Abstract
Based on a novel quarterly dataset for 52 countries for the period 1970-2011, we analyze the use and cyclical properties of reserve requirements as a macroeconomic stabilization tool and whether reserve requirement policy (RRP) substitutes or complements monetary policy. We find that (i) more than 50 percent of developing countries have used RRP as a macroeconomic tool compared to no industrial country; (ii) 74 percent of developing countries have used RRP countercyclically compared to just 35 percent that have engaged in countercyclical monetary policy; and (iii) in most developing countries, RRP has substituted monetary policy as a countercyclical tool. We interpret the latter finding as reflecting the reluctance of many emerging markets to reduce interest rates in bad times for fear of letting their currency depreciate rapidly or raising interest rates in good times for fear of attracting even more capital inflows and currency appreciation. Under these circumstances, RRP provides a second instrument that substitutes for monetary policy as a countercyclical tool. Evidence from expanded Taylor rules supports these mechanisms.

JEL Classification:

Keywords:

*This paper was written while the authors were visiting the World Bank’s Office of the Chief Economist for Latin America and the Caribbean and Vegh was also visiting the Macroeconomics and Growth Division (DEC) at the World Bank, and is part of an ongoing project on macroprudential policy at the Office of the Chief Economist. The authors are very grateful for the hospitality and stimulating policy and research environment and would like to thank Enrique Alberola, Tito Cordella, Augusto de la Torre, Alain Ize, and seminar participants at the Bank of Spain, CEMLA, IDB, IMF, and World Bank for many helpful comments and discussions. Jorge Puig and Pedro Pablo Matinez provided excellent research assistance. The views expressed in the paper are the authors’ own and do not necessarily reflect those of the Office of the Chief Economist or the World Bank.*
1 Introduction

The recent global financial crisis has triggered an intense debate on the pros and cons of using macroprudential policy, broadly defined as the use of prudential tools, such as reserve or capital requirements, for macroeconomic stabilization purposes. Although the discussion is certainly not novel – many emerging countries had resorted to macroprudential policy well before Lehman Brothers’ demise on September 15, 2008 – it took an urgent undertone in light of the sudden realization of the severe contractionary forces that could be unleashed by the abrupt unwinding of financial imbalances and systemic risk.

Perhaps one of best examples of the renewed debate on macroprudential policy is the resurgence of the so-called “Tobin tax” – a financial tax on short-term capital inflows – whose popularity had arguably reached a low point by the mid-2000’s, after gaining some limited popularity in previous decades thanks to its use by Chile.1 The mere fact that even the IMF – presumably a bulwark of macroeconomic orthodoxy – has come out in favor of using Tobin taxes under some circumstances is a dramatic illustration of the search for new policy tools in this much-changed post-Lehman world.

There are, of course, many prudential tools that can be used for macroeconomic stabilization purposes, including reserve requirements, capital requirements, caps on the loan-to-value ratio, credit ceilings, and dynamic provisioning, among many others. Broadly speaking, the purpose of using these instruments is to reduce the amplitude of the financial cycle and contain potential financial vulnerabilities that could be created as a result. Whether many of these instruments should be used at all and how effective they may be is the subject of an emerging literature. For example, based on data from an IMF survey, Claessens and Ghosh (2012) look at seven different prudential instruments and conclude that debt-to-income caps, limits on foreign currency lending, and loan-to-value ratios have been relatively effective in reducing vulnerabilities in banking systems. In a similar vein, Lim et al. (2011) present some empirical evidence to the effect that macroprudential policy may be effective in reducing procyclicality.

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of financial variables and reducing systemic risk.\footnote{See also Borio and Shim (2007), Calderon and Serven (2011), De la Torre, Ize, and Schmukler (2012), IDB (2012, Chapter 6), IMF (2011), Glocker and Towbin (2012), Montoro and Moreno (2011), and Vargas et al. (2010).} By and large, however, the effectiveness of macroprudential policy is still very much an open question.

This paper contributes to the empirical discussion on macroprudential policy by focusing on a particular instrument (reserve requirements).\footnote{We choose to focus on reserve requirements because (i) they are arguably the most popular macroprudential tool, and (ii) by its very nature (a long history and available time series from Central Banks and other domestic sources), it is feasible to gather a large panel dataset.} Due to data limitations, existing studies on the effectiveness of reserve requirements (see, for instance, Tovar et al. 2012) focus on the recent past and a small group of countries. There is simple no readily-available, panel data on reserve requirements. To remedy this situation, we build from scratch a novel quarterly dataset on legal reserve requirements for 52 countries, 15 industrial and 37 developing, for the period 1970-2011.\footnote{As will become clear from our analysis, the quarterly (as opposed to annual) frequency is critical when it comes to assessing the cyclical properties of reserve requirements policy.} We focus on legal (as opposed to actual) reserve requirements because legal reserve requirements are a policy instrument whereas actual reserve requirements constitute an endogenous outcome that will be affected by the amount of deposits (i.e., the state of the business cycle).\footnote{Hence, in what follows (and unless stated otherwise), the expression “reserve requirements” should be taken to refer to the legal reserve requirement rate and “reserve requirement policy” to changes in such a rate.} We believe that gathering such large dataset is a highly fruitful endeavor because it will allow us to characterize the use of reserve requirements over the business cycle drawing on a very heterogenous dataset covering up to four decades and very diverse countries and macroeconomic circumstances.

