

# Reserve requirement policy over the business cycle\*

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## 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 (RR) as a macroeconomic stabilization tool and whether RR policy substitutes or complements monetary policy. We find that (i) around two thirds of developing countries have used RR policy as a macroeconomic stabilization tool compared to just one third of industrial countries (and no industrial country since 2004); (ii) most developing countries that rely on RR use them countercyclically; and (iii) in many developing countries, monetary policy is procyclical and hence RR policy has substituted monetary policy as a countercyclical tool. We interpret the latter finding as reflecting the need of many emerging markets to raise interest rates in bad times to defend the currency and not raise or lower the interest rate in good times to prevent further currency appreciation. Under these circumstances, RR policy provides a second instrument that substitutes for monetary policy. Evidence from expanded Taylor rules (i.e., Taylor rules that include a nominal exchange rate target) supports these mechanisms.

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# 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 middle 2000’s, after gaining some limited popularity in previous decades thanks to its use by Chile.<sup>1</sup> 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.<sup>2</sup>

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 (2013) 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

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<sup>1</sup>See Edwards, De Gregorio, and Valdes (2000).

<sup>2</sup>See IMF (2012).

evidence to the effect that macroprudential policy may be effective in reducing procyclicality of financial variables and reducing systemic risk.<sup>3</sup> 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).<sup>4</sup> 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 simply 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.<sup>5</sup> 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).<sup>6 7</sup> We believe that gathering such large dataset is a fruitful endeavor because it will allow us to characterize the use of reserve requirements over the business cycle drawing on a very heterogeneous 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 requirement policy as a macroeconomic stabilization tool compare in emerging and industrial countries? (iii) In countries that actively use reserve requirements, have they been used

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<sup>3</sup>See also Borio and Shim (2007), Calderon and Servén (2011), Canuto and Ghosh (2013), De la Torre, Ize, and Schmukler (2012), IMF (2011), Glocker and Towbin (2012), Montoro and Moreno (2011), and Vargas *et al.* (2010).

<sup>4</sup>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.

<sup>5</sup>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.

<sup>6</sup>Using reserve requirements as a ratio of deposits would not solve the problem because changes in deposits would change such an effective reserve requirement rate without a change in policy, as would voluntary changes in reserves on the part of the banks.

<sup>7</sup>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.

countercyclically? (iv) Has reserve requirements policy (henceforth RRP) acted as a substitute for or complement to monetary 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 a potential indicator of whether reserve requirements are used for macroeconomic stabilization purposes.<sup>8</sup> In particular, if reserve requirements are changed more than once over the business cycle, we conclude that countries make *active* use of RRP.<sup>9</sup> Based on this indicator, we divide our sample of 52 countries into “active” versus “passive” countries when it comes to RRP. We conclude that 62 percent of the countries in our sample have pursued an active RRP. This figure, however, masks a big difference between emerging markets and industrial countries: 2/3 of developing countries have been active compared to just 1/3 of industrial countries (and no industrial country since 2004). Indeed, almost half 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 70 percent have pursued countercyclical RRP. This figure increases to 90 percent since 2004. 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 little more than half of developing countries have engaged in countercyclical monetary policy (compared to 100 percent of industrial countries). We attribute the asymmetric use of RRP and monetary policy in

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<sup>8</sup>Naturally, it could be the case that reserve requirements are changed frequently for, say, microprudential reasons, but this is unlikely.

<sup>9</sup>The “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 countries those for which the correlation is significantly different from zero. However, while computing correlations makes sense for studying the cyclical properties of fiscal or interest rate policy (see, for instance, Frankel, Vegh, and Vuletin (2013) 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, it would be devoided of economic meaning.

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 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, as already mentioned, 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).<sup>10</sup> 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

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<sup>10</sup>See, for example, Corbo (2000) and Moron and Winkelried (2005).

that make no active use of reserve requirements respond countercyclically with interest rates and positively to the inflation and exchange rate gaps.

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 Reserve requirement data**

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.<sup>11</sup> The data are quarterly and cover the period 1970-2011 (not for every country of course).<sup>12</sup>

This novel dataset on reserve requirements comes from primary sources such 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.<sup>13</sup> 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.<sup>14</sup> Figures 1 to 4 present some examples of those varieties:

- 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.<sup>15</sup>
- 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

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<sup>11</sup>For 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).

<sup>12</sup>The World Bank website <http://go.worldbank.org/D7JYE3SLS0> provides a detailed list of the sample period for every country, the type of legal reserve requirements, the specific source, and the dataset.

<sup>13</sup>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 1 for a description of data and its sources.

<sup>14</sup>Of course, RR may occasionally differ according to other factors. China's Central Bank, for example, imposes lower RR on rural banks than on major banks. As of April 2014, RR stand at 20 percent for major banks and as low as 16 percent for smaller, rural banks.

<sup>15</sup>See Ma *et al.* (2013) for a detailed analysis of RRP in China.

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 counter-cyclical use of reserve requirements – 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 Montono and Moreno (2011), Rossini and Quispe (2010) and Rossini *et al* (2011).
- 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.<sup>16</sup> 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 re-

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<sup>16</sup>Single reserve requirements includes the case of no legal reserve requirement.



quirements 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 currency deposits.<sup>17</sup>

## 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.<sup>18</sup> 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 0.2), 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.<sup>19</sup> For developing countries – and as was the case in Figure 5 – we see a clear

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<sup>17</sup>For a detailed discussion of dollarization, see Savastano, Reinhart, and Rogoff (2003) and the references therein.

<sup>18</sup>This is the simple average of existing reserve requirement for a given country averaged over all countries.

<sup>19</sup>We compute the standard deviation of existing reserve requirements for each country and then average

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.

### **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 RR for macroeconomic stabilization purposes. An obvious example would be countries, such as the industrial countries mentioned above, that have zero legal RR. In other cases, however, RR 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 RR in those countries that use them for macroeconomic stabilization purposes, we need an operational definition that

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across countries.

will allow us to divide countries into those that make active use of RR for such purposes and those that do not. Once we have put countries into these two categories, we can proceed to compute the cyclicity of RR policy for the active group.

### 3.1 Active versus passive countries

To distinguish between active and passive countries, we first compute the frequency of changes in RR. Notice that, unlike standard macroeconomic time series, such as government consumption, which evolve in a continuous fashion over time, the legal RR is a “discontinuous series” in the sense that it may not change for prolonged periods of time.<sup>20</sup> For this type of time series, the frequency of changes is an important statistic. Figure 7 illustrates the quarterly frequency of changes in RR for all the countries in our sample.<sup>21</sup> Yellow bars denote developing economies while black bars indicate industrial countries. For example, a frequency of one indicates that, on average, a country changes RR once per quarter or four times a year, whereas a frequency of 0.25 indicates a change every four quarters. The first obvious message of this picture is that yellow bars tend to be concentrated on the right-side (indicating frequent changes in RR) 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 RR.

