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ABSTRACT

This paper presents a systematic assessment of the macroeconomic factors associated with differences in GDP dynamics in emerging markets in the aftermath of the global financial crisis. We implement a Bayesian Model Averaging approach to explore the drivers of economic resilience – measured by the output recoveries for a group of 40 emerging economies after 2008, which allows us to account for the uncertainty in the model selection of the relevant variables. Out of a large group of variables used in the literature on balance of payments crises and early warning indicators, we find that a reduced set of variables is systematically associated with output dynamics after the crisis. Countries with overvalued currencies, current account deficits and larger external liabilities before the global financial crisis exhibit systematically weaker output recoveries afterwards. These findings are robust to different definitions of output recovery, the distribution of priors and exclusion of potential outliers. There is also some evidence, but less systematic, that de facto financial openness, links to European banks, and trade openness had a negative impact on output recoveries.

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¿QUÉ EXPLICA LA RECUPERACIÓN DEL PRODUCTO EN LAS ECONOMÍAS EMERGENTES Y EN DESARROLLO DESPUÉS DE LA CRISIS FINANCIERA MUNDIAL?

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RESUMEN

Este artículo presenta una evaluación sistemática de los factores macroeconómicos asociados con las diferencias en la dinámica del PIB en los mercados emergentes luego de la crisis financiera mundial. Implementamos un análisis Bayesiano que permite dar cuenta de la incertidumbre en la selección del modelo de las variables pertinentes para explorar los factores que explican las diferencias en la resiliencia económica - medida por la recuperación del PIB para un grupo de 40 economías emergentes después de 2008. De un gran grupo de variables utilizadas en la literatura sobre crisis de balanza de pagos e indicadores de alerta, encontramos que un conjunto reducido de variables se asocia sistemáticamente con la dinámica del producto después de la crisis. Los países con monedas sobrevaluadas, déficits en cuenta corriente y pasivos externos más grandes antes de la crisis financiera mundial muestran sistemáticamente una recuperación del PIB más débil. Estos hallazgos son robustos a las diferentes definiciones de la variable dependiente, la distribución de las probabilidades a priori y la exclusión de posibles valores atípicos. También encontramos algo de evidencia, pero menos sistemáticas, de que la apertura financiera de facto, los vínculos con los bancos europeos y la apertura comercial tuvieron un impacto negativo en la recuperación del PIB en las EME luego de la crisis.

What explains output recoveries in developing and emerging market economies after the global financial crisis?*

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Abstract

This paper presents a systematic assessment of the macroeconomic factors associated with differences in GDP dynamics in emerging markets in the aftermath of the global financial crisis. We implement a Bayesian Model Averaging approach to explore the drivers of economic resilience – measured by the output recoveries for a group of 40 emerging economies after 2008, which allows us to account for the uncertainty in the model selection of the relevant variables. Out of a large group of variables used in the literature on balance of payments crises and early warning indicators, we find that a reduced set of variables is systematically associated with output dynamics after the crisis. Countries with overvalued currencies, current account deficits and larger external liabilities before the global financial crisis exhibit systematically weaker output recoveries afterwards. These findings are robust to different definitions of output recovery, the distribution of priors and exclusion of potential outliers. There is also some evidence, but less systematic, that de facto financial openness, links to European banks, and trade openness had a negative impact on output recoveries.

Keywords: emerging markets; crisis; output; Bayesian Model Averaging; model uncertainty

JEL-classification: E32, F30, F41, G01, O47

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I. INTRODUCTION

Output dynamics across emerging market economies (EMEs) and developing countries have differed significantly in the aftermath of the global financial and economic crisis (GFC) of 2008-09. As Figure 1 shows, the distribution of real GDP growth rates across EMEs and developing countries has changed significantly after the GFC. Not only did average growth fall from around 5% before the crisis to close to 2.5% after the crisis, but also the standard deviation of growth rates across the 40 economies included in this study increased to 4.2% during 2009-14 from 3.1% during the pre-crisis period of 2000-07. A fatter negative tail of the growth rate distribution after the crisis is the main driver of this increase in the dispersion of growth rates across EMEs and developing countries. Understanding what macroeconomic pre-conditions, financial and trade linkages explain this difference in economic performance in the aftermath of the GFC is the main objective of this paper.

[INSERT FIGURE 1]

EMEs and developing countries have historically been at the centre of financial turmoil. According to Reinhart and Rogoff (2014) out of 100 financial crises that occurred in the last 150 years, more than a third occurred in emerging economies. Many of these crises lasted longer and were more severe in terms of output loss that those in advanced economies. In most of these crises, domestic macroeconomic imbalances played a prominent role (Kaminsky and Reinhart, 1999). While some international shock often has triggered these events, such as changes in terms of trade or monetary policy in advanced economies, a significant aspect of crises has been domestic factors and spill-overs between emerging market economies. As the main shock of the GFC originated in developed economies, this episode offers a good "natural experiment" of a relatively exogenous external shock for emerging market and developing economies. With this objective, a contribution of our paper is to undertake a systematic analysis of this episode shedding light on not only the transmission channels, but also macroeconomic and financial policies that might influence the exposure and resilience to external shocks. Our results are relevant to design policies to enhance resilience by reducing the exposure to negative shocks or increasing policy buffers to deal with them in these economies.

A series of papers have recently addressed similar issues. Berkmen et al (2012) is close to our paper in terms of the research question. They study the factors that explain the differences in the impact of the GFC on EMEs and developing countries, focusing on the growth performance in 2009 compared to pre-crisis periods. They find that countries with more leveraged domestic financial systems, stronger credit growth before the crisis, and more short-term debt on average suffered a larger decline in economic activity, with large differences on the individual effect of these factors across different country groups. For emerging economies,

the financial channel is more relevant than the trade channel for explaining the effect on growth, while the trade channel is more relevant for a broader set of developing countries. However, commodity exporters and countries with solid fiscal positions were impacted less severely.

Cecchetti et al (2011) also study the factors that allowed some countries to weather the crisis successfully, whereas other countries were deeply affected by the recession and have not fully recovered. The authors build a measure of macroeconomic performance during the crisis for 46 industrial and emerging economies, relative to the global business cycle.[1] They study the explanatory capacity of trade and financial openness, monetary and fiscal policy, banking sector structure, in the period prior to 2007. The common factor explains about 40 percent of the variation in the average economy's output, with wide variation across economies. Their results show that better-performing economies had a better capitalised banking sector, low loan-to-deposit ratios, a current account surplus and high levels of foreign exchange reserves. At the same time, less financially open economies and countries with weaker credit links with the US were less vulnerable to the crisis. Other determinants, such as the exchange rate regime, budget surplus or government debt are not relevant, with the exception of low levels of government revenues and expenditures before the crisis.

Tsangarides (2012) examines the role of exchange rate regimes in terms of output losses and output rebound during the last financial crisis. Comparing growth performance during crisis (2008-09) and non-crisis periods (2003-07 and 2010-11), and controlling for regime switches, he finds that the growth performance for pegs was not different from that of floats during the crisis. On the contrary, for the period 2010-2011, pegs perform worse than floats for the recovery, suggesting an asymmetric effect during and recovering from the crisis. Also, even if proxies for trade and financial channels are important during the crisis, only the trade channel is important for the recovery.

The literature on early-warning indicators is also linked to the present paper. For example, Frankel and Saravelos (2012) investigate the performance of leading indicators in predicting the cross-country incidence of the GFC. After reviewing the literature of early warning indicators in detail, the authors argue that some indicators, useful in certain crises episodes, are usually ineffective to predicting the next financial crisis. Some of the variables included to measure crisis incidence are drops in GDP and industrial production, currency depreciation, stock market performance, reserve losses and participation in an IMF program. They find that central bank reserves, considered in the pre-2008 crisis literature, and movements in the exchange rate are the two leading indicators in explaining crisis incidence across different countries and crisis episodes.

[1] They calculate seasonally adjusted quarter-over-quarter real GDP growth rates and extract a common factor. The residual of the principal component analysis is used as the measure of the economy's idiosyncratic performance, and a measure of how well or how poorly each economy weathered the crisis relative to its peers.

