On the Empirics of Reserve Requirements and Economic Growth

Abstract

Reserve requirements, as a tool of macroprudential policy, have been increasingly employed since the outbreak of the great financial crisis. We conduct an analysis of the effect of reserve requirements in tranquil and crisis times on long-run growth rates of GDP per capita and credit (%GDP) making use of Bayesian model averaging methods. Regulation has on average a negative effect on GDP in tranquil times, which is only partly offset by a positive (but not robust effect) in crisis times. Credit over GDP is positively affected by higher requirements in the longer run.

Keywords: Reserve requirements, macroprudential policy, credit growth, economic growth, Bayesian model averaging

JEL Classification: E44, F43, G28, C11

1 Introduction

Since the outbreak of the global financial crisis, central banks have employed a wide variety of macroprudential instruments to strongly differing degrees. These instruments were often introduced without much prior empirical evidence on their potential effects. The main aim of this study is to provide robust inference on the medium to long-run effects of reserve requirements, one of the most widespread macroprudential measures, on credit growth and economic growth. To ensure robustness to model specification, we use Bayesian model averaging techniques to quantify the role played by reserve requirements. Our main interest lies in quantifying the real growth effects of reserve requirements as a regulatory (macroprudential policy) tool during normal and stress times. Reserve requirements are not the only existing macroprudential policy instrument[1]. Our paper contributes to a growing empirical literature that aims to identify the effects of these instruments (see Aizenman et al., 2017; Richter et al., 2018, for two very recent examples). Although the interest of researchers in assessing the macroeconomic effects of reserve requirements has increased enormously after the crisis, their use has a long history in economic policy, having been first established in the US at the national level in 1863 (Feinman, 1993) and used extensively in emerging markets and developing economies over the last half a century (Federico et al., 2014).[2]

The main objective of macroprudential policy is to promote the resilience of the financial system (Schoenmaker, 2014). This is important because financial risk taking may not always be beneficial for economic growth. On the one hand, financial risk taking has been found to have – on average – a positive effect on growth by mitigating financial bottlenecks (Rancière et al., 2008). On the other hand, this may not be true to the same extent for countries with strong and sound institutions or for extremely high levels of risk. Financial crises as an undesired outcome of systemic risk taking can have severe adverse consequences for the financial system and the real economy (Laeven and Valencia, 2013). To maximize welfare, a balance therefore needs to be struck between financial stability and some (systemic) risk taking (Borio and Shim, 2007).

A variety of theoretical papers have evaluated costs and benefits of regulation. Statements on the most efficient approach usually depend on the setup of the economy and modeled frictions (Jeanne and Korinek, 2013; Benigno et al., 2013). The assessment of the effects of macroprudential instruments in empirical studies has – in comparison – not kept pace. The first generation of empirical studies on macroprudential instruments and their effects uses aggregate measures in international panel studies, for example by creating simple indices identifying the legal existence of these instruments (Borio and Shim, 2007; Cerutti et al., 2017). The focus of these studies – influenced by the recent financial crisis – has mostly been on measuring the effect on credit growth and house prices. Due to the use of variables based on legal existence, the intensity of an instrument is never a factor in these studies. This problem is addressed in a second group of studies, which employ either microeconomic or time-series analysis to identify the effects of the strengthening of one instrument in a single country (Tovar et al., 2012; Arregui et al., 2013; Camors and Peydro, 2014). In general, both types of studies agree

[1] See the extensive database of Cerutti et al. (2017) on the legal existence of different tools.

[2] Especially in these countries, reserve requirements are used as a form of capital controls. An extensive literature examines costs and benefits of capital controls (see for example Chinn and Ito, 2006; Forbes, 2007), although not with a focus on the potential benefits during a banking crisis. We control for the strength of total capital controls in our estimations.

that macroprudential instruments have countercyclical effects on credit and house price growth found in the first group of studies mentioned above.

The theoretical literature on the link between reserve requirements and economic growth highlights several mechanisms that imply beneficial effects in terms of smoothing cyclical volatility in the short and medium term. In the short term, the reaction of real activity to changes in reserve requirements has been highlighted in different studies both theoretically and empirically. The theoretical framework in Bernanke and Blinder (1988), for instance, expands the standard IS-LM model to include bank reserves as a policy instrument. The analysis shows that reserve requirements can indeed act as a stabilizing device for short-term fluctuations, a result that is confirmed in the empirical results of Loungani and Rush (1995).

Theoretical and empirical results on the long-run effects of reserve requirements are rare in the literature, and our contribution aims precisely to provide robust empirical results on the link between reserve requirements, credit and real activity beyond the short-run horizons usually employed in the existing econometric studies. Exceptions to the lack of theoretical modeling exercises based on longer-run macroeconomic effects of reserve requirements on real activity are the works of Gomis-Porqueras (2002) or Ma (2018). Gomis-Porqueras (2002) shows that imposing reserve requirements may increase welfare in equilibrium under certain parametric assumptions due to changes in bank asset allocations, which affect capital accumulation and therefore long-run real output. Ma (2018) presents an endogenous growth model where the productivity process is affected by potentially binding collateral constraints and where the social planner can choose an optimal macropolicy path based on setting a tax on capital flows. It is precisely the interpretation of reserve requirements as a tax on capital flows (see Reinhart and Reinhart, 1999; Magud et al., 2018) that allows the interpretation of the predictions of the theoretical model in Ma (2018) as providing testable hypotheses on the effects of reserve requirements on income growth. The results of the model predict an ambiguous impact of macroprudential policy on economic growth, with positive effects during crises through its effect on financial vulnerabilities and negative effects during tranquil periods. We are, to the best of our knowledge, the first to test if these theoretical predictions hold empirically.

In this contribution, we aim to address empirically the role played by one particular macroprudential instrument, reserve requirements, as a determinant of credit and economic growth beyond the usual business cycle frequencies used in previous studies. We aim to identify the medium to long-run effect of reserve requirements on credit and GDP per capita growth in the context of economic growth regressions under the presence of model uncertainty, using Bayesian methods. Both the focus on a longer horizon and an extension to GDP growth are aimed at bringing our study more in-line with the welfare-maximizing objective of forward-looking policymakers. The Bayesian analysis has the additional advantage in that it does not presuppose a particular econometric specification to address the effect of reserve requirements on income growth for the sample. In particular, the method creates weighted averages of the effects found across different model specifications. Using posterior model probabilities as weights, it integrates away the uncertainty embodied in the choice of a particular model. Thus it provides inference that accounts for the fact that the true specification is unknown to the researcher. The advantages of such a method depend on the set of models entertained, so we place an emphasis on collecting a dataset that includes the most relevant variables employed in the literature to assess differences in long-run economic growth. Moreover, we address potential nonlinearities by allowing for quadratic and interaction effects in the models used.

Our estimations show that reserve requirements affect medium- to long-run GDP growth negatively at all times, but that higher requirements during crises improve growth prospectives after the crisis beyond the usual catching up. These results are robust across different horizons. We show that both the negative single effect, and the positive interaction effects of requirements and crises are stronger if requirements are either differentiated, or take on extremely high or low values.

The remainder of this paper is organized as follows. Section 2 provides a literature review of the relation of crises, regulation and growth. Section 3 and 4 describe the data and Bayesian model averaging techniques employed in the empirical exercise. Section 5 presents the results of the analysis, and Section 6 concludes.

2 Literature review

The existing theoretical and empirical literature provides evidence that both economic crises and reserve requirements can impact long-run growth developments. Treating these variables as having an impact exclusively at cyclical frequencies and excluding them as potential determinants of long-run economic growth would thus blur the actual mechanisms of interest when assessing their effect. This section gives an overview over the existing literature on the relation between GDP growth, crises and reserve requirements. We also touch on credit growth as one of the predominant objects of interest for macroprudential policy.

In the empirical literature, there is considerable disagreement on the short to medium-run welfare effects of financial crises, our first variable of interest. On the one hand, crises lead to large output losses relative to pre-crisis output growth, which could be either temporary (as found by Laeven and Valencia, 2013) or even permanent (as argued by Cerra and Saxena, 2008). On the other hand, Devereux and Dwyer (2016) argue that output losses should be calculated relative to pre-crisis output levels rather than to a trend, because the latter is hard to establish for volatile (and crisis-prone) middle-income countries. They find that a large share of countries experience output growth even during a crisis. Therefore, the welfare implications are unclear. One reason for this disagreement is that crises have different origins and trigger long and protracted adjustment processes. These structural adjustment processes can affect GDP growth for even longer than five years in the future. Again, there is not much agreement on this channel. On the one hand, persistence would point to a continuing negative effect on both credit and GDP growth (Bordo et al., 2010). On the other hand, standard macroeconomic models would predict stronger growth after a crisis, as the economy moves slowly back to its long-run growth path.

From a theoretical perspective, financial crises can be seen as consequences of frictions on financial markets. With an eye on middle-income countries, Rancière et al. (2008) construct a model of an open economy with two sectors – nontradable and tradable – and two frictions – limited enforcement and systemic bailouts in the case of an external debt crisis. Financial liberalization (a reduction in capital controls) allows firms in the nontradable sector to borrow more, and the bailout guarantees induce them to borrow in foreign currency, which leads to (rare) crises. However, average growth under financial liberalization is higher than under repression. Therefore Rancière et al. (2008) conclude that a volatile high-growth path may be preferable to non-volatile stagnation if frictions cannot be approached directly. The view of efficient crises is shared by proponents of the so-called *Greenspan doctrine*, which states that crises should only be counteracted after their occurrence, as any ex-ante macroprudential regulation will necessarily be too blunt a tool and create negative distortions (Benigno et al., 2013). The distortions on financial markets created by regulation should affect investment, hamper growth (Ramey and Ramey, 1995) and potentially even increase real volatility (Aghion et al., 2010). This view is not unchallenged: if crises are the result of inefficient overborrowing, then ex-ante policy could improve welfare by reducing credit growth (Jeanne and Korinek, 2013; Mendoza and Bianchi, 2011). In practice, it is very likely that a mixture of different policy tools – ex-ante and ex-post – is the second-best option in the face of a multitude of frictions.

Our second variable of interest, reserve requirements, is one of the main tools of macroprudential policy. Reserve requirements describe the percentage of their deposits banks have to hold as reserves at the central bank. Thus, reserve requirements act as a tax on the banking system (Glocker and Towbin, 2012). They increase intermediation costs and drive a wedge between deposit and lending rates (Walsh, 2012). As such, they are very similar to the ex-ante tools considered in Jeanne and Korinek (2013) or the tax on capital flows in Ma (2018).

Three broad reasons have been suggested for the use of reserve requirements (Gray, 2011). First, mainly open developing countries have been using them as a complement to monetary policy (Vargas et al., 2011). Capital flows to a country depend on its interest rate differential towards developed economies. If this differential increases (for example, due to contractionary domestic monetary policy), it attracts capital inflows and vice versa. These capital flow dynamics can render countercyclical monetary policy on its own ineffective. Countercyclical reserve requirements, especially if they are differentiated along currencies, can reduce the effect of interest rates on capital flows. Second, reserve requirements directly affect credit growth. Using them countercyclically can serve the purpose of liquidity management for the banking sector. Third and beyond addressing credit fluctuations, reserve requirements can be implemented with macroprudential policy in mind. In this case, differing requirements for different maturities can incentivize the creation of safer maturity portfolios. All three reasons have in common that reserve requirements are used to reduce bubbles and systemic risk-taking in the financial sector (Arregui et al., 2013). Thus, they aim to mitigate the severe negative short-run effects of systemic banking crises.[3]

The potential short-run effects of reserve requirements, especially as a complement of monetary policy, have been widely studied in the literature.[4] In line with the considerations above, Glocker and Towbin (2015) identify interest rate and reserve requirement shocks via zero and sign restrictions in a structural vector autoregressive model (VAR model) employing Brazilian data. They show that a discretionary tightening of reserve requirements leads to a decline in domestic credit, an increase in unemployment, a depreciation of the exchange rate, an improvement of the current account, and an increase in the price level. Overall, they conclude that reserve requirements provide a potential way to rein in credit

[3] Reserve requirements simultaneously address currency and banking crises (twin crises in the sense of Kaminsky and Reinhart (1999)) if capital flows management is their main objective.