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 RR 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 RR for macro-stabilization purposes, it makes sense to think that if a country changes RR at a frequency that is lower than that of

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<sup>20</sup>Other macroeconomic time series that share this property are, for example, prices of goods at a grocery store or tax rates. The frequency of changes of prices at grocery stores is typically taken as an indicator of how “sticky” are nominal prices; see, for example, *Bils and Klenow (2004)*.

<sup>21</sup>When a country has multiple RR, we compute the frequency for each one and take the average. Generally speaking, the frequency of changes does not vary substantially across different RR for a given country.

its business cycle, it is not actively using RR 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 RR is higher (lower) than the average cycle, then we classify that country as an active (passive) country in terms of RR policy.<sup>22</sup>

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 RR in the same country. Along the 45 degree line, the duration of the business cycle and the time between changes are the same. Generally speaking, points below the 45 degree line are countries in which the time between changes in RR is more than the business cycle frequency (active countries), while the reverse is true for countries above the 45 degree line.<sup>23 24</sup>

Based on Figure 7, 62 percent of countries (32 out of 52) are classified as active countries. As expected, there is a striking difference between developing and industrial countries: 68 percent (or 27 out of 37) of developing countries are classified as active, whereas only 33 percent of industrial countries (5 out of 15) are classified as active.

In fact, the difference between industrial and developing countries becomes even more striking if we divide the sample before and after 2004. For the post-2004 sample – and as Figure 9 illustrates – while the frequency of changes in RR for developing countries looks roughly similar to the whole sample (Figure 7), there is not a single industrial country that has changed legal reserve requirements in this period.<sup>25</sup> Using our formal criterion, 57 percent of developing countries (or 21 out of 37) are classified as active in the 2005-2011 period.

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<sup>22</sup>Formally – and to account for the high variability of the business cycle duration within countries – we will classify a country as pursuing an active RRP if the average duration between changes in RR is lower than the average duration of the business cycle plus one standard deviation.

<sup>23</sup>Countries with zero frequency of change would have an “infinite” amount of time between changes and are plotted out of scale.

<sup>24</sup>We say “generally” because, to keep it simple, the scatter plot does not allow for the one standard deviation of the business cycle duration embedded in our formal definition above. In the figure, a black dot (cross) denotes an active (passive) country.

<sup>25</sup>Of the 15 industrial countries in this sub-sample, 8 have in fact no legal reserve requirement.

### 3.2 Cyclical properties of reserve requirement policy

Having identified a group of countries which, according to our definition, has actively used RR policy, we can now proceed to compute the cyclical properties of RR policy for this group. Figure 10 depicts the correlation between the cyclical components of RR and GDP for the 32 countries classified as active.<sup>26</sup> We can see that most countries (23 out of 32, or 72 percent) have pursued countercyclical RR policy. In particular, 70 percent (or 19 out of 27) of developing countries have used RR countercyclically.

Has the use of RR policy for macroprudential purposes changed/intensified in recent times? As mentioned when discussing Figure 5, it seems that since 2005 or so, countries have resorted more frequently to macroprudential policy. Dividing the sample again before and after 2004 (Figure 11, Panels A and B, respectively), we can see that before 2005, the number of active countries with countercyclical RRP was 60 percent (or 18 out of 30) but after 2004 the number rises sharply to 90 percent (or 19 out of 21). Particularly striking is the fact that in the post-2004 period, there is not a single industrial country that has pursued active RRP.

To sum up, we have found that (i) reserve requirements have been used fairly frequently as a macroeconomic stabilization tool (i.e., countercyclically); (ii) their use has increased considerable since 2004, which is consistent with anecdotal evidence to this effect, and (iii) no industrial country has used RRP actively in the post-2004 period.

## 4 Complementarity/substitutability with monetary policy

In and of itself, the fact that 53 percent (or 10 out of 19) percent of active developing countries (and 71 percent after 2004) have, on average, pursued countercyclical RR policy may not seem that remarkable.<sup>27</sup> But it is indeed remarkable when compared to the percentage of developing countries that have pursued countercyclical monetary policy.<sup>28</sup> Figure 12

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<sup>26</sup>When a country has multiple RR, we compute the correlation between the cyclical component of RR 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 RR are strongly positively related in countries with multiple RR.

<sup>27</sup>We are referring here to correlations which are significantly different from zero.

<sup>28</sup>See Vegh and Vuletin (2012) for a detailed analysis of the cyclicity of monetary policy.

depicts the correlation between the cyclical components of policy interest rates and GDP on a quarterly basis. We can see that 73 percent (11 out of 15) industrial countries (black bars) exhibit a significant positive correlation indicating countercyclical monetary policy. In sharp contrast, only 27 percent (of 22 out of 37) show countercyclical monetary policy (i.e., a significantly positive correlation). In fact, the average correlation for industrial countries is 0.40 (and significantly different from zero), compared to 0.07 (and not significantly different from zero) for emerging countries. In other words, the average industrial country pursues countercyclical monetary policy, whereas the average emerging country is acyclical.

Why do we see such a sharp difference in the conduct of monetary policy between industrial and developing countries? 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).<sup>29</sup> As a result, policymakers increase interest rates to avoid/delay the capital outflow at the same time that they decrease RR to spur the economy (by reducing the lending spread).

An analogous story is true for good times, in what we could refer to as “fear of capital inflows.” The idea is 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, policymakers either keep

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<sup>29</sup>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.”

interest rates unchanged or even lower them to attract less capital inflows at the same time that they raise RR to cool off the economy (by increasing the lending spread).<sup>30</sup>

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 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, RRP 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, which will be referred to as the policy mix matrix, classifies countries according to the cyclical properties of both monetary and reserve requirement policies. Since countries may be procyclical, acyclical, or countercyclical, there are 9 possible cells or combinations. Notice that most industrial countries are on the second row because most of them are acyclical when it comes to RRP (i.e., they do not use RRP for macroeconomic stabilization purposes). In fact, most industrial countries (11 out of 15 or 73 percent) fall in the (2,3) cell, colored orange, given that their monetary policy is countercyclical.

In contrast, 10 developing countries (or 27 percent of all developing countries in our

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<sup>30</sup>As an example, 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.

sample) fall in the third row because they exhibit countercyclical RRP. Of these 10 developing countries, six fall in the cell (3,2) given that they have had acyclical monetary policy, while the remaining four fall in cell (3,3) because they have had countercyclical monetary policy.

As a matter of definition, we will refer to countries falling in cell (3,3) as using RRP as a *complement* to monetary policy in the sense that both policies reinforce each other. These are cases in which both RRP and monetary policy are countercyclical, so that in good (bad) times both RR and the policy interest rate are increased (lowered). In contrast, countries that fall in cell (3,2) and, potentially, cell (3,1) are cases in which RRP acts a *substitute* for interest rate policy because reserve requirements perform the function that the interest rate cannot due to the need of either defending the currency in bad times or not attracting more capital inflows in good times.