Rose and Spiegel (2009) use a Multiple Indicator Multiple Cause (MIMIC) model to model the crisis performance of 85 countries. They explore the international linkages that allowed the crisis to spread across countries, using changes in real GDP, stock market performance, country credit ratings and the exchange rate as dependent variables. Then they consider previous factors to the crisis, for 2006 or earlier, including national causes (e.g. equity market run-ups) and international financial and real linkages. The results show that countries holding American securities were more prone to economic deterioration through the financial channel, while countries exporting to the US were more exposed to a US downturn through the trade channel. The authors do not find strong evidence that international linkages can be clearly associated with the incidence of the crisis. If anything, countries seem to have benefited slightly from American exposure. In a follow-up paper, Rose and Spiegel (2011) use an updated dataset, different measures of cross-country crisis intensity, different potential causes of the crisis, country samples and estimation strategies. The authors are unable to find consistent strong linkages between pre-existing variables that are plausible causes of the GFC and its actual intensity. They argue that cross-country models do not seem to fit the data well even "in sample" and the effects of the wide range of potential causes cannot be estimated with precision. They conclude that it is difficult to generalise results for relatively large economies to medium and small economies during the crisis. For example, while excessive credit growth has been considered a relevant factor in explaining GDP growth after the crisis, countries like Australia, Canada and South Africa, weathered the crisis relatively well despite their high credit levels.

Despite several coincidences with the paper discussed above, as we also look at financial and trade linkages in explaining GDP performance after the GFC, there are also some important differences between this body of research and our contribution. First, we focus on the GDP recovery over a longer time period (the difference between the pre-2008 peak and the last quarter of 2011), taking also into account other factors that might affect growth such as a higher potential growth rate or higher growth rates driven by economic convergence. Therefore, our approach focusses more on resilience in terms of the capacity to absorb the shocks rather than its immediate impact. Second, our paper deals explicitly with model uncertainty. While the empirical specifications in literature discussed above are chosen in an ad hoc way – given the large number of potential explanatory variables relative to the small sample of countries – our paper focusses explicitly on identifying systematically those variables that are associated with output recoveries in a robust way by using a Bayesian Model Averaging (BMA) approach. Based on these methodological differences, despite some coincidences with the existing literature, our results also present some non-trivial differences, which carry different policy implications, as discussed in detail in the following sections of the paper.

From a methodological viewpoint, Crespo-Cuaresma and Slacik (2009) is close to our paper, as they connect the literature on crisis indicators with the econometric BMA methodology also used in the present paper. These authors explore the issue of model uncertainty in the framework of binary variable models of currency crises. Using BMA techniques, they assess the robustness of the explanatory variables proposed in the recent literature for both static and dynamic models. They find that most macroeconomic determinants are insufficient to explain currency crises. By contrast, when having a broad definition of crisis period (one year before a crisis), real exchange rate misalignment and financial market indicators are the most robust determinants of crisis periods.

The principle of BMA derives from the uncertainty of selecting a specific model to analyse economic phenomena. As stated by Draper (1995), statistical models involve two components: The first represents structural assumptions on the functional form, variable interaction or distribution of residuals. The second component deals with the interpretation of estimates from an imposed model. Thus, uncertainty for the researcher is twofold: one part is derived from the estimates of a given model and the issues related to the parameter estimation, and another part to the specification of the empirical model. In the context of linear regression, the BMA methodology offers an alternative to the model selection approach, where inference is based on a single model specification.

The seminal work of BMA was proposed by Leamer (1978)[2], who drew attention on the arbitrary selection of control variables in regression analysis. But it took some time for BMA to be introduced to economics (Raftery 1995, Fernandez et al. 2001). Since then, the applications of model averaging have extended to questions of monetary policy, growth, education and other areas. Brock et al. (2006), in one of the first applications in macroeconomics, consider a Taylor rule and Phillips curve model using BMA, including lags of interest rates, inflation and output gap in the final specification.

A large part of BMA analysis has focused on economic growth. Selecting the "appropriate" variables for linear growth regressions has been matter of study for economists. In their seminal paper, Sala-i-Martin et al. (2004) combine OLS estimates in a Bayesian Averaging of Classical Estimates (BACE) approach. Fernandez et al. (2001) employ benchmark priors for the parameters, using a binomial prior on the model space with different prior expected model sizes.

A more recent branch of this literature deals with causality effects using BMA analysis. Durlauf et al. (2008) use BIC weights and dilution priors on the model space. Moral-Benito (2010) extends the BMA analysis to

[2] A more detailed literature review can be found in Moral-Benito (2011).

a panel data setting using a Bayesian Averaging of Maximum Likelihood Estimates (BAMLE) approach. Granger and Jeon (2004) study model averaging techniques in the context of forecasting and impulse-response functions. In finance, BMA applications for forecasting have been implemented by Avramov (2002), Cremers (2002). In a macro framework, Garratt et al. (2003) and Wright (2008) use BMA estimation for inflation and output in the UK and US economies. Other applications of BMA analysis in economics include applications in portfolio management (Pasaran et al. 2009), determinants of currency crises (Crespo-Cuaresma et al. 2009), trade agreements or environmental exposure and health outcomes (Morales et al. 2006). However, to our knowledge our paper is the first to use BMA techniques to explore the resilience of EMEs and developing countries during the GFC.

The remainder of the paper is structured in the following way. In section II, we discuss the main data and definitions relevant to our empirical exercise, as well as some descriptive statistics. Section III discusses our empirical methodology. The main results are presented in section IV, including a robustness analysis in terms of the prior distribution and definition of the dependent variable. Section V presents the main conclusions.

II. DATA

In terms of our dependent variable, we consider two alternatives to measure the performance of a country's economic recovery in the aftermath of the GFC. First, we define the variable recovery as the difference in quarterly real GDP between the last quarter of 2011 and the peak before 2008. The data come from the IMF's International Financial Statistics and Central Banks for a group of 40 emerging economies.[3] All series were seasonally adjusted with X12-ARIMA and Tramo-Seats routines in EVIEWS. Second, we use an alternative definition that considers the conditional recovery, which results from regressing our recovery variable on GDP per capita in 2007 and the average economic growth between 2000 and 2007. The rationale for this procedure is that the first definition might be affected by economic convergence and differences in potential output growth, as poorer countries would tend to exhibit larger growth rates and countries with higher potential growth would also recovery faster from the crisis. This procedure would therefore isolate these more long-term growth drivers from the factors explaining economic resilience after the GFC. While the correlation between the recovery and the conditional recovery is high (with a correlation coefficient of 0.87), there are sometimes important differences, for example in the cases of Indonesia and the Philippines, which has a positive recovery but a negative residual. The same holds for countries like Georgia and South Africa.

[3] The countries considered in the analysis are Argentina, Bulgaria, Belarus, Brazil, Botswana, Chile, China, Colombia, Czech Republic, Ecuador, Estonia, Georgia, Croatia, Hungary, Indonesia, India, Israel, Jamaica, Jordan, South Korea, Lithuania, Latvia, Morocco, Mexico, Macedonia, Malaysia, Peru, Philippines, Poland, Paraguay, Romania, Russia, Serbia, Slovakia, Slovenia, Thailand, Turkey, Ukraine, Uruguay and South Africa.

In terms of explanatory variables, we follow the existing literature discussed in the introduction by focussing on three different groups of variables regarding the potential transmission channels and buffers: i) trade linkages, ii) financial linkages and iii) macroeconomic fundamentals. All values used for these variables refer to pre-crisis periods (2007 or 2008), to avoid a possible endogeneity problems and capture the pre-determined conditions and underlying factors that allowed some countries to recover faster than others. Based on the literature and data availability, we consider a set of 20 potential explanatory variables to analyse their relationship with the dependent variable.

Regarding trade linkages, a pronounced and abrupt decline in exports was observed in most emerging economies after the fall in demand from advanced economies in 2008. This effect was more patent in countries exporting intermediate and final goods, whereas raw-material exporters suffered less by a decline in demand. Following Berkmen et al. (2011) and Cecchetti et al. (2011), we capture the effect on trade linkages with the following variables: i) trade openness, defined as the sum of exports and imports over GDP, ii) importance of external demand, measured as exports to GDP, iii) market exposure by the share of exports to OECD economies.