[4] Reserve requirements only affect banks and thus have a much less ubiquitous focus than interest rate policy.

growth without attracting net capital inflows and exchange rate appreciation. This finding is supported by microeconomic studies, see for example Becker et al. (2017). Tovar et al. (2012) and Arregui et al. (2013) confirm in panel VARs that macroprudential instruments including reserve requirements reduce (temporary) credit and house price growth. Montoro and Moreno (2011) find that higher requirements have two beneficial effects in crises times. First, higher buffers increase resilience per se. Second, the possibility of lowering requirements helps to offset tighter financing conditions by providing liquidity. However, all these studies share a focus on short-run developments and focus purely on credit development.

We add to their analysis by describing the long-run growth effects of reserve requirements and crises. In particular, we aim to test the predictions of the theoretical setting put forward by Ma (2018) concerning the long-run growth effects of reserve requirements in crisis and noncrisis periods. These imply that reserve requirements, as a macroprudential policy instrument, increase growth during crisis periods, while its effect on external borrowing impacts economic growth negatively in tranquil periods.

3 Data and stylized facts

The predictions derived by the theoretical models presented in the previous section imply ambiguous effects of macroprudential policy (and in particular, reserve requirements) on economic growth. In this section, we present some descriptive evidence on the existing links between reserve requirements, crises, credit growth and economic growth.

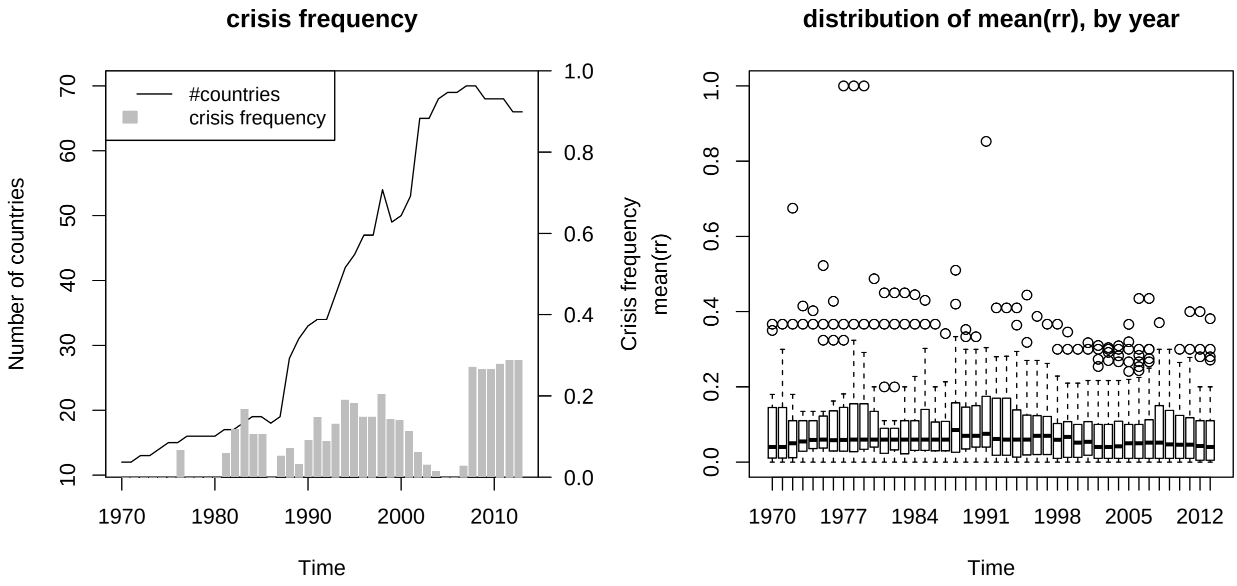
Our main objective is to find the medium-run to long-run influence of reserve requirements and crises on real activity, measured by the growth rate of *GDP per capita*.[5] To complement the existing literature on the effects of regulation and crises on credit growth, we also provide results on the robust determinants of the growth rate of three different credit measures. In particular, we concentrate on the growth rates of *bank credit to private sector*, *credit by financial sector* and *credit to private sector*. While conceptually close, there are accounting differences among the three measures. For example, *bank credit to the private* sector may be much closer to *credit to private sector* in a bank-based financial system than in a market-based financial system. Additionally, the size of the government sector affects the different credit aggregates differently.

Economic crises and reserve requirements were not often employed as potential covariates in the literature on the robust determinants of long-run economic growth. However, as documented in the previous section, both crises and regulation may have long-run effects. In this study, we measure crisis occurrence using dates of systemic banking crises from Laeven and Valencia (2013). To our knowledge, this is the most comprehensive database of systemic banking crises worldwide. For reserve requirements, we use data from the large international database of Federico et al. (2014). This database contains unbalanced quarterly data on reserve requirements in 60 countries (and, additionally, the euro area as an aggregate) from 1969 onwards.

Figure 1 shows the development of our two main variables of interest, systemic banking crises and reserve requirements, over the period spanned by our sample. In the left plot, it can be observed that

[5] An overview of all variables and summary statistics on the full (unbalanced) dataset can be found in the Appendix, Tables A.1 and A.2. Table A.3 provides information on the coverage over countries and time for our baseline estimations.

Figure 1: Descriptive statistics of crises and reserve requirements



Note: The figure shows the frequency of crises and descriptive statistics for the average reserve requirement of a country in a given year (median as a thick line, interquartile range as a box, extended range as dashed line, and outliers as dots). Reserve requirement data are from the database of Federico et al. (2014).

the share of crises per year in our sample is highest during the financial and subsequent sovereign debt crisis. The smaller number of countries in the early part of our sample, together with lower degrees of financial liberalization, have contributed to the low frequency of crises in this period.

The right plot of Figure 1 reports our second variable of interest, reserve requirements, for the same sample. The advantage of the database by Federico et al. (2014) is that we observe the exact value of reserve requirements. Advanced economies tend to set extremely low requirements, sometimes even zero. On the other end, Colombia had requirements of 100% from 1977 to 1979. Mexico and Brazil also set requirements at 50% or above during their respective economic crises in 1988 and 1994.[6] Despite this large cross-sectional variation, the development of the cross-sectional average of reserve requirements over the years is fairly stable. If anything, there seems to be a slight downward trend of requirements both in the median (thick black line) and the outliers (circles). This stability can mainly be attibuted to an expansion of our geographical sample, mainly towards middle-income and low-income countries, which usually have higher requirements than advanced economies. Within nearly every country individually, we observe a downward trend for reserve requirements. However, at all times there are some countries with very high reserve requirements (20% and more).

The descriptive statistics refer to mean reserve requirements. This hides potentially large differences across different types of deposits. Reserve requirements are classified in four different categories. First, there may only be a single (flat) requirement. Second, requirements can be differentiated across maturities (demand, savings and term deposits). Japan, for example, requires banks to hold larger

[6] Other databases such as Cerutti et al. (2017) provide information on the existence or legal opportunity to introduce reserve requirements and other macroprudential policy tools. However, given the large cross-sectional variation in Federico et al. (2014), we should not expect to find strong effects from the pure existence of requirements.

reserves for demand deposits than for savings and term deposits, because the former have shorter maturities and are therefore more prone to bank-runs. Third, requirements may be differentiated across local and foreign currencies. For example, Peru employs different requirements for deposits in local and foreign currencies. As a reaction to large capital inflows in the boom years from 2006 to 2008, requirements on foreign deposits were increased from 20% to 49%, while those on local deposits just went from 6% to 9%. A fourth classification differentiates both across maturities and currencies. In most of our analysis we use the simple average of these requirements, *mean(rr)*.[7] In additional estimations, we also employ the squared average and two different measures for the degree of differentiation across requirements, namely, the difference between the maximum and minimum requirement, *maxdiff(rr)*, and the standard deviation of requirements, *sd(rr)*, see Table A.2 in the Appendix.

Beyond this simple differentiation covered in our data, there are numerous idiosyncratic rules. They are set by the central bank, which can adjust a number of parameters. Possible options are, among others (a) at which rate reserves are remunerated (if at all); (b) to allow reserve averaging (i.e., set a longer period over which reserves must only be met on average); (c) to differentiate requirements over certain types of deposits, or to exclude certain deposits altogether;[8] and (d) to apply requirements to all existing deposits or only to newly created ones (Gray, 2011).

In Figure 2, we plot yearly GDP and credit growth rates from ten years before to ten years after a systemic banking crisis.[9] Growth rates of GDP and credit are both substantially lower in the year of a crisis than in other years. However, GDP growth rates are still positive in nearly 50% of the countries (Devereux and Dwyer, 2016). In line with the discussion in the previous section, neither credit nor GDP growth rates seem to be much higher after a crisis than before (Cerra and Saxena, 2008; Laeven and Valencia, 2013). Beyond average effects, the large uncertainty of all four growth rates allows for both negative or positive medium- to long-run growth effects.

In the previous section, we have documented the use of reserve requirements as a countercyclical policy tool. Figure 3 provides some limited evidence of such a usage around systemic financial crises.[10] In the year of the crisis, requirements drop on average by 2.5% and continue to stay lower than in the year prior to the crisis thereafter.[11]

The stylized facts presented above show patterns in our variables of interest in an unconditional manner. Disentangling the actual effect of reserve requirements on credit and GDP growth requires controlling for a series of other potential determinants of these two variables. Our additional control vari-

[7]As the data are internationally not available, we cannot calculate effective requirements, where the different requirements are weighted by the share of affected deposits (Glocker and Towbin, 2015).

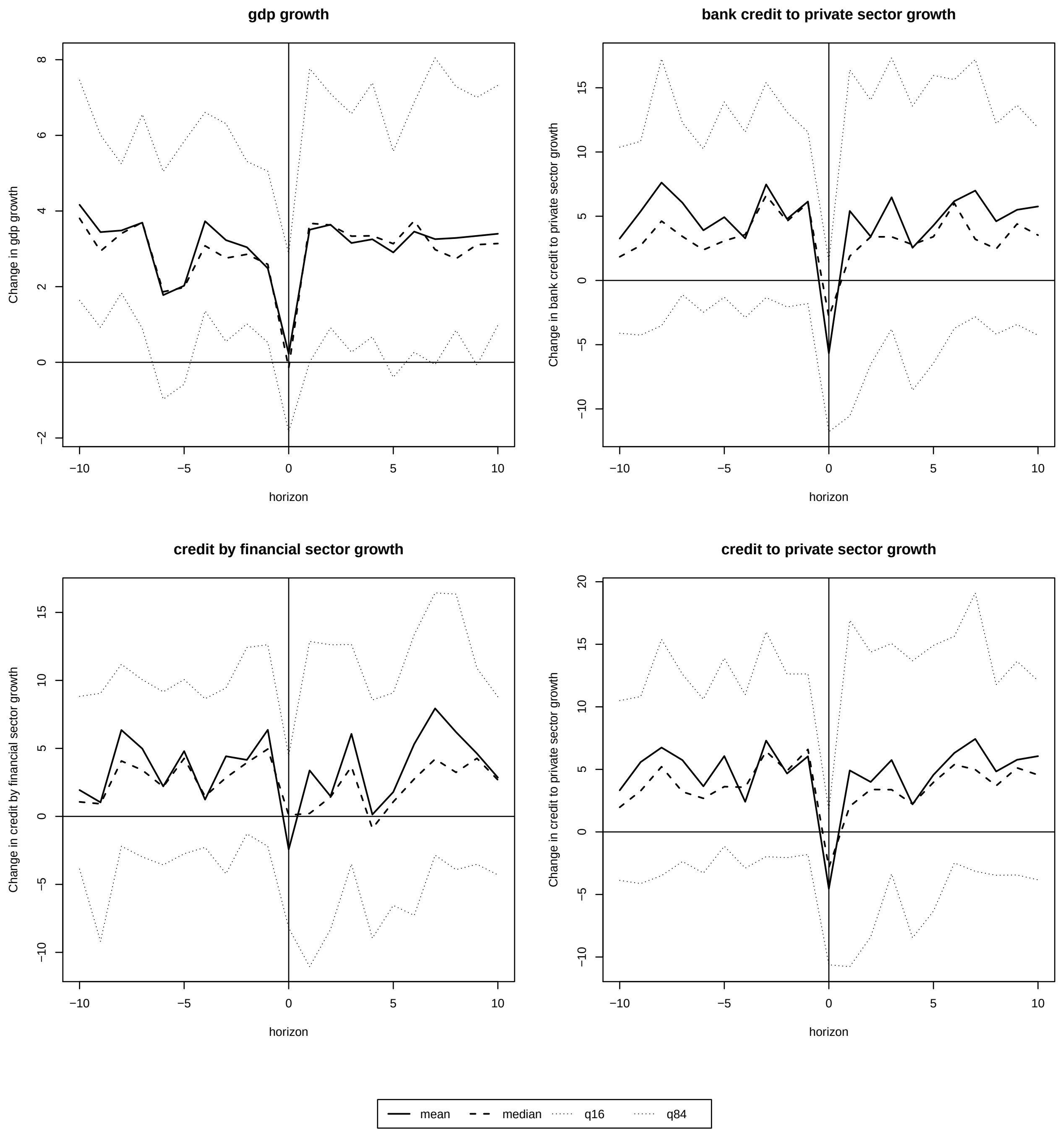
[8]Differentiation can go as far as exempting specific banks. In the case of Brazil, for instance, reserve requirements act as a de facto subsidy from large banks to small banks (Robitaille et al., 2011).