Further, we interpret cell (2,1) as “bad place” to be because here countries feel compelled to use monetary policy procyclically but are not taking advantage of reserve requirements as a second instrument. On the other hand, we can view (2,3) as the “promised land,” in terms of policymaking. The reason is that here countries can use monetary policy for countercyclical purposes without fearing the effects of countercyclical interest rates on the exchange rate and/or capital inflows, presumably reflecting a high degree of policy and institutional credibility.<sup>31</sup>

As before, we break the sample into before and after 2004 and construct the policy matrices for each period, as illustrated in Table 4. Comparing the pre and post-2004 policy mix matrices in Table 4, Panels A and B, three important changes are worth noting: (i) the number of developing countries pursuing procyclical interest rate policy falls from seven in the early period to just one in the more recent period; (ii) the number of developing countries engaging in countercyclical RRP increases from 7 to 15, and (iii) developing countries using monetary policy and RRP as substitutes (as captured in cell (2,2)) increases from 5 to 8 whereas developing countries using monetary policy and RRP as complements (as captured

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<sup>31</sup>Of course, countries may still want to use RR for microprudential purposes, so “promised land” refers exclusively to countries not needing to use RR as a *macrostabilization* tool.



in cell (3,3)) increases from 2 to 7.<sup>32</sup>

In this context, one can imagine different “routes” that countries may take in the policy journey from cell (2,1), a “bad place to be”, to cell (2,3), the “promised land”. One route would be the “direct route” that Chile took. Notice that Chile went from cell (2,1) in the pre-2005 period to cell (2,3) in the post-2004 period. This is remarkable because, in our view, it can only happen in the context of a notable improvement in policy/institutional credibility. In such a case, a country like Chile may not need to resort to countercyclical RRP, which is presumably the situation of a typical industrial country.<sup>33</sup>

A more common route (involving several stages, so to speak) would be to go from cell (2,1) to cell (3,2), then to cell (3,3), and finally to cell (2,3). One could even add an additional stage in which countries would go from cell (2,1) to cell (2,2) and only then to cell (3,2). Mexico and Uruguay, for instance, have gone from cell (2,1) in the pre-2005 period to cell (2,2) in the post-2004 period. This is presumably an improvement in the policy mix because they have graduated from monetary policy procyclicality but the fact that they are in cell (2,2) implies that they have no countercyclical tool.<sup>34</sup> In principle, they would benefit from moving to cell (3,2) where they would be using reserve requirements as a countercyclical tool.

## 5 Taylor rules

Sections 3 and 4 showed suggestive evidence on the use of reserve requirements for macroprudential purposes and illustrated the fact that RRP often acts as a substitute for monetary policy. We also provided a rationalization, based on fear of free falling in bad times and fear

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<sup>32</sup>While clearly suggestive, we should note that the policy mix matrices should be taken with a slight grain of salt to the extent that they are capturing an “average behavior” of any given country over a very long time horizon and thus are completely missing the time series dimension. Below we will compute implicit Taylor rules using panel data which, to the extent that they will indeed capture the time series dimension, should provide a more accurate picture of the complementary/substitutability of monetary and reserve requirement policy.

<sup>33</sup>This would be a “one-step” graduation process, which is the one (implicitly) highlighted by Vegh, and Vuletin (2012) for the case of monetary policy and Frankel, Vegh, and Vuletin (2011) for the case of fiscal policy. For a more detailed analysis of institutional changes that may have allowed Chile to graduate, see Frankel (2011).

<sup>34</sup>Not even fiscal policy because, according to Frankel, Vegh, and Vuletin (2013), both Mexico and Uruguay continue to be procyclical even in the more recent period.

of capital inflows in good times, for such a policy mix. This section presents a more formal analysis that provides 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).<sup>35</sup> By “expanded” Taylor rules, we mean Taylor rules which, 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 about “excessive” depreciation (appreciation) during bad (good) times, as discussed above.

Table 5 shows Taylor rules for both monetary and reserve requirements for countries that have used RRP actively since 2005. We estimate these policy reaction functions using a system of simultaneous equations.<sup>36</sup> Column 1a shows the traditional Taylor rule with output and inflation gap, while column 1b shows the same rule for reserve requirements. Columns 2a and 2b show the results for the case that the rules include the output and nominal exchange rate gaps. Columns 3a and 3b shows the rules for the case in which all three gaps (output, inflation, and nominal exchange rate) are included.<sup>37,38</sup> Columns 3a,b include output and inflation gaps, and output and nominal exchange rate gaps, respectively.

Turning now to the results, columns 1a and 1b illustrate the fact that, as shown in Sections 3 and 4, monetary policy is acyclical whereas RRP is countercyclical. In other words, RRP acts as a substitute for monetary policy. Columns 2a and 2b are consistent with columns 1a and 1b regarding the cyclicity 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 rate

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<sup>35</sup>Similar results are obtained if the entire period was used.

<sup>36</sup>In case of multiple RR, we calculate the cyclical component of the average RR by averaging the cyclical components of each RR.

<sup>37</sup>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.

<sup>38</sup>We calculate the cyclical component of growth rate of the nominal exchange rate as opposed to the one for level of nominal exchange rate.

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). To sum up, monetary policy responds positively to exchange rate depreciations and RRP focuses on the output gap in a countercyclical way.<sup>39</sup> In other words, RRP substitutes for monetary policy.

Table 6 shows Taylor rules for monetary policy for countries that did not use RR policy 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 5, 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 RRP actively is about 7 times that of countries that are categorized under passive users of RR policy.<sup>40</sup> This striking difference in exchange rate volatility since 2005 together with the asymmetric response of monetary and reserve requirement policies depicted in Tables 5 and 6 provide support for 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) for monetary policy.

## 6 Conclusions

Using a unique and novel database, 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 around 2/3 of emerging markets use

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<sup>39</sup>The significance of the nominal exchange rate weakens a little bit (column 3a) due to multicollinearity between inflation and exchange rates gaps.

<sup>40</sup>The coefficient of variation of nominal exchange rate for active users of RR is 112.6, while the one for passive users is 16.9.

reserve requirements as a macroeconomic stabilization tool and most of them use them countercyclically. At the same time, many developing countries engage in procyclical monetary policy, raising interest rates in bad times and lowering them in good times. We argue that procyclical monetary policy may reflect the fear of free falling (the need to defend the currency in bad times by raising policy rates) and the fear of capital inflows (the reluctance to raise policy rates in good times for fear of attracting even more capital inflows and further appreciate the domestic currency). In such a scenario, by providing a countercyclical tool, reserve requirements perform the work that monetary policy cannot do (and, in that sense, reserve requirement policy acts as a substitute for monetary policy).