With this dataset in hand, we ask the following questions: (i) what countries have used reserve requirements as a macroeconomic stabilization tool? (ii) How does the use of reserve requirements policy as a macroeconomic stabilization tool compare in emerging and industrial countries? (iii) In countries that use reserve requirements as a macroeconomic stabilization tool, have they been used countercyclically? (iv) Has reserve requirements policy (henceforth RRP) acted as a substitute for or complement to monetary policy? (v) What economic forces have driven the interaction between RRP and monetary policy (i.e., interest rate policy)?
To answer these questions, we first compute the frequency of change in reserve requirements. Unlike standard economic time-series (like, say, government spending) which vary continuously over time, reserve requirements may stay constant for prolonged periods of time (i.e., they behave more like a tax rate or the price of a single good). In the case of Chile, for instance, legal reserve requirements have changed only twice in our 31-year sample. We take the frequency of changes as an indicator of whether reserve requirements are used for macroeconomic stabilization purposes. In particular, if reserve requirements are changed more than once over the business cycle, we conclude that countries make active use of RRP. Based on this indicator, we divide our sample of 52 countries into “active” versus “passive” countries when it comes to RRP. We conclude that 37 percent of the countries in our sample have pursued an active RRP. This figure, however, masks an enormous difference between emerging markets and industrial countries: while 51 percent of developing countries have been active, no industrial country has been active. Indeed, about 50 percent of industrial countries have zero reserve requirements (i.e., no legal reserve requirements).

We then compute the cyclical properties of RRP for the active group of countries and find that 74 percent have pursued countercyclical RRP. This figure increases to 86 percent during the last 7 years. The fact that so many developing countries have used RRP as a countercyclical tool is nothing short of remarkable in light of the fact that only 35 percent of developing countries have engaged in countercyclical monetary policy (compared to 80 percent of industrial countries). We attribute the asymmetric use of RRP and monetary policy in developing countries to what we refer to as the “fear of free falling” (in bad times) and “fear of capital inflows” (in good times). “Fear of free falling” refers to the reluctance of emerging

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6Naturally, it could be the case that reserve requirements are changed frequently for, say, microprudential reasons, but this is unlikely.

7The “obvious” alternative would be to compute the correlation between the cyclical components of the legal reserve requirement rate and the business cycle (i.e., GDP) and define as active those countries for which the correlation is significantly different from zero. However, while computing correlations makes sense when studying the cyclical properties of fiscal or interest rate policy (see Frankel, Vegh, and Vuletin (2011) and Vegh and Vuletin (2012)), it would make little sense for reserve requirements because while one can mechanically compute a “cyclical” component for a series that has changed only twice in 31 years, such cyclical component would be clearly devoided of economic meaning.

8Throughout this paper, we will use the term “monetary policy” to mean interest rate policy.
markets to lower interest rates in bad times to help the economy get out of the recession for fear of facing rapid currency depreciation. As a result, policymakers may choose to lower reserve requirements to help the economy get out of the recession. In a similar vein, “fear of capital inflows” captures the idea that, during good times, the monetary authority may be reluctant to increase interest rates for fear of attracting more capital inflows, in which case it may choose to increase reserve requirements to cool down the economy. In such cases, RRP acts as a substitute for monetary policy in the sense that, in bad (good) times, reserve requirements do what monetary policy cannot do; that is, spur (cool down) the economy. In contrast, when both RRP and monetary policy are countercyclical, we say that they act as complements because they both pursue the same goal (i.e., reactivating the economy in bad times and cooling it down in good times).

To capture the complementarity/substitutability between monetary policy and RRP, we first construct a 3x3 “policy mix matrix” that combines the cyclical stance of RRP and monetary policy (procyclical, acyclical, and countercyclical). The typical industrial country is acyclical when it comes to RRP and countercyclical in monetary policy. Indeed, most industrial countries rarely change reserve requirements. The most common policy mix for emerging markets is acyclical monetary policy (reflecting, in our interpretation fear of free falling/capital inflows) and countercyclical RRP. We also confirm this stylized fact and the above suggested mechanisms using expanded Taylor rules, which include an exchange rate gap, in addition to output and inflation gaps (as traditional Taylor rules). Analyzing the behavior of both monetary and reserve requirements policy, we find that for countries that use reserve requirements actively, RRP is countercyclical. In contrast, interest rate policy does not respond systematically to output fluctuations (i.e., is acyclical) but increases (decreases) when the currency tends to depreciate (appreciate). On the other hand, countries that make no active use of reserve requirements respond countercyclically with interest rates and positively to the inflation and exchange rate gaps.