[9]Figure 2 should give a flavor of correlations between crises and growth rates. However, it is likely that it paints an incomplete picture for at least two reasons. First, we do not control for additional variables. Second, it could well be that developments before and after a crisis are both extraordinary. By focusing only on a short window around a crisis, we cannot give an impression of growth rates in “normal” times.

[10]Figure 3 is intended to motivate our hypothesis. However, as an event study with a focus on a limited window around crises and without controlling for additional variables, it cannot give the full picture.

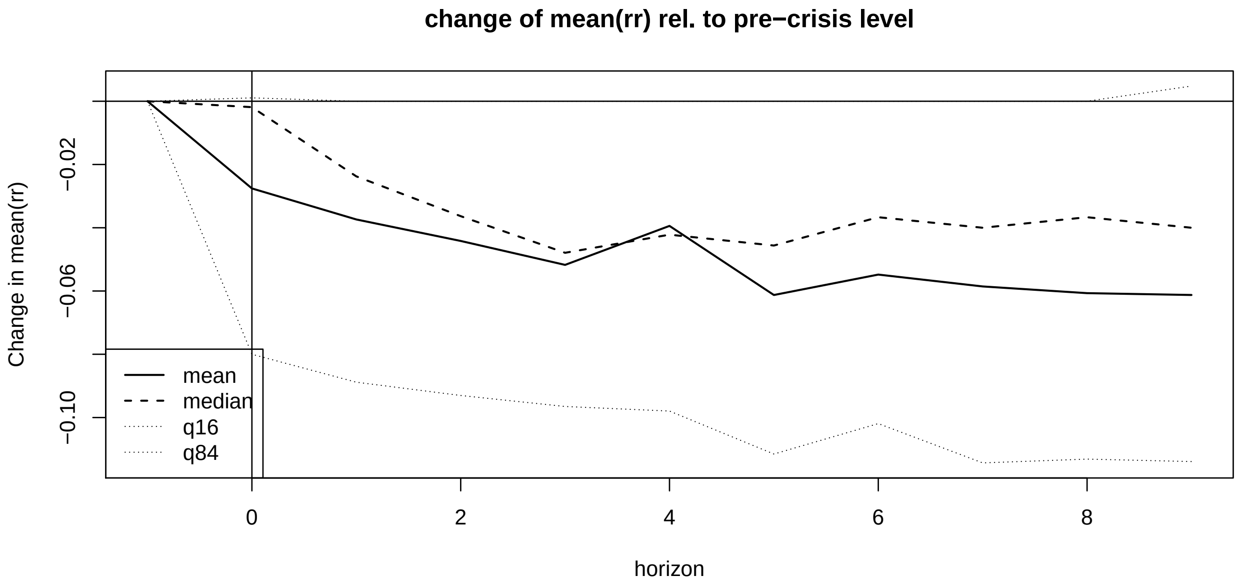
[11]Some advanced economies such as the Eurozone use a low level of requirements to stabilize money market rates and link them to central bank interest rates rather than as countercyclical tools. However, whenever this is the main goal of requirements, they are typically very close to zero. Fluctuations (if they exist) are due to serious shortages on interbank markets, which are internationally linked across advanced economies. We control for this in our empirical setting by using country- and time-fixed effects.

Figure 2: Development of GDP and credit growth around crises



Note: The analysis is based on 54 crises, drawn from Laeven and Valencia (2013). We report mean, median as well as the 16 and 84-percentile of the data.

Figure 3: Development of reserve requirements after crises



Note: The analysis is based on 54 crises, drawn from Laeven and Valencia (2013) and reserve requirements from Federico et al. (2014). We report mean, median as well as the 16 and 84-percentile of the data.

ables are mostly standard covariates employed in the growth literature (see for example Moral-Benito, 2012). These variables focus mostly on determinants of long-run growth and include covariates based on theoretical frameworks that are often used in the empirical literature to study economic growth differences across economies. We include variables that correspond to the human capital-augmented Solow model (gross capital formation, population growth, initial income per capita and educational attainment variables), as well as covariates measuring age structure, which have been highlighted as economic growth predictors by Lindh and Malmberg (1999) or Bloom et al. (2007), variables related to international trade and foreign direct investment (see, for example, Frankel and Romer, 1999) and to credit access (King and Levine, 1993). Importantly, we include capital account openness and other variables of financial liberalization to ensure that our results are driven by macroprudential motives for reserve requirements (Rancière et al., 2008). The set of potential models encompassed by combinations of covariates of the pool used in our analysis corresponds therefore to many of the specifications that are routinely used to address long-run economic growth in modern empirical studies. However, our variables of interest most likely have the strongest effect on growth at business cycle frequencies. To avoid attributing wrong effects to crises and reserve requirements, we need to control for additional macroeconomic variables operating at the same frequency. Therefore, we also include real interest rates, inflation measures and unemployment, as well as the current account and external debt to our list of potential regressors. This captures the most important macroeconomic and financial leading indicators. Our dataset also contains information on exchange rate regimes, which is used in a robustness check aimed at assessing subsample heterogeneity in the effect of reserve requirements on economic growth (see section 5). To control for unobserved country specificity and global shocks, we add country- and period-fixed effects in all our specifications.

As usual in the literature on long-run economic growth, we abstract away from effects within business cycle frequencies by forming nonoverlapping five-year averages for all variables in our main specification. All right-hand side variables are lagged one period (i.e., averages of the prior five-year block). This leaves us with 314 observations in our baseline model covering 5-year periods in 66 countries between 1985 and 2015, see Table A.3 in the Appendix. In a robustness check without reserve requirements and crises, we are able to extend our dataset to 485 observations, covering 97 countries. If we deviate from our baseline estimation by replacing GDP growth with credit growth or by including exchange rate arrangements as an additional explanatory variable, the number of observations varies only slightly.

We also present results from separate Bayesian model-averaging exercises where data are averaged over non-overlapping blocks of different lengths. Specifically, we let the block length vary from three to ten years, the typical length of business cycles. As with the estimates with block length of five years, we lag all explanatory variables by one block. Coefficient estimates on very short blocks (one-two years) would be strongly affected by business cycle effects and are potentially not immune to expectation effects and thus reverse causality. At the other end, estimates on long blocks are conditional on very small sample sizes, a problem that is further aggravated by the fact that we control for country- and time-fixed effects.

4 Methodological framework: Reserve requirements and economic growth under model uncertainty

To assess quantitatively the role played by reserve requirements as a determinant of both credit and income per capita growth in the presence of specification uncertainty, we consider the following class of linear panel data models applied to N observations,

$$g_{i,t} = \alpha_i + \sum_{j=1}^{k} \beta_j x_{i,j,t-1} + \lambda_t + \varepsilon_{i,t}, \tag{1}$$

where $g_{i,t}$ is the dependent variable of interest (alternatively the growth rate of credit or income per capita in country i and five-year period t). A model is defined by the choice of k variables as explanatory covariates. These variables are assumed to belong to a pool of K potential covariates that may explain within-country differences in the dependent variable of interest. All models include country-fixed effects (α_i) and time-fixed effects (λ_t) to control for observable and unobservable differences across economies that remain constant over time, as well as for shocks to $g_{i,t}$ that are common across countries. In addition, we assume that $\varepsilon_{i,t}$ is a homoskedastic, normally distributed shock with variance σ^2.

Our main interest is to quantify the effect of the variable measuring reserve requirements, which is in the pool of available covariates. Since the effect of reserve requirements on both credit growth and income per capita growth is potentially affected by whether the economy is experiencing a crisis, we add the interaction between the reserve requirements covariate and a crisis dummy as an additional variable in the set of potential determinants of $g_{i,t}$. The full set of covariates used to construct panel data models of the type given by equation (1) corresponds to that presented in Table A.2, augmented with the interaction term mentioned above.

We integrate model uncertainty by carrying out inference on the effect of the explanatory variables based on the full set of models that can be created using the pool of potential covariates. In such a setting, the posterior distribution for the parameter corresponding to variable x_j, β_j, is given by

$$P(\beta_j|y) = \sum_{l=1}^{2^K} P(\beta_l|M_l, y)P(M_l|y), \tag{2}$$

where posterior distributions are denoted by $P(\cdot|y)$, and where $P(\cdot|M_l, y)$ stands for the posterior distribution conditional on the specification given by model M_l and data y. Inference is performed based on the posterior distributions obtained from individual specifications, weighted by posterior model probabilities, $P(M_l|y)$. These are proportional to the product of the marginal likelihood of the corresponding model ($P(y|M_l)$) and the prior model probability ($P(M_l)$). The integrated likelihood of a model can be computed as

$$P(y|M_l) = \int_{\beta_l}\int_{\sigma} f(y|\beta_l, \sigma)P(\beta_l, \sigma)d\beta_l d\sigma, \tag{3}$$

where $f(y|\beta_l, \sigma)$ is the likelihood function under model M_l and $P(\beta_l, \sigma)$ is the prior density over the parameters of M_k. It is standard in the literature on Bayesian model averaging (BMA, see for example Fernández et al., 2001b,a; Ley and Steel, 2007, 2012) to assume a flat prior over $\log(\sigma)$, so that $P(\sigma) \propto \sigma^{-1}$, and an independent g-prior over β_l, which implies that

$$\beta_l|\sigma, M_l \sim N(0, g\sigma^2(X_l'X_l)^{-1}), \tag{4}$$

where the columns of matrix X_l contain the observations of the explanatory variables included in M_l. The g-prior given by equation (4) assumes the same covariance structure as for the OLS estimator of β_l, scaled by g. Recent contributions propose the use of a hierarchical prior structure where a prior distribution over g is imposed. Liang et al. (2008), Feldkircher and Zeugner (2009) or Cui and George (2008), for instance, put forward alternative Beta priors over the shrinkage factor (given by $g/(1+g)$) which increase robustness of inference in the presence of model uncertainty further (see also Ley and Steel, 2012, for a comparison of hyper-g-priors in simulated settings). This is the setting employed in the empirical application of this study, which results in relatively flat priors centered around zero for the parameters of all covariates in the pool of potential determinants.[12]

With respect to the prior over models, $P(M_l)$, the BMA literature has moved from assigning a uniform prior over the model space (see for example Fernández et al., 2001b) or fixed prior inclusion probabilities by covariate (see for example Sala-i-Martin et al., 2004) to hierarchical priors, where a (Beta) prior is imposed on the inclusion probability of each variable. Such a Beta-Binomial prior on model specifications has the advantage of providing more robust inference than priors based on fixing the inclusion probability of explanatory variables. Additionally, it makes the prior on model size less de-

[12] Early contributions to the application of BMA to econometric specifications (Fernández et al., 2001b; Sala-i-Martin et al., 2004) tend to use fixed values of g corresponding to settings that result in integrated likelihoods incorporating well understood penalties on the inclusion of new variables in the model. The uniform information prior (UIP) results in an integrated likelihood that can be approximated using the Bayesian information criterion (BIC, see Schwarz, 1978) and corresponds to setting $g = N$. Alternatively, setting $g = K^2$, for instance, leads to the so-called risk inflation criterion (RIC, Foster and George, 1994). Fernández et al. (2001a), making use of a comparison based on simulated settings, propose the so-called BRIC criterion, which corresponds to $g = \max(N, K^2)$.

pendent on the choice of the g-prior (Ley and Steel, 2009). Since our particular application includes an interaction term among the potential covariates, treating all specifications in the model space equally *a priori* may lead to inference, which is difficult to interpret. This is because specifications with an interaction term but without the parent variables would be entertained in the averaging exercise. To avoid basing our inference on such potentially misleading models, we apply a strong heredity prior on covariate inclusion (Chipman, 1996; Crespo Cuaresma, 2011). Under this prior, specifications that include an interactive variable without also including the linear terms corresponding to both of the interacted variables are assigned a zero prior probability, thus ensuring that inference on the interaction term is properly interpretable.