## **Appendix 1. Definition and sources of variables**

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

Real GDP: Most data are from Global Financial Data and International Financial Statistics (IFS/IMF). Data are also complemented in some cases with local sources: Argentina (Central Bank of Argentina), Brazil (Institute for Applied Economic Research - IPEA), Honduras (Central Bank of Honduras), Panama (Central Bank of Panama), Trinidad and Tobago (Central Bank of Trinidad and Tobago), and Uruguay (Central Bank of Uruguay).

Interest rate policy: We take short-term interest rates as a proxy for the stance of monetary policy. In some cases, we have data for overnight interbank interest rates, such as the Federal Funds rate in the United States. In most cases, however, we rely on discount rates due to their longer availability. Source: Global Financial Data.

Legal reserve requirements: See the World Bank website <http://go.worldbank.org/D7JYE3SLS0> for a list of the sample period for every country, the type of legal reserve requirements, the specific source, and the data itself.

Inflation: Based on consumer price index. Source: Global Financial Data.

Nominal exchange rate: Nominal bilateral exchange rate (against USD). Source: IFS/IMF.

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Figure 1. China's reserve requirement over time.

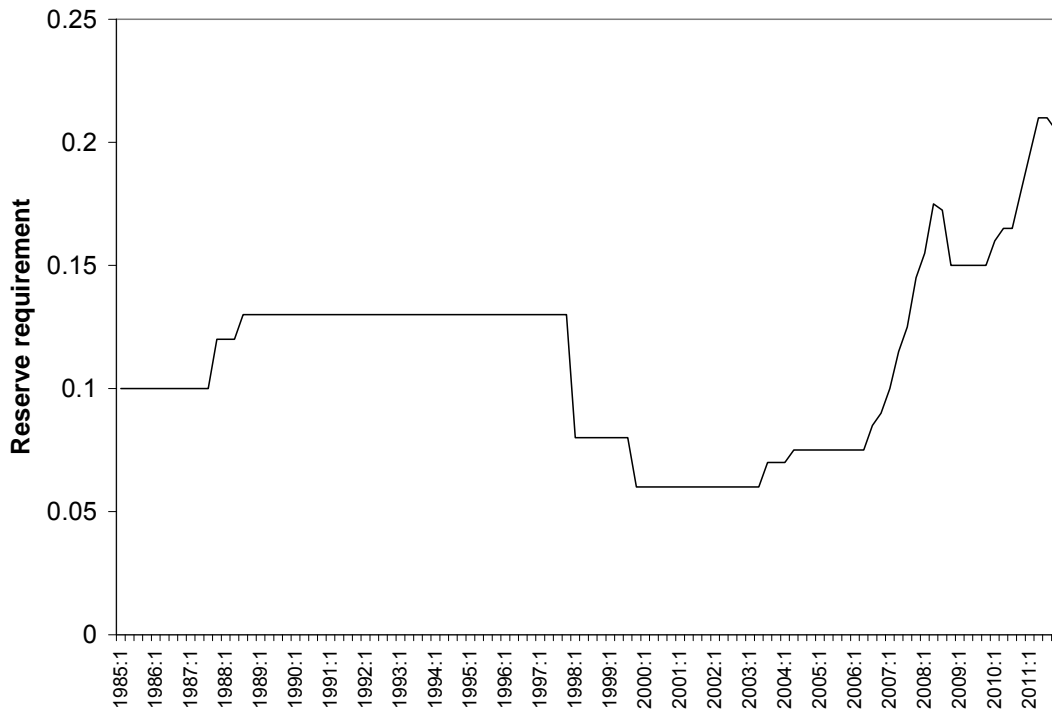


Figure 2. Venezuela's reserve requirements over time

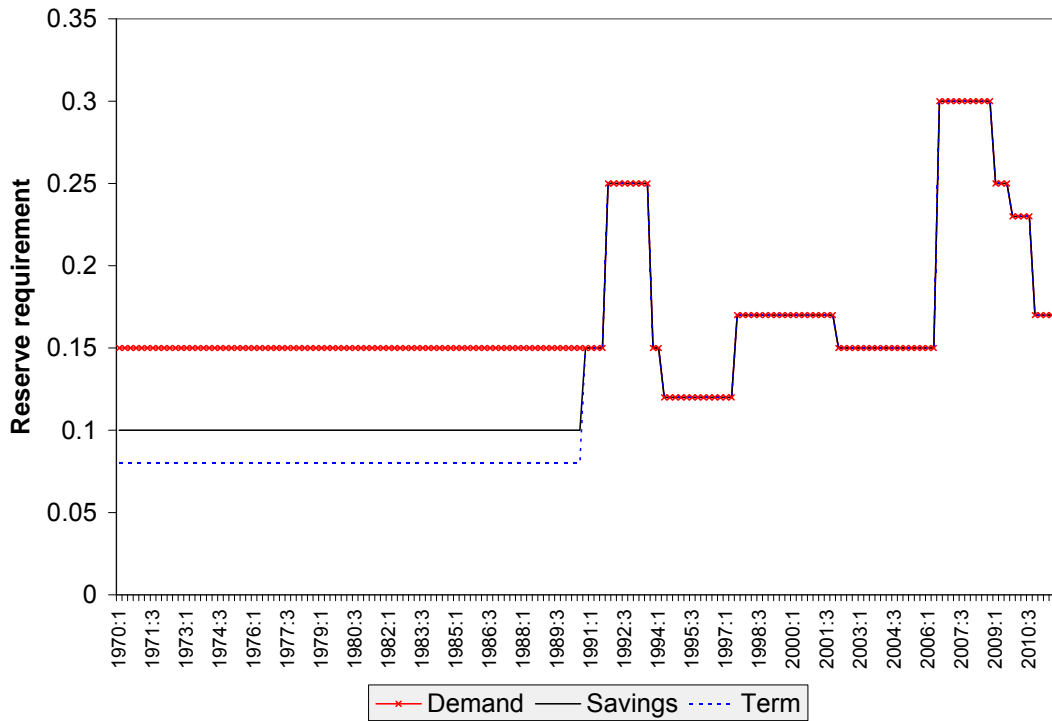




Figure 3. Peru's reserve requirements over time

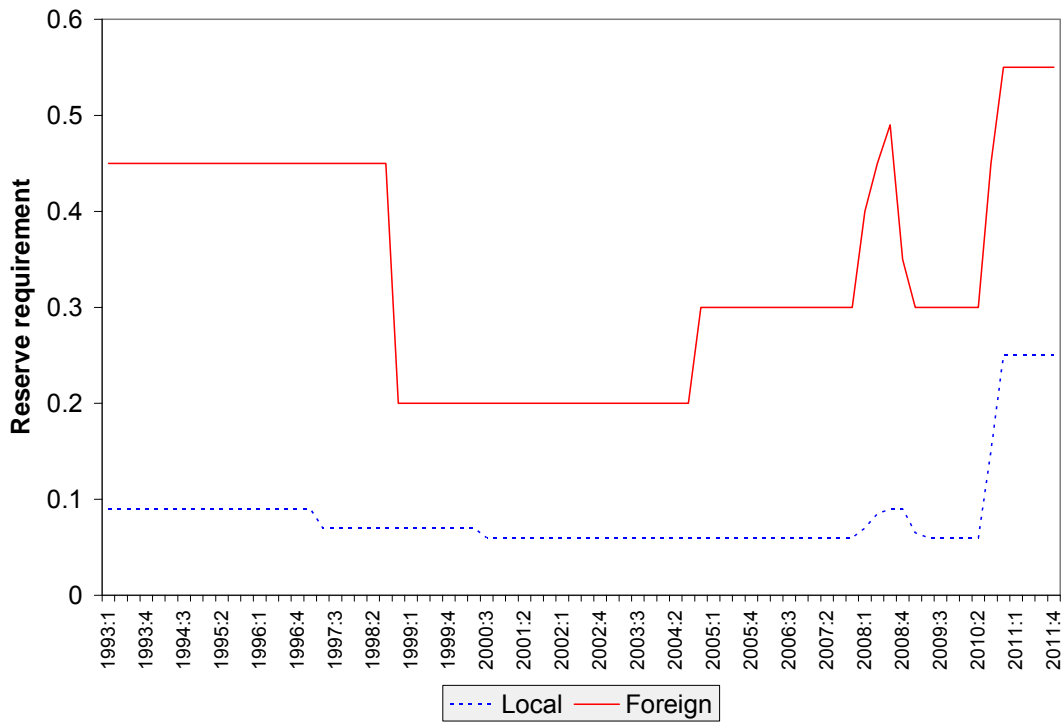
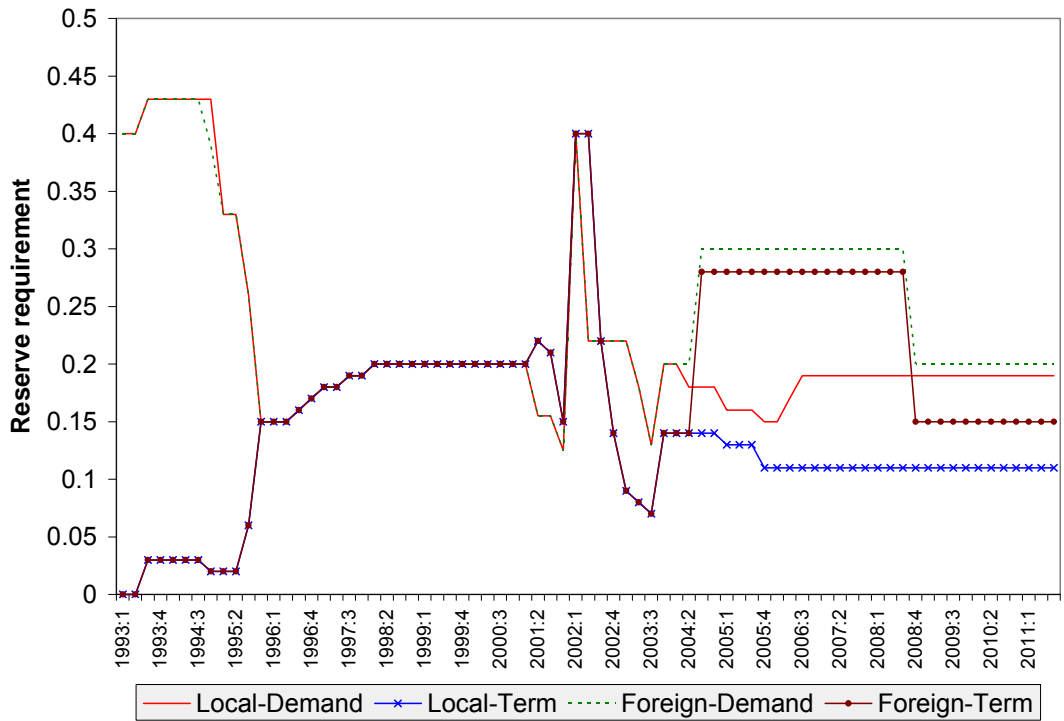