The second transmission channel refers to financial linkages. The increasing interconnectedness of financial markets and the higher correlation of emerging economies' financial fundamentals with global factors in previous crises make this channel a potentially important one, together with the fact that the GFC started within the financial sector itself. For this channel we consider the following variables: i) de-jure financial openness measure by the Chinn and Ito (2006) index, ii) the share of external assets and liabilities (and liabilities alone) over GDP, as a proxy measure of de-facto financial openness, and iii) external financial linkages to crisis affected advanced economies, proxied by the share of foreign claims of European banks in total liabilities.

The third group of variables includes domestic macroeconomic and financial fundamentals. Prior to the GFC, some EMEs and developing economies had reached a solid macroeconomic stance, whereas others were in a more challenging position. For example, countries with a lower inflation rate or a stronger fiscal position (either in terms of flows or stocks), tend to have more policy space to counteract the recessionary impact of the decline in external demand. Similarly, countries with a flexible exchange rate might also be able to absorb external shocks, such as terms of trade shocks.[4] The expansion of credit, facilitated by low interest rates,

[4] See Edwards and Levy Yeyati (2005) for evidence on this point.

might have been particularly important in building up vulnerabilities, given the previous empirical evidence.[5] To analyse these dimensions, we include the following explanatory variables: i) fiscal stance and solvency, such as the ratio of public debt to GDP, the budget balance over GDP; ii) rollover risks proxied by the share of short-term debt to total debt, iii) exchange rate regimes, using the coarse classification of Ilzetzki, et at. (2004) ; as well as iv) the misalignment alignment of the real exchange rate following Rodrik (2008) iii) initial conditions, such as using GDP per capita in 2007, the average GDP growth rate between 2000 and 2007, the current account over GDP in 2007, average pre-crisis inflation (2003-2007), iv) international reserves (both as share of M2 and share of GDP), v) and domestic financial vulnerabilities approximated by the leverage in the banking system (ratio of loans over deposits) and the growth of domestic credit over GDP.

A detailed description of the variables considered and the sources are included in Annex 1. Table 1 presents the descriptive statistics for all variables considered in the analysis.

[INSERT TABLE 1]

Before starting the econometric analysis, we plot some of the variables that most likely contributed (or hindered) to the recovery since 2008. Scatters for the different sets of variables (trade, financial, domestic and fundamentals) are provided in Annex 2a (for the recovery) and 2b (for the conditional recovery).

The correlations analysis for the *recovery* variable suggests a strong negative association with a number of variables, such as the trade openness, the 2007 (pre-crisis) GDP per capita, liabilities with European banks (as share of total liabilities), and the exchange rate misalignment. Only the current account as share of GDP shows a strong positive association with the recovery. The scatterplots in Figure 2a shows a stronger recovery in countries like China, India, Argentina and Peru (with lower liabilities) in contrast to the slow recovery of Estonia, Latvia, Bulgaria or Hungary. Countries with a high exposure to the trade channel in pre-crisis periods measured by trade openness or exports as share of GDP, such as Malaysia, Slovakia and Thailand, experienced a slower recovery. Financial linkages also suggest some role in explaining the recovery for certain countries. Countries more exposed to European banks (measured by the importance of European banks in their liabilities), .e.g. Slovakia, Botswana, Czech Republic, and Romania, experienced a slower recovery in comparison with those less exposed (including India, Indonesia, Colombia and Uruguay). The overall external debt of the economy (public and private sector), measured by its foreign liabilities, shows a similar trend. Regarding financial openness, de jure financial openness (measured by the Chin-Ito Index) as

[5] See for example Mendoza and Terrones (2012) for evidence on the importance of credit booms in preceding banking crises.

well as de facto (measured by the sum of total external assets and liabilities as share of GDP), both show a negative correlation with the rate of recovery. For example, countries relatively closed in financial terms (e.g., China, India, and Argentina) experienced stronger recoveries than more open countries, such as Latvia or Estonia). Other variables such as domestic credit growth or bank leverage show no clear relationship with on the speed of recovery. Regarding fundamentals, several variables seem to have only a weak relationship with the recovery, such as the budget balance, the level of reserves, the term composition of public debt or inflation. There is some evidence that countries with a lower public debt level (e.g. Chile, Bulgaria, and Paraguay) seem to have experienced a faster recovery, whereas high-indebted countries, notably Jamaica, experienced a much slower recovery. Initial conditions, proxied by the countries' 2007 GDP per capita, is another good predictor of the recovery, with those having lower income levels (China, India, Indonesia, Philippines, Morocco) experienced a faster recovery than others with higher income levels (Korea, Slovenia, Czech Republic). This might be due to economic convergence, such that poorer countries continues to growth faster than more developed economies. Finally, there is some indication that the exchange rate regime matters for recoveries, as countries with more flexible exchange rate regimes (a higher value in coarse classification) recovered some faster. Using the *conditional recovery*, Annex 2b shows that most of the correlations and scatterplots exhibit a similar picture. Trade exposure still has a negative correlation, but less strong, while the current account balance continues to show a strong correlation with the recovery, as well as the exchange rate misalignment, total external liabilities and exposure to European banks.

III. ECONOMETRIC METHODOLOGY

A contribution of this paper is applying the BMA methodology to the estimation of the transmission channels for the recovery and the conditional recovery from the GFC for a group of EMEs and developing countries. This section briefly discusses the main methodological issues.[6] Selecting the most appropriate model when a large set of variables could be included in the specification is a recurrent problem in economic analysis, especially in the absence of a clear and unique economic theory to guide the selection of variables. In the context of the crisis recovery literature, the group of potential factors considered is large, even more when considering the transmission channels for EMEs. In this sense, the added value of the BMA methodology is to provide a systematic approach for improving model selection and exploring which factors are robustly associated with the recovery.

[6] For an extensive reference on this methodology see Hoeting et al. (1999) and Zeugner (2012).

The purpose of BMA is to address model uncertainty in linear regressions. Suppose a linear model structure, with y being the dependent variable, α_γ a constant, β_γ the coefficients, and ε a normal IID error with variance σ^2.

$$y = \alpha_\gamma + X_\gamma \beta_\gamma + \varepsilon \qquad \varepsilon \sim N(0, \sigma^2 I)$$

The problem consists in identifying those variables in matrix X that should be included in the regression, among a large set of potential regressors, $X_\gamma \in \{X\}$. The BMA methodology allows estimating models for all possible combinations of $\{X\}$ and constructing a weighted average over all of them. The model assigns weights from posterior model probabilities that arise from Bayes' theorem:

$$p(M_\gamma \mid y, X) = \frac{p(y \mid M_\gamma, X) p(M_\gamma)}{p(y \mid X)} = \frac{p(y \mid M_\gamma, X) p(M_\gamma)}{\sum_{s=1}^{2^k} p(y \mid M_s, X) p(M_s)},$$

where $p(y \mid X)$ is the *integrated* likelihood which is constant over all models and is thus simply a multiplicative term. The posterior model probability (PMP) $p(M_\gamma \mid y, X)$ is proportional to the marginal likelihood of the model $p(y \mid M_\gamma, X)$ times a prior model probability $p(M_\gamma)$, that is, how probable the researcher thinks model M_γ before looking at the data. Renormalization leads to the PMPs and thus the model weighted posterior distribution for any statistic θ:

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

Selection of the prior

The model prior $\mathrm{p}(\mathrm{M}_\gamma)$ has to be elicited by the researcher and reflects prior beliefs. Traditionally in the BMA literature, when no prior beliefs are possible, a uniform distribution of probabilities for all possible models is commonly assumed.

The uniform prior of a model of size k is defined by the probability of model $M_\gamma$as follows:

$$p(M_\gamma) = \frac{1}{2^k}$$

This specification only requires the choice of the prior expected model size. Likewise, the prior model probability of model M_γ with *k* different explanatory variables is expressed as a binomial random variable:

$$p(M_\gamma) = \theta^{k_\gamma}(1-\theta)^{K-k_\gamma}$$

As binomial random variable, the expected value of model size is $\tilde{m} = K\theta$.