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9 See, for example, Corbo (2000) and Moron and Winkelried (2005).
The paper proceeds as follows. Section 2 introduces the reserve requirements dataset and discusses three basic features. First, it describes four different arrangements depending on whether reserve requirements vary according to maturity and/or currency. Second, it identifies some historical trends on the evolution and dispersion of reserve requirements over time. Lastly, it analyzes the relationship between the cyclical components of different reserve requirements in countries which have multiple reserve requirements. The evidence points out to the presence of a common RRP even in the presence of multiple reserve requirements. Section 3 develops the main analysis on macroprudential policy over the business cycle. Section 4 studies the complementarity/substitutability between RRP and monetary policy. Section 5 reinforces the findings of Sections 3 and 4 using expanded Taylor rules. It also provides formal evidence regarding the importance of the fear of free falling and capital inflows channels described above. Section 6 concludes.

2 Data on reserve requirements

The database originally collected for this paper is part of a World Bank regional study on macroprudential policy carried out by the Office of the Chief Economist for Latin America. The database comprises 52 countries, 15 industrial and 37 developing countries: Argentina, Australia, Belarus, Brazil, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Rep., Denmark, Dominican Rep., Ecuador (dollarization), Ecuador (pre-dollarization), El Salvador, Euro-17, France, Germany, Guatemala, Honduras, Hungary, India, Israel, Jamaica, Japan, Latvia, Lithuania, Macedonia, Malaysia, Mexico, New Zealand, Nicaragua, Norway, Panama, Peru, Philippines, Poland, Portugal, Romania, Serbia, Singapore, Spain, Sweden, Switzerland, Thailand, Trinidad and Tobago, Turkey, United Kingdom, United States, Uruguay, and Venezuela.10

This novel quarterly dataset on reserve requirements comes from primary sources such

10For convenience, we will use the term “countries,” but notice that our list includes the Euro zone as a single economic unit and Ecuador as two different economic units (before and after full dollarization in the year 2000).
as central banks’ and government agencies’ websites as well as research and policy papers. In many cases, however, we received invaluable help from staff and researchers at central banks.\textsuperscript{11,12} To set the stage, we begin by briefly discussing some broad features of the data.

### 2.1 Varieties of reserve requirements

We find in the data four different types of arrangements: (i) single reserve requirement; (ii) reserve requirements that vary according to maturity; (iii) reserve requirements that vary according to currency of denomination; and (iv) reserve requirements that vary according to both maturity and currency of denomination. Figures 1 to 4 present some examples of different arrangements:

- Figure 1 shows the evolution of the single reserve requirement in China. As the figure clearly illustrates, since 2007 China has made active use of reserve requirements as a countercyclical tool.\textsuperscript{13}

- Figure 2 shows the evolution of reserve requirements in Venezuela. Until the last quarter of 1990, Venezuela had reserve requirements that varied according to maturity (demand, savings, and term), with the required reserve requirement decreasing with the maturity: 15 percent for demand deposits, 10 percent for saving deposits, and 8 percent for term deposits. This differential reserve requirements structure aimed at discouraging short-term capital inflows and deposits. Since the unification of reserve requirements in the last quarter of 1990, reserve requirements have changed much more frequently and have been used as a countercyclical tool.

- Figure 3 shows the evolution of reserve requirements in Peru, which vary by currency of denomination. While both series have comoved positively – partly reflecting the recent

\textsuperscript{11}See Appendix 7.1 for a detailed description of the data and sources.
\textsuperscript{12}Our study also uses other macroeconomic variables such as real GDP, inflation, and central bank interest rates, all of them at the quarterly frequency. Real GDP data is seasonally-adjusted. Most of this data were gathered from Global Financial Data and IFS (IMF). See Appendix 7 for a description of data and its sources.
\textsuperscript{13}See Ma et al. (2011) for a detailed analysis of RRP in China. In fact, between November 2011 and May 2012, the central bank has cut reserve requirements three times by a total of 1.5 percentage points as the economy has slowed down (Wall Street Journal, August 13, 2012).
counter-cyclical use of reserve requirements, as discussed in Montoro and Moreno (2011) – foreign-currency-deposits reserve requirements are much higher (about 4 times as high) than those for domestic-currency deposits. This differential reflects the concerns with sudden reversals in foreign currency flows, as discussed in Quizpe and Rossino (2010).

- Figure 4 shows the evolution of reserve requirements in Argentina, which vary according to both maturity and currency of denomination. During the early 1990s, the highest reserve requirements were for demand deposits, both for local and foreign currency. Reserve requirements were unified in mid-1995 and remained fairly stable until the end of 2001. Argentina then went back to the pre-1995 regime, with different reserve requirements depending on maturity and currency of denomination. Unlike in the pre-1995 regime, however, the highest reserve requirements during the early and mid-2000s were for foreign-currency deposits (both demand and term deposits).

