifically, for a time interval between a and b periods relative to MaP activation, we compute cumulative excess growth rates (CEGR) as follows:

$$CEGR^s[a,b] = \sum_{i\in[a,b]} \phi_i^s$$

Under the null hypothesis that MaPs have no impact on credit or asset growth, CEGR is expected to be statistically indistinguishable from 0 both in the periods before and after the activation of MaPs. To the extent that the actions of banks and non-banks are influenced by

MaPs, CEGRs are expected to systematically diverge from 0, and if the decision on MaPs is anticipated before their actual activation (and this triggers behavioral changes in financing patterns of banks and non-banks), the divergence is expected to arise prior to the activation date. We test the hypotheses related to CEGR by performing a series of Wald tests on the sums of coefficients in the specification.

B. Results

The estimated coefficients of the control variables in the regressions for the expected growth rate of credit are reported in Table 5. Results are generally in line with the empirical literature on determinants of credit growth. For example, GDP growth shows the expected positive effect on both banking and non-bank credit, while a banking crisis has a negative impact on most sources of credit (except for investment fund growth and domestic private debt issuance). Again, this may reflect that a banking crisis prompts bank deleveraging (decline in credit supply by banks), and thus a shift by borrowers to capital markets. Comparing the explanatory power of the expected growth model across various sectors, we note that the macroeconomic fundamentals explain a much higher proportion of variation in the growth rates of bank credit than non-bank credit.

[Table 5 here]

Overall effect of MaPs

Next, we analyze the behavior of the residuals from the expected growth rate regressions in Table 5 in the periods before and after the activation of MaPs. Panels A-D in Figure 4 plot CEGRs around MaP events for bank, non-bank, and total credit flows, as well as for the net sectoral credit flows as defined in Section II. CEGRs are plotted over the period of 14 quarters before and 12 quarters after the activation of MaPs; in each figure we also report the result of Wald tests on CEGR two years prior to the activation of a MaP and two years after activation. The former tests for an anticipation effect of MaPs on bank and non-bank intermediation, whereas the latter tests for a post-activation effect.

The trajectory of the CEGR for the bank credit equations (Figure 4A) shows a statistically significant downward effect of MaPs: during the two years following MaP activation, the growth rate of bank credit is about 8pp below the baseline level, even after controlling for systemic banking crises and other macroeconomic variables. This finding is statistically significant with a p-value below 1%. The effect on the growth rate of bank credit begins to gather pace several quarters prior to MaP activation, suggesting a pre-emptive slowing of credit supply by banks.

[Figure 4 here]

The CEGR for non-bank credit growth exhibits almost the opposite pattern to that of bank credit growth (Figure 4B): during the two years following a MaP event it rises on average by about 10pp above baseline growth (from a lower level than bank credit). The effect is statistically significant at the 1% significance level. The post-activation decline in bank credit and the contemporaneous rise in non-bank credit is consistent with the cross-sector substitution in credit found in the previous section.

Figure 4C shows the impact of MaP measures on the excess growth in total credit. In line with existing studies (e.g. Cerutti et al., 2015), we find that total credit declines in the two years following the adoption of MaP measures. Specifically, our estimates suggest that total credit growth declines by about 5pp below the baseline, which indicates that the rise in non-bank credit does not fully compensate the decline in bank credit. [8]

Figure 4D shows the behavior of net sectoral credit flows around MaP measures and provides direct evidence of the substitution effect. Prior to MaP events the series is statistically indistinguishable from the baseline (p=0.31), whereas during two years following the event, the series moves about 4pp below the baseline (note that net credit flows are denominated in terms of total credit). The absence of a pre-existing trend further supports the hypothesis of the causal impact of MaP events on net sectoral credit flows.

Effect of MaPs on alternative sources of non-bank finance

We explore the effects of MaPs on the dynamics of specific types of non-bank finance in Panels A and B of Figure 5. These panels plot CEGRs around MaP events for the equation on the rate of growth of investment fund assets (Panel A) and domestic private debt issuance (Panel B). In line with the results on non-bank credit, investment fund assets exhibit strong positive growth around MaP activation. The CEGR of investment fund assets begins to pick up 6 quarters prior to the activation, accelerates during the period 3 quarters before and 3 quarters after the policy measure, and decelerates thereafter. Over the two years following a measure, investment fund assets rise on average by 20pp above the baseline of no MaP policy (p-value=0.019). Domestic private debt issuance also exhibits a strong positive growth up to 6 quarters following the MaP activation (p=0.00). Two years after the policy event, the domestic private debt issuance is 55pp above the baseline. The large magnitude of CEGRs is partially attributable to low initial levels of investment fund assets and private debt issuance in some of the countries in the sample (for example, investment funds in EMEs on average comprise only about 6% of GDP).[9]

[Figure 5 here]

[8] Cerutti et al. (2015) investigate the effects on real growth in bank credit, while we use nominal credit growth as the dependent variable. If we add average inflation rates to the results in Cerutti et al. (2015), the size of the effect in both EMEs and AEs is very similar to our estimate.

[9] The following example helps illustrate this point. Suppose that the initial level of bank credit in country A is 10 local currency units (LCU), and that of a non-bank sources is 1 LCU. Next, suppose that the activation of a MaP results in a shift in credit provision from banks towards non-bank sources of 1 LCU. The post-MaP event credit provision is then 9 LCU for banks and 2 LCU for non-banks. Assuming that during the same period, bank and non-bank credit in countries without policy intervention grew by 0%, the post-MaP CEGR in country A is -10% for banks and +100% for non-banks.

Effect of MaPs across samples and tools

As in section III, we also examine whether the effect of MaPs varies across different instruments and countries. Specifically, we re-do the event study for (1) AEs and EMEs, (2) quantity and price-based MaPs, and (3) the combination of the two. As before, we report event study results for bank credit (Figure 6), non-bank credit (Figure 7), total credit (Figure 8), and net sectoral flows (Figure 9). Table 6 summarizes the results presented in Figures 6-9 by listing the effects for 2-year post-event windows for various samples of countries and tools.

[Figures 6-9 and Table 6A and B here]

The results in the table show that the intended effect of MaPs on bank credit is statistically significant and generally stronger in EMEs than in AEs. In AEs bank credit slows by 3.2pp below the baseline two years after the adoption of MaPs, whereas in EMEs the slowdown is close to 10pp. The results for quantity and price-based measures show that most of the decline in bank credit in both AEs and EME comes from quantity-based constraints: in AEs (EMEs), quantity-based measures lead to a 6.6pp (10.4pp) contraction below the baseline during the two years after the event. This supports the view that quantity limits are more binding than measures that increase the cost of credit. Moreover, bank credit growth is above the baseline before the activation of quantity-based measures. This suggests that authorities respond to periods of high credit growth by implementing stronger constraints. Price-based measures have no statistically distinguishable impact on banks in AEs or EMEs.

With regard to the effects of MaP measures on total credit, the effect is negative both in AEs and EMEs, but statistically significant only in EMEs. The difference in the effects on bank credit and total credit is larger in AEs, especially for quantity constraints. A possible explanation is that substitution effects are larger in countries with more developed financial systems that offer a broader range of opportunities for substitution between forms of finance.

Table 6B summarizes the event-study results for net sectoral credit flows across countries and MaPs. On average, the impact of MaPs is statistically negative in both AEs and EMEs, but only in the case of quantity-based measures.

In summary, the event study methodology applied in this section yields the following results:

1. MaP measures tend to slow the growth rate of bank credit.
2. MaP measures tend to increase the growth rate of non-bank credit.
3. MaP measures tend to reduce the net sectoral credit flow (i.e. stimulate cross-sector substitution to non-bank credit).
4. MaP measures tend to reduce the growth rate of total credit (i.e. substitution effects do not fully compensate the impact on bank credit).
5. Substitution effects are stronger in AEs than in EMEs.
6. The effects of MaPs are stronger when the measures directly constrain credit.

V. Robustness Checks

We perform several tests to check the robustness of our results.

A. Placebo tests

We examine the validity of the empirical approaches used in sections III and IV with a series of placebo tests. In this case, placebo testing involves generating a series of “fake” macroprudential policy shocks, and then testing the behavior of credit measures around those shocks. Since the shocks are generated at random, one expects to observe no abnormal movements in credit outcomes either prior or after the shocks. The presence of such movements would suggest the existence of unexplained trends in the data, and would thus call for changes in the identification methodology.

To conduct these tests we take the following steps:

1. For each country-year observation in the original Cerutti et al. (2015) dataset we draw a Bernoulli distributed indicator to simulate the placebo dates of policy changes. We repeat this process for each of the 12 MaP tools in the original database. We match the distribution of the simulated and the actual MaP events by setting the Bernoulli probability parameter to the relative frequency of the corresponding measure in the original dataset.
2. Using the simulated MaP we compute the aggregate MaP indices, which, in turn, are used to derive MaP event indicators. Figure A1 in the appendix provides an overview of the simulated MaP measures. As in Figure 3, circles mark the periods of MaP activation, the circle size corresponds to the number of policies implemented by a country in that year and the color of circles indicates the percentage of quantity-based MaPs.
3. We repeat the event study in section IV, using the simulated set of MaP indicators in Figure A1.

[Figure A1 here]

Table A1 reports results of the event study with the simulated MaP events. Impact window effects are in most cases statistically indistinguishable from zero. This suggests that the results reported in the previous sections are not driven by spurious trends in the data.

[Table A1 here]

B. Effect of MaP Events Prior to and During the Global Financial Crisis (GFC)

As noted, many of the MaPs in our sample were adopted in the run-up to and immediate aftermath of the GFC. A concern about the effects found in the previous sections is that they capture not only MaPs but also a host of other factors that took place during that time. While our previous analysis tries to control for these factors by explicitly accounting for the presence of banking crises, changes in monetary policy, and other macroeconomic fundamentals, there may be remaining omitted factors that affect credit to the private sector and are also correlated with the timing of MaP activations.