Estimation

Marginal likelihoods $p(M_\gamma \ / y, X)$ and posterior distributions $p(\theta \mid M_{\gamma,}, y, X)$ depend on the estimation framework. In general, the literature uses a *Bayesian regression* linear model with a specific structure using Zellner's g prior (Zeugner, 2012). For each model M_γ suppose a normal error structure, $\varepsilon \sim N(0, \sigma^2 I)$. We suppose that errors are evenly distributed over their domain: $p(\sigma_\gamma) \propto \sigma^{-1}$. For the coefficients β_γ, it is common to assume a prior mean of zero to reflect that not much is known about them. Their variance structure is defined according to Zellner's *g*:

$$\beta_{\gamma|g} \sim N\left(0, \sigma^2\left(\frac{1}{g}X_\gamma^T X_\gamma\right)^{-1}\right)$$

If we believe a-priori that coefficients are zero, the variance-covariance structure is broadly in line with that of data in X_γ. The parameter g reflects how certain the researcher believes that coefficients are zero. The posterior distribution of coefficients depends of prior uncertainty, following a *t*-distribution with expected value $\mathrm{E}(\beta_\gamma \mid \mathrm{y}, \mathrm{X}, \mathrm{g}, \mathrm{M}_\gamma) = \frac{1}{1+\mathrm{g}}\hat{\beta}_\gamma$, where $\hat{\beta}_\gamma$ is the standard OLS estimator for model γ. A more conservative g will translate in coefficients closer to the prior zero mean. The variance of β_γ depends on g as follows:

$$Cov(\beta_\gamma \mid y, X, g, M_\gamma) = \frac{(y-\hat{y})(y-\bar{y})}{N-3}\frac{g}{1+g}\left(1 - \frac{1}{1+g}R_\gamma^2\right)(X_\gamma^T X_\gamma)^{-1}$$

For BMA, this prior framework results into a simple marginal likelihood $\mathrm{p}(\mathrm{y} \mid \mathrm{M}_{\gamma,}, \mathrm{X}, \mathrm{g})$, and includes a size penalty factor adjusting for model k_γ:

$$p(y \mid M_\gamma, X, g) \propto (y-\hat{y})(y-\bar{y})^{\frac{-(N-1)}{2}}(1+g)^{\frac{-k\gamma}{2}}\left(1 - \frac{1}{1+g}\right)^{\frac{-(N-1)}{2}}$$

A common practice consists of selecting a unit information prior setting $g=N$, attributing about the same information to the prior as is contained in one observation. We follow this approach in our baseline estimates.

Computational implementation

A challenge in the BMA framework is the fact that the number of available models increases exponentially with the number of covariates in the regression. A complete estimation of all available models with k covariates would require estimating 2^k possible regressions. In the case of the 20 variables considered, this would imply more than a million potential specifications. An alternative approach to make BMA computationally feasible consists in using a *Markov Chain Monte Carlo Model Composition* (MC3) algorithm as originally proposed by Madigan, Yord and Allan (1995). A similar approach is followed in Crespo-Cuaresma et al. (2009) and Nagengast el at. (2016).

The MC3 approach allows gathering results on the most important part of the posterior model distribution and thus approximates it as closely as possible by constructing a Markov chain in the model space whose stationary distribution converges to the posterior model probability distribution by sampling from "regions" in the available model space where the posterior model probability is higher. The MC3 simulates a chain of models M^s=1,...,S samples where M^s is sampled from the set of all possible models {M_1,...,M_(2^k)}.

The BMA approach mostly relies on the Metropolis-Hastings algorithm, which 'walks' through the model space as follows. At step i, the sampler is situated at a certain current model M_i, with a posterior model probability $p(M_i \mid y,X)$. In step $i+1$ a candidate model M_j is proposed. The birth-death sampler is used in a way that model M_i and model M_j are only different by the inclusion of one variable. This sampler switches from the current model to model M_j with probability $p(i,j)$:

$$p(i,j) = min(1,p(M_j \mid y,X)/p(M_i \mid y,x)$$

In the case model M_j is rejected, the sampler moves to the next step and proposes a new model M_k against M_i. In case M_j is accepted, it becomes the current model and it has to be compared with another candidate model in the next step. In this way, the algorithm runs into convergence to the distribution of posterior model probabilities $p(M_i \mid y,X)$.

The proposed method uses different methods for selecting variables in the MC3. A birth-death sampler is the most standard sampler used, in which one of the K potential variables is selected randomly. If the chosen variable is already part of the current model M_i, then the candidate model M_j will have the same variables

except for the chosen one (i.e. drop a variable). If the selected variable is not contained in M_i, the candidate model will contain all the variables from M_i, plus the selected variable.

Another possible sampler are the reversible-jump sampler and the enumeration sampler, which selects a candidate (with probability 0.5), or proposes a "swap" (also with probability 0.5), where the candidate model M_j randomly drops one covariate with respect to M_i and randomly adds one chosen at random from the potential covariates not included in model M_i. The enumeration sampler, this is, enumerating all possible models, is in general not used for models where there are more than 14 variables.

The quality of the MC3 approximation depends on the number of draws and the initial model. In general, the first iterations (the "burn-ins") are omitted from the computation of results, while the sampler converges towards models with high PMPs. The computational package employed in this paper (BMS) allows for controlling the number of burn-ins and the number of iterations retained.

IV. EMPIRICAL RESULTS

This section presents the empirical results of undertaking the BMA for the two alternative dependent variables: *Recovery* and *Conditional Recovery*, which results from using the residual from the regression:

$$Recovery_i = \beta_0 + \beta_1 * GDP\_per\_cap2007_i + \beta_2 * avg\_gr\_00\_07_i + \mu_i$$

where μ_i represents a residual that can be interpreted as a "clean" version of the recovery, controlling for the country's level of development (pre-crisis GDP per capita) and pre-crisis growth performance (average growth 2000-07). The results from this regression suggest a negative association of recovery with GDP per capita (coef.=-0.0003, t=3.05) while the average GDP growth is non-significant (coef.=0.076, t=0.07) and the goodness-of-it is relatively good (R-squared=0.20). For both alternatives, we first use a uniform distribution of priors as well as a binomial distribution to check the robustness of our results.

The results for the *Recovery* and uniform priors are reported in Table 2. Column 1 provides the posterior inclusion probabilities (PIP), which is defined as the sum of PMPs for all models in which the covariate was included. The PIPs provide a ranking of importance among the different covariates. Column 2 reports the coefficients' average above all models, including the models in which the variable was not included (i.e. a coefficient equals zero). Column 3 reports the average standardized coefficients, which bring the data to the same order of magnitude by normalising variables to mean zero and variance one and therefore allows for an easy comparison across variables in terms of the average estimated impact on the dependent variable. The

coefficients 'posterior standard deviations are illustrated in column 4, whereas column 5 reports the posterior probability of a positive coefficient. The last column denotes the index of the variables' appearance in the original data set, as results are sorted by PIP.

The results for this specification show that the exchange rate misalignment is an important covariate of the recent recovery in emerging economies, such that countries with a more appreciated real exchange rate had a slower recovery. An overvalued exchange rate might reflect overheating of the economy, which often is associated with the build-up of financial vulnerabilities. Similarly, economies with more appreciated exchange rates before the crisis might have been more sensitive to a reversal in capital flows, which combined liabilities in foreign currency would have a negative impact on output (Calvo et al, 2006). The posterior probability of a positive coefficient for this variable is close to zero, which also suggests that in most models considered the point estimate is negative.

The level of GDP per capita in 2007 is the second factor from the BMA associated to the recovery. The average estimated coefficient for this variable is negative, with a similar effect on the recovery as the exchange rate overvaluation as indicated by the standardised coefficient. Therefore, poorer countries tended to have a larger recovery after the crisis, which might be driven by forces of economic convergence. An alternative explanation is that the countries with higher GDP per capita in our sample have greater trade and financial links to the US and Europe.

