International Reserves: Facing Model Uncertainty

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Abstract

The abundant literature on the competing motives for holding international reserves stresses different factors, giving rise to a problem called model uncertainty. In this paper we search for the most important determinants of reserve holdings using data for 104 countries in 1999–2010 and evaluate their importance using Bayesian model averaging (BMA). We enrich the ongoing empirical discussion by examining the role of financial globalization and monetary policy and by introducing new variables and searching for alternatives to the traditional ones. The results confirm that trade openness and the broad-money-to-GDP ratio are the key determinants with a positive link to the level of reserves. On the other hand, financial development seems to lower the need for reserves.

JEL Codes: C23, E58, F41.
Keywords: Bayesian model averaging, determinants, international reserves.

* The research behind this paper was supported initially by the Grant Agency of the Czech Republic under Project No. 13-06229S, which was initiated by CNB Research project A5/2011.

Nontechnical Summary

Although a number of attempts have been made to find the motives for holding international reserves, a consensus is still lacking. In this paper we do not aim to review the validity of the competing models, but rather we set out to provide an empirical analysis of the determinants of cross-country differences in reserve holdings. We refrain from discussing optimality and adopt a purely positive approach. Still, this paper may draw attention to new factors or just be a starting point for discussions on reserve policies and their optimality.

The main difficulty in explaining reserve levels is related to their changing role, i.e., the use of international reserves has evolved over time and new factors have become relevant. Therefore, we concentrate on a large set of 104 countries in 1999–2010. Previous studies have identified a substantial shift in reserve policies after the Asian crisis in 1998, and many of them have concentrated on the sample of emerging countries only. We include all countries with available data, as we believe a mix of different determinants may drive the reserve holdings, still reflecting the stage of development.

Aside from the traditional determinants such as trade and financial openness we consider other factors: size, stage of development, monetary policy regimes, debt, and financial stability. Most of them have already been investigated in the previous literature, but we provide a comprehensive and unique dataset review. We also include several innovations (dummies for inflation-targeting countries and for banking crises, cross-border financial transactions) and test alternatives to some indicators (measures of the size of the financial sector to substitute for broad money). The aim is to reflect the most recent period, marked by rising financial integration.

We start by reviewing the role of determinants within a standard regression framework. The results show that trade openness is one of the most important determinants of cross-country differences in reserve holdings. New variables for financial stability are certainly relevant for the level of international reserves, while the role of debt seems to be limited. Both trade openness and the broad-money-to-GDP ratio lead to higher reserve holdings, as do intermediate exchange rate regimes (pegs and soft pegs) and oil exports. Economic development is associated with lower reserves, while inflation targeters that do not rank among the advanced countries hold higher reserves. The role of financial openness is now less straightforward than in the pre-1998 period, but still provides insights into the trilemma-related choices. However, the degree of financial openness is not a statistically significant reserve determinant. We compare our main results with specifications with country and/or time fixed effects, which confirm the key role of trade openness and financial stability. We also discuss the endogeneity of the broad-money-to-GDP ratio, which seems to have a limited impact on our results.

Finally, as a complete novelty in this type of analysis we introduce Bayesian model averaging in our search for the determinants of reserve holdings. We do not assess the motives for holding reserves as being in conflict or mutually exclusive, so we allow them all to work together. Where we lack a proper empirical model and/or have a large set of potential explanatory variables, we face a problem known as model uncertainty. One possible way to account for model uncertainty is to employ model averaging techniques using Bayesian inference, which goes through all the possible models given a set of variables. The BMA exercise in a cross-sectional setting identifies trade openness and the broad-money-to-GDP ratio as key reserve determinants. For all the variables considered in this study, still reflecting multicollinearity, BMA even picks up the role of domestic credit to the private sector. The results of course reflect the determinants included, so to draw policy recommendations it is still necessary to extend the analysis to include additional factors (explicit

treatment of mercantilist motives, institutional factors, comprehensive measurement of financial development) as well as dynamics and endogeneity.

1. Introduction

The last decade was marked by enormous accumulation of international reserves – a trend with large consequences on the global scale which renewed the interest of both academics and practitioners. Attempts to explain the recent developments and model the motives for accumulating reserves have a long tradition; several competing theories have been proposed, but a consensus is still lacking. In this paper, we do not aim to review the validity of the competing models, but rather we set out to provide some stylized facts about the country characteristics that have influenced the reserve level and the reserve accumulation trends. Explaining reserve levels is demanding, as the set of potential motives is not limited and changes over time, i.e., new factors become relevant.

Moreover, our positive approach refrains from discussing optimality, as the actual reserve policies may not be optimal. In this sense, our paper is similar to earlier studies by Lane and Burke (2001) and Cheung and Ito (2009), which are a natural starting point for further discussions on reserve policies and optimality. However, we remain within a framework with a large cross-sectional dimension and try to assess the relevance of a set of factors over a limited time span using model averaging.

Before we can focus on this innovative approach to model selection, cross-country regressions and model selection checks are necessary to maintain consistency and comparability with the previous literature, as the set of determinants and the country/time span are not the same.

We start with a proposed set of potential variables based on a literature review of reserve accumulation motives and we discuss possible alternatives or substitutes. To summarize, reserve accumulation can be related to three hypotheses. First, it may result from the export growth promotion policies of some countries (mercantilist motives). Second, reserve policies may be aimed at protecting domestic credit markets (financial stability). In previous studies, the broad-money-to-GDP ratio was used to capture financial deepening or even as a measure of a potential internal drain. We try to test other possible measures of banking sector size or potential drain, including the external one via cross-border financial transactions. We include the global financial crisis period to see the effect of a worldwide (systemic) financial shock on reserve holdings. Finally, reserve holdings may reflect attempts to avoid constraints related to monetary policy and/or financial openness. These constraints can be illustrated using the trilemma (or impossible trinity). The trilemma hypothesis states that a country may simultaneously choose any two, but not all, of the three goals of monetary policy: independence, exchange rate stability, and financial market openness to the full extent. If the policy mix is based on exchange rate stability and limited financial openness due to underdeveloped financial markets, the central bank may attempt to gain monetary policy independence by accumulating reserves. The relevance of the trilemma to reserve level determination has so far gained little attention in the empirical literature on reserve holdings.

In the second step we test the relevance of a proposed set of determinants on a sample of 104 countries over 1999–2010. The choice of sample and time span is motivated by the findings of previous studies. After the Asian crisis there was a substantial shift in the motives for accumulating reserves, but they have remained quite stable over the last decade. Moreover, we include a complete set of countries, including the advanced ones, to provide an overall picture. We do not deny that the motives for holding reserves are different across the country groups (advanced, emerging, developing), and we check this possibility on our sample. But there may be a smooth transition that a simple split according to stage of development may not capture. Moreover, even advanced countries (such as Sweden and Australia) may be motivated to use their foreign exchange reserves, as the experience of the global financial crisis showed.

Once we have presented the main regression results, we address two methodological issues. First, previous studies found varying reserve demand based on the actual reserves-to-GDP ratio, but we take a look at different benchmark variables as well. Second, we see if the choice of model is appropriate by including potential endogeneity. After discussing the main choices for our model we provide an insight into the possible relative importance of the determinants under consideration. We address this issue using Bayesian model averaging (BMA), which represents a novel aspect in analyses of this type. This technique helps us to treat model uncertainty by going through all the possible models given a set of variables. The relative importance of a variable is based on the share of the posterior model mass resting on the models that include that particular variable.

As for the results of the regressions, trade openness and the broad-money-to-GDP ratio are the key drivers of the cross-country differences in reserve holdings. Other variables, such as oil exports, monetary policy, and exchange rate regime, contribute to explaining reserve holdings far less, while the role of indebtedness seems to be limited. Both trade openness and the broad-money-to-GDP ratio lead to higher reserve holdings, as do intermediate exchange rate regimes (pegs and soft pegs) and oil exports. Inflation targeters that do not rank among the advanced countries hold higher reserves. Financial openness has no implications for international reserves. BMA confirms the key role of trade openness and the broad-money-to-GDP ratio and picks up the negative effect of financial development on the international reserves. Other determinants seem to be far less important for explaining the cross-country differences in reserve holdings.

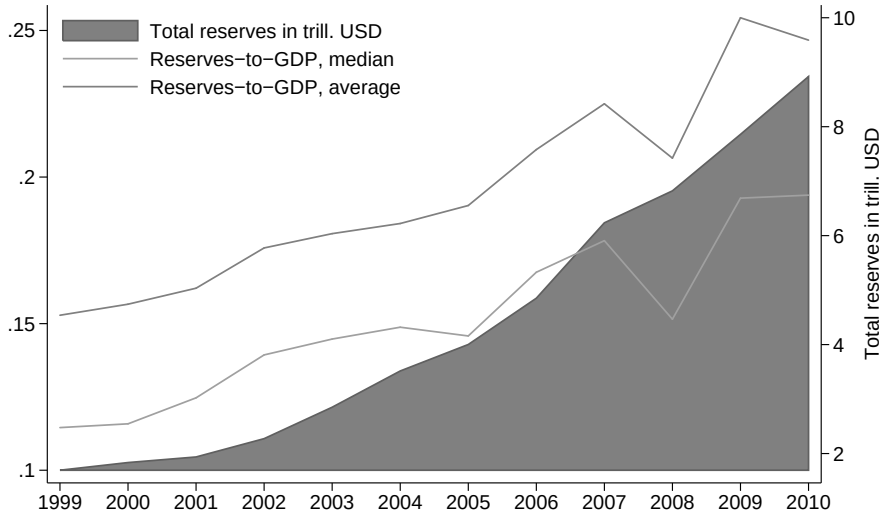
Still, we must acknowledge that several important factors that we are not able to capture in this analysis might be important for policy makers when discussing the reserve level. First, we avoid discussing mercantilist motives for accumulating reserves, as these might be strongly endogenous to our model setup and difficult to measure. Similarly, we are not able to capture the effects of herd behavior or contagion, although clustering by country deals with this issue to a certain extent. Moreover, we acknowledge that reserve holdings are driven by high persistency and might be limited by constraints related to monetary policy conduct and suchlike.

The paper is organized as follows. Section 2 provides a short introduction to the reserve trends in the period under review. The third section presents the main streams of literature on international reserves determinants, illustrating the changing motives and ongoing debate by including the most recent and relevant developments in the field. Based on that, it offers a selection of potential determinants, which are used in the empirical part. The econometric analysis in Section 4 starts with the regression estimates and, after recursive estimates and a model specification check, also gives the BMA results. Section 5 presents a summary of the main findings and policy implications as well as hints for future research.