Table 1 illustrates in a more systematic the wide diversity of reserve requirements arrangements in our sample.\textsuperscript{14} We can see that all industrial countries (including the Euro zone) fall in the first two categories, including Australia, Canada, Denmark, New Zealand, Norway, Sweden (since 1995), and United Kingdom, which have no legal reserve requirements. In contrast, developing countries span the whole spectrum, ranging from Mexico, which has had zero legal reserve requirements since 1992, to a fairly numerous group that has reserve requirements that vary according to both maturity and currency of denomination. Developing countries are fairly evenly distributed across categories: 32 percent have single reserve requirements, 22 percent have reserve requirements that vary according to maturity or currency of denomination, and about 24 percent of the countries have reserve requirements that vary according to both maturity and currency of denomination. The existence of reserve requirements based on currency of denomination in many developing countries should perhaps come as no surprise given the widespread phenomenon of “dollarization” or, more broadly, foreign

\textsuperscript{14}Single reserve requirements includes the case of no legal reserve requirement.
currency deposits.  

2.2 Long-run trends

To get an idea of how reserve requirements have evolved over time, Figure 5 plots the average reserve requirement across countries since 1975 to the present and the corresponding linear trend. On average, developing countries (solid line) have reserve requirements that are about 7 times higher than those of industrial economies (dashed line). The historical average reserve requirement for industrial countries is around 0.02, compared to 0.14 for developing economies.

For developing countries, we can see a clear declining trend reflecting financial liberalization and financial deepening. Reserve requirements reached their highest average values in the late 1970s (around 0.21), while they got to historical lows in the late 1990s with reserve requirements averaging 0.1. We can also see an increase in actual average reserve requirements in the period 2005-2010 reflecting – as discussed in detail below – a more active use of macroprudential policy in the period surrounding Lehman’s fall on September 15, 2008. We see a similar declining trend, but much less steeper, for industrial countries.

Figure 6 depicts the dispersion of reserve requirements over time and the corresponding linear trend. For developing countries – and as was the case in Figure 5 – we see a clear declining trend with an increase in the actual dispersion over the last 5 years. In other words, during the last three decades there has been a convergence in terms of different reserve requirements, with the value for 2011 not too far from that for industrial countries. On the other hand, we see essentially no change over time for industrial countries.

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15 For a detailed discussion of dollarization, see Savastano, Reinhart, and Rogoff (2003) and the references therein.
16 This is the simple average of existing reserve requirements for a given country averaged over all countries.
17 We compute the standard deviation of existing reserve requirements for each country and then average across countries.
2.3 Multiple reserve requirements: Correlation between cyclical components

If countries around the world had a single reserve requirement, the analysis regarding RRP over the business cycle would be fairly straightforward since we would need to focus only on the cyclical component of the single reserve requirement. The presence of multiple reserve requirements that vary according to maturity and/or currency presents, in principle, a challenge for the analysis of RRP. For example, it could be the case that while reserve requirements for one of type of deposits is increasing, the one on some other type of deposits is decreasing. If this kind of asymmetric pattern across different reserve requirements were fairly common, it would be difficult to assess the overall behavior of RRP over the business cycle. Interestingly, however, while the levels of reserve requirements may vary across different categories of deposits, their cyclical components appear to be positively related (Table 2). Indeed, in almost all cases we cannot reject that such correlations are positive and statistically significant.

3 Macroprudential policy over the business cycle

Needless to say, not all countries make use of reserve requirements for macroeconomic stabilization purposes. An obvious example would be countries, such as the industrial countries mentioned above, which have zero legal reserve requirements. In other cases, however, reserve requirements may occasionally change but owing to microprudential reasons (broadly defined as including any reason not related to the business cycle). Since our purpose is to analyze the cyclical properties of reserve requirements in those countries that use them for macroeconomic stabilization purposes, we need an operational definition that will allow us to divide countries into those that make active use of reserve requirements for such purposes and those that do not. Once we have put countries into these two categories, we can proceed to compute the cyclicality of RRP for the active group.

Our operational definition will be based on the frequency of change in reserve requirements.
Notice that, unlike standard macroeconomic time series, such as government consumption, which evolve in a continuous fashion over time, the legal reserve requirement rate is a “discontinuous series” in the sense that it may not change for prolonged periods of time. For this type of time series, the frequency of changes is an important statistic.\textsuperscript{18} Figure 7 illustrates the quarterly frequency of changes in reserve requirements for all the countries in our sample.\textsuperscript{19} Yellow bars denote developing economies while black bars indicate industrial countries. For example, a frequency of 1 indicates that, on average, a country changes reserve requirements once per quarter or 4 times a year, whereas a frequency of 0.25 indicates a change every 4 quarters. The first obvious message of this picture is that yellow bars tend to be concentrated on the right-side (indicating frequent changes in reserve requirements) whereas black bars tend to be bunched towards the left-side (including many industrial countries with zero frequency and hence no discernible bar). This already tells us that we should expect to find many more developing countries in our group of active users of reserve requirements.