Given the large number of models that need to be estimated to compute posterior distributions (in our benchmark estimation we have $K = 36$, so the model space contains approximately 69 billion specifications), we employ a Markov Chain Monte Carlo (MCMC) method to analyze the space of specifications (Kass and Wasserman, 1995). Our inference is based on 1'000'000 MCMC draws (visiting approximately 550'000 different models), after discarding 100'000 steps as a burn-in sample. The usual statistics used to ensure convergence of the Markov chain indicate systematically that statistics based on the visited models can be safely used to perform inference.[13]

5 Empirical results: The effect of reserve requirements on economic growth

5.1 Reserve requirements and credit growth

The previous literature has documented in a number of studies that tightening reserve requirements tends to be followed by lower credit growth. However, most of these studies focus on short-term to medium-run effects. Camors and Peydro (2014), for example, exploit a single change in regulation in Uruguay to identify reactions by banks. Glocker and Towbin (2015) and Tovar et al. (2012) employ VAR methods with monthly data and are therefore in principle able to identify longer-run effects of reserve requirement shocks. However, they restrict their impulse-response functions to four-year and one-year horizons. Our analysis has a natural focus on longer horizons, and therefore provides a reference to compare the conclusions of these studies and assess whether short-run reactions persist at longer horizons. Moreover, our Bayesian approach to addressing inference allows us to integrate away the uncertainty attached to the choice of controls in the specification, thus providing robust alternative empirical evidence compared to the findings from (admittedly rather large-scale) VARs. The comparative disadvantage of our analysis, on the other hand, is that we are not able to provide results on adjustment dynamics beyond conditional convergence speeds, nor can we strictly identify exogenous shocks. To rule out reverse causality, we assume that reserve requirements and other control variables do not react to medium-run expectations (covering the following five years) of credit and GDP growth. The lag structure imposed in our model space, where explanatory variables are lagged by five years, provides a chronology that makes endogeneity concerns arguably unimportant in our setting.

[13]The correlation between the analytical and MCMC-based posterior model probabilities is above 0.99 in the baseline

Table 1: Bayesian model averaging results for credit growth

	bank credit to private sector			credit by financial sector			credit to private sector		
variable	pip	mean	t-stat	pip	mean	t-stat	pip	mean	t-stat
mean(rr)	0.472	4.572	1.048	0.766	9.408	1.379	0.450	4.061	1.053
crisis	0.427	0.344	0.401	0.758	1.967	1.270	0.551	-0.545	-0.479
mean(rr)#crisis	0.241	-5.887	-1.534	0.704	-33.076	-2.899	0.304	-9.133	-1.984
bank credit to private sector	1.000	-0.206	-4.272	0.422	-0.018	-0.998	0.434	-0.030	-1.459
credit by financial sector	0.837	0.078	2.352	0.988	-0.126	-3.882	0.690	0.063	2.286
credit to private sector	0.402	-0.024	-0.917	0.353	0.004	0.177	0.970	-0.182	-3.041
EU dummy	0.954	-7.037	-2.975	0.697	-3.010	-1.747	0.931	-6.018	-2.803
labor force part.	0.844	-0.202	-2.494	0.546	-0.078	-1.528	0.700	-0.139	-2.198
pop. above 65	0.840	-1.423	-2.730	0.351	0.114	0.572	0.617	-0.775	-2.161
pop. growth	0.798	2.434	2.341	0.871	2.704	2.518	0.933	3.362	3.024
log gdp/capita	0.772	4.731	2.251	0.960	7.964	3.187	0.702	3.979	2.207
low-income country dummy	0.723	6.388	1.961	0.625	5.114	1.647	0.529	3.694	1.714
pop. under 14	0.600	-0.345	-1.868	0.344	-0.021	-0.205	0.367	-0.135	-1.222
capital account openness	0.562	2.070	1.669	0.413	0.876	0.971	0.344	0.773	1.061
upper-middle income dummy	0.534	-1.336	-1.061	0.432	0.008	0.007	0.373	-0.606	-0.749
tertiary education	0.472	0.152	1.344	0.391	-0.077	-0.817	0.249	0.007	0.127
lower-middle income dummy	0.467	0.781	0.452	0.546	2.115	1.181	0.337	0.470	0.443
urban pop.	0.414	-0.084	-1.126	0.337	0.008	0.143	0.256	-0.018	-0.410
inflation, cpi	0.407	0.022	0.990	0.536	0.015	0.755	0.428	0.033	1.298
inflation, gdp deflator	0.373	-0.013	-0.795	0.538	0.013	0.841	0.395	-0.020	-1.122
current account	0.360	0.030	0.491	0.456	0.086	1.068	0.318	0.029	0.562
fdi outflows	0.348	0.054	0.733	0.351	0.025	0.348	0.253	0.005	0.111
imports/GDP	0.348	-0.009	-0.023	0.370	-0.102	-0.169	0.288	0.024	0.068
life expectancy	0.346	0.071	0.750	0.327	-0.003	-0.038	0.288	0.057	0.761
secondary education	0.335	0.012	0.441	0.339	0.006	0.229	0.265	0.000	-0.018
household consumption	0.329	-0.045	-0.114	0.433	0.161	0.243	0.278	-0.065	-0.184
exports/GDP	0.319	-0.026	-0.066	0.373	0.078	0.129	0.272	-0.050	-0.146
govt. consumption	0.316	0.026	0.066	0.716	0.533	0.620	0.301	0.023	0.062
investment/gdp	0.315	-0.041	-0.105	0.519	0.009	0.012	0.315	-0.084	-0.224
govt. debt	0.313	-0.004	-0.397	0.534	-0.022	-1.504	0.270	-0.004	-0.566
trade openness	0.312	0.008	0.456	0.341	0.008	0.424	0.310	0.015	0.921
reserves (months of imports)	0.310	-0.029	-0.393	0.341	-0.030	-0.373	0.270	-0.028	-0.444
pop. density	0.310	0.000	-0.145	0.337	0.000	0.270	0.267	0.000	0.552
fdi inflows	0.308	-0.012	-0.160	0.340	0.016	0.218	0.254	0.014	0.275
primary education	0.306	-0.005	-0.181	0.434	-0.037	-0.993	0.379	-0.036	-1.186
total pop.	0.301	0.000	0.262	0.359	0.000	0.478	0.266	0.000	0.383
political rights	0.292	-0.005	-0.101	0.348	-0.031	-0.498	0.241	0.006	0.143
Fixed effects		YES			YES			YES	
Observations		305			305			305	

Note: Columns report the posterior inclusion probability (*pip*), unconditional mean (*mean*) and t-statistic conditional on inclusion (*t-stat*) of the coefficients. The corresponding BMA results without average reserve requirements and crisis dummies can be found in the appendix in Table A.4.

Table 1 reports results from our BMA exercise with three different measures of credit growth as a dependent variable. Specifically, we consider growth rates of (i) domestic credit provided by the financial sector, (ii) total credit to the private sector, and (iii) credit to the private sector provided by the banking sector. All credit measures are expressed as shares of GDP. For every credit growth measure, we report results for BMA applied to the model space spanned by combinations of control variables in Table A.2 including *mean(rr)*, the crisis dummy and the interaction of the two. In all cases, we report the posterior inclusion probability, the unconditional mean and the ratio of posterior mean to posterior standard deviation (thus resembling the frequentist t-statistic) conditional on inclusion for all variables entertained in the exercise. The posterior inclusion probability of a variable is given by the sum of posterior model probabilities of the specifications that include that variable as a covariate and is routinely interpreted as the importance of the variable when explaining variability in our dependent variable. As a different representation, Figure 4 depicts the *conditional* posterior distribution of our three main variables of interest in the regression on the growth rate of credit by the financial sector. The reported conditional mean effect (denoted by *Cond. EV* in the figure) can be interpreted as the effect of this variable if it was always included. The effect is determined by the unconditional mean in the Table 1 divided by the corresponding inclusion probability.

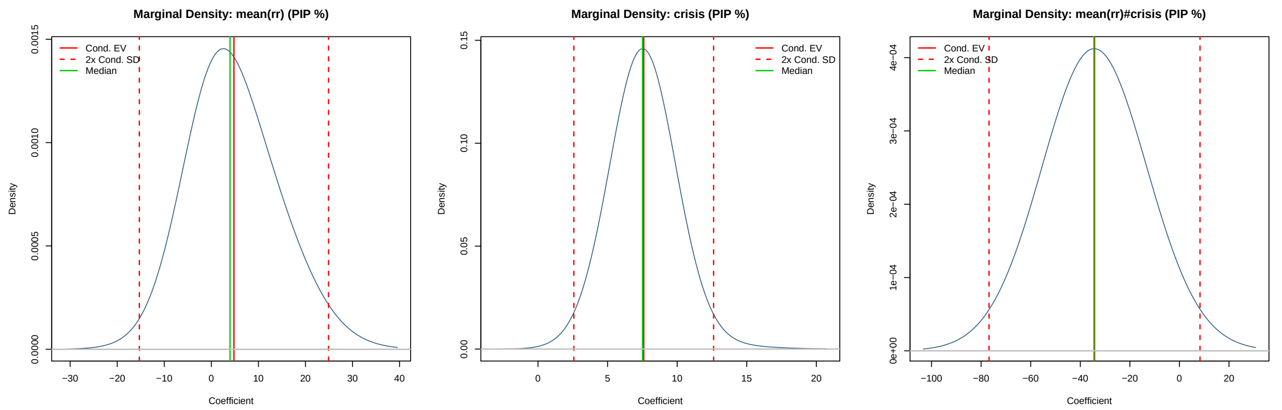
Several results among those presented in Table 1 stand out. First, we find fairly high posterior inclusion probabilities for *mean(rr)*, *crisis* and their interaction, in particular for credit by the financial sector, indicating that the data tend to support the robustness of these variables as determinants of credit growth. Second, we find that past crises and past levels of reserve requirements have a positive effect on credit growth. Since crises rarely extend over more than one period and are contemporaneously associated with a sharp slowdown of credit growth (see Figure 2), the positive coefficient on lagged crises implies a credit expansion back to normal levels. We also find a positive coefficient on mean reserve requirements. Studies based on VAR models (Tovar et al., 2012; Arregui et al., 2013; Glocker and Towbin, 2015) suggest a short-run negative effect of increasing requirements on credit growth. However, as requirements are highly persistent, increases have an effect in the medium to long run (our measure of analysis), which seems to be positive for credit growth according to our findings. Taken together, faster credit growth after a short-run credit tightening may be a sign that either reserve requirements do not create permanent impairments to credit levels, or that there is an initial overreaction of financial markets in a reduction of credit.

Third, high reserve requirements during systemic banking crises have a strongly negative effect on credit growth even in the long run. This is consistent with the idea that reserve requirements should be lowered during a crisis to remove constraints from the stressed banking sector and enable its quick stabilization. Indeed, our data suggest that requirements are lowered in the first year of a crisis (see Figure 3). Once model uncertainty is taken into account, the standard deviation of our coefficient estimates is quite large (see Figure 4 for the estimation on growth of credit by the financial sector). Only the mean of the posterior distribution of the interaction coefficient is more than two standard deviations away from zero, further strengthening the recommendation of reducing requirements during a crisis.