2. Trends in Reserve Accumulation 1999–2010

The evolution of world international reserves over the period under review was marked by enormous accumulation, launching a debate about whether these trends should somehow be limited. This concern has disappeared recently as the global financial crisis reaffirmed the role of reserves as the main liquidity buffer for most countries. Figure 1 illustrates the overall reserve trends over the last decade on our sample of 104 countries. The growth in reserves even surpassed the current gross domestic product dynamics, with the average share of reserves in GDP increasing from nearly 15% in 1999 to over 25% in 2010. The median value increased slightly less during the same period, from 11% to 19%, suggesting rather widespread accumulation of reserves. The rally was interrupted only in 2008, during the peak of the financial crisis, when the ratios eventually dropped as reserves were depleted.

Figure 1: Total Reserves (Minus Gold) And Reserves-to-GDP Ratios for our Sample of 104 Countries



Among the top reserve holders are the Asian countries (see Table 1), with the shares of Japan and China at the highest levels. The rise in reserve stocks in Japan came as a consequence of unconventional measures, while China was accused of engaging in exchange rate manipulation and even mercantilism in order to promote export growth. But many oil-exporting countries (Saudi Arabia, Russia, etc.) also built up their stocks. This may have been related to the surge in oil prices, which was particularly strong after 2004.

The country ranking changes if we consider reserve holdings as a share of GDP (Table 1, last column). The values for China, Japan, and India do not exceed 50% of GDP, while some countries, such as Hong Kong and Saudi Arabia, hold more reserves in nominal terms than the current value of their gross domestic product.

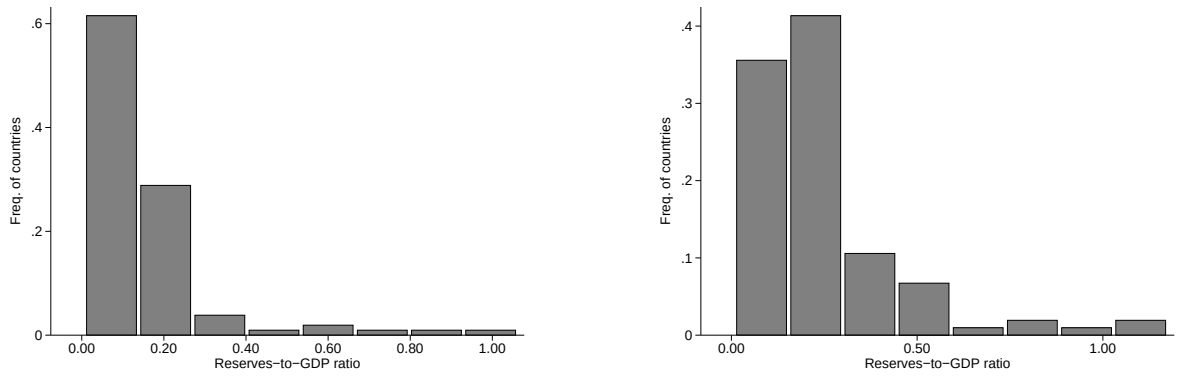
At the other end of the scale, the euro area countries and the USA have the lowest ratios of reserves to GDP. However, even the advanced countries witnessed an increase in reserve holdings compared to their GDP. In a stable sample of 16 advanced countries as defined by the International Monetary Fund (IMF), with the euro area as an aggregate, the average reserves-to-GDP ratio increased from around 16.7% in 1999 to 28.4% at the end of the period under review.

Table 1: Top 15 Reserve Holders, Ranked by Volume in 2010, in Trill. USD

	1999	**2001**	**2003**	**2005**	**2007**	**2009**	**2010**	*% of GDP, 2010*
China	158	216	408	822	1530	2416	2866	*48%*
Japan	287	395	663	834	953	1022	1061	*19%*
Saudi Arabia	17	18	23	155	305	410	445	*84%*
Russia	8	33	73	176	467	417	444	*29%*
South Korea	74	103	155	210	262	270	291	*29%*
Brazil	35	36	49	53	179	237	287	*13%*
India	33	46	99	132	267	265	275	*16%*
Hong Kong	96	111	118	124	153	256	269	*117%*
Euro area	243	212	214	179	203	236	250	*2%*
Singapore	77	75	96	116	163	188	226	*104%*
Switzerland	36	32	48	36	44	98	223	*40%*
Thailand	34	32	41	51	85	135	168	*53%*
Algeria	5	18	33	56	110	149	163	*101%*
United States	60	58	75	54	60	120	121	*1%*
Mexico	32	45	59	74	87	100	120	*12%*

The overall changes in the distribution of the reserves-to-GDP ratios in our sample between 1999 and 2010 are shown in Figure 2. The number of countries with a reserves-to-GDP ratio below 12.5% nearly halved in the period under review, while the group with a ratio of between 12.5% and 25% is now the largest. Also, the number of large reserve holders, with reserves covering at least half of nominal GDP, increased from five countries to eight in 2010.

Figure 2: Histograms of Reserves-to-GDP Ratios in 1999 (left) and 2010 (right)



(a) 1999

(b) 2010

3. Motives for Holding Reserves

While the previous section presented a set of stylized facts on recent reserve trends with some hints on drivers, here we aim to provide the background to our empirical investigation. First, we summarize all the theories that have emerged to explain the reserve holdings. Based on that, we propose a set of determinants to account for the motives so far considered in the literature.

3.1 Findings from the Literature

In this subsection we review the most important motives cited for holding international reserves. In the simplified view, the central bank's decision on reserve levels is driven by cost-benefit considerations. The literature on international reserves has concentrated mainly on investigating different motives and hence the benefits of reserve holdings, while cost assessment has gained far less attention. The potential benefits were defined based on historical experience and derived from the theoretical concepts on optimal reserve holdings. For clarity, the literature on international reserves can thus be subdivided in historical sequence into several strands.

The early studies by Heller (1966) and Olivera (1969) concentrated on the role of reserves in buffering fluctuations in external transactions, compared with the opportunity cost of holding reserves. According to these papers, optimal reserve levels should be determined by balance-of-payments disequilibria, the propensity to import, and opportunity cost. Frenkel and Jovanovic (1981) extended these considerations to include an inventory theoretic approach. The reserve authority should solve the minimizing costs problem – the opportunity cost of holding reserves versus the cost of adjustment whenever the level of reserves reaches the lower bound. Higher levels of reserves mean a larger buffer against any change but higher forgone earnings.

With the collapse of the Bretton Woods system in 1973 the discussion on foreign reserves changed substantially as many countries became vulnerable to what Calvo (1998) defines as the sudden stop syndrome: a massive reversal of capital inflows. This gave rise to a stream of literature considering currency crisis prevention and the mitigation motive for holding reserves.

In the late 1990s, countries such as Mexico and Argentina faced speculative attacks on their officially controlled exchange rates. First-generation models explained how overly expansive domestic policies together with fixed exchange rate regimes can lead to currency crises (Krugman, 1979). Higher reserve levels can postpone a crisis until the reserves are depleted and the fixed exchange rate regime is abandoned. Second-generation models, however, stressed the self-fulfilling aspect of currency crises, and that reserves can be understood as reflecting fundamentals or the commitment to defend a peg, as in Obstfeld (1996). The exchange rate regime should thus be reflected in the reserve levels.

Moreover, the 1997 Asian financial crisis showed how excessive and poorly supervised foreign borrowing together with (partially) fixed exchange rate regimes and large current-account deficits can cause a disaster covering a whole region. Therefore, a substantial stream of literature appeared suggesting how to indicate vulnerable countries (i.e., countries endangered by sudden stops of capital) and what measures are appropriate to minimize current costs and future attacks. The first attempt to propose suitable indicators – made by IMF staff – suggested that overvaluation of the real exchange rate, the M2-to-reserves ratio, and growth of domestic credit tend to signal a currency crisis quite effectively. The ratio of short-term debt to reserves has also proved to be important in many studies,

for example, Mulder et al. (1999), who imply that a benchmark of one for the ratio of reserves to short-term debt is broadly appropriate.[1]

The lesson learned from the Asian crisis was straightforward. If economic fundamentals are weak and the risk of contagion is high, the policy response can include a build-up of reserves and/or extension of liquidity by an international body or lender of last resort. As a result, policy makers changed their view of reserve management as a strong instrument in crisis mitigation and prevention. Mendoza (2010) found that policy makers in developing countries were more responsive in holding reserves than in the pre-Asian crisis period. The elasticity of the reserves to several indicators (external debt and liabilities) increased, indicating that the level of reserves became one of the true measures with regard to crisis prevention.

Soon after 2000 the accumulation of reserves became a global phenomenon. The period of the “Great Moderation" was marked by an increase in levels of international reserves worldwide far larger than that implied by the simple crisis prevention literature. New theories for reserve accumulation, such as mercantilist motives, appeared in order to explain such developments. For example, Dooley et al. (2004) suggest that the accumulation of financial assets and liabilities, in particular international reserve assets and domestic currency liabilities, represents a development strategy based on channeling investment to export industries. As a result, exporting countries finance U.S. current account deficits and real interest rates are lower than they would otherwise be. Aizenman and Lee (2007) test this motive in comparison to the precautionary motive, finding the latter to dominate.

The reserve accumulation trend may also have appeared as a result of monetary policy constraints. All monetary policy regimes must follow the binding constraint of the “trilemma," while international reserves may play a role in relaxing it according to Aizenman (2010). The trilemma hypothesis states that a country may simultaneously choose any two, but not all, of the three goals of monetary policy independence, exchange rate stability, and financial market openness to the full extent.

Finally, there is the financial stability motive. Financial integration and growth of cross-border financial flows have changed the architecture of the global financial system. The financial flows boom may have forced countries to improve their financial stability by accumulating reserves, as their exposure to capital flight and deleveraging crises has increased. For example, Obstfeld et al. (2008) extend the generally accepted macroeconomic view by including aspects of financial globalization. The main reason for holding reserves here is to protect the domestic banking sector (or credit markets), while limiting currency depreciation. Traditional models, considering debt and trade, view as dangerous the situation where the export of home assets suddenly stops (capital outflow). But in fact the shock may appear when the import of foreign assets suddenly starts. Obstfeld et al. (2008) consider the literature on the “double drain" (internal and external) phenomenon to show its importance in a credit market crisis. Such a crisis originates purely as an internal matter but leads to capital flight from the country. Therefore, reserve adequacy should be considered with regard to M2. More generally, financial factors – such as a high degree of dollarization as in Magnusson (2011) and banking sector financing abroad (as in the case of Sweden) – are now considered when discussing the motives for reserve accumulation.