Clearly, a country with zero frequency of changes will fall in the category of passive (i.e., non-active) countries. A country like Chile with a frequency of 0.016 (having changed reserve requirements only twice in our 31 year-sample) will also fall in the passive category. But where do we draw the line? Since we are focusing on the use of reserve requirements for macro-stabilization purposes, it makes sense to think that if a country changes reserve requirements at a frequency that is lower than that of its business cycle, it is not actively using reserve requirements to smooth out the business cycle. Hence, what we do is to compute for each country the average duration of the business cycle based on quarterly GDP. If the frequency of changes in reserve requirements is higher (lower) than the average cycle, then we classify that country as an active (passive) country in terms of reserve requirements policy.\textsuperscript{20} For example,
the average duration of the business cycle for Turkey is 3.8 years, whereas reserve requirements change, on average, every 2.1 years. We thus classify Turkey as an active country when it comes to using reserve requirements as a macroeconomic stabilization tool. Conversely, the average business cycle for Chile is 2.5 years whereas reserve requirements change, on average, every 15 years, which makes Chile a passive country for our purposes.

Figure 8 uses a scatter plot to illustrate the classification of countries into active and passive. The horizontal axis measures the average duration (in years) of the business cycle in a given country while the vertical axis measures the time (also in years) between changes in reserve requirements in the same country. Along the 45 degree line, the duration of the business cycle and the time between changes are the same. According to our definition, points below the 45 degree line are countries in which the time between changes in reserve requirements is more than the business cycle frequency (active countries), while the reverse is true for countries above the 45 degree line.\footnote{Countries with zero frequency of change would have an “infinite” amount of time between changes and are plotted out of scale.}

Based on this criterion, 19 out of the 52 countries (or 37 percent) depicted in Figure 7 are classified as active countries. As expected, there is a striking difference between industrial and developing countries: 19 out of 37 (or 51 percent) of developing countries are classified as active, whereas there is not a single industrial country with active reserve requirements policy.

Having identified a group of countries which, according to our definition, has pursued RRP for macroeconomic stabilization purposes, we can now proceed to compute the cyclical properties of RRP for this group. Figure 9 depicts the correlation between the cyclical components of reserve requirements and GDP for active countries.\footnote{When a country has multiple reserve requirements, we compute the correlation between the cyclical components of reserve requirements and GDP for each one and then take the average. It is important to recall that, as discussed in subsection 2.3, the cyclical components of reserve requirements are strongly positively related in countries with multiple reserve requirements.} We can see that most countries (14 out of 19, or 74 percent) have pursued countercyclical RR policy.

\footnote{The “discontinuous” nature of reserve requirements as a time series.}
Has the use of RRP for macroprudential purposes changed/intensified in recent times? As mentioned when discussing Figure 5, it seems that over the last 6 years or so, countries have resorted more frequently to macroprudential policy. Figure 11 shows the cyclicality of reserve requirements since 2005 for those countries that are classified as active for the period 2005-2011.\textsuperscript{23} We can see that now a higher proportion of countries (12 out of 14, or 86 percent) have pursued countercyclical RRP. Moreover, the average correlation between the cyclical components of reserve requirements and output increased by almost 3 times (from 0.15 to 0.43).

To sum up, based on the frequency of change in reserve requirements, all industrial countries and 49 percent of developing economies do not seem to have typically used reserve requirements for macroprudential purposes. Of the 51 percent of developing countries that have used reserve requirements in an active manner, 74 percent show countercyclical behavior of reserve requirements. The latter figure increases to almost 86 percent during the last 6 years.

4 The policy mix matrix

In and of itself, the fact that 74 percent of active developing countries have, on average, pursued countercyclical RRP may not seem that remarkable. But it is actually quite remarkable when compared to the percentage of developing countries that have pursued countercyclical monetary policy.\textsuperscript{24} Figure 10 depicts the correlation between the cyclical components of policy interest rates and GDP on a quarterly basis. We can see that all industrial countries (black bars) exhibit a positive correlation indicating countercyclical monetary policy (i.e., the policy rate is low in bad times and high in good times) and in 12 out of 15 cases (or 80 percent), the correlation is significantly different from zero. In sharp contrast, only 35 percent (or 13 out of 37) of developing countries show countercyclical monetary policy (i.e., positive correlation

\textsuperscript{23}Colombia and Philippines emerge as new active users of RRP.

\textsuperscript{24}See Vegh and Vuletin (2012) for a detailed analysis of the cyclicality of monetary policy.
significantly different from zero).

Why do we see such a sharp difference in the conduct of monetary policy? Vegh and Vuletin (2012) argue that a critical factor is the “fear of free falling,” defined as the need for developing countries to defend their currency in bad times. While a typical industrial country can lower interest rates in bad times without the fear of a sharp depreciation of their currency, this is often not true of developing countries. In bad times, when capital is flowing out and credibility is at a low point, many developing countries see the value of their currency plummet. In those circumstances, the monetary authority may have no choice but to either increase the interest rate to defend the currency (or at least not reduce it for fear of exacerbating the fall). As a result, they increase interest rates to avoid/delay the capital outflow at the same time that they decrease reserve requirements to spur the economy (by reducing the lending spread).

While “fear of free falling” offers a plausible story for bad times, an analogous story is based on what we could refer as “fear of capital inflows.” The idea would be that in periods of capital inflows (and ensuing output boom), the monetary authority is reluctant to raise interest rates because of the fear of attracting even more capital inflows (or fear of currency appreciation). As a result, they either keep interest rates unchanged or even lower them to attract less capital inflows at the same time that they raise reserve requirements to cool off the economy (by increasing the lending spread).