Figure 4. Argentina's reserve requirements over time



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

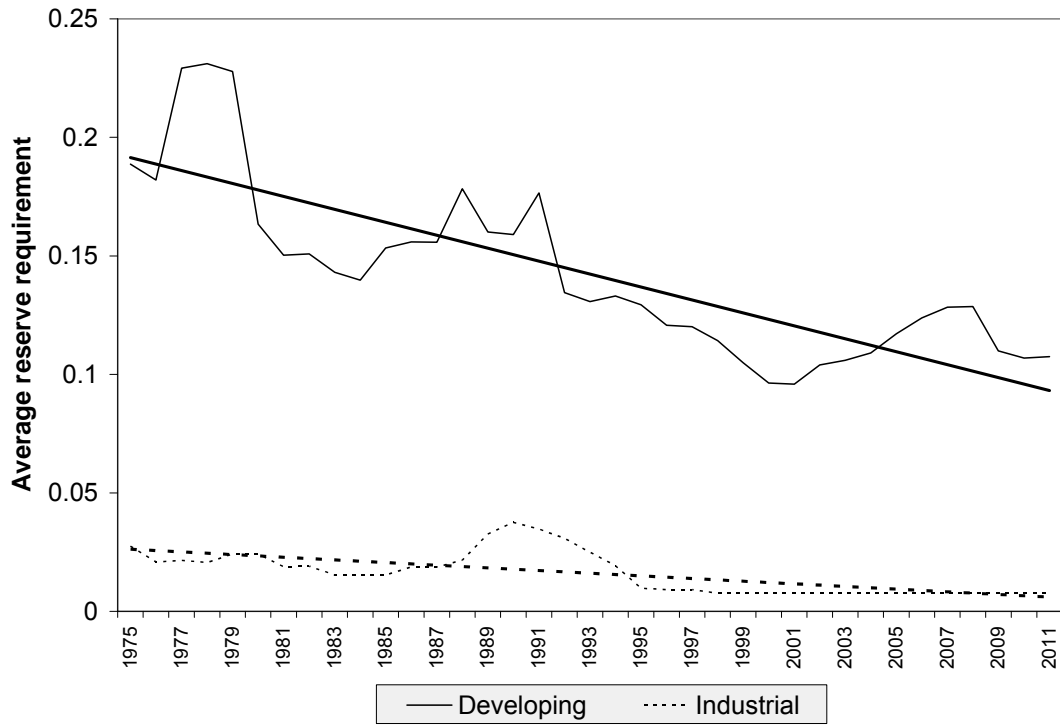


Figure 6. Dispersion of reserve requirements over time

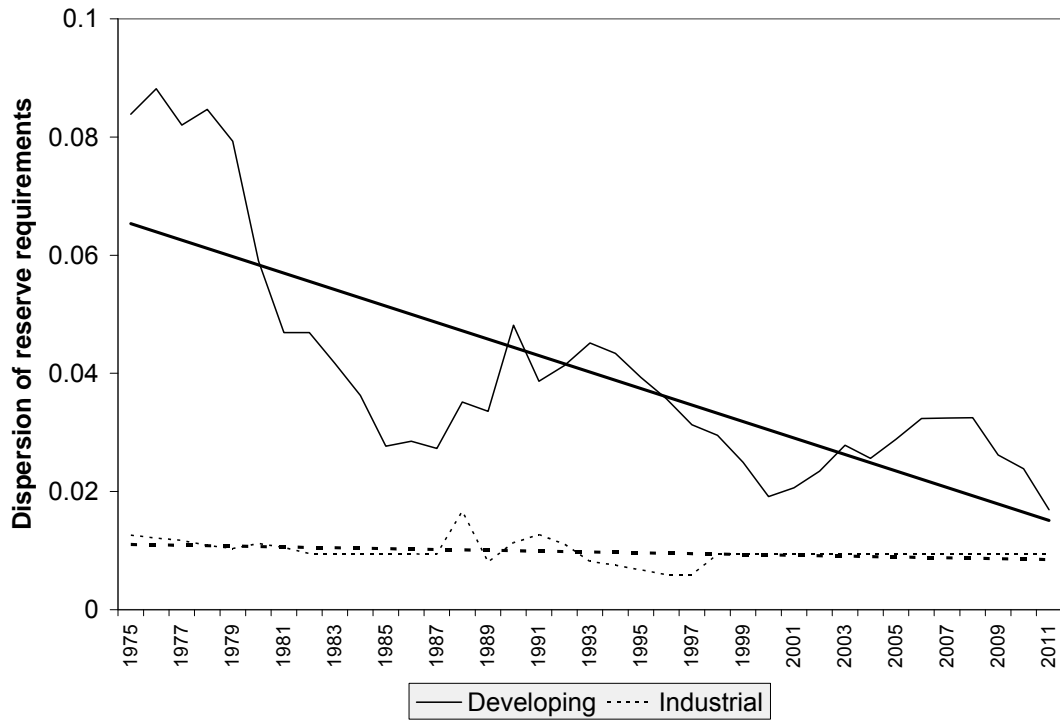


Figure 7. Frequency of changes in reserve requirements (1970-2011)

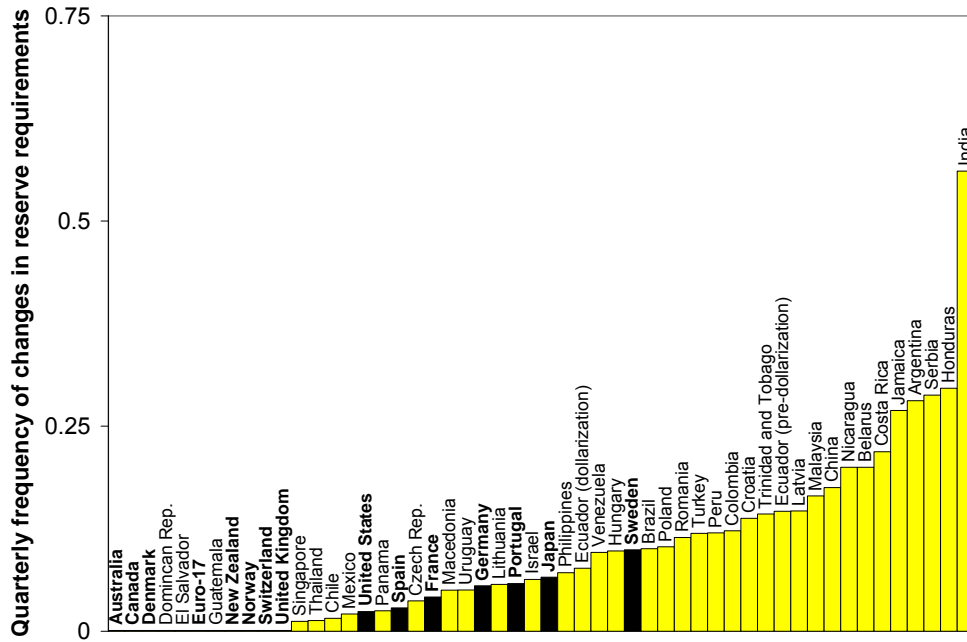
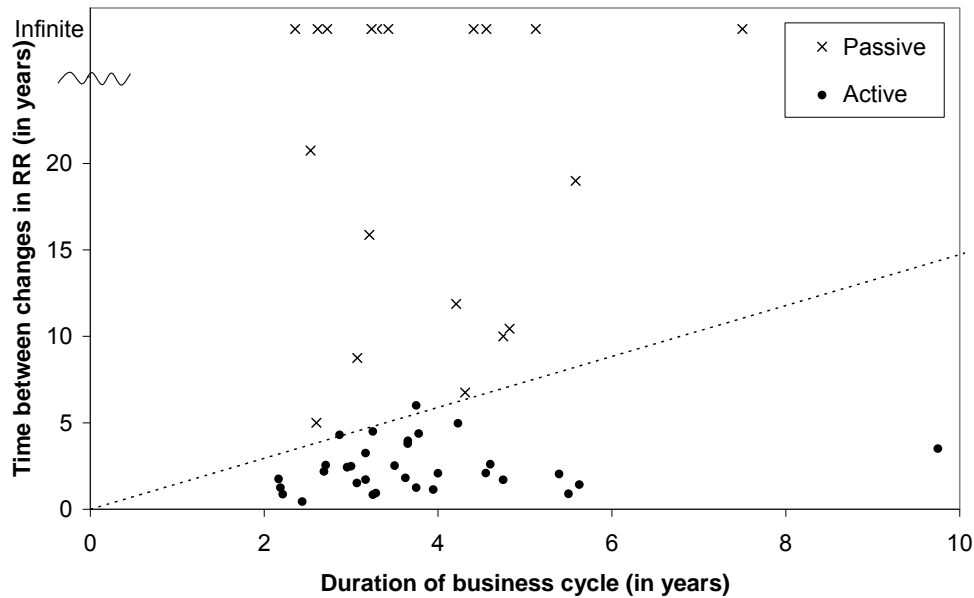


Figure 8. Active versus passive reserve requirement policy (1970-2011)



Note: The dashed 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. Countries are classified as active if the average duration of business cycle plus one standard deviation of business cycle is larger than the average time between changes in reserve requirements.