[1] On the other hand, the former Argentine deputy minister of finance Pablo Guidotti argued that reserves should cover scheduled external amortization for one year. Furthermore, according to former Fed chairman Alan Greenspan, a country’s external liquidity position should be calculated over a wide range of possible outcomes.

Most studies have tried to evaluate a specific hypothesis on a cross-country dataset (usually using a sample of emerging countries), controlling for other factors (such as the level of development) as well. Some studies have taken a broader view, incorporating all possible determinants, as in our case. Different specifications have been used, but two of them in particular are quite close to our approach. Lane and Burke (2001) investigated the determinants of reserve holdings over 1981–1995 and found that trade openness (and to a certain extent financial deepening as well) was the most important factor. Cheung and Ito (2009) used a larger set of explanatory variables for 100 countries in 1974–2004. They found that the model for reserve holdings differs between developed and developing economies and that building a unique empirical model for reserve levels may be challenging.

Further studies have reflected the differences between countries by using special methods such as quantile regressions (Ghosh et al., 2012), but smooth transition between the relevant determinants may occur (Delatte and Fouquau, 2011). We recognize the importance of changing motives, but we are still aware that the benchmark – the level of development as in Cheung and Ito (2009) or the actual reserve-to-GDP ratio as in Ghosh et al. (2012) – may influence the results. Hence, we prefer to use a large dataset and review the most important determinants.

3.1.1 Determinants of International Reserves

The previous discussion has indicated a number of potential reserve holding determinants worth investigating. There is no consensus on theoretical reserve behavior, so we decided to include as many potential determinants as possible. In this section we review the motivation for their selection and describe their expected relationship with the reserve levels. As the reserve level (the dependent variable) we use the ratio of total reserves (excluding gold) to current GDP, expressed in log form.

Our set of potential determinants contains 24 variables. They reflect the important motives for accumulating reserves, i.e., the precautionary motive[2] (to face down fluctuations in capital flows and/or trade) and the mercantilist motive (export promotion). We also included other potential reserve accumulation drivers. Some of them had already been considered in the literature (natural resource exports, exchange rate regimes), while others, such as monetary policy and financial stability indicators, are our innovations. The exact definitions can be found in Table A.2 in the Appendix.

For clarity, we split the factors into several areas: (i) general country-specific determinants with measures of size, level of development or oil exports, (ii) the balance of payments, (iii) monetary policy and exchange rate arrangements, (iv) indebtedness, and (v) credit markets and financial development. The abbreviation of each variable is given in brackets.

Country-specific Determinants

Level of development: This determinant has appeared in most empirical studies since the 1960s. In this study we use **GDP per capita** (GDPC), in constant 2000 U.S. dollars. The expected relationship is unclear, as a higher level of development was found to be associated with higher reserve holdings. Still, as Obstfeld et al. (2008) note, the reserves-to-GDP ratio is low for most developed countries. Therefore, there could be a non-linear relationship, which may explain the puzzling results from previous studies. So as an alternative, we employ a dummy variable for **advanced countries** (ADV), using the IMF definition, as a measure of creditworthiness. Advanced countries may have better access to international financing and currency swap lines, which lowers their de-

[2] The precautionary motive gave rise to the optimal reserve literature – see Jeanne and Ranciere (2011) or Calvo et al. (2012) – as well as adequacy assessment benchmarks.

mand for reserves. On the other hand, emerging countries may fear sudden capital outflows causing a severe macroeconomic downturn and secure themselves by piling up reserves. So, we test the effect of a dummy variable for emerging markets (EM) as well.

Country size: The measure of **population** (POP) in millions is included to capture the effect of country size on reserve holdings (Lane and Burke, 2001). For example, if the absolute value of reserves matters for speculators, a larger country may well maintain a lower reserves-to-GDP ratio.

Oil exports: Reserves may be accumulated to ensure stable oil revenues in the domestic currency and save part of the natural wealth for future generations in foreign currency. Previous studies used a dummy variable based on the IMF classification, but we decided to employ the**country's share of world net oil exports** (OIL), using International Energy Agency data to capture size effects contemporaneously. Large oil exporters may pay more attention to this issue than small ones.

Opportunity cost of reserves: This determinant comes from early theoretical models of reserve holdings such as Heller (1966). It should capture the costs associated with reserves and it is measured as the difference between the local interest rate and the U.S. interest rate. There is also a macroeconomic view of the cost of reserves (as forgone income from alternative investment), but we stick to this purely financial context. Even so, exact estimation of the opportunity cost as the difference between government bond yields (domestic vs. U.S. dollar denominated) is not possible in this sample, as many countries are not so financially developed. Thus, we used the **differential between domestic lending rates and U.S. Treasury bill rates** (COST) from the IMF database.

Balance of Payments

Trade openness: the importance of international reserves as a way to protect a country from sudden swings in external trade was recognized in the early buffer stock literature. As a measure of trade openness we use the ratio of **exports and imports** to GDP (TOPEN), following Obstfeld et al. (2008). More options are possible, but this definition reflects the current nature of international trade, where the import content of exports is increasing (OECD, 2011). Such a definition thus captures precautionary as well as mercantilist motives, but the link should be positive in either case. Greater trade openness increases the exposure to trade shocks and hence may scatter precautionary reserve accumulation, while mercantilism-led reserve accumulation is associated with boosting exports.

Financial openness: The Asian crisis in the late 1990s substantially changed the behavior of central banks (Mendoza, 2010), which became aware of potential threats stemming from fully liberalized capital accounts. This precautionary motive should thus have a positive relationship with reserve levels, but a negative one is also possible as capital controls may reduce the risk of speculative attack. As the primary measure of a country's financial openness we use the **Chinn-Ito capital market openness index** (KAOPEN), from Chinn and Ito (2008). It is based on restrictions on cross-border financial transactions, as reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). This variable ranges between -1.86 and +2.43, and higher numbers stand for a more open capital account.

Alternatively, we employ the sum of **foreign assets and liabilities** (FAL), expressed as a percentage of GDP, from Lane and Milesi-Ferretti's updated database (Lane and Milesi-Ferretti, 2007). The reason for including this is that countries with open capital accounts may be actually engaged in global financial transactions, while countries with capital controls may still witness large capital movements.

Monetary Policy and Exchange Rate Arrangements

Exchange rate regime: The role of reserves in defending a currency regime gave a rise to an early currency crisis literature showing that fixed arrangements may be vulnerable and the support of reserves is crucial. Moreover, reserve accumulation can occur as a result of unconventional monetary policy at the zero lower bound (as in the case of Japan), where exchange rate manipulation becomes a key instrument. Therefore, we used a set of dummy variables for the **exchange rate regime** (REGIME). We follow the IMF classification of exchange rate arrangements, de facto since 1997, available from the AREAER. It has eight categories, from “No separate legal tender" to “Independently floating," as shown in Table 1. To simplify the analysis, we combined some subgroups to allow for four categories only. Regime 1 stands for a fixed exchange rate regime, Regime 2 for pegged arrangements, Regime 3 for managed regimes, and Regime 4 for floaters.

Table 2: Exchange Rate Regime Definitions

Our definition	IMF cathegories
Regime 1	Exchange arrangement with no separate legal tender
	Currency board arrangement
Regime 2	Conventional pegged arrangement
	Pegged exchange rate within horizontal bands
	Crawling peg
	Crawling band
Regime 3	Managed floating with no predetermined path for the exchange rate
Regime 4	Independently floating

As an alternative, **exchange rate volatility** (ERVOL) can be tested. It is defined as the standard deviation of the national exchange rate against SDR. Far from the obvious reflection of de facto regimes, the reverse relationship was found in the literature, i.e., holding adequate reserves reduces exchange rate volatility, raising questions of potential endogeneity. We also test if **currency crisis** (CRISIS) is associated with reserve depletion, using the definition by Laeven and Valencia (2008).

Monetary policy arrangements: A special monetary policy arrangement (inflation targeting) is associated with the limited use of reserves and free floating exchange rate regimes. Hence, we test if a claimed **inflation targeting** (IT) regime can be linked negatively with reserve levels, as this theory would suggest. However, inflation targeters may fear appreciation and hence intervene on the foreign exchange market (Levy-Yeyati and Sturzenegger, 2007).

External Indebtedness

Indebtedness: External indebtedness is an important indicator of external vulnerability, and several indicators are used by the IMF to assess potential weaknesses. Short-term debt in particular has proved to be important in many studies, e.g. Mulder et al. (1999) andChang and Velasco (2000). Due to limited data availability we use the ratio of gross **external debt** to GDP (DEXT). External debt can substitute for reserves, i.e., higher reserve holdings are unnecessary as external transactions can be financed by debt. On the other hand, reserves may be required as collateral for raising external debt. Unfortunately, data on external debt are not available for high-income countries and our sample shrinks by 19 countries.

Still, reserves can play a role in assessing a country's creditworthiness in the event of raising debt, so we also employ the ratio of **public debt** (DPUB) to GDP from the historical public debt database of Abbas et al. (2010).

Moreover, we use the Joint External Debt Hub (JEDH) database to construct a time series for the countries in the data set as a substitute for a broad external debt measure. The ratio of **debt securities** (DSEC) held by non-residents to GDP captures the actual portfolio investment liabilities which are in the hands of non-residents.

Credit Markets and Financial Development

Financial deepening and stability: The speed of financial integration over the last two decades has drawn attention to assessing financial shock exposure. As a part of liabilities is denominated in foreign currency, financial deepening should be associated with reserve accumulation (Lane and Burke, 2001). But this may hold regardless of currency denomination. In the view of Obstfeld et al. (2008), see p. 2, "the primary reason for a central bank to hold reserves is to protect the domestic banking sector, and domestic credit markets more broadly, while limiting external currency depreciation." This approach is similar to the earlier double drain literature, which considered situations where apart from sudden foreign capital outflows the country can suffer from domestic capital flight as well. The international reserves thus have a key role in improving domestic financial stability, and the first indicator to consider is the ratio of **broad money** to GDP (M2).