We thus examine the effectiveness of macroprudential policies before and after the onset of the GFC. Specifically, we repeat the event studies in section IV for the periods before and after the onset of the GFC, which we take to be the third quarter of 2007. The results of the exercise are reported in Table A2. Because of the lack of price-based MaP events prior to the GFC, we only report the results for the quantity-based measures for the pre-GFC period.

[Table A2 here]

In line with our previous analysis, quantity-based tools during the pre-GFC years are found to reduce bank credit growth in both AEs and EMEs. Furthermore, cross-sector substitution towards non-banks is statistically and economically significant in both groups of countries, both before and after the GFC. Interestingly, in AEs, the cross-sector substitution associated with the activation of quantity-based measures is larger during the pre-GFC era.

VI. Concluding Remarks

Macroprudential policies are being activated in advanced and emerging market economies both to boost the resilience of the financial system and to dampen the financial cycle. This paper examines the effectiveness of those policies with a battery of empirical techniques. Our results suggest that macroprudential policies are effective to reduce bank credit growth: on average, bank credit falls by almost 8 percentage points in the 2 years following the adoption of macroprudential policy measures. We also find evidence of substitution effects: credit provision shifts from banks towards non-banks following the adoption of MaPs. Cross-sector substitution is particularly pronounced following the adoption of quantity-based MaPs, in advanced economies and bank-based financial systems. The growth of investment funds and of capital market debt issuance following macroprudential measures illustrates how these measures are offset by new forms of credit growth outside the banking sector.

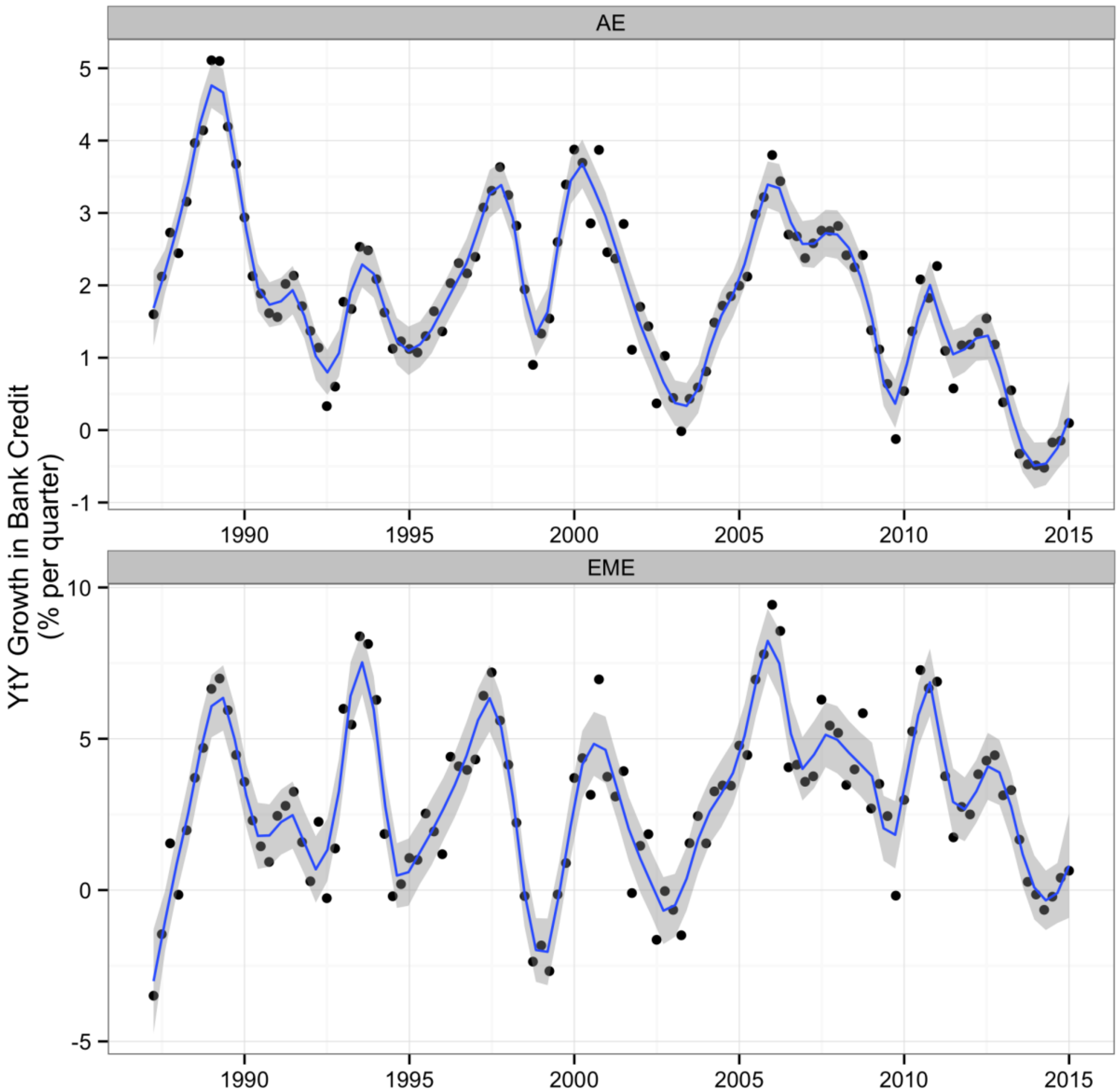
Concern about cross-sector substitution effects of macroprudential policies can be tempered by a number of factors. First, non-bank financial institutions are generally less leveraged and have less liquidity risks than the banking sector; they are also separated from systemic functions related to the payments infrastructure. Second, the non-bank financial sector generally does not have access to public sector safety nets, such as deposit insurance and central bank liquidity support. In this light, policymakers may welcome a shift to market-based financing, which can function as a “spare tire” in the supply of credit in times of systemic banking crises (IMF, 2015). In fact, these considerations underly the proposals for the creation of a European Capital Markets Union (EC, 2015).

Cross-sector substitution may, however, entail new systemic risks. When a credit bubble shifts from banks to financial markets, and households or corporates continue to accumulate debt, macroeconomic vulnerabilities continue to rise and may result in a crisis, even if the debt is owed to investment funds or to capital markets. Similarly, when investment funds purchase illiquid debt securities while promising liquidity to end investors, debt markets become vulnerable to refinancing risks and sudden price shocks. Moreover, when the non-bank financial sector is interconnected with the formal banking sector (e.g. through credit lines, participation in banks’ debt issuances, or ownership links), shocks in the former reverberate through the latter.

For macroprudential policymakers, there is thus work to be done. While macroprudential policy mitigates banking sector risks, there is a need to extend its scope beyond banking. The focus should be on systemic risks, and not on substitution per se. In some cases, activity-based instruments, which target the risk of an activity regardless of where it is conducted, can address risks more effectively. In other cases, instruments similar to those applied to banks can be applied to non-bank institutions. For example, margin requirements for securities financing transactions may perform a similar function as leverage requirements for banks and LTV limits for mortgages (Schoenmaker and Wierts, 2015). Similarly, limits on leverage and liquidity transformation can ensure that investment funds engaging in bank-like activities and taking on bank-like risks face comparable requirements.

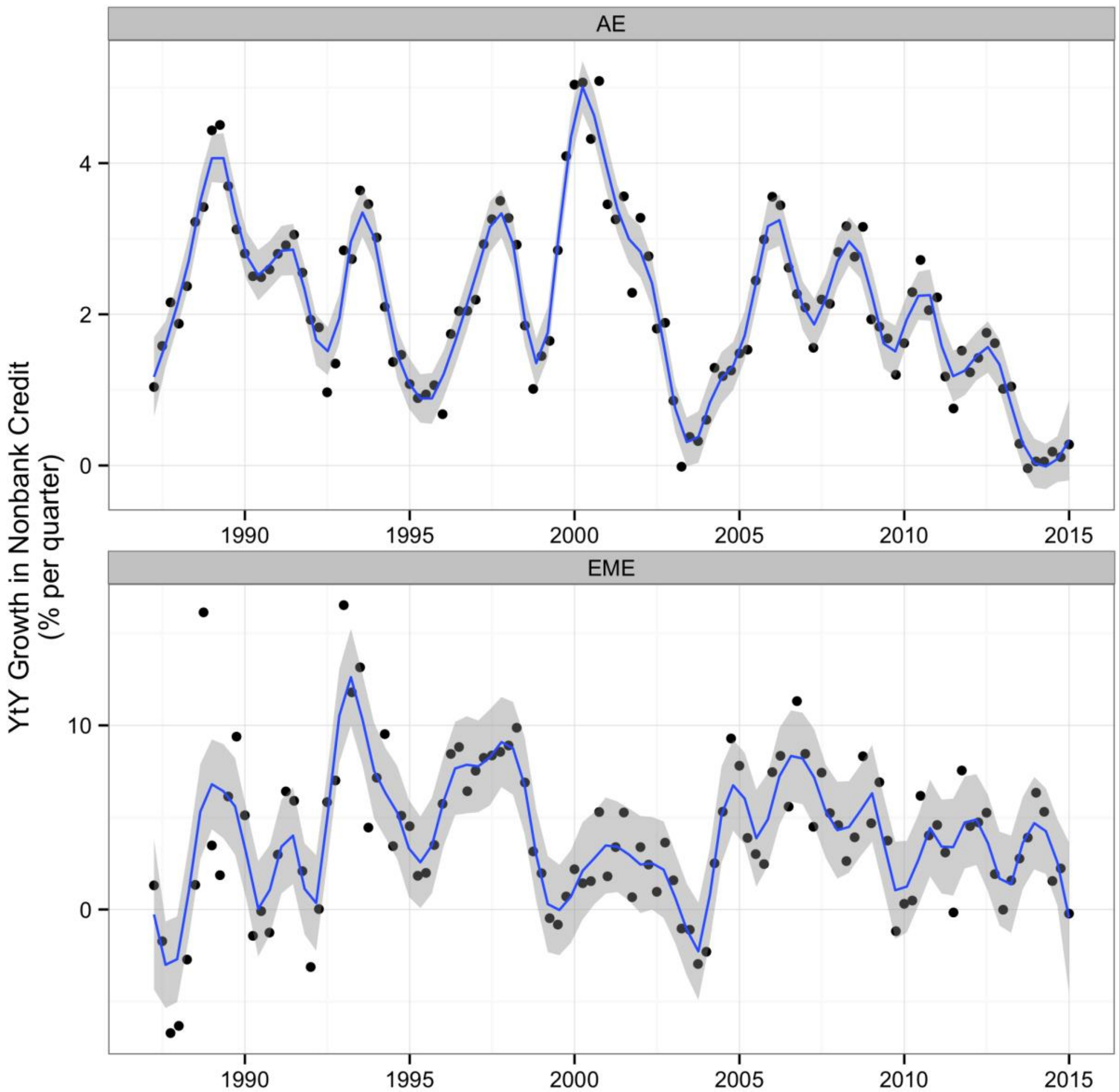
FIGURES AND TABLES

Figure 1A: Bank credit flows in advanced and emerging market economies.