This implies that developing countries may be caught in the common policy dilemma of too few instruments (the policy interest rate) relative to the number of targets (output and

\[25\text{In fact, this has been part of the standard IMF policy advice to developing countries, most notably during the Asian crisis of 1997. To quote Stanley Fischer, at the time the IMF’s First Deputy Managing Director, in a 1998 lecture delivered at UCLA, “[i]n weighing this question [are the IMF programs in Asia too tough?], it is important to recall that when they approached the IMF, the reserves of Thailand and Korea were perilously low, and the Indonesian rupiah was excessively depreciated. Thus, the first order of business was, and still is, to restore confidence in the currency. To achieve this, countries have to make it more attractive to hold domestic currency, which, in turn, requires increasing interest rates temporarily, even if higher interest costs complicate the situation of weak banks and corporations.”}

\[26\text{This was the position of the Turkish Central Bank as described in a Financial Times article on Dec 13, 2010. The deputy governor argued that the way to deal with heavy capital inflows was to reduce interest rates (to reduce capital inflows and currency appreciation) while using other instruments (i.e., reserve requirements) to reduce credit growth.}]}
the nominal exchange rate). Viewed in this light, it is perhaps not surprising to see developing
countries resort to the use of reserve requirements in a countercyclical manner, as they provide
the second instrument that may be needed to achieve the two targets just mentioned. In other
words, during bad times a country may not be able to lower interest rates (as it would like,
were it not for the fear of free falling), but may lower reserve requirements instead. Similarly,
during good times a country may not be able to increase interest rates (as it would like, were
it not for the fear of capital inflows), but may increase reserve requirements instead. In other
words, reserve requirements policy is acting as a substitute for monetary policy.

On the other hand, there are emerging markets that do not suffer from the fear of free
falling and capital inflows and may therefore be able to pursue countercyclical monetary
policy. If, in addition, they also use reserve requirements in a countercyclical way, we say that
RRP is acting as a complement for monetary policy since both instruments are being used
for the same purpose (to increase output in the case of a recession).

Table 3 can be viewed as a “policy mix matrix” that classifies countries according to the
cyclical properties of both monetary and reserve requirements policies. Since countries may
be procyclical, acyclical, or countercyclical, there are 9 possible cells or combinations. Given
that, as already discussed, all industrial countries are passive when it comes to RRP, they
will all be located along the second row. And, since most of them pursue countercyclical
monetary policy, they will be located in the cell (2,3), colored in orange (dark gray).

In contrast, most active developing countries pursue countercyclical RRP and are therefore
located along the third row. Within this group, most are located in cell (3,2), colored in yellow
(light gray), because they are acyclical when it comes to monetary policy. Two countries
(Argentina and India) are in cell (3,1) because they exhibit procyclical monetary policy. In
light of the above discussion, we refer to countries in cells (3,1) and (3,2) as cases in which RRP
is a substitute for monetary policy. In contrast, we refer to countries in cell (3,3), where both
monetary and RRP are countercyclical, as cases in which RRP is a complement for monetary
policy. This decomposition based on the policy mix matrix indicates that most countries that
use reserve requirements countercyclically use them as a substitute for monetary policy (10 out of 14, or 71 percent).

5 Taylor rules

Sections 3 and 4 showed evidence on the use of reserve requirements for macroprudential purposes and illustrated the fact that RRP typically acts as a substitute for monetary policy. We also provided a rationalization, based on fear of free falling in bad times and fear of capital inflows in good times, for such a policy mix. This section provides further evidence on these empirical regularities and sheds light on the policy channels discussed above. For this purpose, we estimate “expanded” Taylor rules for developing countries over the period 2005-2011, which saw the heaviest use of reserve requirements as a countercyclical tool (Section 3).27 By “expanded” Taylor rules, we mean Taylor rules that, in addition to the output and inflation gaps, include the nominal exchange rate gap (see, for instance, Corbo, 2000, and Moron and Winkelried, 2005). The nominal exchange rate gap captures policymakers’ concerns with excessive depreciation (appreciation) in bad (good times).

Table 4 shows Taylor rules for both monetary and reserve requirement policy for countries that have used RRP actively since 2005. We estimate these policy reaction functions using a system of simultaneous equations.28 Columns 1a,b, on the one hand, and 2a,b, on the other hand, show the results when including the output and inflation gaps, and output and nominal exchange rate gaps, respectively.29,30 Columns 3a,b include output, inflation, and nominal exchange rate gaps.