As an innovation, we decided to test whether other measures can capture the actual importance of the banking sector. They include three indicators of the size of the financial institution sector or financial depth: the ratio of **liquid liabilities** (LIQLIA) to GDP (for the volume of assets threatened by immediate withdrawal) and the more general ratios of **domestic credit to the private sector** (PC) to GDP and **bank deposits** (BD) to GDP. All of them come from the Global Financial Development Database of Cihak et al. (2012). Similarly to our approach, Dominguez (2010) used the sum of domestic private credit creation and stock market capitalization as a ratio of GDP to capture financial development, but the estimated reserve equation differs from the one we use.

However, there is one more factor which has proved to be important over the last decade. Globalization led to growth of international financial transactions, and when the sudden stop in international liquidity occurred at the peak of the financial crisis, some central banks (such as in Denmark) started to provide foreign currency liquidity to substitute for the market. So, we look at **cross-border loans** (CBLOAN) and **cross-border deposits** (CBDEP) to check whether central banks were aware of this weakness.

Banking crisis: Finally, we check whether the banking crisis had any impact on the level of reserves and whether reserves were depleted during the crisis. The **banking crisis dummy** (SBC) used in this paper comes again from the Global Financial Development Database and Laeven and Valencia (2008).

4. Estimation Results

This section presents an empirical analysis of the potential reserve level determinants we discussed previously. In order to retain clarity and comparability with previous studies we first present the traditional model, which is subsequently extended to include a new set of variables according to their respective areas. The step-by-step approach is preferable, as some measures may be linked through other factors or even directly correlated, being substitutes (see Table A.3 in the Appendix). This part is based on simple pooled OLS estimations, which are in line with previous studies but may have some drawbacks. We review a few open issues, namely, sub-sample stability across a selected benchmark and flaws in model choice, including endogeneity. The motive for this section is not only to enlarge our understanding of the determinants of reserve holdings, but also to firm up our specification choice. Finally, we aim to address the issue of model uncertainty, i.e., we allow for all determinants to work together, providing an insight into their relative importance.

Our dataset covers 104 countries, while the euro area is treated as an aggregate. The countries are listed in Table A.1 in the Appendix together with their development stage according to the IMF. We cover annual data for the 1999 to 2010 period only, as we suspect the presence of a structural break in 1998 due to the Asian crisis and an observed change in reserve management at least in Asian countries. Moreover, the literature review also suggests that the motives for reserve accumulation were changing in the post-war period to reflect the new global monetary system, and the post-1998 period is marked by stability in reserve motives (Ghosh et al., 2012). To allow for heteroskedasticity across countries and serial correlation we use clustering by country.[3]

Table A.4 in the Appendix reports summary statistics. All variables are expressed in log form where possible. As Table A.2 in the Appendix shows, most of the variables are scaled by GDP, which is motivated by the need to make the series stationary and to remove the scale effect. The data set is balanced for the traditional model with the maximum number of observations per variable equal to 1,248, but it becomes unbalanced in some extensions. Still, we always report the number of observations used in each case and discuss the implications of the restricted model.

4.1 The Traditional Model and its Extensions

This section reviews the traditional as well as potential new determinants of cross-country differences in reserve holdings using pooled OLS. The traditional model is based on assessing the role of trade or capital account openness as well as other country-specific factors such as country size, level of development, and the role of commodity exports. We also include exchange rate regime measures. Next, we extend the discussion on regime settings to include monetary policy variables and debt ratios. Finally, we investigate different proxies for financial stability.

The regression results for traditional determinants are presented in Table A.5 in the Appendix. We start with a simple set of country-scale variables as well as the opportunity cost of reserves, trade openness, and oil exports (Model 1). Countries that are more involved in international trade tend to have larger reserves. Size as measured by population and the crisis dummy seem to have no particular effect. In the latter case this might be due to the fact that this dummy captures only a few minor events in the period under review as well as measurement problems (reserve depletion is hard to estimate). Intermediate exchange regimes and oil exports are modestly associated with higher reserve holdings, while the opportunity cost of reserves lowers them. The coefficient on

[3] Series of tests check the properties of the baseline model. The Levin-Lin-Chu unit-root test confirms stationarity, while the presence of heteroskedasticity is found by tests in both the pooled and LSDV settings. Similarly, autocorrelation is substantial according to the Wooldridge test.

GDP per capita is not significant, so we test the effect of the advanced country dummy only. The results in Model 2 confirm substantially lower reserves in the case of advanced countries, while the difference between emerging countries and developing ones is not significant. Model 3 and Model 4 contain both measures of financial openness, but these measures do not seem to play any role in cross-country reserve holdings. So, we test if the situation changes with the stage of development.

Including the emerging markets dummy does not yield any result, so we split the sample according to the log GDP per capita mean (equivalent to USD 7,309). If we consider only countries below the mean threshold (Low income, LI), the coefficient for financial openness becomes statistically significant and positive (fourth column, Table A.5 in the Appendix). Finally, Model 5 then demonstrates that exchange rate volatility is not a superior proxy for exchange rate regimes (neither is it for LIs).

We start our extension exercise with debt variables as well as an inflation-targeting dummy. As Table A.6 in the Appendix shows, the inflation-targeting regime itself cannot be associated with lower reserve levels (Model 1). But IT countries that are not advanced hold larger reserves (see column nonAdv IT). This supports the "fear of floating" hypothesis for at least some of them. Second, we test the role of external debt as a measure of vulnerability. Please note the lower number of observations, as data on external debt are not available for advanced countries. The results (Model 2) suggest that in this sample, more indebted countries hold lower reserves. This negative relationship suggests that debt may substitute for reserves as a means of financing external transactions, still accounting for the stage of development. The coefficient for public debt is also negative, but insignificant, as is that for debt securities over GDP (Models 3 and 4).

Finally, in Table A.7 in the Appendix we review the role of financial stability and deepening. The results for the ratio of M2 to GDP (Model 1) confirm the financial stability reasons for reserve accumulation, improving the model fit compared with the traditional model. Moreover, GDP per capita now turns significant but negative. If we account for the financial motives for holding reserves as well, more advanced countries hold lower reserves. This evidence helps to explain why we observe such low reserves-to-GDP ratios for countries with high GDP per capita, illustrating the interaction between stage of development and financial deepening. Similarly to our results, Dominguez (2010) finds a negative impact of financial development on total reserves, which might be counterbalanced by the positive effect of banking sector fragility.

As for alternative measures that might capture the importance of a country's banking sector, bank deposits and liquid liabilities (both scaled by GDP) have the same implications for reserve holdings (Models 2 and 3). This supports the internal drain view, where a country may suffer domestic capital flight aside from the external one. On the other hand, a banking crisis itself does not lead to reserve depletion, as the dummy for banking crisis is not significant in either specification. Compared with the traditional model there are two changes. First, oil exporters now firmly hold higher reserves, while the coefficient for the opportunity cost of reserves loses its significance. Second, there is also a clear interaction with the exchange rate regime choice. We come back to these issues in the next subsections.

As for overall financial development, domestic credit to the private sector has no effect on cross-country differences in reserve holdings (Model 4). Finally, countries with large cross-border transactions (Models 5 and 6) do not hold substantially larger reserves, suggesting that they do not fear sudden stops in international liquidity.

To conclude this section, it seems that traditional factors are still important for cross-country differences in reserve holdings. The new variables for financial stability improve our understanding of the determinants of reserve holdings, while the role of debt seems to be limited. The role of financial openness is now less straightforward than in previous studies.

4.2 Investigating Sub-samples, Model Specification, and Endogeneity

Sub-sample Check

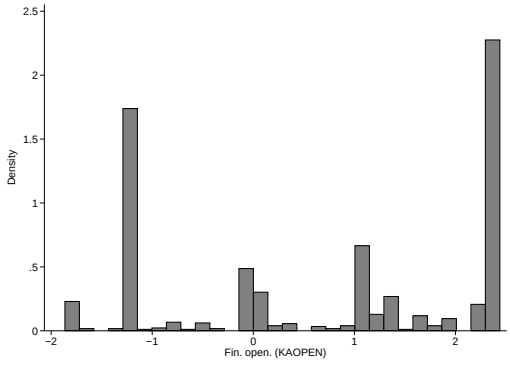
In the second step we aim to verify the outcomes of the estimations on sub-samples in both the country and time dimension. Ghosh et al. (2012) realized that the motives for holding reserves can change with the ratio of reserves to GDP. Their quantile approach identified shifting motives, i.e., some of the determinants turning significant for a sub-sample despite being insignificant in the main OLS estimation. We have already touched on two similar cases (non-advanced inflation targeters and the size of external debt).

We adopt a different approach based on recursive estimates, allowing for benchmark variables other than dependent variables. The recursive estimates are run on sub-samples that satisfy a certain condition that is changing across the distribution of the benchmark variable. Moreover, we can run them both ways, from the highest values of the benchmark variable or from the lowest, adding observations until a whole dataset is covered. This approach is similar to quantile regression, but we do not explicitly assume the presence of different behavior across specific percentiles of the distribution. We are aware of the weak points of this approach, i.e., selection bias, the arbitrary choice of benchmark variable, and the size of the step, but it provides an alternative, zooming in on a dataset based on specific questions we wish to answer.

For example, the trilemma suggests that financially open and financially closed economies face different policy choices that may impact on their motives for holding reserves. Table A.8 in the Appendix presents the results for a recursive exercise on our sample using KAOPEN as a benchmark variable. This indicator has rather stable distribution over time. We start with the sample of countries with KAOPEN above 2 in the first column, i.e., economies with nearly no restrictions on capital flows. The relative size of the sample can be illustrated using a histogram (Figure 3). For financially open economies traditional determinants such as trade openness or financial ones such as the ratio of broad money to GDP do not seem to play an important role, but GDP per capita does matter. This would suggest that their policy makers are quite confident about overall economic flexibility and fear neither financial nor real shocks. On the other hand, the countries with intermediate exchange rate regimes (Regime 3) have significantly higher reserves. So, some countries may still aim to smooth exchange rate movements and/or build up precautionary reserves. Moreover, the trilemma suggests a loss of monetary autonomy for economies with open capital markets and pegged exchange rates. This loss could be offset by interventions with an impact on the reserve levels. In the second column we enlarge the sample to all countries with KAOPEN above 1, covering more than half of the sample. Now we are closer to the standard model we estimated in the previous subsection. We can run the recursive estimates the other way round, looking at a sample of financially closed economies first (see Table A.9 in the Appendix). Now the ratio of broad money to GDP drives the results in the first column. So, countries with larger financial sectors have higher reserves than ones with heavy restrictions on financial transactions.