The actual growth rates are represented by dots. The blue line is the locally weighted least squares regression (LOESS) fitted curve, with the smoothing parameter set to 0.1, and the shadowed region corresponds to the 95% confidence interval around the fitted values.

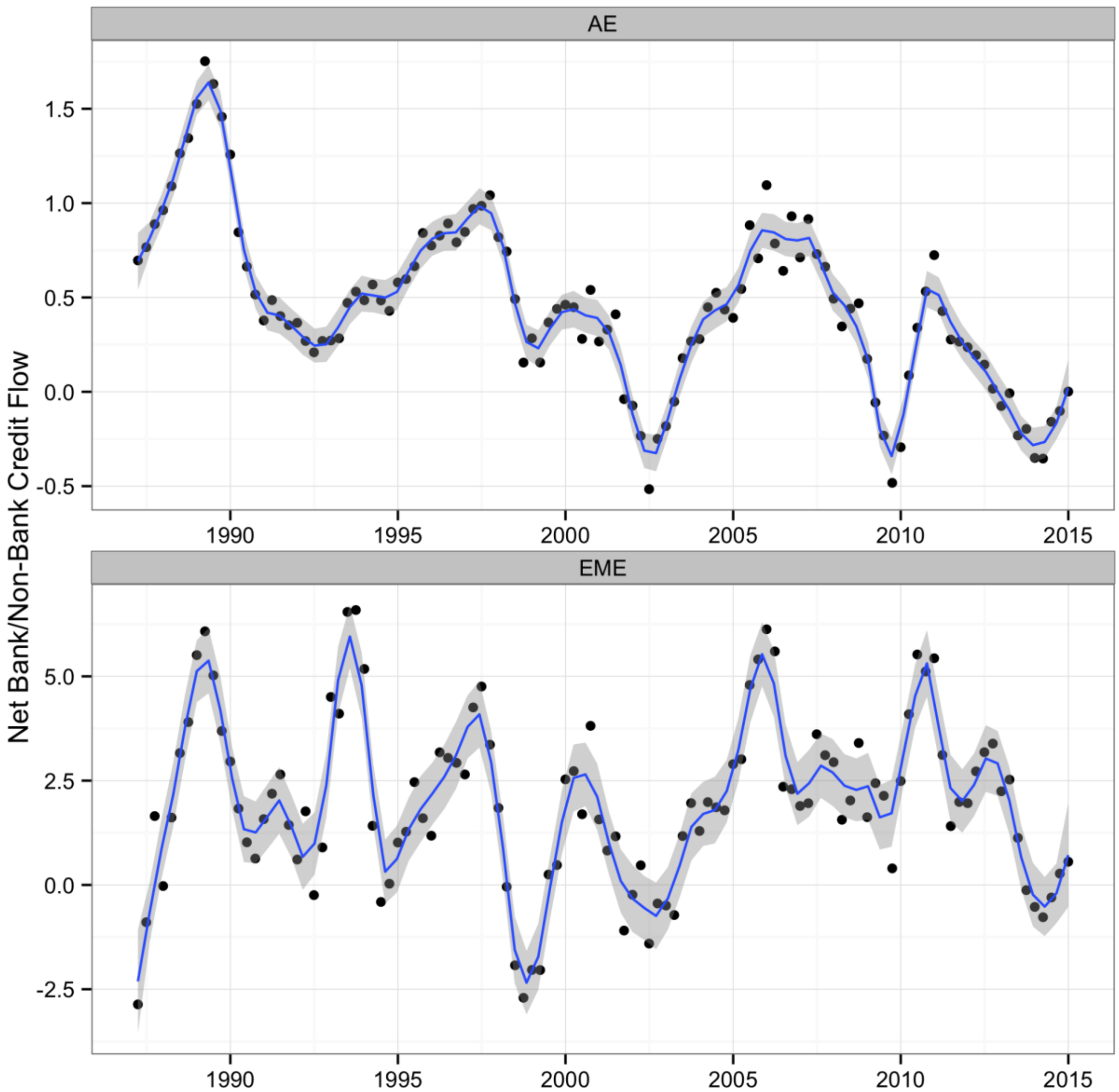
Figure 1B: Non-bank credit flows in advanced and emerging market economies.



Actual growth rates are represented by dots. The blue line is the locally weighted least squares regression (LOESS) fitted curve, with the smoothing parameter set to 0.1, and the shadowed region corresponds to the 95% confidence interval around the fitted values.

Source: BIS, own caclucations

Figure 1C: Substitution between bank/non-bank credit flows.



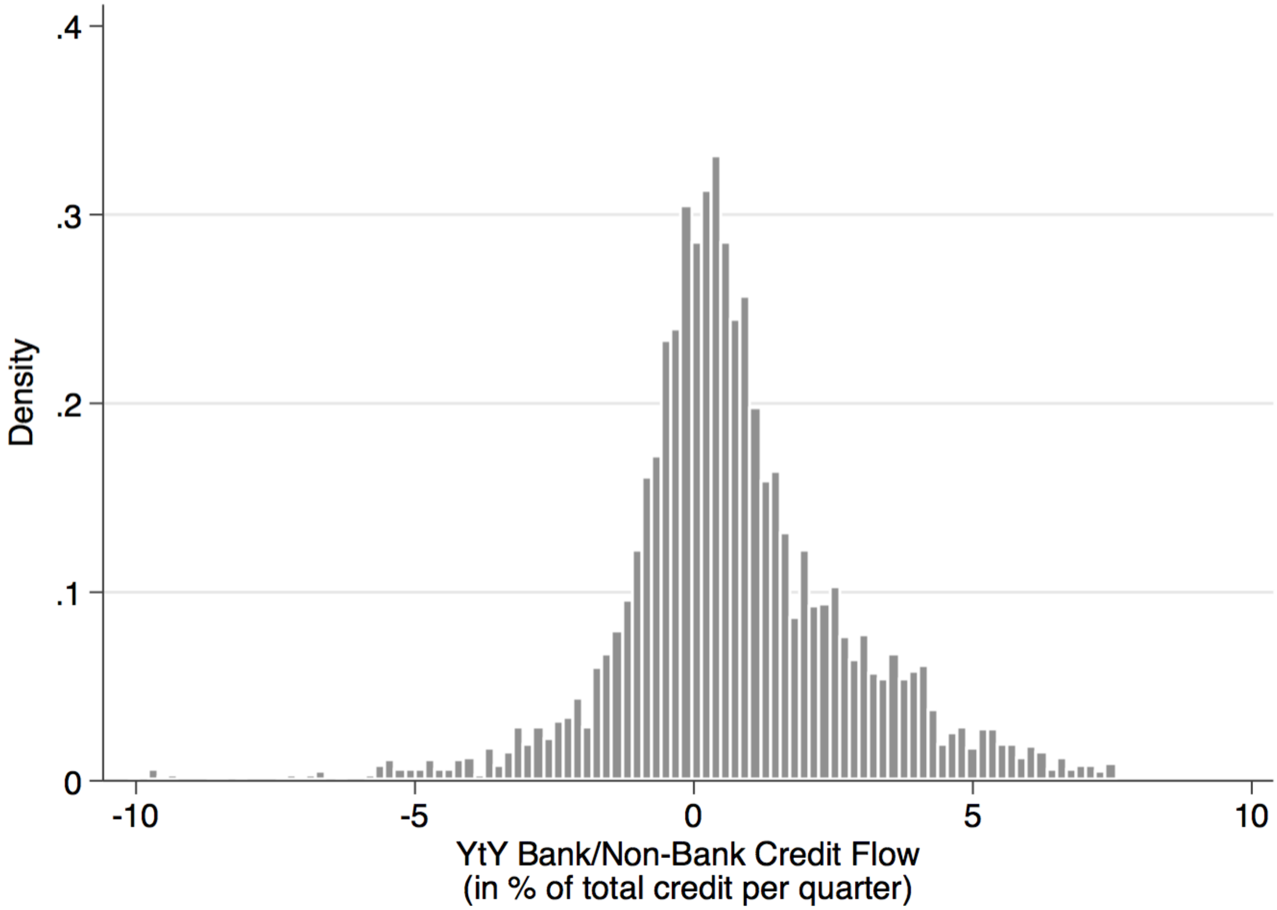
Net sectoral credit flows are defined as follows:

$$[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}} .$$

Actual flow rates are represented by dots. The blue line is the locally weighted least squares regression (LOESS) fitted curve, with the smoothing parameter set to 0.1, and the shadowed region corresponds to the 95% confidence interval around the fitted values.

Source: BIS, own caclucations

Figure 2: Histogram of the substitution between bank/non-bank credit flows.