Given the relatively large number of (potentially correlated) covariates, the lack of "significance" of

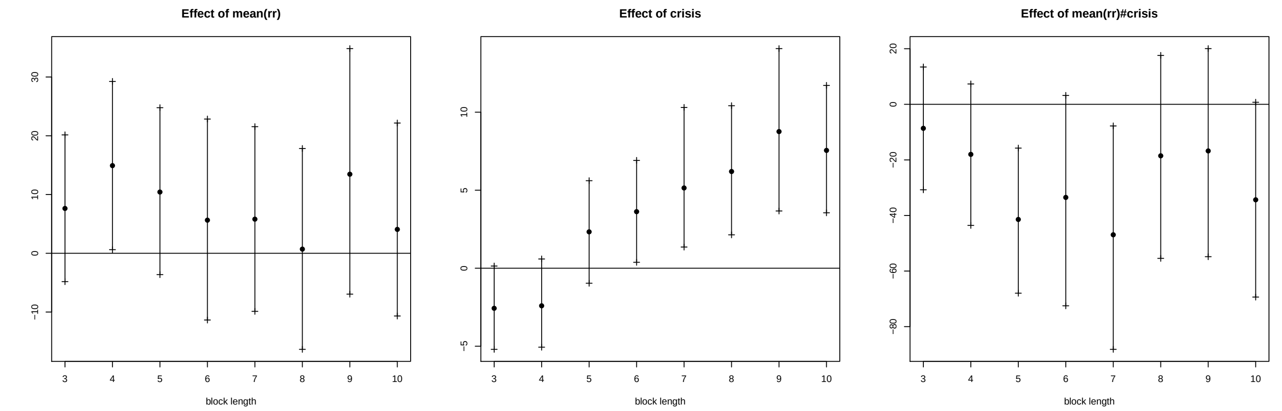
model on GDP growth. Further convergence checks can be obtained from the authors.

Figure 4: Credit by financial sector, posterior marginal densities of selected coefficients



Note: Densities are conditional on inclusion of the variable in the model. The full posterior density would be given by a scaled version of the reported densities, combined with a point-mass at zero.

Figure 5: Credit by financial sector, selected coefficients from models with different block lengths



Note: We report median coefficients together with 90% confidence sets conditional on inclusion from separate estimations with varying block length between three and ten years.

coefficients (in a frequentist sense) does not appear surprising. Following Raftery (1995), applications of Bayesian model averaging have also used other thresholds different from the standard frequentist ones. Masanjala and Papageorgiou (2008), for instance, proposes the use of posterior mean-to-standard deviation ratio thresholds of 1 or 1.3 to identify well estimated effects.[14]

Our results are confirmed for more than just the five-year blocks used in the main analysis. In Figure 5, we show the results from separate Bayesian model average exercises for growth of credit by the financial sector with different block lengths, as described above. We report median coefficients and 90% confidence sets conditional on inclusion in the posterior model. The figure confirms that reserve requirements have a positive or insignificant effect on credit growth at medium to long horizons. The

[14]Raftery (1995) studies the link between the relative improvement in posterior model probability and the t-statistics aimed at testing significance. For the standard settings applied in Bayesian model averaging a ratio of posterior mean to posterior standard deviation above unity (a t-stat of 1) appears equivalent to an improvement in the fit of the regression after accounting for the inclusion of a new variable.

effect of crises shows a very familiar s-shape, whereby a credit crunch shortly after a crisis is followed by a strong rebound at longer horizons.[15] Lastly, the interaction effect is negative (albeit often at low inclusion probabilities) for block lengths of four years and longer.

In addition to our results for reserve requirements and crises, we also find evidence of conditional convergence dynamics in all credit measures, which materializes in robust negative partial correlations between the initial level of credit and subsequent credit growth.[16] Systematic robust effects with relatively precise estimates for the effect of all credit measures are also found for the following control variables: An economy with faster *population growth* also tends to exhibit faster credit growth, while *older populations* tend to reduce their reliance on credit. Moreover, richer economies (as measured by *GDP/capita*) show faster credit growth. Furthermore, *EU economies* tend to present lower growth rates of credit independently of the measure used, while the opposite is true for *low income countries* (as defined by the World Bank classification). Finally, a higher *labor force participation* is associated with lower credit growth, a result that is likely to be caused by the fact that the highest increases in labor force participation (due mostly to the incorporation of women into the labor force, as well as improvements in educational attainment levels) tend to occur in the low and middle-income countries of our sample.

5.2 Reserve requirements and income growth

We now turn to the main analysis, where we investigate the effects of reserve requirements and systemic banking crises on economic growth. In a first step, we perform a similar analysis as above with the growth rate of GDP per capita as a dependent variable. The results of the BMA applied to this setting are reported in Table 2. Here, we also report estimation results, where we exclude our variables of interest and stick to the usual control variables. This increases the sample size and thus provides better estimated effects. We can see that differences between the two estimations are mostly small. As expected, initial GDP per capita levels have a strong negative effect on growth after controlling for other covariates, indicating conditional convergence to country-specific long-run balanced growth paths. Moreover, variables describing economic openness and international competitiveness appear as important robust determinants of economic growth. Concerning demographics, population growth has the expected negative effect on income growth, while the size of the population affects growth positively.

We report the distribution of our three main coefficients of interest, the ones on *mean(rr), crisis* and their interaction, in Figure 6. Average reserve requirements have (on average) a negative long-run effect on growth, as would be expected from stronger regulation.[17] Increasing requirements by 10

[15]This result may partly be driven by the somewhat different cyclical behavior of credit compared to GDP as documented in the literature on financial cycles Drehmann et al. (2012). In particular, the larger individual coefficients of reserve requirements for shorter block length may still capture cyclical effects.

[16]We also conduct a similar estimation without the variables of interest, reported in Table A.4 of the Appendix. Due to missing observations, the dataset including our variables of interest is markedly smaller. Twenty-eight (mostly developing) economies were removed from the dataset due to lack of information in the covariates of interest. While coefficients remain broadly robust, posterior inclusion probabilities are generally much more extreme and mostly closer to zero in the model estimates based on datasets without reserve requirements and crises. That is, the posterior model size distribution favors much smaller models (four to six regressors) among the latter models compared to the specifications reported in Table 1 (15 to 18 regressors).

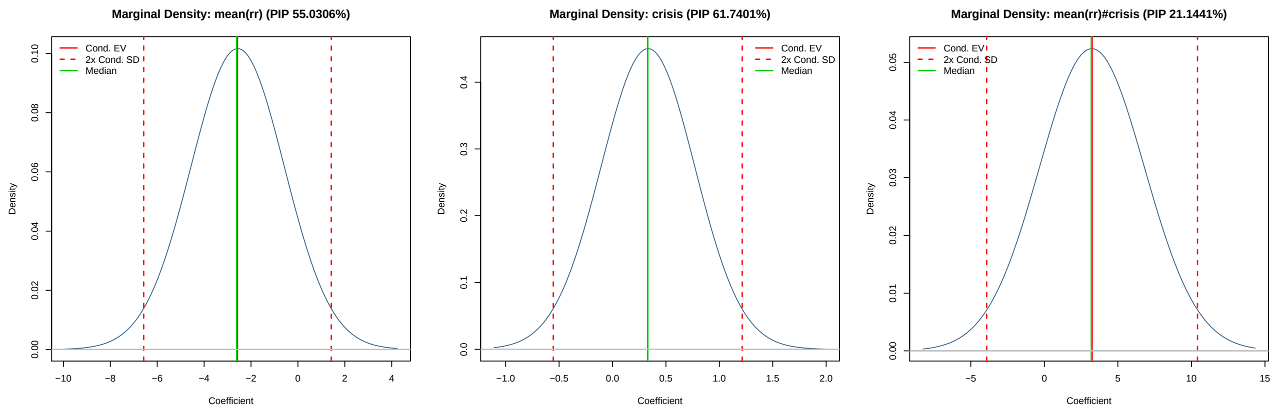
[17]These effects remain nearly identical if we drop capital account openness from the set of explanatory variables.

Table 2: Bayesian model averaging results with and without reserve requirements and crisis

	GDP growth			GDP growth, with RR and crisis		
variable	pip	mean	t-stat	pip	mean	t-stat
mean(rr)				0.553	-1.290	-1.188
crisis				0.628	0.303	1.186
mean(rr)#crisis				0.221	0.621	0.779
log gdp/capita	1.000	-3.735	-6.672	0.986	-2.061	-2.930
pop. growth	0.983	-0.785	-3.109	0.605	-0.289	-1.555
total pop.	0.954	0.000	3.183	0.890	0.000	2.404
fdi outflows	0.849	-0.115	-2.300	0.998	-0.272	-3.988
urban pop.	0.583	0.034	2.122	0.543	0.027	1.280
credit to private sector	0.568	-0.011	-1.571	0.629	-0.012	-1.440
fdi inflows	0.530	0.049	1.889	0.997	0.251	3.629
life expectancy	0.504	0.044	1.898	0.332	0.003	0.126
investment/gdp	0.455	-0.018	-0.317	0.424	-0.003	-0.028
current account	0.434	0.021	1.626	0.947	0.102	2.710
credit by financial sector	0.372	0.004	1.285	0.546	0.008	1.239
reserves (months of imports)	0.343	-0.020	-1.481	0.813	-0.105	-2.328
lower-middle income dummy	0.341	0.287	1.173	0.453	0.307	0.890
trade openness	0.333	0.004	1.325	0.417	-0.004	-0.883
inflation, gdp deflator	0.313	0.001	0.776	0.331	0.000	-0.060
inflation, cpi	0.302	0.001	0.514	0.335	-0.001	-0.232
upper-middle income dummy	0.297	0.218	1.169	0.524	0.387	1.266
exports/GDP	0.247	0.008	0.199	0.378	0.013	0.126
bank credit to private sector	0.239	0.000	0.120	0.377	-0.001	-0.307
low-income country dummy	0.233	0.038	0.134	0.434	-0.284	-0.575
pop. above 65	0.219	-0.021	-0.849	0.501	-0.093	-1.320
imports/GDP	0.210	-0.007	-0.178	0.366	-0.016	-0.151
pop. under 14	0.207	-0.008	-0.676	0.366	-0.012	-0.506
secondary education	0.202	0.002	0.745	0.333	-0.001	-0.093
household consumption	0.195	0.007	0.184	0.396	0.021	0.192
govt. debt	0.189	0.000	0.070	0.770	0.010	2.017
labor force part.	0.186	-0.002	-0.617	0.330	-0.002	-0.268
political rights	0.185	0.004	0.613	0.607	-0.041	-1.635
pop. density	0.185	0.000	0.496	0.334	0.000	0.187
govt. consumption	0.179	0.003	0.072	0.339	0.007	0.066
capital account openness	0.177	0.042	0.521	0.567	0.460	1.603
primary education	0.171	0.000	-0.021	0.363	0.004	0.546
tertiary education	0.170	0.002	0.227	0.457	-0.029	-1.170
EU dummy	0.170	-0.013	-0.147	0.336	0.040	0.211
Fixed effects		YES			YES	
Observations		475			306	

Note: Columns report the posterior inclusion probability (*pip*), unconditional mean (*mean*) and t-statistic conditional on inclusion (*t-stat*) of the coefficients.

Figure 6: GDP growth, posterior marginal densities of selected coefficients



Note: Densities are conditional on inclusion of the variable in the model. The full posterior density would be given by a scaled version of the reported densities, combined with a point-mass at zero.

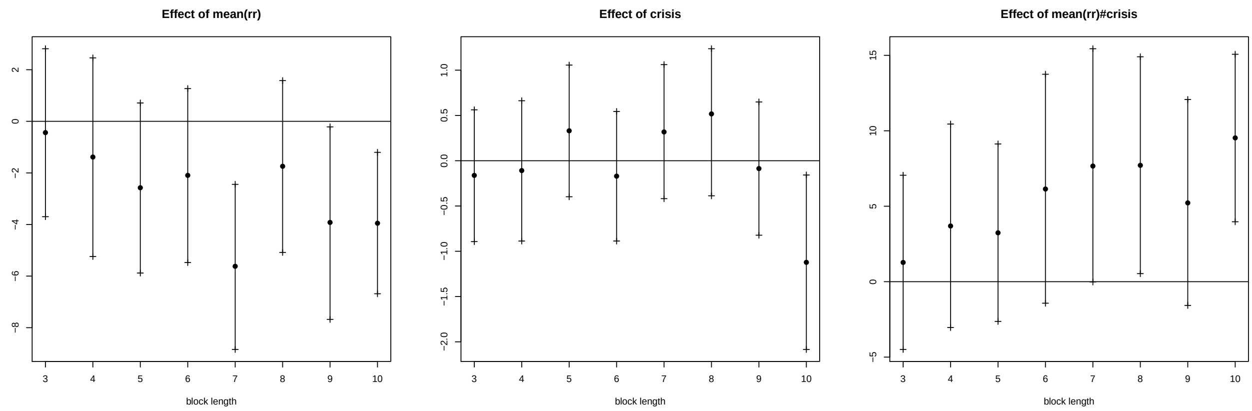
percentage points reduces economic growth by approximately 0.13 percentage points. However, higher levels of reserve requirements tend to be associated with a lower fall in economic growth during crises. A possible reason for such a result is that crises are less severe if regulation is stronger and that reserve requirements are employed countercyclically and loosened to free liquidity during a crisis, see Figure 3. It should be noted, however, that the low inclusion probability of the interaction term of *mean(rr)* and *crisis* implies little evidence for the robustness of such asymmetric effects of reserve requirements in this particular setting. Moreover, while reserve requirements may smooth volatility of GDP through a crisis, the overall effect appears negative for the data at hand. As in the results for credit growth, we find that past crises have a positive effect on income growth. Recessions and recoveries after crises take longer than usual business cycles, and cyclical amplitudes are higher (Reinhart and Rogoff, 2009, 2014; Bordo and Haubrich, 2017), which can explain why crises have a positive effect on long-run growth on average in our results. A second reason may be related to the fact that crises provide a trigger to improve institutions (for example through IMF programs), having an additional and permanent positive effect on economic growth (Acemoglu et al., 2005). However, it should be noted that all coefficients are small and very imprecisely estimated.