Now let's use this method to zoom in on the shifting motives. Recursive estimates with the ratio of actual reserve holdings to GDP as the benchmark variable are presented in Table A.10 in the Appendix. More caution is necessary when interpreting these data because of time variation in the

Figure 3: Histogram of KAOPEN, Full Dataset



mean. As for the first column, for the sub-sample with a reserves-to-GDP ratio of less than 16% (i.e., far below the mean) the traditional determinants do not have a significant coefficient, and to a certain extent this holds for the sub-sample up to a reserves-to-GDP ratio of 27%. But they are certainly valid for the emerging and developing countries sample, as shown in the last column of Table A.10 in the Appendix.

Model Specification and Testing for Endogeneity

No matter how many individual specific factors one includes, the simple pooled OLS may still suffer from unobserved heterogeneity, causing bias and inconsistency. The usual (and widely used) remedy involves introducing a fixed effects estimator (in the country and/or time dimensions). Such an approach removes the mean, thus providing a (demeaned) view of the reserve accumulation drivers.

Table A.11 in the Appendix presents a set of different model specifications: country fixed effects (CFE) and country and time fixed effects (CTFE). In this case, determinants such as oil exports, GDP per capita, and exchange rate regime lose significance, while the opportunity cost of reserves (i.e., the interest rate differential) now contributes to the explanation. We can argue that the cost indicator captures more effects than desired. For example, it may well reflect financial market disturbances due to a crisis (time variation). When a country faces a situation such as a capital flow reversal, domestic interest rates may increase compared to U.S. Treasury yields. This indicator may be superior to a simple crisis dummy, as the yield spillovers can occur without a severe currency crisis and may still require policy interventions. The significant coefficient on population in the settings with fixed effects disappears when time effects are accounted for. The time dummies, which are not reported, are significant.[4] On the other hand, the most important variables, i.e., the evolution of trade and the ratio of broad money to GDP, still have a significant and large effect on reserve accumulation even if we remove country-specific features.

Finally, we address the issue of endogeneity for the broad money indicator. Neither of the previous studies found strong evidence for this problem, but nonetheless we used our specification and instrumented the broad money variable using its second and third lag. The results are reported along with

[4] The time trend, when included, contributes significantly to the explanation of the reserve trends. This finding still supports the self-accumulating nature of reserves. The foreign exchange reserves generate yields. These can be either reinvested or converted into the domestic currency, which may still affect the relative exchange rate. We do not report the results here, as we are more interested in the determinants than in the best fit.

the exogeneity test for instruments in the last column of Table A.11 in the Appendix. We cannot rule out the presence of endogeneity, but this effect is certainly not driving reserve holdings.

To summarize this part, we reviewed some potential weaknesses of our main estimations both in a sub-sample check and in model specifications. They might be a good starting point for further refining this analysis. Nevertheless, the main reserve drivers, i.e., the evolution of trade and broad money, prove to be stable determinants. Far less certainty surrounds the other determinants, so we address this issue in the last subsection.

4.3 Facing Model Uncertainty

As we have discussed, the theories on reserve determination are not necessarily in conflict. There have been attempts to validate one theory over another (mercantilist vs. precautionary, for example), but in a way a combination of theories could well stand for the empirical model. Eventually, our previous analysis suggests that a mix of different determinants may drive the reserve holdings, so rather than verifying one theory over another we can avoid a single specification and consider all of them together. When a theory does not provide enough guidance to select the proper empirical model and/or we have a large set of potential explanatory variables, we face a problem known as model uncertainty.

One possible way to account for model uncertainty is to employ model averaging techniques using Bayesian inference, which goes through all possible models given a set of variables. Doppelhofer et al. (2000) used Bayesian Averaging of Classical Estimates (BACE) to determine which variables should be included in linear cross-country growth regressions. Fernandez et al. (2001) investigated the same topic with Bayesian Model Averaging (BMA). These studies concentrated on cross-sectional data; Moral-Benito (2012) extended the framework to deal with panel data and country-specific fixed effects. We follow the BMA approach – explained in more detail in the Appendix – in a pure cross-sectional setting. We are mostly interested in the determinants (and country-specific effects are not very informative), and the previous analysis suggests that reserve policies remained rather stable over the last decade.

We start with a restricted set of determinants excluding alternatives that are strongly correlated (such as additional financial variables) and carry similar information. Aside from those 13 variables presented in Table A.11 in the Appendix, there are five more which we have studied and may yield some additional information (financial openness (FAL), the public-debt-to-GDP ratio, exchange rate volatility, the IT dummy, and the emerging markets dummy). This gives us a dataset of 18 determinants, expressed as period means, keeping the log specification. In the second step we include all possible determinants mentioned in this study in a "kitchen sink" way, excluding two variables due to missing data: external debt and debt securities. In this specification we have 24 determinants.

For the estimations we use the standard uniform prior (lack of prior knowledge) and a dilution prior as implemented by Durlauf et al. (2008), as we suspect the presence of multicollinearity. In the latter case, lower prior probabilities are assigned to sets containing strongly correlated variables than to sets containing weakly correlated variables. So, we ran 1,000,000 iterations with 500,000 burn-ins using the dilution and standard uniform model priors.

Table A.12 in the Appendix reports the posterior inclusion probability, the posterior mean, and the posterior standard deviation for the restricted sample. The correlation between the iteration counts and the analytical posterior model probabilities for the 100 best models (over 0.998 for both)

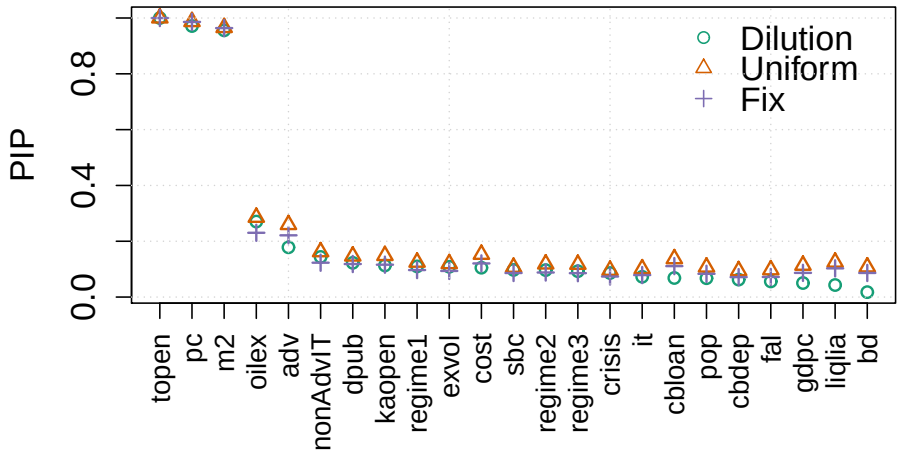
indicates a good degree of convergence. Posterior inclusion probability (PIP) stands for the posterior probability that the coefficient of a variable is not equal to zero. It indicates the importance of the variable in explaining the cross-country differences in reserve holdings. In both cases we identify only a few variables worth considering, namely, trade openness and the broad-money-to-GDP ratio, followed by GDP per capita and oil exports.

These results are in line with the findings from the previous subsection as given in Table A.11 in the Appendix. The ranking when using different priors is almost identical, the only difference being in the assessment of population and non-advanced IT. These determinants may be correlated with other variables. Using dilution priors also results in lower PIPs for the broad-money-to-GDP ratio, GDP per capita, and oil exports.

Figure 4 shows the posterior inclusion probabilities using the dilution, uniform, and fixed priors when we include 24 determinants. Trade openness and the broad-money-to-GDP ratio retain their high PIPs, but GDP per capita now loses importance. Domestic credit to the private sector has a PIP above 0.9 with a negative posterior mean (-0.5), whereas Table A.7 in the Appendix indicated no statistical significance. It seems that financial development plays a far more important role than the simple regressions would suggest. As we have noted, Dominguez (2010) used a similar measure of financial development and found the same significant impact on total reserves. In her view, the accumulation of reserves results from under-insurance of the private sector in developing countries. To a certain extent, this factor was captured by overall economic development and/or the advanced country dummy. But the underlying driver is financial development. Improving the ability of the private sector to obtain financing could be a key switch away from reserve accumulation strategies.

As for sensitivity checks, we also tested whether a different prior on the regression coefficients (in our baseline, Zellner's g) changed the overall assessment – and the results for the coefficients were virtually the same. The use of log transformation makes no difference.

Figure 4: Posterior Inclusion Probabilities: Dilution, Uniform, and Fixed Priors



5. Conclusions and Policy Implications

In spite of a long tradition and a large number of studies, the determinants of cross-country differences in reserve holdings are far from well understood. This paper provides an additional insight into reserve policy motives, covering a compact set of countries in the most recent period. The results show that traditional factors such as trade openness are still important for cross-country differences in reserve holdings. New variables for financial stability are certainly relevant for the level of international reserves, while the role of debt seems to be limited. Both trade openness and the broad-money-to-GDP ratio lead to higher reserve holdings, as do intermediate exchange rate regimes (pegs and soft pegs) and oil exports. Economic development is associated with lower reserves, while inflation targeters that do not rank among the advanced countries hold higher reserves. The role of financial openness is now less straightforward than in the pre-1998 period, but still provides insights into the trilemma-related choices.

So, in the second step we abandoned the concept of a single model and faced the uncertainty using Bayesian model averaging. This method confirmed that external trade and financial stability contribute significantly to reserve accumulation trends, but it also drew attention to the role of financial development as a counterbalancing effect. Diverging from the reserve accumulation path may thus require long-term structural changes, so short-term measures, such as developing a global financial safety net or a swap line network, could be a feasible alternative in the interim.

Still, the results of this paper are far from conclusive. First, we could improve the current work by incorporating a more explicit treatment of mercantilist motives and extending the set of determinants to include institutional factors. Second, we could attempt to construct a measure of financial development that incorporates its different dimensions. We also do not account explicitly for contagion, i.e., the occurrence of shocks that contemporaneously hit multiple countries. Currency crises do spread at least within a region, while reserve policies might be subject to monetary policy conduct constraints. Clustering by time could be helpful in this case, but the time dimension must be extended.