Figure 9. Frequency of changes in reserve requirements (2005-2011)

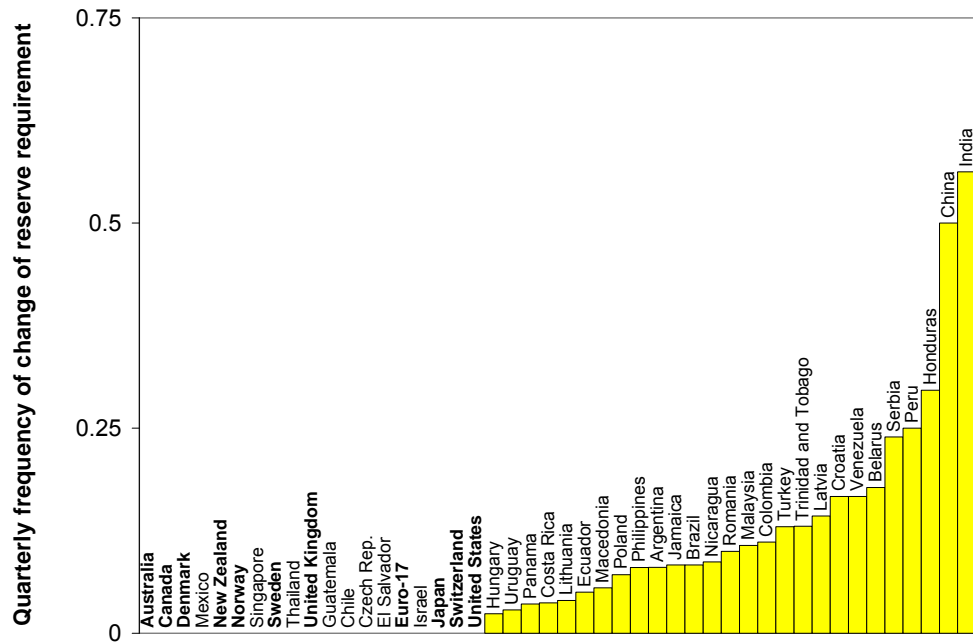
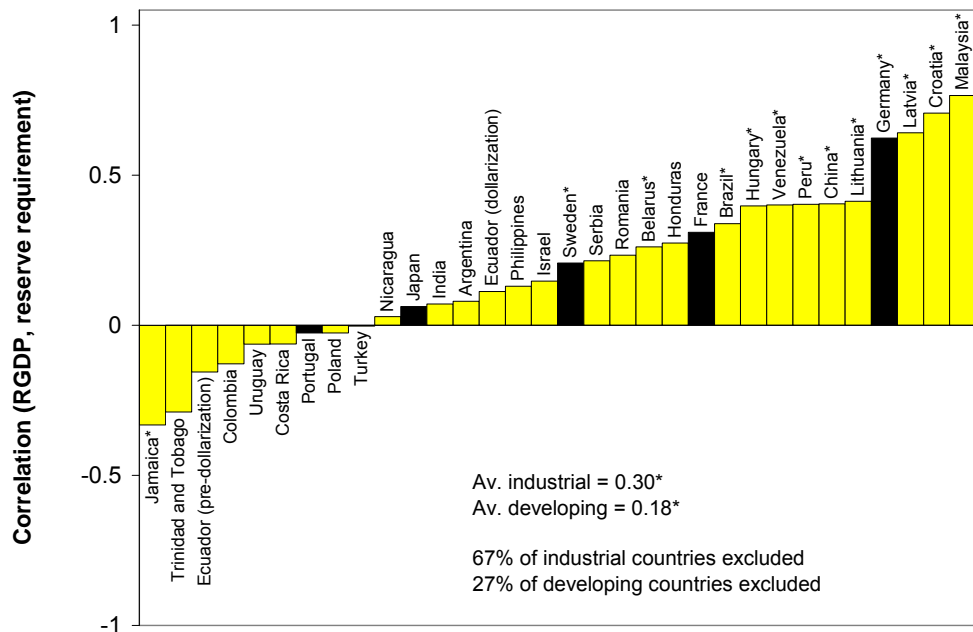
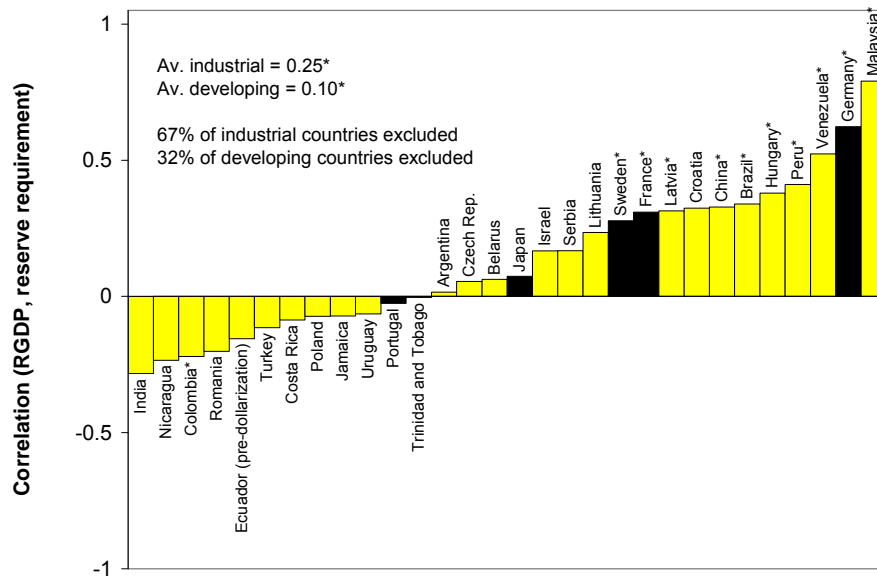


Figure 10. Cyclical policy of reserve requirements (1970-2011)



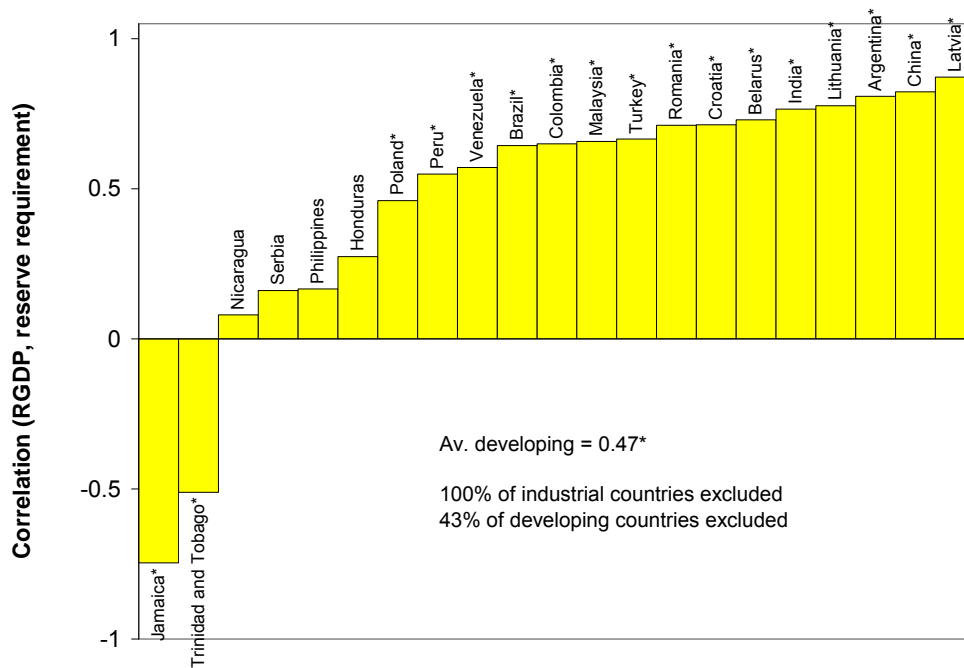
Note: Average reserve requirement is used for calculations. Sample only includes active reserve requirement policy countries (5 of 15 industrial countries and 19 of 37 developing economies are active). \* indicates that the correlation is statistically positive at five percent level.