Turning now to the results, columns 1a,b illustrate the fact that, as shown in sections 3 and 4, monetary policy is acyclical whereas RRP is countercyclical. In other words, RRP

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27 Similar results are obtained if the entire period is used.
28 In case of multiple reserve requirements, we calculate the cyclical component of the average reserve requirement by averaging the cyclical components of each reserve requirement.
29 The nominal exchange rate is defined as units of local currency per dollar. Therefore an increase (decrease) in the nominal exchange rate represents a depreciation (appreciation) of the local currency.
30 We calculate the cyclical component of the growth rate of the nominal exchange rate (as opposed to the one for the level of the nominal exchange rate).
acts as a substitute for monetary policy. Columns 2a and 2b are consistent with columns 1a and 1b regarding the cyclicality of the policy rate and reserve requirements, but illustrate the importance of nominal exchange rate fluctuations for monetary policy. In particular – and as discussed in Section 4 – the policy rate reacts positively to the nominal exchange gap, which captures the fear of free falling (higher interest rates in response to a nominal depreciation) and fear of capital inflows (lower interest rate in response to a nominal appreciation). Columns 3a and 3b confirm these results. To sum up, monetary policy responds positively to exchange rate depreciations and RRP focuses on the output gap in a countercyclical way. In other words, RRP substitutes for monetary policy.

Table 5 shows Taylor rules for monetary policy for countries that did not use RRP actively since 2005. Columns 1 and 2 show the results when including the output and inflation gaps, and output and nominal exchange rate gaps, respectively. Column 3 includes output, inflation, and nominal exchange rate gaps. In sharp contrast to the active countries considered in Table 4, passive countries have been able to use monetary policy to respond to output fluctuations in a countercyclical way. In addition, they have also responded positively to the inflation and exchange rate gaps. It is interesting to note that the coefficient of variation – defined as the ratio between the standard deviation and its mean – of the (cyclical component) of the nominal exchange rate for countries that use reserve requirements actively is about 7 times that of countries that are categorized under passive users of RRP. This striking difference in exchange rate volatility since 2005 together with the asymmetric response of monetary and reserve requirements policy illustrated in Tables 4 and 5 strongly support our arguments regarding the mechanisms involved, the role of fear of free falling and capital inflows, and the underlying reasons for RRP to substitute (if necessary) monetary policy.

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31 The nominal exchange rate gap becomes less significant due to multicolinearity between the inflation and exchange rates gaps.

32 The coefficient of variation of the nominal exchange rate for active users of reserve requirements is 112.6, while the one for passive users is 16.9.
6 Conclusions

This paper has uncovered several stylized facts regarding the use of reserve requirements as a macroeconomic stabilization tool and its relation to monetary policy. In particular, we have seen that more than 50 percent of emerging markets use reserve requirements as a macroeconomic stabilization tool compared to no industrial country in our sample. Of these emerging markets, around three quarters have actively used reserve requirements as a countercyclical tool and most have used it as a substitute for monetary policy. We have argued – and provided evidence in the form of expanded Taylor rules – that two possible explanations for the use of reserve requirements as a substitute for monetary policy are (i) the fear of free falling (the need to defend the currency in bad times by raising policy rates) and (ii) the fear of capital inflows (the reluctance to raise interest rates in good times for fear of attracting even more capital inflows).

7 Appendix 1. Definition and sources of variables

All data is at quarterly frequency. X-12-ARIMA is used for seasonal adjustment. Cyclical components were obtained using the Hodrick-Prescott filter.

7.1 Reserve requirements

Legal reserve requirements. Data period covers 1970-2011. What follows is a description of the reserve requirement data and its sources.
References


Figure 1. China's reserve requirement over time.

Figure 2. Venezuela's reserve requirements over time.
Figure 3. Peru's reserve requirements over time

Figure 4. Argentina's reserve requirements over time

Note: RR associated with savings deposits are the same than those of demand deposits, both for local and foreign currency.
Figure 5. Average reserve requirements over time

Figure 6. Dispersion of reserve requirements over time
Figure 7. Frequency of changes in reserve requirements (1970-2011)

Figure 8. Active versus passive reserve requirement policy (1970-2011)

Note: The solid line is a 45 degree line. Countries located below (above) the 45 degree line are countries for which the change in reserve requirements takes place, on average, at least (less than) one time per business cycle.
Figure 9. Cyclicality of reserve requirement policy (1970-2011)

Note: Sample only includes active reserve requirement policy countries.

Figure 10. Cyclicality of interest rate policy (1970-2011)
Figure 11. Cyclicality of reserve requirement policy (2005-2011)

Av. developing = 0.43
100% of industrial countries excluded
60% of developing countries excluded
Table 1. Varieties of reserve requirements

<table>
<thead>
<tr>
<th>Developing (37)</th>
<th>Single RR (19)</th>
<th>Maturity RR (16)</th>
<th>Currency RR (8)</th>
<th>Maturity and currency RR (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>Brazil</td>
<td>Croatia</td>
<td>Argentina</td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>Chile</td>
<td>Guatemala</td>
<td>Belarus</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>El Salvador</td>
<td>Lithuania</td>
<td>Dominican Republic</td>
<td></td>
</tr>
<tr>
<td>Jamaica</td>
<td>Hungary</td>
<td>Macedonia</td>
<td>Ecuador (before dollarization)</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>Israel</td>
<td>Nicaragua</td>
<td>Poland</td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>Latvia</td>
<td>Peru</td>
<td>Romania</td>
<td></td>
</tr>
<tr>
<td>Panama</td>
<td>Venezuela</td>
<td>Serbia</td>
<td>Turkey</td>
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<td>Philippines</td>
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<td>Uruguay</td>
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<tr>
<td>Singapore</td>
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<td></td>
</tr>
<tr>
<td>Thailand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Industrial (15)</th>
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<th>Canada</th>
<th>Denmark</th>
<th>New Zealand</th>
<th>Norway</th>
<th>Sweden</th>
<th>United Kingdom</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Euro</td>
<td>France</td>
<td>Germany</td>
<td>Japan</td>
<td>Portugal</td>
<td>Spain</td>
<td>Switzerland</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>United States</td>
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</tbody>
</table>