[INSERT TABLE 2]

A third factor related to the recovery is the share of foreign liabilities to GDP. The crisis literature often refers to the importance of foreign liabilities and their composition as a triggering factor for crises episodes. For example, Catao and Milesi-Ferreti (2013) identify a threshold of 50% (as share of GDP) for net foreign liabilities that leads to a higher likelihood of crises. Moreover, they find also that the *composition* of the external liabilities matters, with a higher sensitivity towards debt liabilities as a gauge for default risk. The empirical literature is less conclusive when referring to the role of liabilities in the economic recovery.[7] Our results suggest that the ratio of foreign liabilities to GDP has a sizeable negative effect on the recovery. For example, a 10 percentage point increase in foreign liabilities to GDP (which is around one-fourth of the standard deviation in the sample) would reduce GDP with respect to its pre-crisis peak by around 6

[7] There is of course a large literature related to a possible debt overhang, but it generally focuses on if public debt has a negative effect on growth (see e.g. Reinhart et al, 2012).

percentage points.[8] Given that public debt to GDP does not appear to be systematically linked to differences in the recovery across countries, it seems that two aspects, international exposure and private-sector exposure, are important to take into account. Therefore, the national balance sheet seems to be the relevant variable to take into account. This is in line with recent historical evidence for advanced economies that finds interactions between private and public debt levels to matter for recoveries in the aftermath of financial crises (Jordà et al, 2013; 2016).

The ratio of European-based to total bank liabilities is another factor that, according to the posterior inclusion probabilities, explains systematically some of the variation in the recovery. As in the case of the ratio of total liabilities, the effect is negative. This result could suggest that countries financially more exposed to Europe were more likely to experienced longer recoveries. During the crisis, European banks were particularly hit and emerging markets with important presence of European bank subsidiaries. As the headquarter company began to experience financial stress, this could spill-over to the emerging markets via a tightening of credit by its subsidiaries. This finding is consistent with the evidence that global banks have been an important transmission mechanism to emerging markets in the GFC (Cetorelli and Goldberg, 2012).

Regarding trade linkages, the share of exports to GDP is important to understand differences in the economic recovery across countries, based on the posterior inclusion probability. Although the average coefficient is positive, the posterior probability of a positive coefficient (0.39) is ambiguous; pointing towards many specifications where the coefficient might actually be negative (see Figure 2). The positive effect might be capture the fact that trade openness is associated with a lower risk of a sudden stop, as shown by Cavallo and Frenkel (2008). Alternatively, these differences might be driven in part by the composition of exports according to their destination. For example, although it is only marginally significant in most models, the share of exports to high-income countries, which were at the centre of the GFC, has a negative effect on the recovery (see Table 2). In contrast, trade openness has a significant and negative relationship with the recovery. This seems more in line with the finding by Blanchard et al (2010), who find a negative correlation between the export share in GDP and the short-term impact of the crisis on GDP in emerging markets. Actually, Figure 2 shows that exports to GDP have a negative coefficient in most specifications that do not include trade openness as an additional regressor, which might be explained by multicollinearity – as the correlation between both variables is above 0.9 – or the fact that trade captures better the integration into global value chains, which played a role during the GFC in transmitting demand shocks more widely (Bems et al, 2010).

[8] Based on the standardised coefficient from Table 2 and the standard deviation reported in Table 1 the effect can be computed as -0.2861*0.1/0.47 = -0.061.

[INSERT FIGURE 2]

Next, we consider the best-performing models by looking at the cumulative model probabilities. The results are represented in Figure 2. The blue colour represents a positive coefficient, red a negative coefficient and white non-inclusion (zero coefficient). The horizontal axis displays the best models, scaled by their PMPs. Since we are using a uniform model prior, more weight is given to "intermediate" models. To see how far the posterior model size distribution matches up to this prior, we plot the posterior model size distribution.

The average model size is an important statistic in the BMA estimation, as it reflects how the model prior can affect the average number of selected regressors. As it will be illustrated, different prior distributions can have a different average sizes for the model. In the case of the uniform distribution, the expected mean number of regressors in this model is 9.5. With a uniform model prior and 2^K possible combinations, the common prior model probability is $P(M_y) = \frac{1}{2^K}$. Under a uniform distribution, this implies a prior expected model size of $\sum_{i=1}^{K} k\frac{1}{2^K} = K/2$. However, the posterior expected model size (Figure 3) is lower (7.4 variables). While the prior distribution is symmetrical around K/2=10 (K being the number of variables), in the posterior distribution more importance is given to models with less variables. This shows that in the uniform model prior more weight is given to "intermediary" models.

[INSERT FIGURE 3]

V. ROBUSTNESS

The results so far show that some financial linkages (the share of European bank liabilities in total liabilities), some domestic vulnerabilities (high external public and private debt and an overvalued exchange rate) and trade openness are systematically linked to the differences in recovery rates across countries. Interestingly, other variables that in the analysis of correlations seemed relevant, like the financial openness (de jure or de facto), as well as macroeconomic fundamentals or buffers (e.g. the level of reserves) do not appear to have a robust correlation with the recovery variable.

Next, to test for the robustness of these results we estimate the Bayesian model using the binomial model as an alternative distribution for the priors. The binomial prior places a common and fixed inclusion probability θ on each regressor, such that the prior probability of a model of size k is defined as the inclusion and exclusion probabilities:

$$p(M_\gamma) = \theta^{k_\gamma}(1-\theta)^{K-k_\gamma}$$

The expected value of model size in this case is $\tilde{m} = K\theta$. Since the expected model size is $m = \theta K$, the BMS allow for choosing a determined θ to reach a specific size. A $\theta = 1/2$ would be equivalent to the uniform distribution. A $\theta < 1/2$ allows of smaller average model sizes. To contrast with the uniform results, we select a $\theta = 1/10$, such that the expected model size is 2. The results for the estimation using the binomial model prior are presented in Table 3 and Figure 4. Other model sizes are considered in the robustness check section.

[INSERT TABLE 3]

The results with the binomial prior show only some slight differences with respect to the uniform distribution in terms of the ranking according to the relative importance of the variables in explaining the recovery. In both cases, the exchange rate misalignment seems to play a crucial role in the recovery, as well as the level of GDP per capita. Similarly, the national balance sheet and external financial linkages (external liabilities to GDP and the share of European liabilities in total banking liabilities). Trade open also appears high on the list of significant variables using this alternative distribution of priors. However, when using the binomial model priors, factors such as the current account, financial openness and leverage in the domestic banking system have also relatively high PIPs. The current account balance is positively related to the recovery, such that output recovery was stronger in countries with a surplus. This finding is consistent with the earlier evidence provided by Cecchetti et al (2011) and Blanchard et al (2010) and points to the importance of financial flows. There is also some evidence that countries with greater de facto financial openness, measured by the sum of external assets and liabilities to GDP, seem to have had a slower recovery. Finally, more leveraged banking systems before the crisis are also associated with a slower recovery. This result is linked to the literature of booms and bursts and the recurring pattern of banking leverage and rapid growth in bank lending that generates asset price bubbles and precipitate financial crises (Reinhart and Rogoff, 2009). It is also in line with Berkmen et al. (2012) and Cecchetti et al. (2011), where countries with more leveraged domestic financial systems and credit growth tend to suffer a larger effect on economic activity.

[INSERT FIGURE 4]

It is also interesting to notice that the PIPs in the uniform prior tend to be considerably higher for the main variables (68% of models have exchange rate misalignment in the Uniform prior, compared to 52% in the binomial). The average number of regressors (2.32) is naturally lower than in the uniform prior, after defining

a low θ. However, and to confirm the robustness of results, the selected variables do not considerably differ from those of the uniform prior analysis.

Next, we perform the same BMA exercises for the alternative recovery, the *Conditional Recovery*. The idea of using the residual instead of the *Recovery* is that the information contained in the residual is independent of the country's previous growth performance (therefore separating the cyclical effect of the recovery) and its level of development, which are likely to affect the speed of the recovery as higher growth rates are expected for poorer countries due to convergence reasons. The results for the uniform distribution using the *Conditional Recovery* are displayed in Table 4.