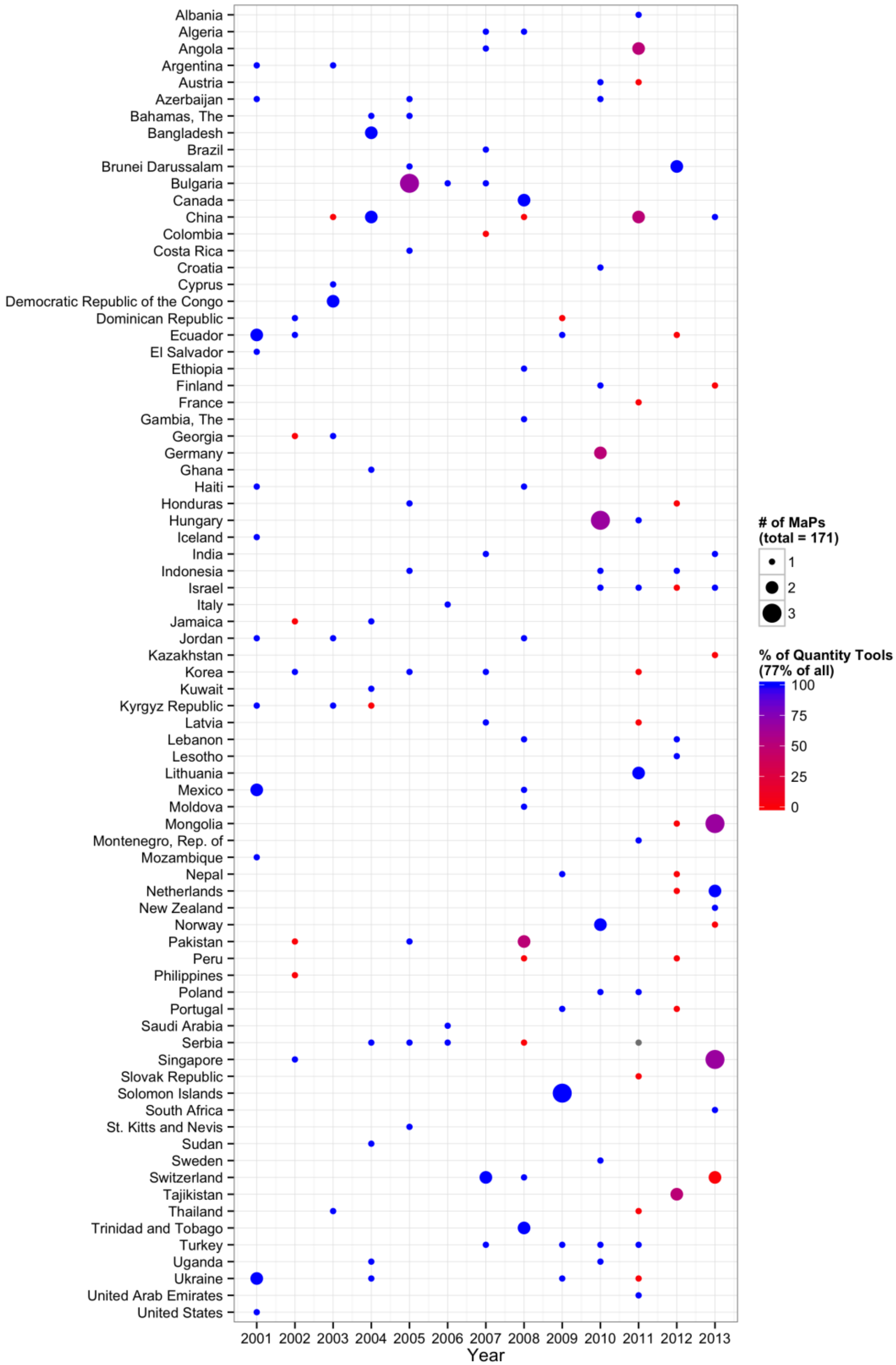


The measure is defined as:

$$[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$$

Source: BIS, own caclucations

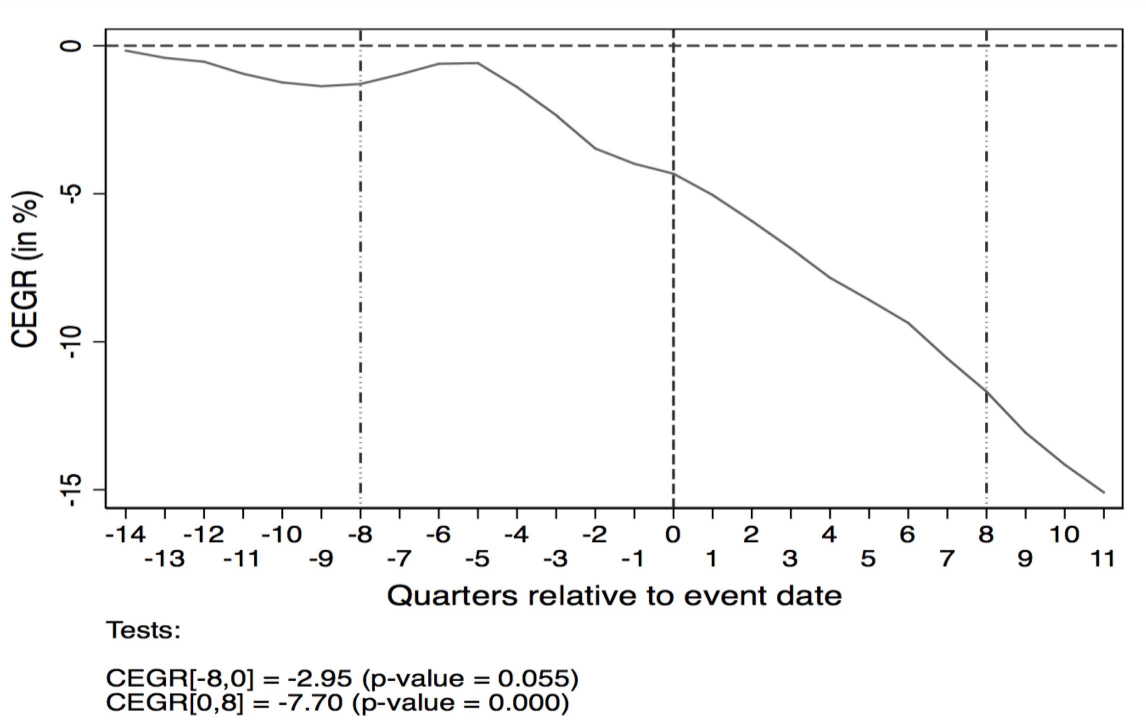
Figure 3: Activation of macroprudential policy measures, 2000-2013.



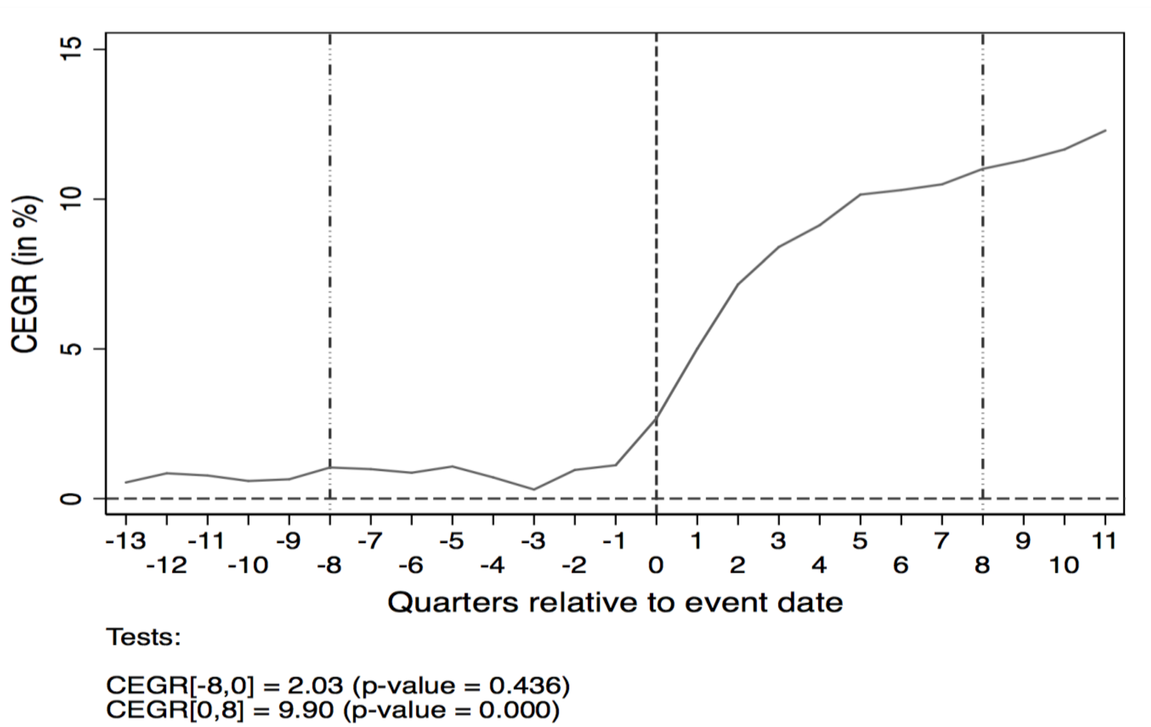
Source: Cerutti et al. (2015). Blank spaces refer to no new MaPs in a country in a given year.

Figure 4: Cumulative excess credit growth rates around macroprudential measures.