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Appendix A: Bayesian Model Averaging

Bayesian model averaging aims to address model uncertainty when considering a linear regression model in the following form:

$$y_t = \alpha_\gamma + X_\gamma \beta_\gamma + \varepsilon, \varepsilon \sim N(0, \sigma^2 I) \tag{A.1}$$

where y_t is a dependent variable, α_γ is a constant, β_γ are coefficients, and ε is a normal IID error.

Let's consider a matrix of potential explanatory variables X where we do not know which ones should be included. BMA estimates the models for all potential combinations and constructs a weighted average over all of them. If X contains K potential variables, this means estimating 2^K variable combinations and thus 2^K models.

The model weights for this averaging are given by the posterior model probability (PMP), i.e., $p(M_\gamma \mid y, X)$, which is proportional to the marginal likelihood of the model $p(y \mid M_\gamma, X)$ times the prior model probability $p(M_\gamma)$.

The model-weighted posterior distribution for any statistics can then be obtained:

$$p(\theta \mid y, X) = \sum_{\gamma=1}^{2^K} p(\theta \mid M_\gamma, y, X) p(M_\gamma \mid X, y) \tag{A.2}$$

Looking back at the simple regression model, the key question that arises is which prior should be used for the coefficients β_γ. Zellner's g prior is usually employed:

$$\beta_\gamma | g \sim N(0, \sigma^2 (\frac{1}{g} X_\gamma' X_\gamma)) \tag{A.3}$$

The hyperparameter g captures beliefs if the coefficients are zero. Its small value indicates certainty that the coefficients are zero. Also in this case, the marginal likelihood $p(M_\gamma \mid X, y)$ can be derived as a function of hyperparameter g. When using the "unit information prior" (UIP), g is set to N, i.e., $g = N$.

Second, the priors for the model space must be set. Apart from the uniform model prior, binomial or beta-binomial model priors can be employed. In the practical computation, evaluating all potential variable combinations can be quite time consuming, so Markov Chain Monte Carlo sampling is useful. We employed the BMS package for R developed by Zeugner (2012) with a birth-death sampler. BMS relies mostly on the Metropolis-Hastings algorithm, which "walks" through the model space.

Table A.1: List of Countries with World Bank Code and Type

Albania	ALB	DEV	Lao PDR	LAO	DEV
Algeria	DZA	DEV	Latvia	LVA	EM
Angola	AGO	DEV	Lebanon	LBN	DEV
Argentina	ARG	EM	Lesotho	LSO	DEV
Armenia	ARM	DEV	Lithuania	LTU	EM
Australia	AUS	ADV	Macedonia, FYR	MKD	DEV
Azerbaijan	AZE	DEV	Madagascar	MDG	DEV
Bahrain	BHR	DEV	Malaysia	MYS	EM
Bangladesh	BGD	DEV	Maldives	MDV	DEV
Belarus	BLR	DEV	Mauritius	MUS	DEV
Belize	BLZ	DEV	Mexico	MEX	EM
Bhutan	BTN	DEV	Moldova	MDA	DEV
Bolivia	BOL	DEV	Mongolia	MNG	DEV
Bosnia and Herzeg.	BIH	DEV	Morocco	MAR	DEV
Botswana	BWA	DEV	New Zealand	NZL	ADV
Brazil	BRA	EM	Nicaragua	NIC	DEV
Bulgaria	BGR	EM	Nigeria	NGA	DEV
Burundi	BDI	DEV	Norway	NOR	ADV
Canada	CAN	ADV	Oman	OMN	DEV
Cape Verde	CPV	DEV	Pakistan	PAK	EM
Colombia	COL	EM	Paraguay	PRY	DEV
Costa Rica	CRI	DEV	Peru	PER	EM
Croatia	HRV	DEV	Philippines	PHL	EM
Czech Republic	CZE	EM	Poland	POL	EM
Denmark	DNK	ADV	Qatar	QAT	DEV
Dominican Rep.	DOM	DEV	Romania	ROU	EM
Egypt, Arab Rep.	EGY	DEV	Russian Federation	RUS	EM
Estonia	EST	EM	Rwanda	RWA	DEV
Ethiopia	ETH	DEV	Saudi Arabia	SAU	DEV
Euro area	EMU	ADV	Sierra Leone	SLE	DEV
Gambia, The	GMB	DEV	Singapore	SGP	ADV
Georgia	GEO	DEV	Slovak Republic	SVK	EM
Guatemala	GTM	DEV	South Africa	ZAF	EM
Guyana	GUY	DEV	Sri Lanka	LKA	DEV
Haiti	HTI	DEV	Swaziland	SWZ	DEV
Honduras	HND	DEV	Sweden	SWE	ADV
Hong Kong SAR	HKG	ADV	Switzerland	CHE	ADV
Hungary	HUN	EM	Syrian Arab Republic	SYR	DEV
Chile	CHL	EM	Tajikistan	TJK	DEV
China	CHN	EM	Tanzania	TZA	DEV
Iceland	ISL	ADV	Thailand	THA	EM
India	IND	EM	Trinidad and Tobago	TTO	DEV
Indonesia	IDN	EM	Turkey	TUR	EM
Israel	ISR	ADV	Uganda	UGA	DEV
Jamaica	JAM	DEV	Ukraine	UKR	EM
Japan	JPN	ADV	United Arab Emirates	ARE	DEV
Jordan	JOR	DEV	United Kingdom	GBR	ADV
Kazakhstan	KAZ	DEV	United States	USA	ADV
Kenya	KEN	DEV	Uruguay	URY	DEV
Korea, Rep.	KOR	ADV	Venezuela, RB	VEN	EM
Kuwait	KWT	DEV	Yemen, Rep.	YEM	DEV
Kyrgyz Rep.	KGZ	DEV	Zambia	ZMB	DEV

Table A.2: Definitions of Variables, and Sources

Variable	Code	Source
Total reserves, % of GDP, in current USD, minus gold	FXR	World Bank
General		
GDP per capita, constant 2000 USD	GDPC	World Bank
Dummy variable, 1 for advanced countries	ADV	WEO April 2012, IMF
Share on net oil exports on world	OILEX	International Energy Agency
Population in mil.	POP	World Bank
Difference between lending rate and US Treasury bills	COST	World Bank, IMF, EIU
Balance of payments		
Exports and imports of goods and services, % of GDP	TOPEN	World Bank
Chinn-Ito capital market openness index	KAOPEN	Chinn and Ito (2008)
(Foreign assets + liabilities)/GDP	FAL	Lane and Milesi-Ferretti (2007)
Monetary policy		
Dummy variable, fixed regime	REG1	AREAER
Dummy variable, intermediate	REG2	
Dummy variable, managed float	REG3	
Dummy variable, float	REG4	
St. deviation of national exchange rate against SDR	EXVOL	IFS IMF
Dummy variable, 1 for currency crisis	CRISIS	Laeven and Valencia (2008)
1 for targeting countries	IT	Hammond (2012), AREAR
Indebtedness		
Total external debt stocks in current USD, % of GDP	EXD	World Bank, United Nations
Public debt, % of GDP	DPUB	Abbas et al. (2010)
Debt securities held by nonresidents, % of GDP	DSEC	Joint External Debt Hub (JEDH)
Financial stability and development		
M2 or equivalent, % of GDP	M2	World Bank
Liquid liabilities, % of GDP	LIQLIA	Global Financial Development
Bank deposits, % of GDP	BD	Database (GFDD)
Domestic credit to private sector, % of GDP	PC	Cihak et al. (2012)
Cross-border loans from BIS reporting banks, % of GDP	CBLOAN	JEDH
Cross-border deposits with BIS rep. banks, % of GDP	CBDEP	JEDH
Dummy variable, 1 if banking crisis ocurred	SBC	Laeven and Valencia (2008), GFDD

Table A.3: Correlation Matrices, All Variables, Cross Section

	fxr	adv	gdpc	oilex	pop	cost	topen	kaopen	fal
adv	0.02	1							
gdpc	0.005	0.8***	1						
oilex	0.07	-0.04	0.1	1					
pop	-0.04	0.009	-0.03	-0.007	1				
cost	-0.2*	-0.4***	-0.5***	-0.08	-0.1	1			
topen	0.6***	0.1	0.1	-0.08	-0.2*	-0.2	1		
kaopen	0.07	0.4***	0.5***	-0.008	-0.2	-0.2*	0.2	1	
fal	0.3**	0.4***	0.5***	-0.04	-0.1	-0.2*	0.5***	0.3***	1

	fxr	gdpc	reg1	reg2	reg3	crisis	it	exvol	exd	dpub
gdpc	0.005	1								
reg1	0.2	0.03	1							
reg2	0.2*	-0.07	-0.2	1						
reg3	-0.02	-0.4***	-0.2	-0.5***	1					
crisis	-0.2	-0.008	-0.09	-0.2	0.2*	1				
it	-0.2*	0.3**	-0.1	-0.4***	-0.1	0.2	1			
exvol	-0.1	-0.2	-0.07	-0.2*	0.3**	0.1	-0.02	1		
exd	-0.1	0.7***	0.02	-0.1	-0.1	0.05	0.2	0.05	1	
dpub	0.02	-0.02	-0.2*	-0.06	0.1	-0.05	-0.2*	0.2	0.2*	1

	fxr	gdpc	m2	pc	bd	liqlia	cbloan	cbdep	sbc
gdpc	0.005	1							
m2	0.4***	0.5***	1						
pc	0.05	0.8***	0.8***	1					
bd	0.4***	0.5***	0.9***	0.7***	1				
liqlia	0.4***	0.5***	1.0***	0.7***	1.0***	1			
cbloan	0.2*	0.5***	0.4***	0.4***	0.4***	0.4***	1		
cbdep	0.3**	0.3**	0.4***	0.3**	0.4***	0.4***	0.8***	1	
sbc	-0.2	0.3**	0.07	0.3**	0.06	0.08	0.09	-0.01	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.4: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Total reserves	0.195	0.178	0.004	1.195	1248
GDP per capita	7309.262	10615.121	108.902	41904.21	1248
Advanced country	0.157	0.364	0	1	1248
Emerging markets	0.587	0.493	0	1	1248
Oil exports	0.008	0.024	0	0.19	1248
Population	55.09	172.83	0.25	1354.15	1248
Opportunity cost	0.13	0.123	-0.038	1.168	1248
Trade openness	0.894	0.55	0.188	4.441	1248
Fin. open. (KAOPEN)	0.739	1.538	-1.864	2.439	1247
Fin. open. (FAL)	2.215	4.278	0.17	75.506	1248
Regime 1	0.051	0.221	0	1	1248
Regime 2	0.355	0.479	0	1	1248
Regime 3	0.352	0.478	0	1	1248
Regime 4	0.242	0.428	0	1	1248
Exchange rate vol.	0.29	1.223	0	23.317	1248
Currency crisis	0.018	0.135	0	1	1248
IT dummy	0.212	0.409	0	1	1248
External debt	0.653	0.708	0.036	10.016	1020
Public debt	0.557	0.404	0.027	2.494	1248
Debt securities	0.09	0.19	0	2.529	1040
Broad money	0.597	0.447	0.067	3.253	1248
Liquid liabilities	0.548	0.422	0.067	3.136	1114
Bank deposits	0.462	0.387	0.028	3.027	1130
Credit to private sector	0.508	0.477	0.016	3.195	1248
Cross-border loans	0.227	0.444	0.001	3.891	1236
Cross-border deposits	0.331	0.67	0.015	7.209	1236
Banking crisis	0.062	0.241	0	1	1248