[INSERT TABLE 4]

As in the case of the recovery, the BMA shows a similar set of variables explaining the recovery residual. The main five factors are the exchange rate misalignment, trade openness, the ratio of liabilities to GDP, the ratio of European to total liabilities, and the share of exports to OECD (high income) countries. In this configuration, the GDP per capita level and pre-crisis average growth rates are excluded from the Bayesian averaging. The posterior inclusion probabilities (PIPs) are similar to the ones obtained with the *recovery* variable. On the contrary, the ratio of assets and liabilities to GDP is less associated to the *residual* than to the *recovery*. The average pre-crisis inflation, between 2003 and 2007, is also not relevant to explain the residual. The average number of models for the uniform model prior is 6.8 variables. Finally, the BMA for the binomial prior distribution and the conditional recovery show similar results to the uniform distribution, with a large part of the exchange rate misalignment, followed by the share of liabilities to GDP, the current account as share of GDP, the share of assets and liabilities and trade openness (Table 5). Overall, although there are some differences regarding the posterior probabilities, the uniform and binomial priors identify similar covariates as the most significant to explain the conditional recovery.

[INSERT TABLE 5]

A summary of results comparing posterior probabilities for the 2 variables (recovery and conditional recovery) and prior specifications (uniform and binomial) highlights the most important determinants of the recovery in emerging economies (Figure 7). Although the different specifications show some differences in the identified determinants, the BMA results show that a small group of variables can explain the recovery and the conditional recovery quite well: the exchange rate misalignment, the share of liabilities to GDP, the

share of European to total liabilities, trade openness, the current account balance, and de facto financial openness. Posterior inclusion probabilities are in general lower and more volatile with the binomial distribution, when compared to the uniform.

[INSERT FIGURE 7]

Although initial conditions (GDP per capita 2007) and the 2000-07 average growth have relatively high posterior inclusion probabilities for the recovery, posterior probabilities for the conditional recovery (*i.e.* once controlling by GDP per capita and GDP growth) are not too different, suggesting that external factors, both financial and trade, are more important to explain recoveries after the global financial crisis. The different specifications suggest that, on average, emerging countries with more external commercial linkages and more exposed to financial vulnerabilities had a slower recovery than those with less linkages. Domestic factors, including the debt factors, credit or the share of reserves do not seem to have played, on average, a significant role explaining differences in the recovery. At the regional level, it is noticeable that some Asian (China, India) and Latin American economies (Argentina, Colombia, Peru) recovered fast, while countries from Eastern Europe (Ukraine, Estonia, Latvia) experienced much slower recoveries. A potential explanation for this is that these countries could adjust their currency and devaluate to remain more competitive, while European countries where constrained by the Euro and also much more exposed to the risks in the European banking sector that spread across borders. Other domestic factors, such as public debt levels or the budget deficit, have a less clear association with the recovery in the sample. On the contrary, this does not mean that they did not matter. Actually, the results show the importance of national balance sheets, rather than just public or private sector problems, as the main explanatory variables behind the differences in recoveries, as the robustness in the explanatory power of total external liabilities and current account balances show.

To check for potential effects of outliers on some variables, we perform the BMA analysis excluding some countries. In particular, for the ratio of reserves to M2 Botswana exhibits an unusual (1.861), and considerably higher than the mean observed (0.42). Also, for the variable of exchange rate misalignment, the results for Argentina (0.88) are high. We exclude the observations of Argentina and Botswana to check for the robustness of results in the BMA.

The results show no large differences with the results obtained with the two outliers (see Table 6). The exchange rate misalignment variable (excluding the Argentinian outlier) becomes more important in the posterior inclusion probabilities (PIP), with an increase in the PIP from 0.68 to 0.95 for the recovery, and

from 0.61 to 0.85 for the case of the residual. Regarding the Botswana outlier, the variable of reserves to M2 does become slightly less important in the new model, with a declining posterior inclusion probability (PIP) of 0.38 to 0.20 (uniform prior) and from 0.36 to 0.17 for the residual (uniform prior).

[INSERT TABLE 6]

All in all, we do observe some modifications in the PIP order, but the main variables in each model remain close to the original sample, which lead us to think the results are not dependent on outliers (for reserves and exchange rate misalignment).

VI. CONCLUSIONS

This paper addresses the problem of model uncertainty in the context of analysing external shocks, in this case the 2008 financial crisis, on the output performance of a group of emerging economies. Based on a Bayesian model averaging approach, we assess the robustness of potential factors identified in the literature traditionally associated to the output recovery, defined as the GDP difference between the last quarter of 2011 and the 2008 peak. A second definition of the recovery, the conditional recovery, which controls for the country's previous growth performance and its development level, is also analysed. The methodological approach presented in this paper, to our knowledge the first one focusing on the output recovery as the variable of study, allows having a more objective selection criterion of factors associated to the recovery.

Our results suggest that the exchange rate misalignment is an important factor associated to both the recovery and the conditional recovery. Furthermore, financial linkages represented by the ratio of liabilities to GDP or the ratio of assets and liabilities to GDP tend to be strongly related to the output recovery. The trade channel, either through the form of trade openness or the exposure to OECD markets, is also a relevant, but secondary, factor related to the recovery. We find less evidence on the role that domestic fundamentals, such as the budget balance, inflation or public debt, played a primary in the recovery for emerging economies. The results are robust to different prior probability distributions and both definitions of recovery. We do not establish a probability threshold for the selection of relevant variables. However, most posterior inclusion probabilities are above a 0.50 threshold in the uniform distribution and 0.20 in the binomial distribution.

These results highlight the considerable importance that external factors still have in explaining the pattern of recovery in emerging economies. Moreover, they suggest that a more comprehensive scope is needed when analysing the patterns of output recovery. A national balance-sheet approach seems to be particularly useful. As pointed out above, while the public sector debt and deficit are not systematically linked to the

speed of recovery, the national debt (i.e. public and private debt) and the current account (which is the national equivalent to the budget balance) are quite important. This somewhat points towards the need to monitor also risks and imbalances in the private sector as they might land on the public sector´s balance sheet or lead to excess leverage that usually is difficult to deal with.

Finally, future work should shed more light on the role of the real exchange rate. A cheap exchange rate is an outcome of a combination of policies that include probably restrictions to financial flows, domestic credit market restrictions and other macroeconomic policies that lead to high national savings. Our results show the importance that undervalued exchange rates had for the recovery. While there is some evidence that it has a positive effect on growth (Rodrik, 2008), our paper contributes new evidence that overvalued exchange rates were bad for the recoveries in emerging markets after the crisis, while undervalued exchange rates helped in the recovery. However, our paper is silent about its drivers, as well as if from other perspectives (e.g. long-term growth) if this is a desirable outcome.

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FIGURES AND TABLES

Figure 1 – Distribution of GDP growth rates before and after the crisis

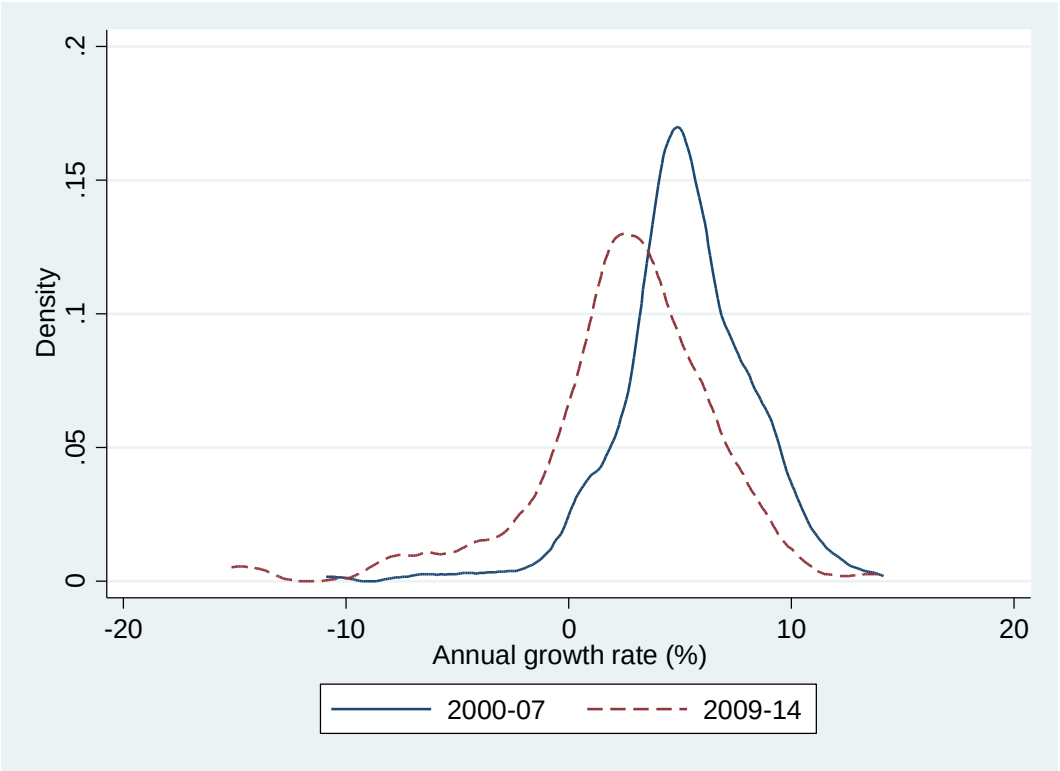


Figure 2 – Cumulative Model Probabilities with uniform priors and recoveries as dependent variable