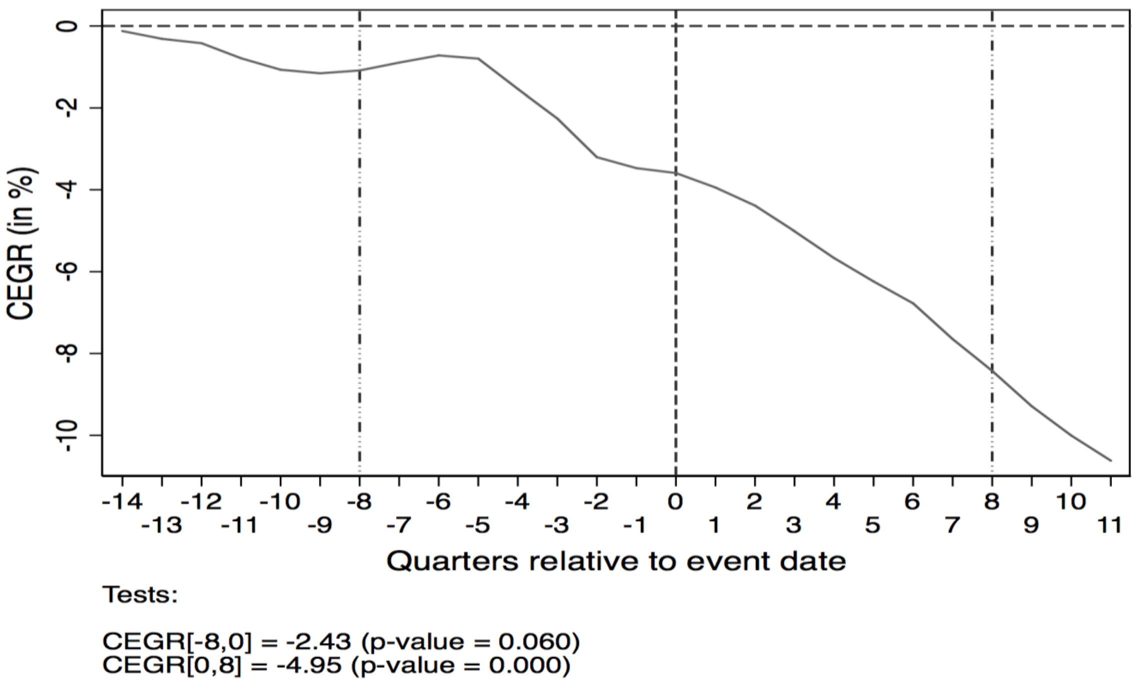
Panel A: Bank credit



Panel B: Non-bank credit



Panel C: Total credit



Panel D: $[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \dfrac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$

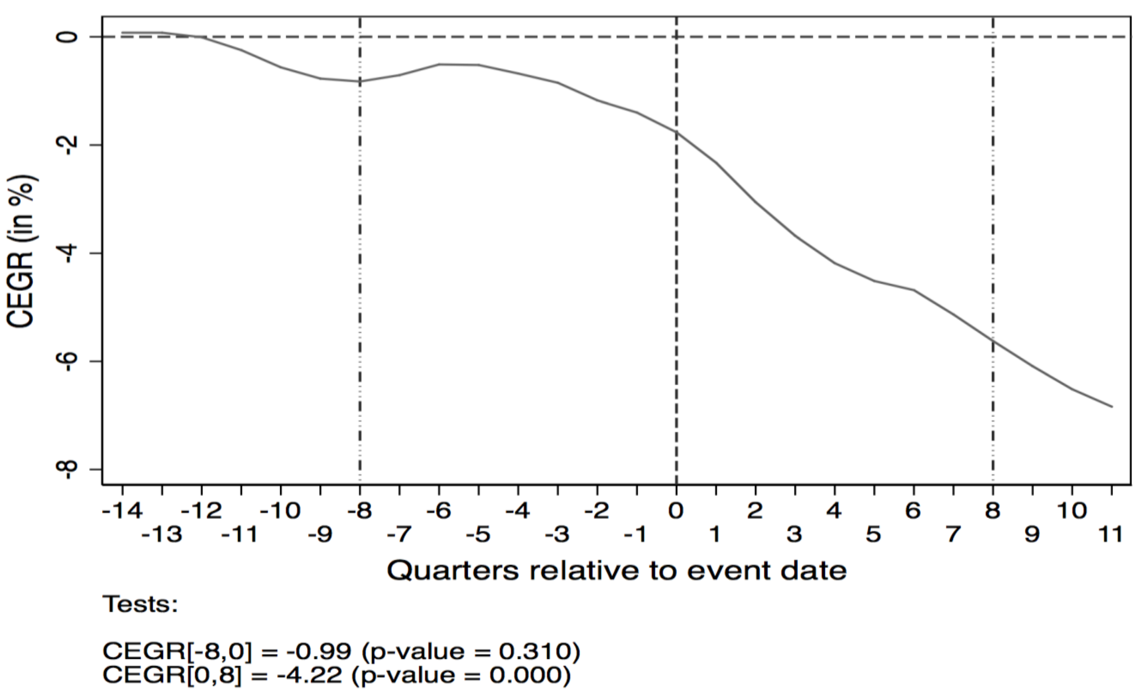
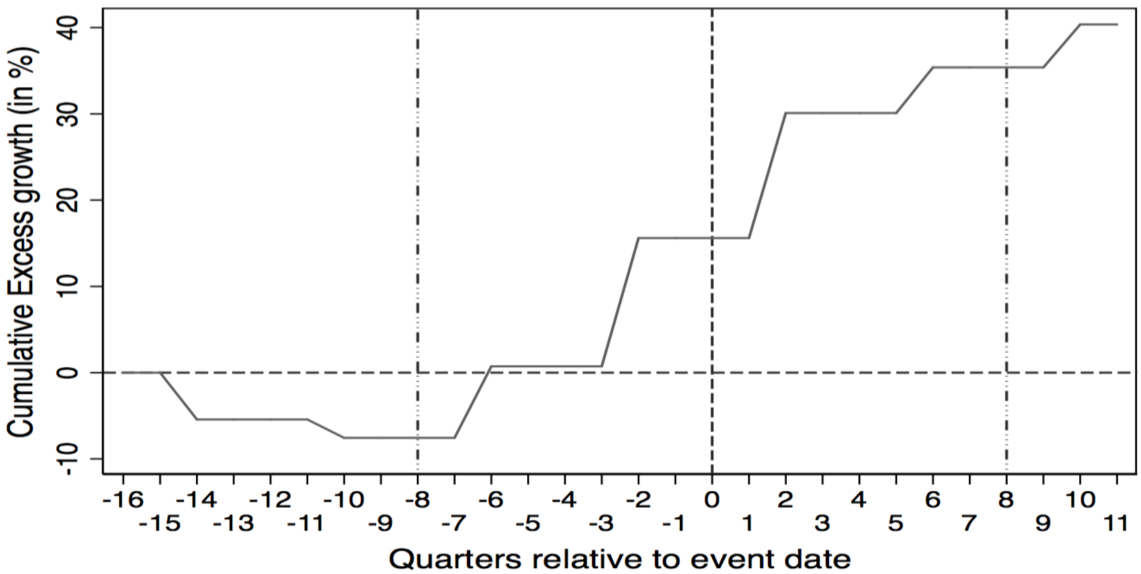


Figure 5: Cumulative excess growth of non-bank FIs' assets around macroprudential measures.

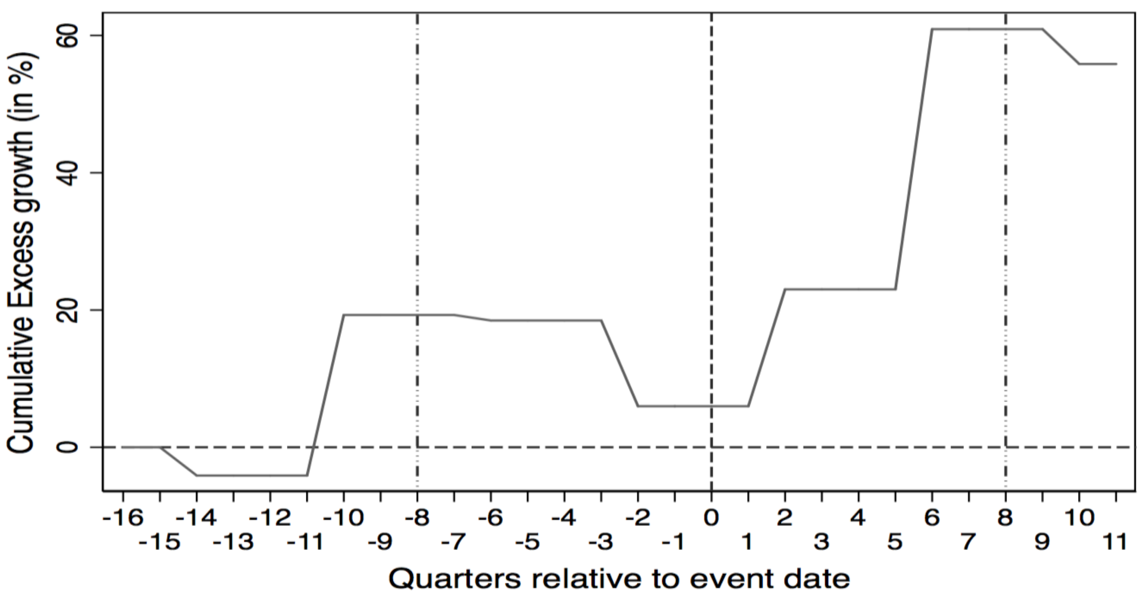
Panel A: Investment Fund Asset Growth



Tests:

CEGR[-8,0] = 23.18 (p-value = 0.011)
CEGR[0,8] = 19.77 (p-value = 0.019)

Panel B: Domestic Private Debt Issuance



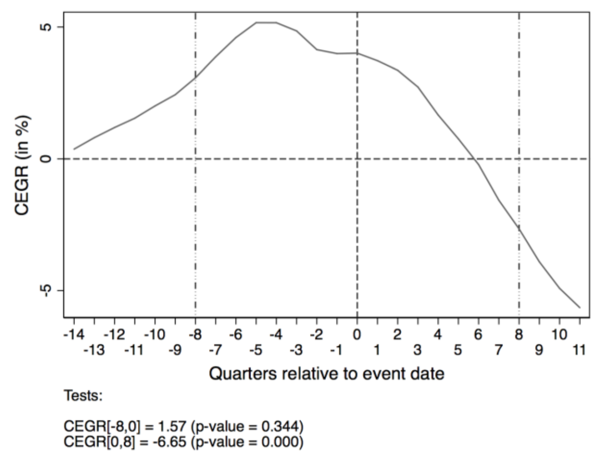
Tests:

CEGR[-8,0] = -13.30 (p-value = 0.290)
CEGR[0,8] = 54.94 (p-value = 0.000)

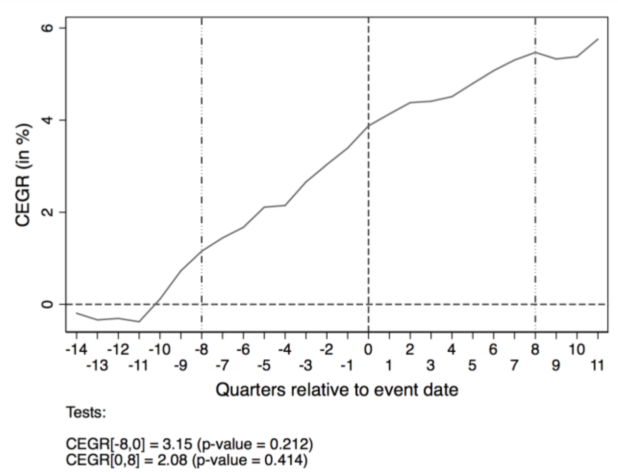
Figure 6: Impact of MaP measures on bank credit.

