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Whereas the use of macroprudential instruments has been growing since the global financial crisis, there remains a need for verification of their overall and relative effectiveness. Most extant work has focused on the impact of macroprudential policy on house price rises and credit growth. We contend that it is crucial also to address the effectiveness of macroprudential policy and its instruments in reducing the build-up of financial imbalances in the wider economy. We focus on the credit-GDP gap, which besides being recommended to trigger the Basel III countercyclical buffer, is also widely seen as a key indicator of financial imbalances and

As the usage of macroprudential policy instruments continues

The article is structured as follows. First, we provide a brief overview of recent empirical research on macroprudential policy tools' effectiveness. Second, we focus on work related to the BIS credit-to-GDP gap and its usefulness or otherwise as an indicator of financial imbalances that may lead on to financial crises[6].

Building on the work of Lim et al (2011), Cerutti et al (2017) used the second IMF survey

added benefit of increasing the resilience of the banking system. They found that policies such as LTV limits have a better chance to curb a boom and the narrower the focus of a such a policy, the better the effectiveness and performance of macroprudential policy.

Dell'Ariccia et al (2012) conducted analysis of credit booms and busts with the aim of assessing the effectiveness of macroprudential measures in reducing the risk of a crisis, or at least limiting its consequences. They identified a credit boom episode by analysing the country's private non-financial sector credit-to-GDP ratio. They classified an episode as a boom if either of the following two conditions was satisfied, (i) the deviation from trend is greater than 1.5 times its standard deviation and the annual growth rate of the credit-to-GDP ratio exceeds 10 percent; or (ii) the annual growth rate of the credit-to-GDP ratio exceeds 20 percent. They argued that credit booms are often a result of financial reform and periods of strong economic growth. Booms tend to be more frequent in fixed exchange rate regimes with weak banking supervision. Yet not all booms are bad or end up in a financial crisis and it is difficult to tell a good boom from a bad one that end up in a crisis. They found that macroprudential instruments have proven to be effective in containing booms, and more often in limiting the consequences of busts. Yet, there are some trade-offs which entail costs and distortions in the macroeconomy if these instruments are not carefully designed, coordinated with other policies and with close supervision to ensure the efficacy of the instruments.

Claessens et al (2014) looked at the use of macroprudential policy to reduce banking system vulnerabilities. They assessed the effectiveness of macroprudential policies in 48 countries, including 1650 banks in 23 advanced countries and 1,170 banks in 25 emerging markets and some 18,000 observations. They grouped the macroprudential policies according to whether they are borrower specific (caps on debt-to-income (DTI) and loan-to-value (LTV) ratios), specific to banks' assets or liabilities (limits on credit growth (CG), foreign currency credit growth (FC) and reserve requirements (RR)), and policies that encourage counter-cyclical buffers (counter-cyclical capital (CTC), dynamic provisioning (DP) and profits distribution restrictions (PRD)). There was a final group of miscellaneous policies (which have some overlap with the three groups).

Using panel GMM regressions and relating these policies to changes in individual banks' assets, they found that policies aimed at borrowers are effective in (indirectly) reducing the build-up of banking systems vulnerabilities. Measures aimed at banks' assets and liabilities are very effective, but countercyclical buffers as a group show less promise. The group of miscellaneous policies is also very effective. Also, when distinctions were made between upswings and downswings in the overall credit cycle in the countries, all except for the buffer-based category, directly help reduce asset growth during upswings. And policies aimed at banks' asset and liabilities and miscellaneous measures again are very significant. During a contractionary period, the borrower-based measures help reduce asset growth to a lesser degree. They stop declines in bank asset growth in contractionary periods. Measures aimed at banks' asset and liabilities side and the miscellaneous measures also have positive impact in contractionary periods and measures aimed at building banks' buffers are not productive in downswings.

Kuttner and Shim (2016) looked at a variety non-interest rate policies' effect on house prices and housing credit for 57 economies over 1990-2012. They used panel regressions for growth rates of housing credit and house prices, with controls for lagged growth of the dependent variable, the level of the short rate, the growth in real GNP per capita and the credit/GDP gap, as well as country fixed effects. They found debt-service-to-income limits and increases in housing-related taxes, have significant negative effects on housing credit. Increases in housing-related taxes also moderate house price growth.

There are also count

The trend t in the ratio is derived from using the Hodrick-Prescott (HP) filter.[12] The HP filter is a mathematical tool used in macroeconomics to establish the trend of a variable over time. The HP filter is based on assumptions that the credit-to-GDP ratio: (c_t/y_t) can be decomposed into two components: the trend (t_t) and the cycle (c_t), which means $y_t = t_t + c_t$.