Table 2. Correlations between the cyclical components of multiple reserve requirements

Panel A. Reserve requirements that vary according to maturity

<table>
<thead>
<tr>
<th>RR demand</th>
<th>RR savings</th>
<th>RR term</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.56***</td>
<td>0.61***</td>
</tr>
<tr>
<td>RR savings</td>
<td>1</td>
<td>0.75***</td>
</tr>
<tr>
<td>RR term</td>
<td>0.61***</td>
<td>1</td>
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</table>

Panel B. Reserve requirements that vary according to currency of denomination

<table>
<thead>
<tr>
<th>RR local</th>
<th>RR foreign</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.31***</td>
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</table>

Panel C. Reserve requirements that vary according to maturity and currency of denomination

<table>
<thead>
<tr>
<th>RR demand-local</th>
<th>RR savings-local</th>
<th>RR term-local</th>
<th>RR demand-foreign</th>
<th>RR savings-foreign</th>
<th>RR term-foreign</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.27***</td>
<td>1</td>
<td>0.06</td>
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<td>RR savings-local</td>
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<td>0.34***</td>
<td>0.01</td>
<td>0.98***</td>
<td>0.49***</td>
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<tr>
<td>RR demand-foreign</td>
<td>0.31***</td>
<td>0.26***</td>
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<td>1</td>
<td></td>
</tr>
<tr>
<td>RR savings-foreign</td>
<td>0.26***</td>
<td>0.10**</td>
<td>0.28***</td>
<td>0.57***</td>
<td>0.49***</td>
</tr>
<tr>
<td>RR term-foreign</td>
<td>0.26***</td>
<td>0.10**</td>
<td>0.28***</td>
<td>0.57***</td>
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</tr>
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</table>
Table 3. Policy mix matrix (1970-2011)

<table>
<thead>
<tr>
<th>Reserve requirement policy</th>
<th>Pro-cyclical</th>
<th>A-cyclical</th>
<th>Counter-cyclical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro-cyclical</td>
<td>Costa Rica, Ecuador (pre-dollarization)</td>
<td>Jamaica</td>
<td>Colombia, Trinidad and Tobago</td>
</tr>
<tr>
<td>A-cyclical</td>
<td>Chile, Dominican Rep., Mexico, Uruguay</td>
<td>Brazil, Hungary, Israel, Japan, Macedonia, Panama, Portugal, Romania, Sweden, Thailand</td>
<td>Australia, Canada, Czech Rep., Denmark, Ecuador (dollarization), El Salvador, Euro-17, France, Germany, Guatemala, Lithuania, New Zealand, Norway, Poland, Singapore, Spain, Switzerland, United Kingdom, United States</td>
</tr>
<tr>
<td>Counter-cyclical</td>
<td>Argentina, India</td>
<td>Belarus, Croatia, Latvia, Nicaragua, Philippines, Serbia, Turkey, Venezuela</td>
<td>China, Honduras, Malaysia, Peru</td>
</tr>
</tbody>
</table>

Substitutes | Complements
### Table 4. Taylor rules for monetary and reserve requirement policies for countries with active reserve requirement policy (2005-2011)

<table>
<thead>
<tr>
<th></th>
<th>i gap</th>
<th>rr gap</th>
<th>i gap</th>
<th>rr gap</th>
<th>i gap</th>
<th>rr gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1a)</td>
<td>(1b)</td>
<td>(2a)</td>
<td>(2b)</td>
<td>(3a)</td>
<td>(3b)</td>
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<tr>
<td>RGDP gap</td>
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<td>0.054***</td>
<td>0.005</td>
<td>0.055***</td>
<td>0.015</td>
<td>0.056***</td>
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<tr>
<td>π gap</td>
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<td>-0.001</td>
<td>0.001</td>
<td>-0.001</td>
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<td></td>
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<tr>
<td>NER gap</td>
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<td></td>
<td>0.055***</td>
<td>-0.037</td>
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<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
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</tbody>
</table>

Note: NER stands for nominal exchange rate.

### Table 5. Taylor rules monetary policy for countries with passive reserve requirement policy (2005-2011)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGDP gap</td>
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<td>0.119***</td>
<td>0.091**</td>
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<tr>
<td>π gap</td>
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<td>0.175*</td>
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<tr>
<td>NER gap</td>
<td>0.038**</td>
<td>0.043**</td>
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<tr>
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<tr>
<td>Number of countries</td>
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<td>36</td>
<td>36</td>
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</tbody>
</table>

Note: NER stands for nominal exchange rate.