Panel A: Advanced economies

Quantity Measures

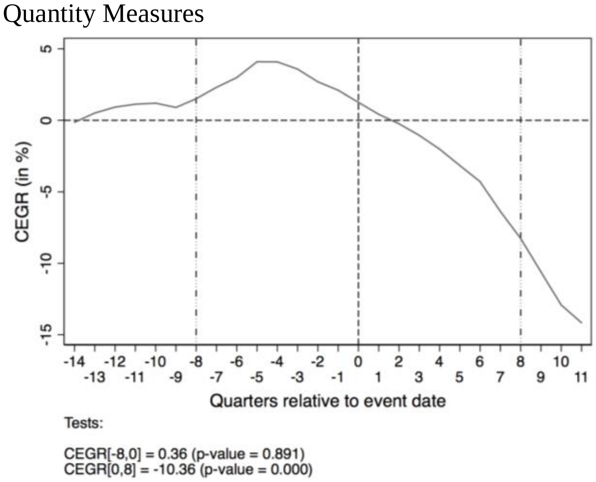


Price Measures



Panel B: Emerging market economies

Quantity Measures



Price Measures

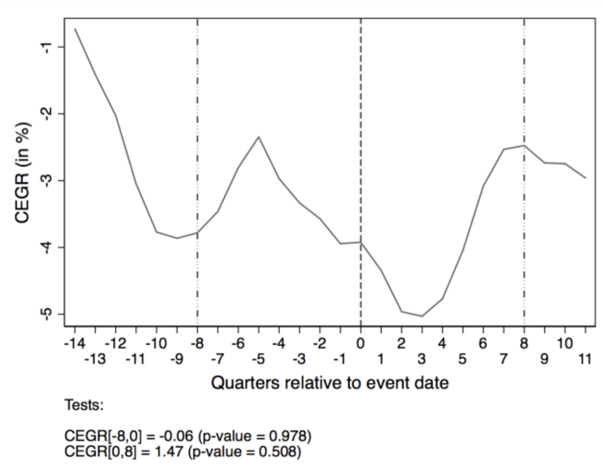
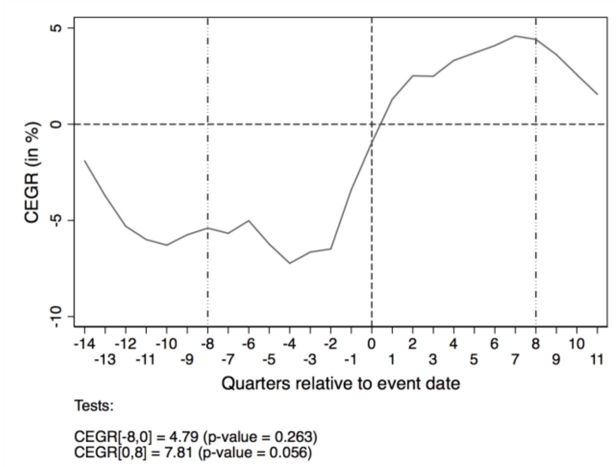


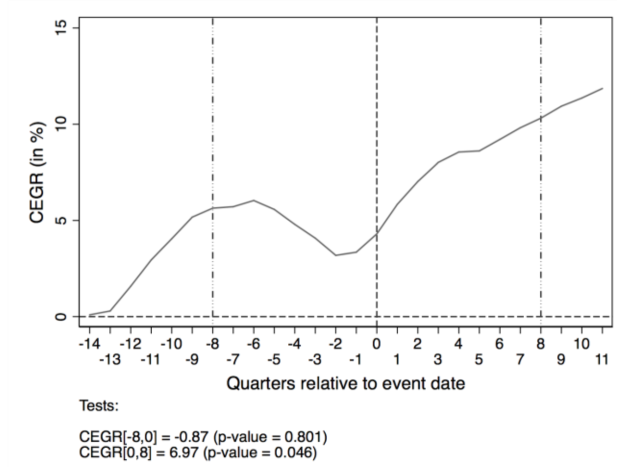
Figure 7: Impact of MaP measures on non-bank credit.

Panel A: Advanced economies

Quantity Measures

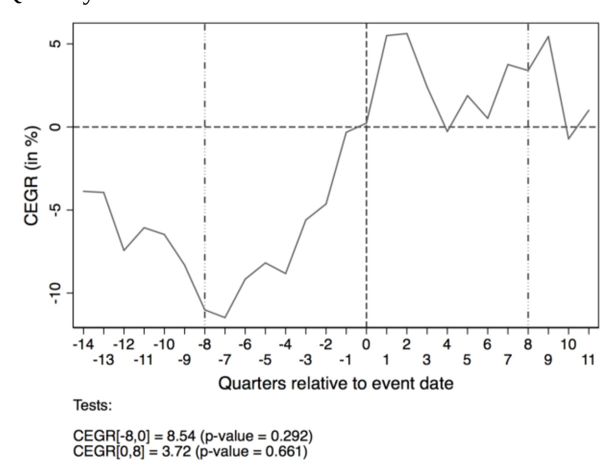


Price Measures



Panel B: Emerging market economies

Quantity Measures



Price Measures

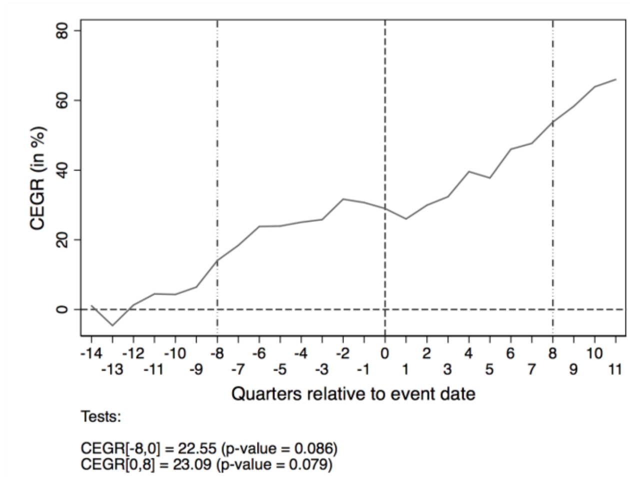
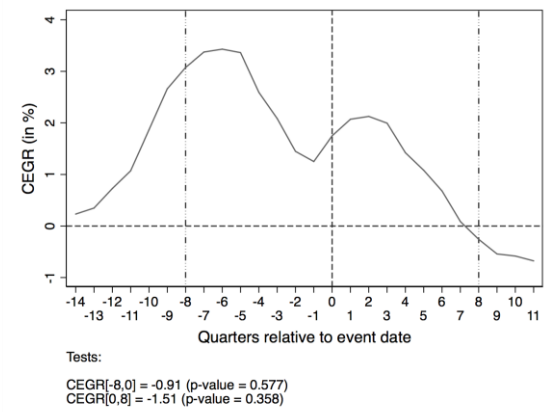


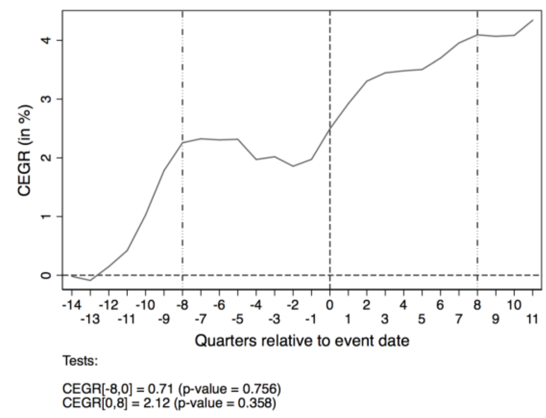
Figure 8: Impact of MaP measures on total credit.