Figure 7 gives further confirmation to our findings and shows the median coefficients together with 90% confidence sets conditional on inclusion for estimations with different block lengths.[18] With longer horizons, the negative effect of reserve requirements becomes more pronounced. A similar strengthening of our findings can be observed for the interaction term, with zero not being part of the confidence set for most longer blocks. Crises, however, have no significant and systematic effect on GDP growth. That is, we cannot reject the possibility that there is no catching up after a crisis (Cerra and Saxena, 2008).

How can we align the results for GDP growth and credit growth with each other? Crises tend to be followed by increased growth five years in the future in both cases. This finding seems sensible as the correlation between credit and GDP growth is particularly high around financial crises. However,

[18] Inclusion probabilities are on average 70% for reserve requirements, 75% for crises and approximately 50% for the interaction term, with probabilities increasing for longer blocks.

Figure 7: GDP growth, selected coefficients from models with different block lengths



Note: We report median coefficients together with 90% confidence sets conditional on inclusion from separate estimations with varying block length between three and ten years.

the coefficients on average reserve requirements and its interaction with crises must be reconciled. There are at least four possible arguments that link the results. First, credit is measured as shares of GDP. That is, if credit growth picks up after increasing reserve requirements, this indicates that credit increases relative to GDP. Second, the correlation of credit and GDP growth may not be extremely high in normal times, as indicated by the finding that credit cycles may take three to four times as long as business cycles (Drehmann et al., 2012). That is, the pure effect of average reserve requirements on growth does not necessarily need to point in the same direction. Third and with respect to the interaction effect, there may be a timing issue after a crisis. A financial crisis may trigger a credit crunch, which lowers investment and thus leads to a strong drop in real GDP growth. To achieve long-run growth in GDP, capital deepening must take place, which may take some time and some advance credit (Kydland and Prescott, 1982). That is, we could expect credit growth to pick up earlier than GDP growth after a crisis. The development of the interaction term over time, as shown in Figures 5 and 7, points to this possibility: coefficient estimates increase as the block length increases. Fourth, we control for credit variables in the regression on GDP growth. That is, the negative effect of reserve requirements on GDP growth is on top of the effect predicted purely by credit volumes, which all turn out to be more important for GDP growth once reserve requirements and crises are included as control variables. The fact that we find negative growth effects of reserve requirements on economic growth in tranquil times is thus not only related to the credit channel, but also due to other effects that are not explicitly controlled for in the specification.[19] Negative growth effects from financial repression due to the distortionary nature of changes in reserve requirements have been often predicted in the theoretical literature (see, for instance Roubini and Sala-i Martin, 1995; Basu, 2001) depending on the complementarity (or lack thereof) of private and publicly provided inputs. Effects of changes in reserve requirements on macroeconomic variables that go beyond changes in investment are also reported by

[19] If we include an interaction effect mean(rr) with any of the three credit volume measures, we find that the individual effect of mean(rr) on GDP growth and its interaction with credit volumes are negative. This indicates that higher reserve requirements indeed weigh negatively on growth not only via a credit channel. A regression that includes interactions of mean(rr) with all three credit volumes simultaneously is hard to interpret due to high degrees of multicollinearity in the credit volume measures.

Glocker and Towbin (2015), who find reactions of exchange rates and inflation. This, together with a widening of interest rate spreads (Romer, 1985) may lead to net negative effects on economic activity.

Table 3: Nonlinear effects of reserve requirements

	Baseline			SD(RR)			Difference(RR)			RR squared		
variable	pip	mean	t-stat	pip	mean	t-stat	pip	mean	t-stat	pip	mean	t-stat
mean(rr)	0.543	-1.266	-1.189	0.478	-1.092	-1.144	0.473	-1.080	-1.146	0.618	1.846	0.549
crisis	0.613	0.297	1.194	0.596	0.286	1.184	0.575	0.277	1.193	0.763	0.467	1.257
mean(rr)#crisis	0.209	0.583	0.773	0.160	0.404	0.570	0.151	0.385	0.582	0.397	-5.675	-1.226
sd(rr)				0.370	-0.624	-0.386						
sd(rr)#crisis				0.138	0.526	0.484						
maxdiff(rr)							0.359	-0.245	-0.366			
maxdiff(rr)#crisis							0.129	0.214	0.463			
mean(rr)^2										0.740	-9.342	-1.282
mean(rr)^2#crisis										0.494	23.526	1.431
Controls		YES			YES			YES			YES	
Fixed effects		YES			YES			YES			YES	
Observations		306			306			306			306	

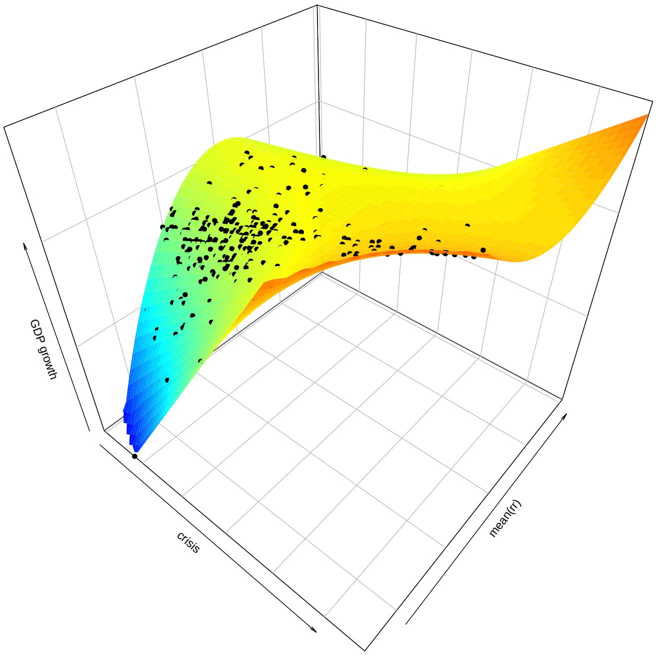
Note: Columns report the posterior inclusion probability (*pip*), unconditional mean (*mean*) and t-statistic conditional on inclusion (*t-stat*) of the coefficients.

The database of Federico et al. (2014) not only reports average reserve requirements but also differentiates requirements across maturities and/or currencies of regulated deposits. Thus, it allows for us to construct and investigate additional measures of reserve requirements that may shed light on the degree of differentiation embodied in different policy strategies with respect to reserves. During crises, more differentiation should allow policymakers a more targeted response to the crisis, having a positive effect on economic growth. During normal times, increased differentiation could either be positive (due to the same targeting argument), or regulatory complexity could weigh negatively on growth. We look at the standard deviation of requirements across categories, and the difference between maximum and minimum requirements to check these hypotheses.[20] We use these variables individually and – as for *mean(rr)* – interact them with the crisis dummy. The findings on control variables are nearly unaffected, thus we report only variables of interest in Table 3. The differentiation measures have only a minor effect on the results obtained for the parameters of our baseline variables of interest. In addition, we find that inclusion probabilities are very similar to those of *mean(rr)* and its interaction with the crisis dummy. Regarding the effects of differentiation (*sd(rr), maxdiff(rr)* and their interactions with the crisis variable), we can confirm the hypothesis of downsides during normal times and upsides during crisis times. However, posterior inclusion probabilities and t-stats are low, and the positive interaction effect is never strong enough to fully counter the negative effect during normal times.

The fourth set of columns in Table 3 presents the model averaging results for models where the quadratic term of the reserve requirements covariate and its interaction with the crisis dummy are included as part of the pool of explanatory variables, capturing a potential nonlinear effect of average reserve requirements on economic growth. A quadratic relation could imply an "optimal level" of requirements, balancing growth against volatility. Indeed, we find that the posterior inclusion proba-

[20] These are, admittedly, blunt measures for the degree of regulatory differentiability, as they measure the de facto differentiation, rather than regulatory options.

Figure 8: Joint effect of crisis and reserve requirements: quadratic specifications



Note: The surface plot reports the quadratic function implied by the coefficients on *crisis, mean(rr), mean(rr)*^{2} and their interactions. Black dots report actual observations.

bilities of these two variables are high, indicating a more complex nature of the link between economic growth and reserve requirements than that implied by linear models, and its modulation by crisis occurrence. The relationship unveiled by the data, however, does not support a simple hump-shaped link and reveals more complicated conditional correlations between these variables. The estimated partial relationship between crisis and reserve requirements (jointly) and economic growth is presented in Figure 8. It reports the joint effect of individual and interaction terms and displays the actual observations on which our estimates are based. The dominating feature is a strong positive effect on growth for larger values of the crisis variable, consistent with the large positive coefficient in our estimations.[21] On a more subtle note, we can see some differences when we vary the amount of reserve requirements. For low levels of the crisis occurrence variable (that is, for tranquil periods), the function is strongly hump-shaped. Moreover, the majority of observations have lower reserve requirements than the function maximum. That is, higher reserve requirements could have had a positive effect on growth. This finding is reassuring for the use of reserve requirements, which should provide a safeguard against crises and large economic fluctuations without affecting growth too negatively. Apparently, this strategy works for medium levels of reserve requirements. For larger values of the crisis variable, we do not find the same hump-shaped relationship. Instead, the relationship flattens, indicating that reserve requirement levels do not affect the growth path after a long and severe financial crisis. However, we must be careful about overinterpreting the results at high crisis values, as we have very few observations at such levels of the variable.

[21]Note that we calculate all variables as averages over five-year blocks. Thus, the crisis variable (which is binary on a yearly level) can take on the values $\{0, 0.2, 0.4, 0.6, 0.8, 1\}$ in the estimation.

Last, we account for the fact that many developing economies employed reserve requirements for monetary policy or as capital controls, rather than as macroprudential policy. As argued by Walsh (2012) in his discussion of the contribution by Glocker and Towbin (2012), reserve requirements may weigh more negatively on growth under fixed exchange rates. Higher reserve requirements increase the gap between lending and deposit rates necessary to maintain bank profitability. Thus, they should lead to higher capital outflows and currency devaluation. Under a fixed exchange rate regime (where devaluation is not an option), the central bank needs to increase its interest rate or continuously sell reserves in order to counteract the capital outflows. This interest rate tightening, in turn, has an additional negative effect on growth. We test whether we can confirm this hypothesis even in a setup with a focus on longer horizons and allowing for crises. To do so, we make use of the exchange rate arrangement classification of Ilzetzki et al. (2017). We construct two measures in addition to their coarse and fine classification schemes (where increasing index values are associated with lower degrees of exchange rate control). First, we remove all periods in which Ilzetzki et al. (2017) classify the currency as either free-falling or as a "dual market in which parallel market data are missing" (their two last categories). Second, we construct a simple dummy that is one if the fine index is equal or above the median (eight). In addition to exchange rate arrangements, we also test the interaction with the capital openness index of Chinn and Ito (2008).