Table A.5: Traditional Model

	Model 1	Model 2	Model 3	LI	Model 4	Model 5
Trade openness	0.62***	0.61***	0.61***	0.48***	0.61***	0.67***
	(0.16)	(0.16)	(0.16)	(0.13)	(0.17)	(0.18)
Population	-0.023	-0.044	-0.037	0.015	-0.044	-0.035
	(0.047)	(0.053)	(0.055)	(0.043)	(0.057)	(0.056)
Opportunity cost	-0.88*	-1.04**	-1.01**	-1.33***	-1.04**	-1.05***
	(0.49)	(0.40)	(0.40)	(0.34)	(0.40)	(0.39)
Oil exports	2.95*	2.24	2.13	2.80	2.23	2.32
	(1.49)	(1.36)	(1.38)	(2.26)	(1.42)	(1.41)
Currency crisis	-0.12	-0.13	-0.11	-0.091	-0.13	-0.085
	(0.15)	(0.14)	(0.14)	(0.15)	(0.14)	(0.15)
Regime 1	0.32	0.14	0.13	-0.099	0.14	
	(0.25)	(0.30)	(0.30)	(0.23)	(0.30)	
Regime 2	0.33**	0.20	0.21	0.11	0.20	
	(0.15)	(0.14)	(0.13)	(0.15)	(0.14)	
Regime 3	0.33**	0.27**	0.28**	0.012	0.27**	
	(0.13)	(0.12)	(0.12)	(0.12)	(0.12)	
GDP per capita	-0.058					
	(0.055)					
Advanced country		-0.59**	-0.62**		-0.59**	-0.68**
		(0.26)	(0.26)		(0.27)	(0.27)
Emerging markets		-0.19	-0.19		-0.19	-0.13
		(0.14)	(0.14)		(0.14)	(0.14)
Fin. open. (KAOPEN)			0.026	0.086**		
			(0.043)	(0.041)		
Exchange rate vol.				-0.025		-0.015
				(0.019)		(0.020)
Fin. open. (FAL)					0.00075	-0.0022
					(0.12)	(0.12)
Constant	-1.46***	-1.55***	-1.59***	-1.67***	-1.55***	-1.40***
	(0.50)	(0.20)	(0.21)	(0.15)	(0.22)	(0.20)
N	1248	1248	1247	953	1248	1248
R^2	0.26	0.29	0.29	0.22	0.29	0.28
F	4.73	4.67	4.89	8.20	4.24	6.21

Note: Robust standard errors clustered by country in parentheses.

Significant at * 10%, ** 5% and *** 1%. Sample of low income countries (LI).

Table A.6: Model Extended to Include Monetary and Debt Determinants

	Model 1	nonAdvIT	Model 2	Model 3	Model 4
Trade openness	0.62***	0.60***	0.42***	0.62***	0.65***
	(0.16)	(0.16)	(0.13)	(0.16)	(0.18)
Population	-0.021	-0.034	-0.028	-0.018	-0.0064
	(0.049)	(0.051)	(0.045)	(0.049)	(0.051)
Opportunity cost	-0.83*	-0.89**	-1.00***	-0.86*	-0.40
	(0.49)	(0.44)	(0.35)	(0.50)	(0.57)
Oil exports	3.27**	3.44**	2.23	2.93**	3.45**
	(1.64)	(1.60)	(2.03)	(1.44)	(1.68)
Currency crisis	-0.098	-0.10	-0.042	-0.10	-0.35
	(0.14)	(0.13)	(0.14)	(0.14)	(0.23)
Regime 1	0.43	0.41	0.16	0.31	0.36
	(0.29)	(0.27)	(0.23)	(0.27)	(0.28)
Regime 2	0.44**	0.42***	0.18	0.34**	0.36**
	(0.18)	(0.15)	(0.15)	(0.15)	(0.15)
Regime 3	0.38***	0.36***	0.17	0.33**	0.43***
	(0.14)	(0.13)	(0.12)	(0.13)	(0.14)
GDP per capita	-0.085	-0.074	-0.0058	-0.068	-0.064
	(0.064)	(0.054)	(0.051)	(0.057)	(0.072)
Fin. open. (KAOPEN)	0.025	0.023	0.066	0.021	0.0047
	(0.043)	(0.044)	(0.041)	(0.044)	(0.044)
IT dummy	0.20				
	(0.21)				
Not advanced IT		0.39**			
		(0.15)			
External debt			-0.24**		
			(0.11)		
Public debt				-0.010	
				(0.10)	
Debt securities					0.0046
					(0.039)
Constant	-1.38***	-1.42***	-1.92***	-1.42***	-1.48**
	(0.51)	(0.48)	(0.43)	(0.50)	(0.72)
N	1247	1247	1019	1247	956
R^2	0.27	0.28	0.22	0.26	0.28
F	4.21	4.89	5.34	4.20	4.76

Note: Robust standard errors clustered by country in parentheses.

Significant at * 10%, ** 5% and *** 1%. Non advanced IT countries dummy(nonAdvIT).

Table A.7: Model Extended to Include Financial Determinants

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Trade openness	0.51***	0.57***	0.61***	0.62***	0.70***	0.66***
	(0.15)	(0.15)	(0.15)	(0.16)	(0.15)	(0.15)
Population	-0.082*	-0.065	-0.032	-0.023	0.0079	0.019
	(0.048)	(0.050)	(0.051)	(0.049)	(0.045)	(0.048)
Opportunity cost	-0.26	-0.36	-0.44	-0.78	-0.85*	-0.84*
	(0.45)	(0.48)	(0.44)	(0.53)	(0.49)	(0.49)
Oil exports	6.36***	5.39***	5.94***	3.29**	2.38	2.36
	(1.70)	(1.54)	(1.61)	(1.56)	(1.54)	(1.51)
Currency crisis	-0.090	-0.045	-0.063	-0.10	-0.067	-0.077
	(0.15)	(0.16)	(0.15)	(0.14)	(0.14)	(0.14)
Regime 1	0.33	0.48**	0.25	0.32	0.25	0.25
	(0.22)	(0.21)	(0.25)	(0.26)	(0.25)	(0.23)
Regime 2	0.28**	0.27*	0.25*	0.34**	0.31**	0.31**
	(0.13)	(0.14)	(0.15)	(0.15)	(0.14)	(0.14)
Regime 3	0.33**	0.31**	0.29**	0.33**	0.29**	0.29**
	(0.14)	(0.14)	(0.13)	(0.13)	(0.13)	(0.13)
GDP per capita	-0.19***	-0.15**	-0.16**	-0.083	-0.036	-0.071
	(0.060)	(0.060)	(0.062)	(0.066)	(0.066)	(0.052)
Fin. open. (KAOPEN)	0.017	0.0052	0.029	0.020	0.035	0.029
	(0.045)	(0.049)	(0.046)	(0.044)	(0.043)	(0.044)
Banking crisis	-0.087	-0.071	-0.043	-0.049	-0.058	-0.081
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
Broad money	0.54***					
	(0.12)					
Liquid liabilities		0.38***				
		(0.12)				
Bank deposits			0.36***			
			(0.098)			
Credit to private sector				0.044		
				(0.097)		
Cross-border loans					-0.043	
					(0.075)	
Cross-border deposits						0.067
						(0.078)
Constant	0.033	-0.39	-0.33	-1.24*	-1.76**	-1.29**
	(0.60)	(0.59)	(0.61)	(0.63)	(0.68)	(0.50)
N	1247	1114	1130	1247	1235	1235
R^2	0.34	0.33	0.31	0.26	0.26	0.26
F	6.80	6.24	6.86	4.25	4.38	4.76

Note: Robust standard errors clustered by country in parentheses.
Significant at * 10%, ** 5% and *** 1%.

Table A.8: Recursive Estimates by Fin. Openness (KAOPEN): From no Restrictions

	Above 2	Above 1	Above 0	Above -1	All
Trade openness	0.51	0.51*	0.55**	0.52**	0.51***
	(0.37)	(0.26)	(0.24)	(0.20)	(0.15)
Population	-0.17*	-0.14*	-0.11*	-0.091	-0.086*
	(0.099)	(0.074)	(0.068)	(0.059)	(0.046)
Opportunity cost	0.15	-0.57	-0.031	-0.13	-0.27
	(0.85)	(0.79)	(0.71)	(0.65)	(0.45)
Oil exports	5.56	5.74***	6.00***	5.93***	6.35***
	(5.76)	(1.87)	(1.92)	(1.84)	(1.70)
Currency crisis	-0.35	-0.36	-0.69*	-0.48*	-0.10
	(0.29)	(0.26)	(0.36)	(0.24)	(0.15)
Regime 1	0.46	0.34	0.26	0.35	0.33
	(0.35)	(0.30)	(0.25)	(0.23)	(0.21)
Regime 2	0.36*	0.41**	0.33**	0.39***	0.26*
	(0.20)	(0.17)	(0.15)	(0.15)	(0.14)
Regime 3	0.57**	0.41**	0.29*	0.39***	0.32**
	(0.22)	(0.18)	(0.16)	(0.14)	(0.13)
GDP per capita	-0.21**	-0.24***	-0.23***	-0.21***	-0.19***
	(0.10)	(0.081)	(0.075)	(0.067)	(0.061)
Banking crisis	-0.11	-0.072	-0.16	-0.15	-0.090
	(0.19)	(0.19)	(0.18)	(0.16)	(0.13)
Broad money	0.43	0.49***	0.51***	0.49***	0.54***
	(0.26)	(0.16)	(0.15)	(0.14)	(0.12)
Constant	0.16	0.47	0.43	0.13	0.011
	(1.08)	(0.86)	(0.79)	(0.70)	(0.60)
N	445	682	769	888	1248
R^2	0.53	0.45	0.42	0.41	0.34
F	4.51	5.25	5.47	6.57	6.61

Note: Robust standard errors clustered by country in parentheses.
Significant at * 10%, ** 5% and *** 1%. Starting from the financially open (KAOPEN above 2) subsample and adding obs., see the main text.