Panel A: Advanced economies

Quantity Measures

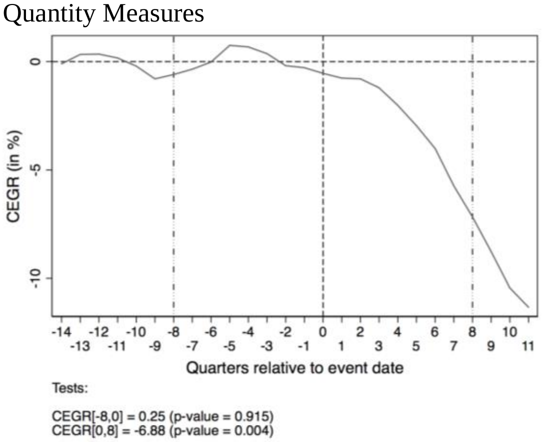


Price Measures



Panel B: Emerging market economies

Quantity Measures



Price Measures

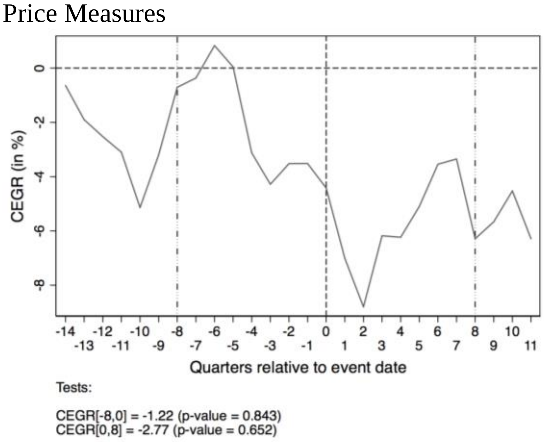
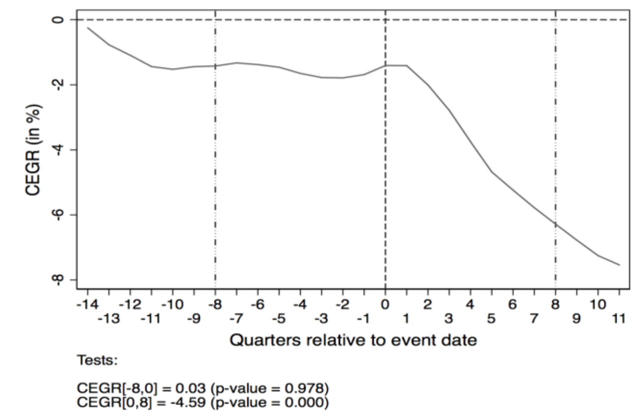


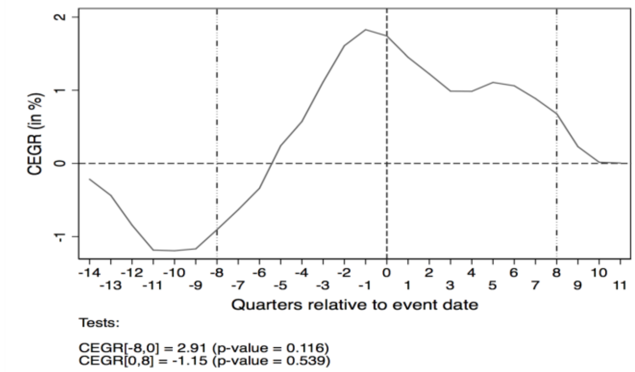
Figure 9: Impact of MaP measures on net sectoral credit flows.

Panel A: Advanced Economies

(i) Quantity-Based MaPs

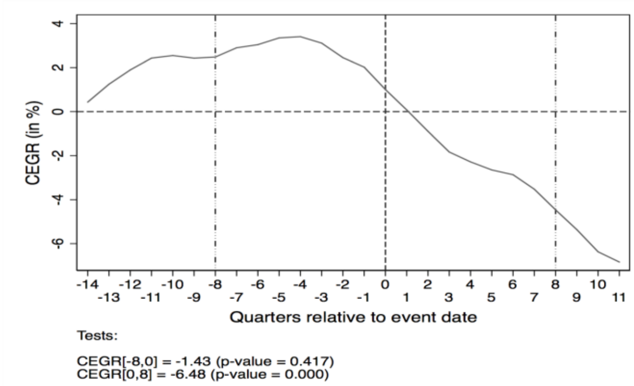


(ii) Price-Based MaPs

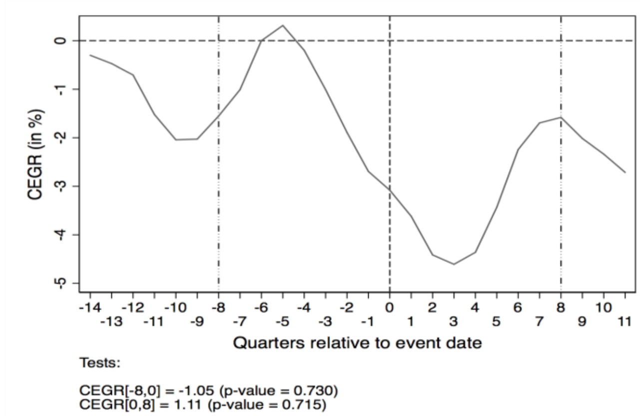


Panel B : Emerging Market Economies

(i) Quantity-Based MaPs



(ii) Price-Based MaPs



Net sectoral credit flows are defined according to the following formula:

$$[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$$

Table 1: Summary statistics on credit, macroprudential policies and macroeconomic indicators.
Mean values across sub-samples and full sample; standard deviations in parentheses.

	1997-2014, Quarterly		
	Advanced Economies	Emerging market Economies	Full Sample
Panel A: Credit Series			
Bank Credit to Private Sector (% of GDP), Source: BIS	84.79 (36.86)	60.41 (42.48)	77.83 (40.08)
Non-Bank Credit to Private Sector (% of GDP), Source: BIS	55.78 (41.25)	9.32 (14.18)	42.49 (41.39)
Investment fund assets to GDP (%), Source: WB-GFDD	31.11 (68.26)	6.38 (9.68)	21.74 (55.43)
Bank Credit, YtY % Change, Source: BIS	6.47 (11.18)	10.53 (16.35)	7.65 (13.03)
Non-Bank Credit, YtY % Change, Source: BIS	7.33 (13.95)	11.59 (31.87)	8.57 (20.90)
Total Credit, YtY % Change, Source: BIS	6.68 (9.98)	9.78 (15.10)	7.59 (11.79)
Net Sectoral Credit Flow, % of Total Credit, Source: BIS	1.29 (6.36)	5.76 (11.10)	2.59 (8.29)
Panel B: **Macroprudential Policy Indices**			
Overall Index	1.56 (1.41)	2.00 (1.63)	1.83 (1.56)
Quantity-Based Regulatory Index	1.57 (1.43)	1.96 (1.52)	1.81 (1.50)
Price-Based Regulatory Index	0.16 (0.38)	0.25 (0.51)	0.22 (0.46)
Panel C: Other Macroeconomic Indicators			
Inflation, average consumer prices, Source: IMF-WEO	2.91 (2.75)	7.27 (7.45)	6.00 (6.74)
YtY Real % Growth in GDP, Source: IMF-IFS,	3.58 (7.48)	5.59 (7.78)	5.00 (7.75)
Current account balance, Source: IMF-WEO	1.90 (11.53)	-5.03 (10.35)	-3.04 (11.15)

General government net lending/borrowing, Source: IMF-WEO	-0.10 (7.28)	-2.14 (5.56)	-1.54 (6.18)
Equity inflows, % of GDP, Source: IMF-IFS	6.17 (11.56)	1.43 (4.81)	2.79 (7.71)
Debt inflows, % of GDP, Source: IMF-IFS	11.78 (33.73)	1.52 (8.11)	4.47 (19.89)
CB Lending Rate (in %), Source: IMF-IFS	7.26 (4.65)	16.73 (9.93)	13.82 (9.70)
YtY % Growth in CB Assets, Source: WB-GFDD	8.97 (47.49)	13.00 (43.89)	11.81 (45.02)
GDP per capita, current prices, Source: IMF-WEO	29042 (17691)	2943 (2951)	10433 (15342)
Banking crisis dummy (1=banking crisis, 0=none), Source: WB-GFDD	0.19 (0.39)	0.03 (0.16)	0.07 (0.26)

Table 2: Classification of Macroprudential Policies

Abbreviation	Name	Number of Events	Borrower/ Lender-Based	Price/ Quantity Restriction
LTV	Loan-to-Value Ratio	32 [18%]	Borrower	Quantity
DTI	Debt-to-Income Ratio	23 [13%]	Borrower	Quantity
DP	Time-Varying/Dynamic Loan-Loss Provisioning	10 [5%]	Lender	Price
CTC	General Countercyclical Capital Buffer/Requirement	6 [3%]	Lender	Price
LEV	Leverage Ratio	13 [7%]	Lender	Quantity
SIFI	Capital Surcharges on SIFIs	7 [4%]	Lender	Price
INTER	Limits on Interbank Exposures	16 [9%]	Lender	Quantity
CONC	Concentration Limits	22 [12%]	Lender	Quantity
FC	Limits on Foreign Currency Loans	15 [8%]	Lender	Quantity
RR	Reserve Requirement Ratios	12 [7%]	Lender	Quantity
CG	Limits on Domestic Currency Loans	7 [4%]	Lender	Quantity
TAX	Levy/Tax on Financial Institutions	17 [9%]	Lender	Price

Table 3: Substitution from bank to non-bank credit.

	Net Bank/Non-Bank Credit Flow				
	ALL (1)	AE (2)	EME (3)	Market-Based (4)	Bank-Based (5)
[Banking Crisis Indicator]	-1.18***	-0.59***	-2.48***	-0.55***	-1.37***
	(0.11)	(0.09)	(0.36)	(0.20)	(0.14)
Δ^{1-year} MaP Index	-0.26**	-0.27***	-0.30	-0.34*	-0.24*
	(0.13)	(0.10)	(0.29)	(0.21)	(0.16)
Δ^{1-year} [CB Lending Rate]	0.00	0.04***	-0.09***	0.03***	-0.08***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Δ^{1-year} [Log of CB BS Size]	-0.46***	-0.68***	0.54*	-0.08	-0.58***
	(0.11)	(0.08)	(0.35)	(0.18)	(0.14)
Constant	0.61***	0.63***	-0.15	0.26	0.78**
	(0.23)	(0.16)	(0.83)	(0.33)	(0.31)
R-squared	0.133	0.123	0.289	0.154	0.153
Obs.	3224	2291	933	1061	2163
# of Countries	31	22	9	10	21

The table report the estimated coefficients from OLS regressions for the following specification:

$$NetFlow_{c,t} = \alpha_c + \beta_t + \theta_1 BankCrisis_{c,t} + \theta_2 \Delta MonetaryPolicy_{c,t} + \theta_3 \Delta MaP_{c,t} + \epsilon_{c,t}$$

where $BankCrisis_{c,t}$ is a dummy variable capturing the presence of systemic banking crisis, $\Delta MonetaryPolicy_{c,t}$ measures changes in the monetary policy, and $\Delta MaP_{c,t}$ measures changes in the MaP stance. $NetFlow_{c,t}$ is defined as:

$$[NetFlow]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$$

Table 4: Substitution from bank to non-bank credit with price and quantity measures.