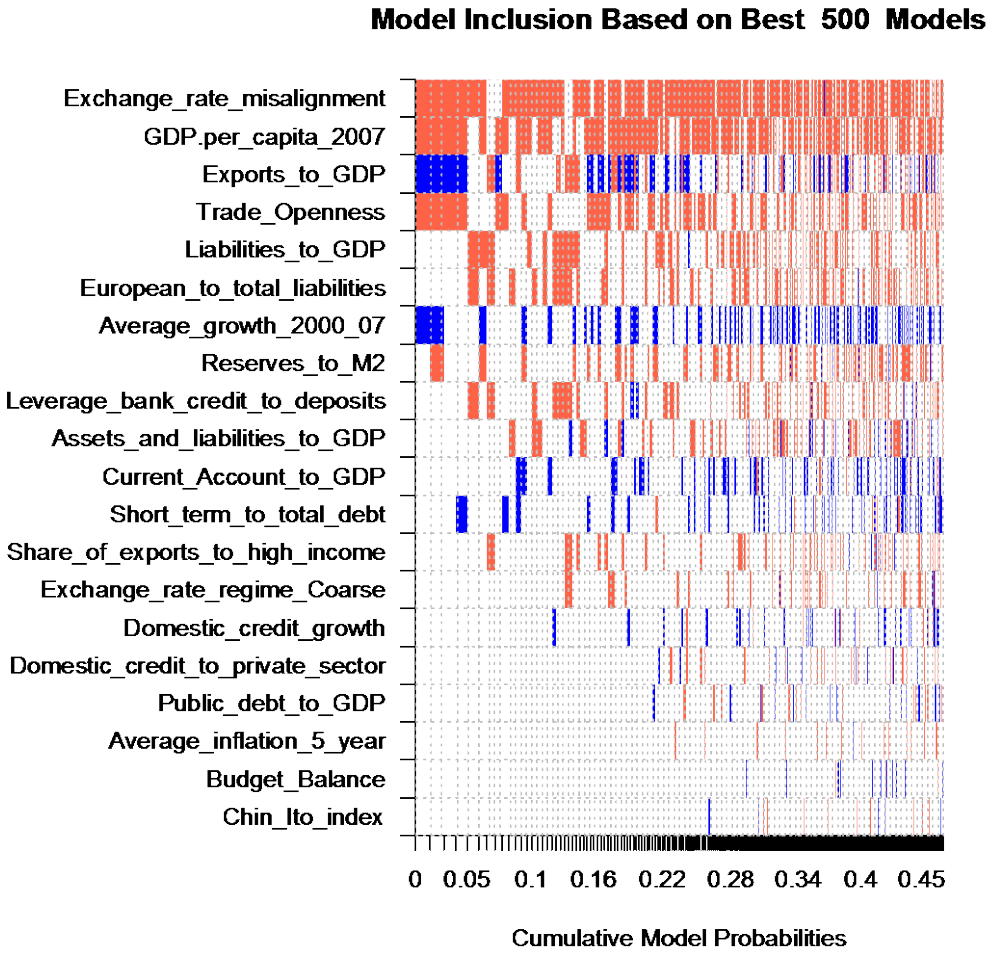


Figure 3 – Posterior model distribution – Recovery (uniform prior)

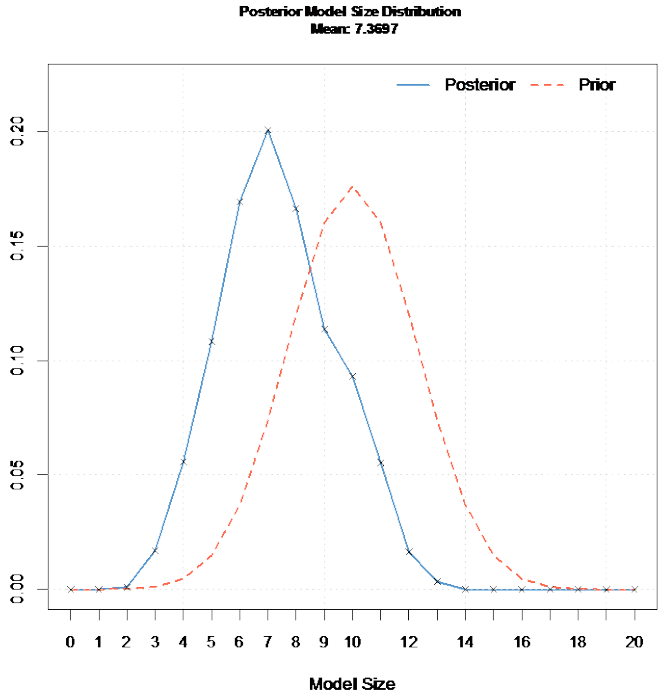


Figure 4 – Cumulative Model Probabilities with binomial priors and recoveries as dependent variable

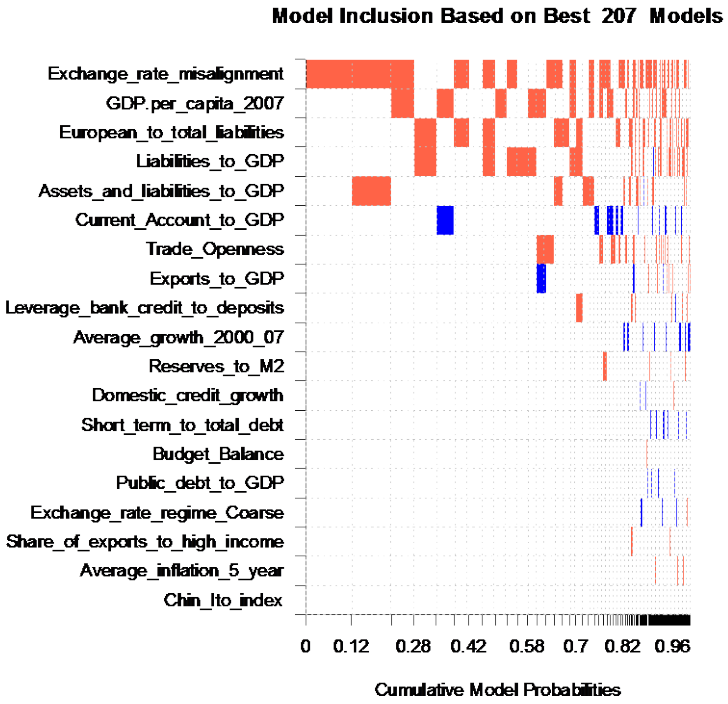


Figure 5 – Cumulative Model Probabilities with uniform priors and conditional recoveries as dependent variable