Independent of the way we measure exchange rate arrangements, we cannot confirm the theoretical hypothesis.[22] In all cases, increasingly fixed exchange rates (i.e., lower index values) together with higher reserve requirements tend to be followed by higher growth, as indicated by the negative coefficients on the interaction terms. Somewhat pointing in the opposite direction, larger capital account openness in interaction with higher reserve requirements are also good for growth. We draw from this set of results that both our results and the theoretical prediction should be taken with a grain of salt. First, the time horizon at which predictions of the theoretical model hold is most likely shorter than in our empirical analysis. Furthermore, the theoretical model does not explicitly account for crises, which may heavily influence our estimation results. There remains a considerable number of systemic banking crises even if we exclude periods where exchange rates were freely falling.

6 Conclusion

This paper investigates the effect of reserve requirements on medium- to long-run credit and GDP growth. Adding to the previous literature on reserve requirements, we employ a large international panel study. Our Bayesian estimation framework, aimed at explicitly assessing model uncertainty and incorporating it to our estimates, provides robust evidence on the importance of reserve requirements for growth, and its effect. In terms of credit growth, previously indicated *negative* effects of reserve requirements seem to be short-lived. After five years, we instead find a robust *positive* effect of past requirements on current credit growth. In terms of GDP growth, reserve requirements have on average the expected negative effect of regulation, and although they seem to be somewhat helpful on average in mitigating the effects of a crisis, their effect is not robust to specification uncertainty in the economic growth regressions entertained. A nonlinear estimation suggests that medium levels of

[22] Table A.5 in the Appendix presents the results.

reserve requirements may in fact be optimal for medium- to long-run growth.

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Appendix

Table A.1: Variable sources and description

Variable Name	Source	Description
crisis	Laeven and Valencia (2013)	Dummy for systemic banking crisis
reserve requirements	Federico et al. (2014)	Level of reserve requirements, potentially differentiated across currencies and maturities of deposits
gdp growth/capita	World Bank WDI	GDP/capita growth (annual %)
credit by financial sector	World Bank WDI	Domestic Credit Provided By Financial Sector (%GDP)
bank credit to private sector	World Bank WDI	Domestic Credit To Private Sector By Banks (%GDP)
credit to private sector	World Bank WDI	Domestic Credit To Private Sector (%GDP)
gdp/capita	IMF World Economic Outlook	Gross Domestic Product Per Capita, Current Prices
investment/gdp	World Bank WDI	Gross Capital Formation (%GDP)
household consumption	World Bank WDI	Household Final Consumption Expenditure (%GDP)
govt. consumption	World Bank WDI	General government final consumption expenditure (%GDP)
govt. debt	(Abbas et al., 2011)	Govt. Debt (%GDP) from the Historical Public Debt Database, updated yearly
inflation, cpi	World Bank WDI	Inflation, CPI (annual %)
inflation, gdp deflator	World Bank WDI	Inflation, GDP deflator (annual %)
trade openness	World Bank WDI	Merchandise Trade (%GDP)
capital account openness	Chinn and Ito (2008)	Capital account openness, based on IMF AREAER, updated to 2015
era	Ilzetzki et al. (2017)	Classification of de facto exchange rate arrangements
fdi inflows	World Bank WDI	Foreign Direct Investment, Net Inflows (%GDP)
fdi outflows	World Bank WDI	Foreign Direct Investment, Net Outflows (%GDP)
exports/GDP	World Bank WDI	Exports Of Goods & Services (%GDP)
imports/GDP	World Bank WDI	Imports Of Goods & Services (%GDP)
reserves (months of imports)	IMF IFS	Total reserves in months of imports
current account	World Bank WDI	Current Account Balance (%GDP)
political rights	Marshall et al. (2016)	Strength of political rights, ranges from +10 (strongly democratic) to -10 (strongly autocratic).
labor force part.	World Bank WDI	Labor Force Participation Rate, (% Of Total, Ages 15+)
primary education	Barro and Lee (2013)	Primary Educational Attainment for Total Population, 1950-2010
secondary education	Barro and Lee (2013)	Secondary Educational Attainment for Total Population, 1950-2010
tertiary education	Barro and Lee (2013)	Tertiary Educational Attainment for Total Population, 1950-2010
pop. growth	World Bank WDI	Population Growth (annual %)
total pop.	World Bank WDI	Population, Total
urban pop.	Oxford Economics	Population - Urban (% of total)
life expectancy	World Bank WDI	Life Expectancy At Birth, Total (Years)
pop. density	World Bank WDI	Population Density (People Per Sq. Km Of Land Area)
pop. under 14	World Bank WDI	Population Ages 0-14 (% of total)
pop. above 65	World Bank WDI	Population Ages 65 & Above (% of total)
low-income country dummy	World Bank	Country dummy, GNI per capita (WB Atlas method) of $1,005 or less in 2016
lower-middle income dummy	World Bank	Country dummy, GNI per capita (WB Atlas method) between $1,006 and $3,955
upper-middle income dummy	World Bank	Country dummy, GNI per capita (WB Atlas method) between $3,956 and $12,235
EU dummy		Dummy for EU countries

Table A.2: Summary statistics of full dataset

variable	min	mean	median	max	sd	Observations
gdp growth/capita	-4.485	2.390	2.182	13.880	2.460	475
mean(rr)	0.000	0.087	0.054	0.486	0.096	306
crisis	0.000	0.138	0.000	1.000	0.277	475
mean(rr)#crisis	0.000	0.010	0.000	0.306	0.032	306
log gdp/capita	5.419	8.748	8.666	11.405	1.383	475
govt. consumption	4.080	15.781	15.912	38.678	5.458	475
household consumption	26.184	62.834	61.886	104.064	12.471	475
investment/gdp	5.884	24.191	23.230	48.920	6.101	475
inflation, gdp deflator	-6.214	15.152	5.972	582.726	43.258	475
inflation, cpi	-0.516	14.378	5.996	411.608	34.476	475
labor force part.	22.494	59.856	59.680	88.187	9.372	475
trade openness	10.950	63.470	53.006	321.084	41.934	475
current account	-32.366	-1.477	-1.814	38.704	6.637	475
reserves (months of imports)	0.049	4.359	3.475	33.379	3.619	475
fdi outflows	-4.798	1.501	0.366	45.562	3.723	475
fdi inflows	-3.206	3.346	2.236	40.410	4.206	475
exports/GDP	5.882	38.066	31.568	218.892	26.085	475
imports/GDP	6.158	40.866	35.050	191.972	25.286	475
bank credit to private sector	3.292	50.784	42.130	183.040	36.627	475
credit by financial sector	-57.156	70.313	56.686	338.886	52.747	475
credit to private sector	3.314	55.121	44.422	208.736	41.237	475
primary education	0.200	17.366	16.400	50.560	10.073	475
secondary education	0.540	26.004	23.720	69.600	15.185	475
tertiary education	0.140	7.367	5.740	30.000	5.954	475
political rights	-9.800	5.806	8.000	10.000	5.248	475
life expectancy	43.655	70.957	72.316	83.090	7.386	475
pop. growth	-1.514	1.199	1.156	5.880	1.139	475
pop. density	1.670	207.943	80.202	7494.225	686.086	475
total pop.	6.680E+05	6.365E+07	1.448E+07	1.351E+09	1.853E+08	475
pop. under 14	13.122	27.982	27.662	49.720	9.776	475
pop. above 65	1.888	8.765	6.704	24.308	5.211	475
urban pop.	5.628	60.379	63.846	100.000	21.840	475
EU dummy	0.000	0.183	0.000	1.000	0.380	475
low-income country dummy	0.000	0.141	0.000	1.000	0.336	475
lower-middle income dummy	0.000	0.316	0.000	1.000	0.438	475
upper-middle income dummy	0.000	0.235	0.000	1.000	0.394	475
capital account openness	0.000	0.568	0.523	1.000	0.357	475
govt. debt	4.220	54.491	47.880	302.660	34.090	475
mean(rr)^2	0.000	0.017	0.003	0.270	0.034	306
mean(rr)^2#crisis	0.000	0.002	0.000	0.118	0.010	306
sd(rr)	0.000	0.020	0.000	0.283	0.041	306
sd(rr)#crisis	0.000	0.004	0.000	0.226	0.018	306
maxdiff(rr)#crisis	0.000	0.008	0.000	0.492	0.041	306
maxdiff(rr)	0.000	0.044	0.001	0.642	0.092	306
era fine	1.000	8.008	8.000	15.000	3.639	468
era coarse	1.000	2.368	2.000	6.000	1.042	467
era dummy	0.000	0.576	1.000	1.000	0.469	456
era fine rest.	1.000	7.647	8.000	13.000	3.469	456
mean(rr)#era fine	0.000	0.720	0.402	5.197	0.931	304
mean(rr)#era coarse	0.000	0.214	0.105	1.876	0.291	305
mean(rr)#era dummy	0.000	0.051	0.012	0.486	0.083	298
mean(rr)#era fine rest.	0.000	0.660	0.388	4.858	0.840	298
mean(rr)#ka_open	0.000	0.041	0.018	0.355	0.060	306
era fine#crisis	0.000	1.046	0.000	13.900	2.423	468
era coarse#crisis	0.000	0.326	0.000	4.950	0.722	467
era dummy#crisis	0.000	0.073	0.000	1.000	0.200	456
era fine rest.#crisis	0.000	0.966	0.000	13.000	2.254	456
ka_open#crisis	0.000	0.086	0.000	1.000	0.218	475
mean(rr)#era fine#crisis	0.000	0.085	0.000	3.601	0.313	304
mean(rr)#era coarse#crisis	0.000	0.026	0.000	1.282	0.103	305
mean(rr)#era dummy#crisis	0.000	0.006	0.000	0.273	0.023	298
mean(rr)#era fine rest.#crisis	0.000	0.076	0.000	2.728	0.271	298
mean(rr)#ka_open#crisis	0.000	0.003	0.000	0.098	0.011	306

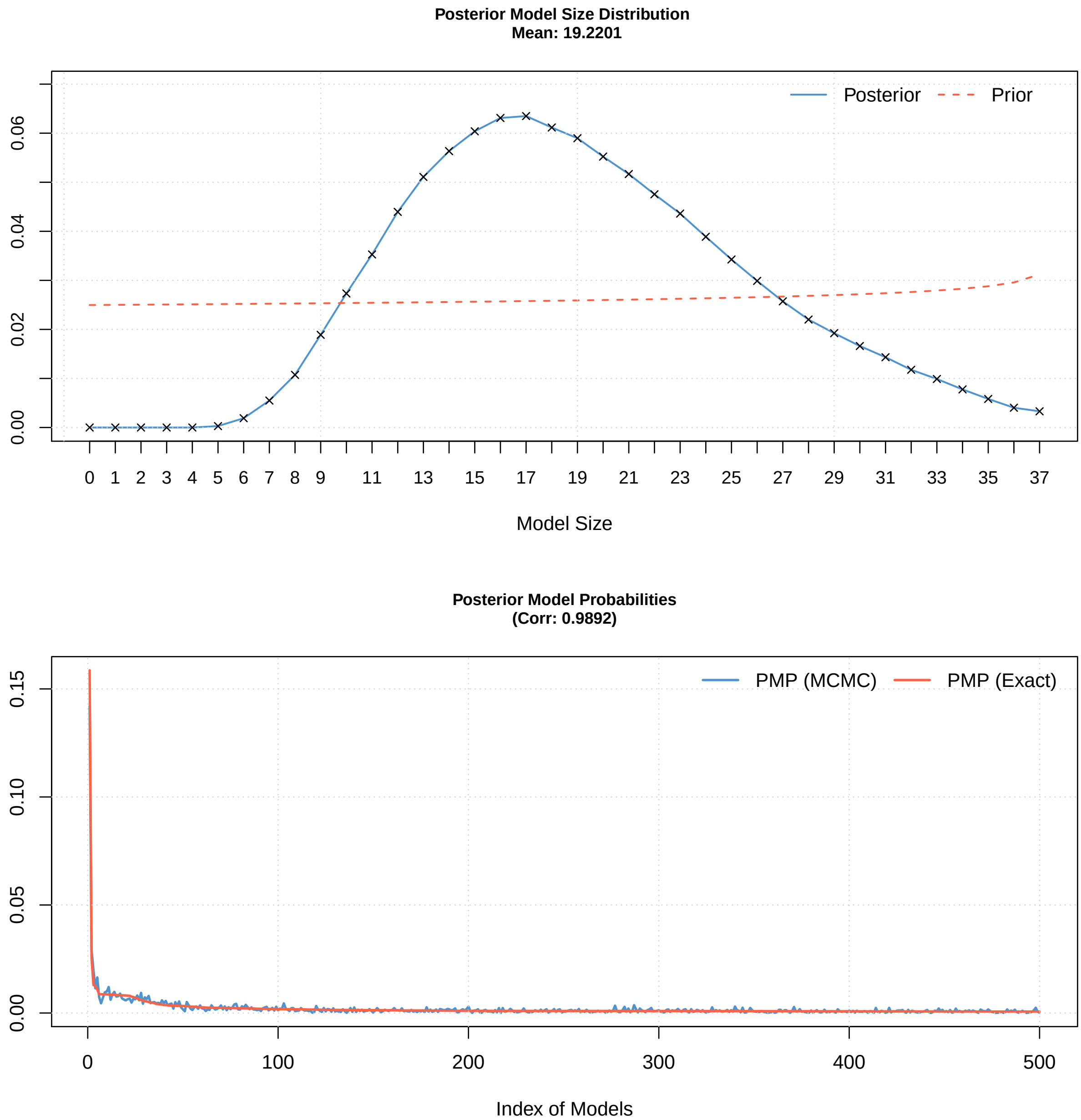
Note: The different reserve requirements variables (*mean(rr), sd(rr), maxdiff(rr) and mean*^{2}*(rr)*), as well as the different exchange rate arrangement indizes (*era fine/coarse/dummy/fine rest.*) are described in the text. *ka_open* refers to capital account openness.