	Net Bank/Non-Bank Credit Flow				
	ALL	AE	EME	Market-Based	Bank-Based
	(1)	(2)	(3)	(4)	(5)
[Banking Crisis Indicator]	-1.20***	-0.61***	-2.51***	-0.59***	-1.40***
	(0.11)	(0.09)	(0.36)	(0.20)	(0.14)
Δ^{1-year} MaP Quantity-Based Index	-0.49***	-0.45***	-0.38	-0.69***	-0.42**
	(0.15)	(0.12)	(0.34)	(0.25)	(0.18)
Δ^{1-year} MaP Price-Based Index	0.56**	0.12	0.81	0.36	0.71**
	(0.26)	(0.20)	(0.74)	(0.42)	(0.34)
Δ^{1-year} [CB Lending Rate]	0.00	0.04***	-0.09***	0.03***	-0.08***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Δ^{1-year} [Log of CB BS Size]	-0.46***	-0.68***	0.52*	-0.09	-0.58***
	(0.11)	(0.08)	(0.35)	(0.18)	(0.14)
Constant	0.62***	0.63***	-0.15	0.26	0.79**
	(0.23)	(0.16)	(0.83)	(0.33)	(0.31)
R-squared	0.137	0.125	0.292	0.158	0.158
Obs.	3224	2291	933	1061	2163
# of Countries	31	22	9	10	21

The table report the estimated coefficients from OLS regressions for the following specification:

$$NetFlow_{c,t} = \alpha_c + \beta_t + \theta_1 BankCrisis_{c,t} + \theta_2 \Delta MonetaryPolicy_{c,t} + \theta_3 \Delta MaP_{c,t} + \epsilon_{c,t}$$

where $BankCrisis_{c,t}$ is a dummy variable capturing the presence of systemic banking crisis, $\Delta MonetaryPolicy_{c,t}$ measures changes in the monetary policy, and $\Delta MaP_{c,t}$ measures changes in the MaP stance. $NetFlow_{c,t}$ is defined as:

$$[NetFlow]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$$

Table 5: Drivers of growth in credit, investment fund assets and domestic private debt securities.

	(1) 1-Year Growth in Bank Credit to Private Sector. Source: BIS	(2) 1-Year Growth in Non-Bank Credit to Private Sector. Source: BIS	(3) 1-Year Growth in Total Credit to Private Sector. Source: BIS	(4) 1-Year Growth in Investment fund assets. Source: WB-GFDD	(5) Issuance of domestic private debt securities. Source: WB-GFDD
Inflation (YtY % change in CPI)	0.25	0.18	0.17	0.05	0.94*
	(0.18)	(0.19)	(0.15)	(0.41)	(0.51)
YtY % Real GDP growth	0.85***	1.05***	0.76***	0.63***	0.31**
	(0.14)	(0.22)	(0.12)	(0.23)	(0.16)
Current account balance (% of GDP)	-0.01	-0.06	0.02	-0.89***	-0.54*
	(0.18)	(0.15)	(0.16)	(0.31)	(0.29)
General government net lending/ borrowing (% of GDP)	0.62**	0.16	0.50**	0.20	0.72
	(0.28)	(0.30)	(0.23)	(0.40)	(0.50)
Equity inflows (% of GDP)	-0.11***	-0.11	-0.06	0.03	0.15
	(0.04)	(0.10)	(0.04)	(0.14)	(0.09)
Debt inflows (% of GDP)	0.03	-0.04	0.01	-0.04	0.00
	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)
CB Lending Rate (in %)	-0.20	0.29	-0.07	-0.16	-0.21
	(0.13)	(0.34)	(0.13)	(0.18)	(0.37)
YtY % Growth in CB Assets	-0.02**	0.01	-0.01	-0.05***	-0.03
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Log GDP per capita	-9.13***	4.51	-6.71***	-22.50**	0.19
	(2.64)	(4.15)	(2.11)	(9.03)	(6.31)
Banking crisis dummy	-5.73***	-5.68**	-6.19***	1.23	4.24***
	(1.73)	(2.36)	(1.65)	(4.57)	(1.34)
Constant	101.97***	-32.42	78.19***	239.85***	5.87
	(24.44)	(38.76)	(19.25)	(81.62)	(61.34)
R-squared	0.427	0.183	0.430	0.331	0.231
Observations	2433	2421	2425	3539	2852
Number of Countries	34	34	34	72	43

Standard errors in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$

Table 6: Summary of event study results.

Panel A: Effects on bank and total credit.

	All Instruments		Quantity Measures		Price Measures	
	Bank Credit	Total Credit	Bank Credit	Total Credit	Bank Credit	Total Credit
All	-7.7***	-4.9***	-8.7***	-4.1***	1.7	1.2
AEs	-3.2**	-1.6	-6.6***	-1.5	2.0	2.1
EMEs	-9.9***	-6.5***	-10.4***	-6.9***	1.5	-2.8

The table reports the effects of MaP events on the average cumulative credit growth rates during the 2-year period following the activation of macroprudential policies. Growth rates are adjusted for the baseline rates of growth implied by countries' macroeconomic fundamentals.

Panel B: Cross-sector credit substitution.

	All Instruments	Quantity Measures	Price Measures
All	-4.3***	-5.2***	2.3
AEs	-4.1***	-4.6***	-1.2
EMEs	-6.2***	-6.5***	1.1

The table reports the effects of MaP events on the net sectoral credit flow cumulated over the 2-year period following the activation of macroprudential policies. The measure is defined as follows:

$$[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}} .$$

Note: * $p < .1$, ** $p < .05$, *** $p < .01$. The emerging market economy group consists of: Brazil, China, Hungary, Indonesia, India, Mexico, Malaysia, Thailand, Turkey, and South Africa. The advanced economy group consists of: Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Poland, Portugal, Russia, Saudi Arabia, Singapore, Sweden, and the USA.

APPENDIX

Figure A1: Simulated macroprudential policy measures used in the placebo tests.

Dots correspond to simulated MaP events. Blank spaces refer to no new MaPs in a country in a given year.

Table A1: Event study using placebo event dataset. Summary of results.

Panel A: Effects on bank and total credit.

	All Instruments		Quantity Measures		Price Measures	
	Bank Credit	Total Credit	Bank Credit	Total Credit	Bank Credit	Total Credit
All	0.9	1.1	-0.8	0.1	1.6	-0.2
AEs	2.0	1.8	-0.2	0.3	2.9	-0.9
EMEs	-4.5	-6.0*	-4.2	-6.6	-7.9	-8.4

This table reports the effects of MaP events on the average cumulative credit growth rates during the 2-year period following the activation of macroprudential policies. Growth rates are adjusted for the baseline rates of growth implied by countries' macroeconomic fundamentals.

Panel B: Cross-sector credit substitution.

	All Instruments	Quantity Measures	Price Measures
All	-0.1	-1.2	4.4*
AEs	1.5	0.2	5.4*
EMEs	-3.8	-6.2	0.7

This table reports the effects of MaP events on the net sectoral credit flow cumulated over the 2-year period following the activation of macroprudential policies. The measure is defined as follows:

$$[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$$

Note: * $p < .1$, ** $p < .05$, *** $p < .01$. The emerging market economy group consists of: Brazil, China, Hungary, Indonesia, India, Mexico, Malaysia, Thailand, Turkey, and South Africa. The advanced economy group consists of: Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Poland, Portugal, Russia, Saudi Arabia, Singapore, Sweden, and the USA.

Table A2: Event study on MaP Effects prior to and during the GFC. Summary of results.

Panel A: Effects on bank and total credit.

Effects prior to 2007Q3:

	All Instruments		Quantity Measures		Price Measures	
	Bank Credit	Total Credit	Bank Credit	Total Credit	Bank Credit	Total Credit
All	-8.8***	-4.7**	-8.8***	-4.7**	NA	NA
AEs	-7.3**	-6.5*	-7.3**	-6.5*	NA	NA
EMEs	-9.2**	-3.3	-9.2**	-3.3	NA	NA

Effects after 2007Q3

	All Instruments		Quantity Measures		Price Measures	
	Bank Credit	Total Credit	Bank Credit	Total Credit	Bank Credit	Total Credit
All	-3.7**	-1.7	-4.8***	-2.8**	4.1*	5.8**
AEs	-1.3*	0.4	-1.6*	0.4	1.0	2.2
EMEs	-9.6***	-7.5***	-10.5***	-8.6***	3.5	5.8*

This table reports the effects of MaP events on the average cumulative credit growth rates during the 2-year period following the activation of macroprudential policies. Growth rates are adjusted for the baseline rates of growth implied by countries' macroeconomic fundamentals.

Panel B: Cross-sector credit substitution.

Effects prior to 2007Q3:

	All Instruments	Quantity Measures	Price Measures
All	-6.1***	-6.1***	NA
AEs	-5.7***	-5.7***	NA
EMEs	-6.0***	-6.0***	NA

Effects after 2007Q3

	All Instruments	Quantity Measures	Price Measures
All	-2.6***	-4.2***	3.1
AEs	-1.9**	-2.7**	0.1
EMEs	-5.1***	-6.5***	2.5

This table reports the effects of MaP events on the net sectoral credit flow cumulated over the 2-year period following the activation of macroprudential policies. The measure is defined as follows:

$$[\text{Quarterly Net Sectoral Credit Flow}]_{ct} = 100 * \frac{\frac{1}{4}[\Delta^{YtY}\text{Bank Credit}]_{ct} - \frac{1}{4}[\Delta^{YtY}\text{Non-Bank Credit}]_{ct}}{[\text{Total Credit}]_{c,t-4}}$$

Note: * $p < .1$, ** $p < .05$, *** $p < .01$. The emerging market economy group consists of: Brazil, China, Hungary, Indonesia, India, Mexico, Malaysia, Thailand, Turkey, and South Africa. The advanced economy group consists of: Australia, Austria, Belgium, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Poland, Portugal, Russia, Saudi Arabia, Singapore, Sweden, and the USA.

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