By using the Hodrick-Prescott (1997) technique, the BIS note that obtaining the trend involves solving the following optimisation problem:

(3)

where λ (lambda) is the smoothing parameter. The first term in the loss function penalises the variance of the cyclical component, while the second imposes a penalty on the lack of smoothness in the trend. Hence, the solution to the problem is a trade-

exchange rate. They noted that good early warning indicators have two important properties. These properties are, (1) the indicator should predict a high percentage of crises that do occur; and (2) the indicator should have a low false negative, meaning the indicator should not signal a crisis that does not materialise. The credit and exchange rate gaps tended on average to rise one period before and to peak in the crisis year, respectively. But the equity price gap was

Our key data stem on the one hand from the BIS for the credit-to-GDP gap and the other, the IMF GMPI survey data on macroprudential instruments (Cerutti et al 2015, 2017).

In September 2016, the BIS released time-series quarterly data on the credit-to-GDP gap covering 42 countries and one economic region, the Euro area, starting at the earliest in 1961. In May 2017, Colombia was added and is included in our model testing. However, the Euro area is excluded from the panel analysis as many individual countries in the Euro area are already included in the data. The countries in the panel analysis are the following.

The IMF dataset on macroprudential instruments cover 119 countries annually over 2000 to 2013. The data are from the IMF's Global Macroprudential Policy Instruments (GMPI) survey. There are 12 survey instruments and 2 additional derived instruments and three summary instruments in the publicly available dataset. The instruments are as follows:

Survey Instruments		
Loan-to-Value Ratio	LTV	Constrains highly levered mortgage down payments by enforcing or encouraging a limit or by determining regulatory risk

Macroprudential instruments focused on the financial institution	MPIB	Sum of other instruments, including RR_REV rather than RR

Source: Cerutti, Claessens and Laeven (2015). Version February 24th, 2015. Notes: each variable is a dummy that takes on two values: 0 for no policy and 1 for policy in effect. The database covers a sample from 2000 to 2013 with annual data.

Reflecting the coverage of the dataset, the period for the analysis is from 2000q1 to 2013q4, with the IMF GMPI survey data being converted from yearly to quarterly data frequency. The measures were coded from the beginning of the year they are actually in place and subsequently all quarters after that starting year until the period they were discontinued. Quarterly data for the measures is the most appropriate approach since we are testing the macroprudential policies' effectiveness against the lowering of the credit-to-GDP gap, which is a quarterly measure, it is appropriate to have a quarterly frequency for the measures.

The starting point for the empirical analysis is the work of Cerutti et al (2015, 2017) as noted above, who looked at how the macroprudential index and its various sub-indexes shown in Table 2 relate to the growth in countries' credit and house prices. Also important background is the work of Akinci and Olmstead-Rumsey (2015), who using quarterly data investigated macroprudential policies' effects on

used in Akinci and Olmstead-Rumsey (2015) and Cerutti et al (2017)). The sample begins in 2000q1 and ends in 2013q4. Instruments were second lagged levels of the independent variables and the second lag of the dependent variable. The initial estimates for the baseline model are shown in the following table, together with estimates for the same specification for the periods 2000-2006 and 2007-2013.

Loan-to-Value Ratio (LTV (-1))	-	3.23*** (28.6)

effects when gaps are negative. FC is positive for the both positive and negative gaps. MPI, MPIB and MPIF are all positive for the negative gaps. Overall, these results are consistent with the conclusion of Cerutti et al (2017) noted above, that policies are effective but especially in the upturn.

We summarise the work here and compare results for our work with other work using the same IMF

It is noteworthy that the tools that we find most consistently effective in reducing the credit-to-GDP gap are the housing market focused tools, the loan-to-value ratio and the debt-to-income ratio. There is also a significant result for dynamic provisioning and concentration in the full sample, and for leverage post crisis.

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Dependent	DCGDGAP	CGDPGAP	CGDPGAP
CONSTANT		2.512 (10.4)	2.18 (8.4)
CGDPGAP(-1)		0.981 (190.6)	0.983 (184.7)
DCGDPGAP(-1)	0.103 (18.5)		
BCRISIS(-1)	-5.99 (6.5)	-0.777 (4.4)	-0.763 (3.6)
UNEMPLRATE(-1)	-0.962 (20.9)	-0.28 (10.3)	-0.237 (8.3)
INFLATRATE(-1)	-0.15 (9.1)	-0.0877 (5.0)	-0.0954 (5.4)
REALGDPRATE(-1)		-0.0803 (4.3)	-0.0589 (2.5)
BANKRATE(-1)	0.0457 (2.9)	0.0542 (3.3)	0.0484 (2.7)
Observations	2124	2210	2210
Sargan (J-Statistic) (p-value)	0.43	n/a	n/a
Periods included	53	55	55

Finally, as regards further research, this could utilise the graduated macroprudential database of Cerutti et al (2016) as well as that of Kuttner and Shim (2016), and it could use the GMM system specification of Arellano and Bover (1995) and Blundell and Bond (1998). Separate regressions for advanced and EME countries and further robustness checks could also be undertaken. Further work with bank level data could be envisaged. In addition,

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