Figure 11. Panel A. Cyclicity of reserve requirement policy (1970-2004)



Note: Average reserve requirement is used for calculations. Sample only includes active reserve requirement policy countries (5 of 15 industrial countries and 25 of 37 developing economies are active). \* indicates that the correlation is statistically positive at five percent level.

Figure 11. Panel B. Cyclicity of reserve requirement policy (2005-2011)



Note: Average reserve requirement is used for calculations. Sample only includes active reserve requirement policy countries (21 of 37 developing economies are active). \* indicates that the correlation is statistically positive at five percent level.

Figure 12. Cyclicity of interest rate policy (1970-2011)

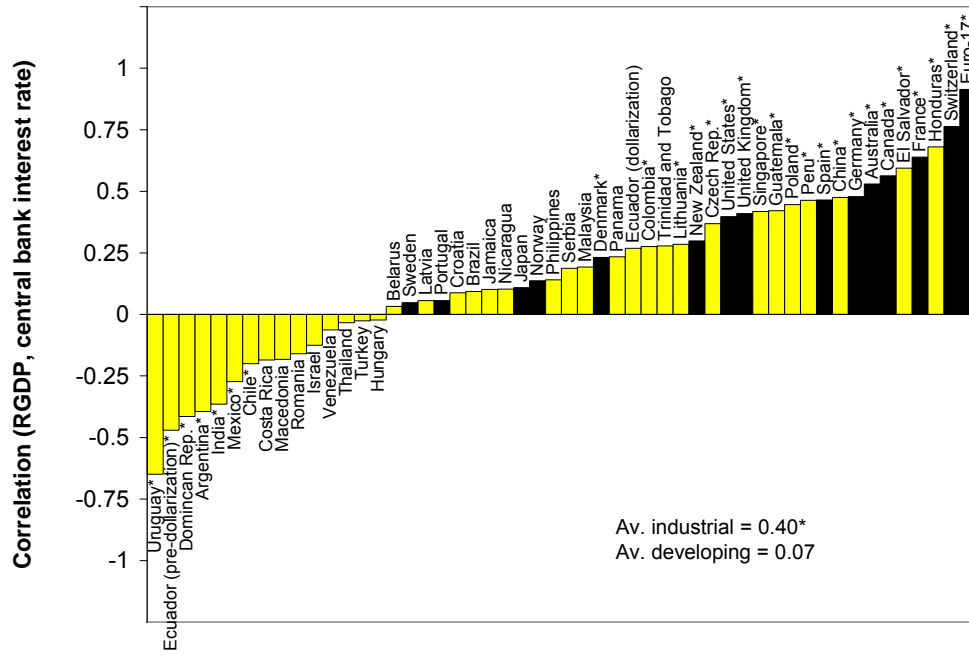


Table 1. Varieties of reserve requirements

	Single RR (19)	Maturity RR (16)	Currency RR (8)	Maturity and currency RR (9)
<b>Developing (37)</b>	China Colombia Ecuador (after dollarization) India Jamaica Malaysia Mexico Panama Philippines Singapore Thailand Trinidad and Tobago	Brazil Chile Czech Rep. El Salvador Hungary Israel Latvia Venezuela	Croatia Guatemala Honduras Lithuania Macedonia Nicaragua Peru Serbia	Argentina Belarus Costa Rica Dominican Republic Ecuador (before dollarization) Poland Romania Turkey Uruguay
<b>Industrial (15)</b>	Australia Canada Denmark New Zealand Norway Sweden United Kingdom	Euro France Germany Japan Portugal Spain Switzerland United States		

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

Panel A. Reserve requirements that vary according to maturity

	RR demand	RR savings	RR term
RR demand	1		
RR savings	0.56***	1	
RR term	0.61***	0.75***	1

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

	RR local	RR foreign
RR local	1	
RR foreign	0.31***	1

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

	RR demand-local	RR savings-local	RR term-local	RR demand-foreign	RR savings-foreign	RR term-foreign
RR demand-local	1					
RR savings-local	0.61***	1				
RR term-local	0.32***	0.27***	1			
RR demand-foreign	0.31***	0.26***	0.06	1		
RR savings-foreign	0.22***	0.34***	0.01	0.98***	1	
RR term-foreign	0.26***	0.10**	0.28***	0.57***	0.49***	1

Table 3. Policy mix matrix (1970-2011)

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

Substitutes

Complements

Table 4. Panel A. Policy mix matrix (1970-2004)

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

Substitutes

Complements

Table 4. Panel B. Policy mix matrix (2005-2011)

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

Substitutes

Complements



Table 5. Taylor rules for monetary and reserve requirement policies for countries with active reserve requirement policy (2005-2011)

	i gap (1a)	rr gap (1b)	i gap (2a)	rr gap (2b)	i gap (3a)	rr gap (3b)
RGDP gap	0.016 [1.4]	0.054*** [2.9]	0.005 [0.4]	0.055*** [3.1]	0.015 [1.3]	0.056*** [3]
$\pi$ gap	0.001 [1.4]	-0.001 [-1.4]			0.001 [1.2]	-0.001 [-1.3]
NER gap			0.055*** [2.8]	-0.037 [-1.3]	0.034* [1.8]	-0.037 [-1.2]
Observations	345	345	349	349	345	345
Number of countries	14	14	14	14	14	14

Note: NER stands for nominal exchange rate.

Table 6. Taylor rules monetary policy for countries with passive reserve requirement policy (2005-2011)

	(1)	(2)	(3)
RGDP gap	0.115*** [2.8]	0.119*** [2.8]	0.091** [2]
$\pi$ gap	0.152* [1.8]		0.175* [1.8]
NER gap		0.038** [2.1]	0.043** [2.2]
Observations	934	834	777
Number of countries	36	36	36

Note: NER stands for nominal exchange rate.