Table A.9: Recursive Estimates by Fin. Openness (KAOPEN): From Full Restrictions

	Below 1	Below 1.5	Below 2	All	EmDev
Trade openness	0.43***	0.51***	0.50***	0.51***	0.37***
	(0.14)	(0.13)	(0.13)	(0.15)	(0.12)
Population	-0.058	-0.032	-0.034	-0.086*	-0.032
	(0.059)	(0.042)	(0.042)	(0.046)	(0.039)
Opportunity cost	-0.70**	-0.58	-0.60	-0.27	-0.70**
	(0.29)	(0.36)	(0.37)	(0.45)	(0.27)
Oil exports	7.75***	5.63***	5.39***	6.35***	4.08***
	(2.58)	(1.42)	(1.43)	(1.70)	(1.23)
Currency crisis	-0.032	-0.13	-0.15	-0.10	-0.17
	(0.12)	(0.15)	(0.15)	(0.15)	(0.14)
Regime 1	0.26	0.025	0.038	0.33	-0.12
	(0.17)	(0.42)	(0.36)	(0.21)	(0.22)
Regime 2	-0.10	0.032	0.044	0.26*	-0.031
	(0.16)	(0.14)	(0.14)	(0.14)	(0.12)
Regime 3	0.019	0.091	0.084	0.32**	-0.0022
	(0.15)	(0.13)	(0.13)	(0.13)	(0.11)
GDP per capita	-0.055	-0.12*	-0.12*	-0.19***	-0.11*
	(0.071)	(0.066)	(0.066)	(0.061)	(0.055)
Banking crisis	-0.091	0.033	0.049	-0.090	0.055
	(0.11)	(0.094)	(0.092)	(0.13)	(0.076)
Broad money	0.57***	0.59***	0.57***	0.54***	0.50***
	(0.16)	(0.13)	(0.13)	(0.12)	(0.10)
Fin. open. (KAOPEN)					0.063
					(0.041)
Constant	-0.67	-0.32	-0.39	0.011	-0.44
	(0.71)	(0.64)	(0.64)	(0.60)	(0.50)
N	566	758	803	1248	1055
R^2	0.32	0.31	0.30	0.34	0.28
F	10.5	9.07	8.99	6.61	12.1

Note: Robust standard errors clustered by country in parentheses.
Significant at * 10%, ** 5% and *** 1%. Starting from the financially closed (KAOPEN below -1) subsample and adding obs., see the main text. EmDev - emerging/developing countries subsample.

Table A.10: Recursive Estimates by Total Reserves on GDP: From the Lowest FXR

	Below 16pct	Below 27pct	Below 45pct	All	Up to 2007
Trade openness	0.092	0.31*	0.42***	0.51***	0.54***
	(0.18)	(0.16)	(0.15)	(0.15)	(0.15)
Population	-0.095*	-0.083*	-0.064	-0.082*	-0.073
	(0.052)	(0.049)	(0.047)	(0.048)	(0.052)
Opportunity cost	-0.078	-0.25	-0.28	-0.26	-0.48
	(0.38)	(0.39)	(0.41)	(0.45)	(0.40)
Oil exports	4.43*	4.12	5.02*	6.36***	5.09**
	(2.62)	(2.53)	(2.58)	(1.70)	(2.28)
Currency crisis	-0.0013	-0.052	-0.064	-0.090	-0.094
	(0.14)	(0.15)	(0.14)	(0.15)	(0.16)
Regime 1	0.038	0.17	0.30	0.33	0.37*
	(0.31)	(0.22)	(0.23)	(0.22)	(0.20)
Regime 2	0.065	0.13	0.19	0.28**	0.18
	(0.13)	(0.12)	(0.12)	(0.13)	(0.14)
Regime 3	0.082	0.22*	0.27**	0.33**	0.16
	(0.13)	(0.12)	(0.12)	(0.14)	(0.13)
Fin. open. (KAOPEN)	0.039	0.035	0.036	0.017	0.042
	(0.048)	(0.043)	(0.042)	(0.045)	(0.053)
GDP per capita	-0.10	-0.13*	-0.18***	-0.19***	-0.20***
	(0.080)	(0.069)	(0.062)	(0.060)	(0.064)
Banking crisis	-0.16	-0.021	-0.0027	-0.087	0.16
	(0.17)	(0.14)	(0.13)	(0.13)	(0.14)
Broad money	-0.017	0.23	0.39***	0.54***	0.45***
	(0.19)	(0.15)	(0.13)	(0.12)	(0.13)
Constant	-1.51*	-0.79	-0.29	0.033	0.069
	(0.87)	(0.69)	(0.61)	(0.60)	(0.63)
N	712	1034	1149	1247	831
R^2	0.15	0.18	0.25	0.34	0.33
F	1.01	2.43	4.59	6.80	6.08

Note: Robust standard errors clustered by country in parentheses.
Significant at * 10%, ** 5% and *** 1%. Starting from the small reserve holders (FXR less than 16pct) subsample and adding obs., see the main text. Up to 2007 - subsample for 1999-2006.

Table A.11: Different Model Specifications

	Pooled OLS	Between	CFE	CTFE	Instrum
GDP per capita	-0.21***	-0.16**	0.10	-0.077	-0.20***
	(0.061)	(0.071)	(0.20)	(0.26)	(0.063)
Trade openness	0.48***	0.38**	0.37***	0.48***	0.42**
	(0.15)	(0.16)	(0.14)	(0.14)	(0.16)
Population	-0.10**	-0.11**	1.24**	0.68	-0.11**
	(0.051)	(0.049)	(0.55)	(0.55)	(0.053)
Opportunity cost	-0.26	0.15	-0.93***	-1.01***	-0.31
	(0.38)	(0.75)	(0.26)	(0.28)	(0.49)
Oil exports	7.13***	6.68**	6.36	8.37	7.83***
	(1.87)	(2.73)	(5.71)	(5.27)	(1.76)
Currency crisis	-0.11	-1.09	0.019	0.0084	-0.25
	(0.13)	(1.64)	(0.092)	(0.085)	(0.22)
Regime 1	0.45*	0.79**	-1.74	-1.77	0.47*
	(0.23)	(0.34)	(1.11)	(1.22)	(0.27)
Regime 2	0.36***	0.60***	-0.10	-0.092	0.43***
	(0.14)	(0.22)	(0.089)	(0.089)	(0.16)
Regime 3	0.36***	0.69***	-0.027	-0.024	0.46***
	(0.14)	(0.25)	(0.068)	(0.067)	(0.16)
Fin. open. (KAOPEN)	0.019	0.017	0.018	0.017	-0.0066
	(0.045)	(0.050)	(0.044)	(0.045)	(0.046)
Not advanced IT	0.47***	0.69***	0.023	-0.023	0.43***
	(0.14)	(0.22)	(0.086)	(0.087)	(0.15)
Broad money	0.57***	0.57***	0.45***	0.31**	0.59***
	(0.12)	(0.14)	(0.14)	(0.15)	(0.13)
Banking crisis	-0.042	-0.64	0.046	0.034	-0.17
	(0.12)	(0.60)	(0.068)	(0.064)	(0.19)
Constant	0.13	-0.56	-5.11**	-2.51	0.0077
	(0.59)	(0.72)	(2.06)	(2.56)	(0.62)
N	1247	1247	1247	1247	936
R^2	0.37	0.47	0.26	0.29	0.36
F	7.45	6.19	9.20	12.9	6.54
Hansen test (p-value)					0.12
Endogeneity test (p-value)					0.13

Note: Clustered by country if possible, otherwise robust s.e., significant at * 10%, ** 5% and *** 1%.
CFE - Country Fixed Effects, CTFE - Country and Time Fixed effect. For Between/CFE/CTFE estimation between/within R-sq reported.
The Hansen test is a test of overidentifying restrictions with null hypothesis that the model is correctly specified. Endogeneity test is a Hausman-Wu test for endogeneity with the null hypothesis that a variable can be treated as exogeneous in the model.

Table A.12: Determinants for a Cross Section of 104 Countries, 1999-2010

	Dilution Prior			Uniform Prior		
Variable	Posterior Inclusion Probability	Posterior Mean	Posterior Standard Errors	Posterior Inclusion Probability	Posterior Mean	Posterior Standard Errors
Trade openness	0.99	0.70	0.17	0.98	0.66	0.19
Broad money	0.60	0.23	0.24	0.79	0.35	0.24
GDP per capita	0.48	-0.08	0.10	0.66	-0.12	0.11
Oil exports	0.34	1.87	3.22	0.48	3.06	3.85
Banking crisis	0.31	-0.36	0.63	0.29	-0.30	0.59
Non adv IT	0.24	0.10	0.23	0.37	0.19	0.31
Regime 2	0.19	0.06	0.18	0.26	0.10	0.23
Population	0.19	-0.02	0.04	0.38	-0.04	0.06
Regime 3	0.18	0.07	0.20	0.25	0.11	0.25
FAL	0.12	-0.02	0.07	0.18	-0.03	0.08
Regime 1	0.12	0.04	0.19	0.17	0.08	0.26
IT dummy	0.12	-0.03	0.13	0.18	-0.05	0.18
Currency crisis	0.11	-0.13	0.68	0.11	-0.12	0.65
ER volatility	0.09	0.00	0.02	0.10	0.00	0.02
Public debt	0.09	0.00	0.04	0.12	0.00	0.05
KAOPEN	0.08	0.00	0.02	0.11	0.00	0.02
Emerging markets	0.08	0.00	0.06	0.12	-0.01	0.09
Opportunity cost	0.08	-0.01	0.22	0.10	0.00	0.25