Table A.3: Coverage across countries and time

	Baseline without crises and mean(rr)		Baseline			Baseline without crises and mean(rr)		Baseline	
Country	Start	End	Start	End	Country	Start	End	Start	End
Albania	2005	2015	2005	2015	Lesotho	2010	2015	NA	
Algeria	1985	2015	NA		Lithuania	2000	2015	2000	2015
Argentina	1990	2015	1995	2015	Malawi	2000	2015	NA	
Armenia	2000	2015	NA		Malaysia	1985	2015	1990	2015
Australia	1990	2015	1990	2015	Mauritius	1990	2015	NA	
Austria	2010	2015	2010	2015	Mexico	1985	2015	1990	2015
Bangladesh	1995	2015	1995	2015	Moldova	2000	2015	2005	2015
Belgium	2005	2015	2005	2015	Mongolia	2010	2015	NA	
Botswana	1985	2015	NA		Morocco	1990	2015	NA	
Brazil	1985	2015	1985	2015	Mozambique	2010	2015	NA	
Bulgaria	1995	2015	NA		Nepal	2015	2015	NA	
Burundi	1990	2010	NA		Netherlands	1985	2015	2000	2015
Cambodia	2000	2015	NA		New Zealand	2005	2010	2005	2010
Canada	1985	2010	1995	2010	Nicaragua	2010	2015	2010	2015
Chile	1985	2015	1985	2015	Norway	1985	2015	1985	2015
China	1990	2015	1990	2015	Pakistan	1985	2015	1985	2015
Colombia	1985	2015	1985	2015	Panama	1985	2015	2000	2015
Costa Rica	1985	1995	1990	1995	Paraguay	1995	2015	NA	
Croatia	2000	2015	2005	2015	Peru	1985	2015	1995	2015
Czech Republic	2000	2015	2000	2015	Philippines	1985	2015	2005	2015
Dem. Rep. Congo	2010	2010	NA		Poland	1995	2015	1995	2015
Denmark	1985	2015	1985	2015	Portugal	1985	2015	1990	2015
Dominican Republic	1985	2015	1985	2015	Romania	2000	2015	2000	2015
Ecuador	1985	2015	1990	2015	Russian Federation	2000	2015	NA	
El Salvador	2000	2015	2005	2015	Singapore	1985	2015	1995	2015
Estonia	2000	2015	2000	2015	Slovakia	2000	2015	2000	2015
Fiji	1985	2015	NA		Slovenia	2000	2015	2000	2015
Finland	1985	2015	2000	2015	South Africa	1985	2015	1985	2015
France	1985	2015	1990	2015	South Korea	1985	2015	NA	
Germany	1995	2015	1995	2015	Spain	1985	2015	1995	2015
Ghana	1995	2015	2010	2015	Sri Lanka	1990	2015	2000	2015
Guyana	2000	2005	NA		Sudan	2010	2010	NA	
Haiti	2000	2015	NA		Sweden	1985	2015	1985	2015
Honduras	1985	2015	2005	2015	Switzerland	2000	2015	2000	2015
Hungary	1995	2015	1995	2015	Thailand	1985	2015	1985	2015
India	1985	2015	1985	2015	The Gambia	2015	2015	NA	
Indonesia	1985	2015	2010	2015	Trinidad And Tobago	1985	2015	1985	2015
Ireland	2010	2015	2010	2015	Tunisia	1985	2015	NA	
Israel	1985	2015	1990	2015	Turkey	1985	2015	1990	2015
Italy	1985	2015	2000	2015	Uganda	2000	2015	2000	2015
Jamaica	1995	2015	1995	2015	Ukraine	2000	2015	NA	
Japan	2000	2015	2000	2015	United Kingdom	1990	2015	1990	2015
Jordan	1985	2015	NA		United States	1985	2015	1985	2015
Kazakhstan	2000	2015	NA		Uruguay	1985	2015	1985	2015
Kenya	1990	2000	NA		Venezuela	1985	2010	1985	2010
Kuwait	2000	2015	NA		Vietnam	2010	2015	NA	
Kyrgyz Republic	2000	2015	NA		Zambia	2015	2015	NA	
Latvia	2000	2015	2000	2015					

Note: Data availability refers to the two estimations in Table 2.

Figure A.9: Posterior model size and probabilities, baseline estimation on GDP growth



Note: The upper plot shows the distribution of prior and posterior model sizes. The lower plot reports the posterior model probabilities calculated from numerical integration ("exact") and as implied by the MCMC draws for the 500 models with the highest posterior likelihood.

Table A.4: Bayesian model averaging results for credit growth, without reserve requirements and credit

	bank credit to private sector			credit by financial sector			credit to private sector		
variable	pip	mean	t-stat	pip	mean	t-stat	pip	mean	t-stat
bank credit to private sector	1.000	-0.178	-7.084	0.110	-0.006	-0.990	0.083	-0.009	-1.635
credit by financial sector	0.054	0.001	0.577	0.962	-0.127	-4.680	0.048	0.001	0.499
credit to private sector	0.079	0.003	0.794	0.110	-0.007	-0.848	0.963	-0.163	-7.055
EU dummy	0.419	-2.071	-2.493	0.097	-0.213	-0.817	0.242	-1.019	-2.267
labor force part.	0.085	-0.007	-1.194	0.443	0.101	2.307	0.041	-0.001	-0.507
pop. above 65	0.059	-0.001	-0.031	0.067	-0.010	-0.233	0.022	0.000	-0.012
pop. growth	0.090	0.111	1.369	0.297	0.637	1.824	0.093	0.134	1.742
log gdp/capita	0.057	0.021	0.164	0.087	0.156	0.559	0.026	0.001	0.014
low-income country dummy	0.202	1.327	1.645	0.144	0.890	1.205	0.039	0.140	1.217
pop. under 14	0.152	-0.055	-1.701	0.092	-0.033	-0.940	0.055	-0.010	-0.988
capital account openness	0.184	0.645	1.774	0.090	0.083	0.353	0.048	0.095	1.044
upper-middle income dummy	0.252	-0.714	-1.841	0.138	-0.211	-0.575	0.119	-0.257	-1.698
tertiary education	0.058	0.007	0.689	0.085	-0.019	-0.848	0.039	-0.002	-0.270
lower-middle income dummy	0.185	0.598	1.202	0.132	0.407	0.960	0.048	0.063	0.681
urban pop.	0.104	0.015	1.280	0.134	-0.025	-1.224	0.069	0.009	1.291
inflation, cpi	0.181	0.005	1.023	0.157	0.003	0.607	0.094	0.003	0.897
inflation, gdp deflator	0.126	0.001	0.182	0.120	0.001	0.322	0.043	0.000	-0.225
current account	0.967	0.326	3.873	0.135	-0.028	-1.206	0.901	0.288	3.884
fdi outflows	0.057	0.005	0.656	0.131	0.037	1.264	0.032	0.002	0.456
imports/GDP	0.098	-0.006	-0.203	0.089	-0.018	-0.174	0.096	-0.015	-1.289
life expectancy	0.070	0.006	0.490	0.995	1.004	4.079	0.044	0.007	0.910
secondary education	0.059	-0.001	-0.128	0.147	-0.020	-1.401	0.029	0.000	-0.233
household consumption	0.118	-0.016	-0.463	0.096	0.001	0.014	0.154	-0.029	-1.809
exports/GDP	0.059	-0.002	-0.066	0.081	0.017	0.170	0.054	0.009	1.126
govt. consumption	0.047	0.002	0.068	0.086	0.016	0.150	0.045	-0.001	-0.128
investment/gdp	0.072	-0.003	-0.113	0.095	0.009	0.085	0.052	-0.008	-1.055
govt. debt	0.053	0.000	-0.083	0.101	-0.003	-0.862	0.028	0.000	-0.148
trade openness	0.043	0.000	0.203	0.074	-0.001	-0.317	0.035	0.001	0.390
reserves (months of imports)	0.044	-0.001	-0.151	0.099	-0.008	-0.363	0.026	0.000	-0.079
pop. density	0.079	0.000	-0.879	0.076	0.000	-0.025	0.038	0.000	-0.610
fdi inflows	0.052	0.001	0.087	0.086	-0.008	-0.347	0.016	0.001	0.280
primary education	0.105	-0.011	-1.283	0.107	-0.017	-1.228	0.076	-0.010	-1.755
total pop.	0.066	0.000	0.581	0.076	0.000	-0.509	0.029	0.000	0.381
political rights	0.083	-0.012	-1.126	0.101	-0.011	-0.589	0.024	-0.002	-0.693
Fixed effects		YES			YES			YES	
Observations		473			473			473	

Note: Columns report the posterior inclusion probability (*pip*), unconditional mean (*mean*) and t-statistic conditional on inclusion (*t-stat*) of the coefficients.

Table A.5: Reserve requirements and exchange rate arrangements

	ERA fine			ERA coarse			ERA dummy, no free falling			ERA fine, no free falling			Capital account openness		
variable	pip	mean	t-stat	pip	mean	t-stat	pip	mean	t-stat	pip	mean	t-stat			
mean(rr)	0.729	0.393	0.100	0.735	1.509	0.437	0.924	1.465	0.584	0.945	8.133	1.737	0.533	-1.476	-1.238
crisis	0.582	0.274	1.031	0.737	-0.082	-0.135	0.582	0.215	0.827	0.611	0.272	0.926	0.585	0.199	0.395
mean(rr)#crisis	0.150	0.161	0.148	0.248	0.197	0.102	0.172	-0.070	-0.083	0.185	0.182	0.101	0.170	1.008	0.988
era fine	0.539	0.020	0.598												
mean(rr)#era fine	0.340	-0.298	-1.916												
era fine#crisis	0.113	0.001	0.077												
mean(rr)#era fine#crisis	0.107	0.014	0.159												
era coarse				0.714	0.125	0.974									
mean(rr)#era coarse				0.481	-1.129	-1.864									
era coarse#crisis				0.409	0.206	1.602									
mean(rr)#era coarse#crisis				0.228	0.039	0.063									
era dummy							0.913	0.389	0.965						
mean(rr)#era dummy							0.847	-7.269	-2.955						
era dummy#crisis							0.171	0.051	0.420						
mean(rr)#era dummy#crisis							0.161	0.221	0.204						
era fine rest.										0.928	0.083	1.496			
mean(rr)#era fine rest.										0.887	-1.337	-3.121			
era fine rest.#crisis										0.175	0.002	0.132			
mean(rr)#era fine rest.#crisis										0.172	-0.025	-0.126			
ka_open													0.590	0.385	1.115
mean(rr)#ka_open													0.175	0.779	1.028
ka_open#crisis													0.159	0.110	0.444
mean(rr)#ka_open#crisis													0.134	-1.333	-0.763
Controls	YES			YES			YES			YES			YES		
Fixed effects	YES			YES			YES			YES			YES		
Observations	304			305			298			298			306		

Note: Columns report the posterior inclusion probability (*pip*), unconditional mean (*mean*) and t-statistic conditional on inclusion (*t-stat*) of the coefficients. *ka_open* refers to capital account openness.