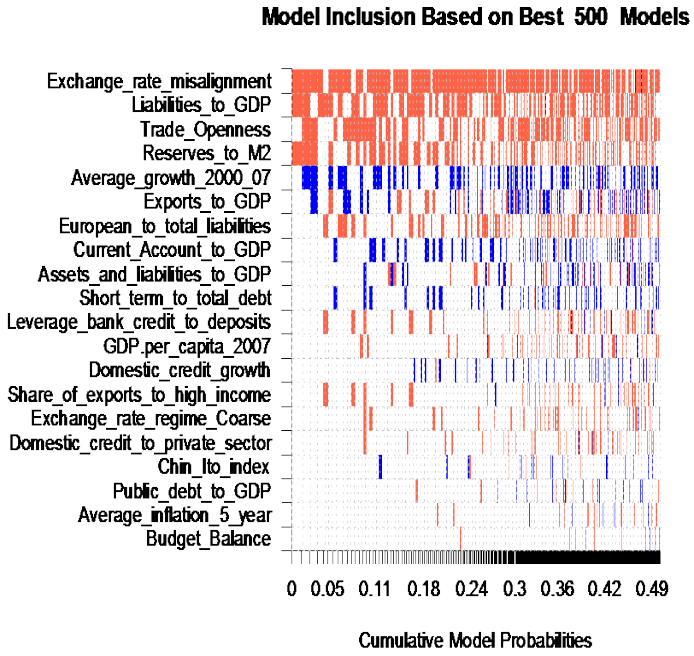


Figure 6 – Cumulative Model Probabilities with binomial priors and conditional recoveries as dependent variable

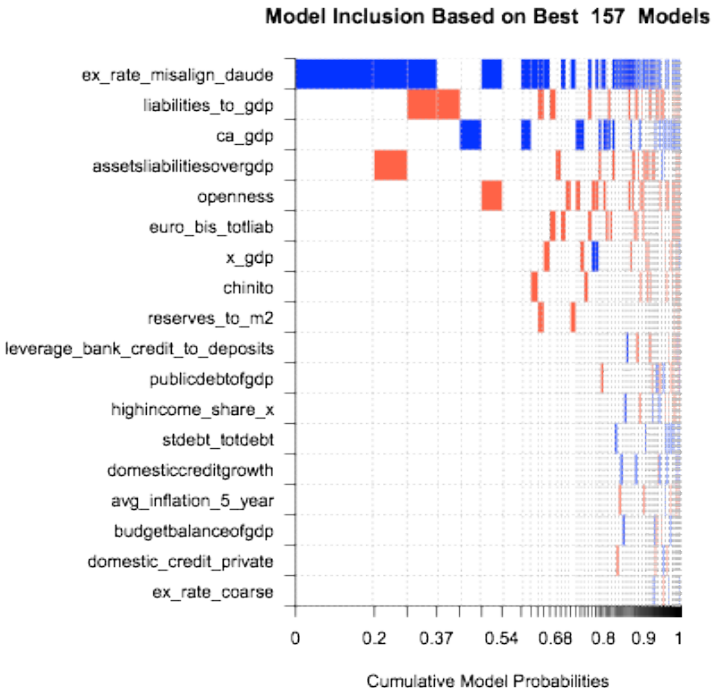
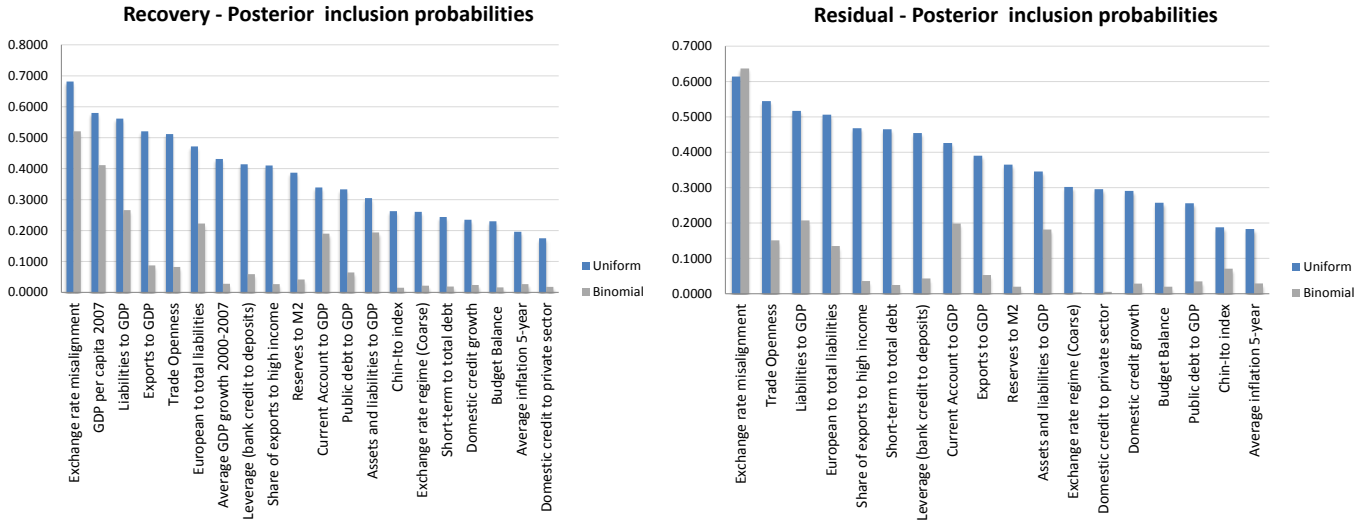


Figure 7. Summary of results: recovery vs residual - Uniform and Binomial prior distribution



Source: Authors' calculation.

Table 1 – Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Recovery	40	7.760	13.565	-17.898	47.862
Conditional recovery (residual)	40	0.000	12.122	-22.338	33.688
Trade openness	40	89.037	43.080	5.090	183.210
Budget Balance % GDP	40	0.054	2.698	-4.874	8.350
Public debt % GDP	40	33.903	22.781	3.890	109.565
Domestic credit growth	40	24.234	21.790	-40.445	76.980
Domestic credit to private sector	40	55.099	35.121	11.436	160.125
Chin Ito Index (Financial openness)	39	1.039	1.348	-1.159	2.456
European liabilities over total liabilities	38	0.337	0.254	0.036	0.874
Leverage (credit to deposits)	40	3.922	2.138	1.178	9.418
Liabilities over GDP	40	1.003	0.468	0.215	2.425
Assets and liabilities over GDP	40	1.614	0.692	0.550	3.870
Current account % GDP	40	-5.058	8.464	-22.914	17.470
Export to high income as % total	38	61.213	19.843	0.525	90.105
Short term debt over total debt	28	22.645	13.171	7.832	56.730
Exports to GDP	40	0.453	0.198	0.138	1.033
Annual average growth 2000 2007	40	5.185	1.925	1.110	10.510
Average inflation 5-year	40	5.852	3.785	0.840	14.460
GDP per capita 2007	40	11650.8	6490.1	2573.0	26324.0
Reserves to M2	39	0.422	0.305	0.035	1.861
Exchange rate Coarse	40	2.225	0.920	1.000	4.000
Ex. Rate misalignment	40	0.045	0.224	-0.886	0.360

Table 2 – BMA results with uniform priors and recoveries as dependent variable

	Posterior Inclusion Probability	Average Coefficient	Standardised average coefficient	Coeff.'s posterior standard deviation	Posterior probability of a positive coefficient	Original order
Exchange rate misalignment	0.7323	-16.1050	-0.2847	12.9324	0.0086	19
GDP.per capita 2007	0.6460	-0.0008	-0.2409	0.0008	0.0000	16
Exports to GDP	0.5203	10.1293	0.1400	47.0086	0.4241	14
Liabilities to GDP	0.4867	-9.3160	-0.2861	15.0473	0.0281	9
European to total liabilities	0.4660	-12.4279	-0.1861	17.1632	0.0107	7
Trade Openness	0.4343	-0.1314	-0.3627	0.2504	0.0169	1
Reserves to M2	0.4057	-3.7897	-0.0910	6.9617	0.0649	17
Average growth 2000 07	0.3973	0.5594	0.0864	0.9621	0.9690	15
Leverage bank credit to deposits	0.3823	-0.6939	-0.1147	1.3821	0.0828	8
Assets and liabilities to GDP	0.3807	1.4642	0.0617	9.1657	0.4834	10
Current Account to GDP	0.3580	0.1160	0.0770	0.2955	0.8333	11
Share of exports to high income	0.3320	-0.0511	-0.0635	0.1198	0.1606	12
Short term to total debt	0.3160	0.0870	0.0837	0.1890	0.9262	13
Domestic credit to private sector	0.3087	-0.0204	-0.0548	0.0627	0.1944	5
Exchange rate regime Coarse	0.2417	-0.5628	-0.0382	1.5753	0.0524	18
Domestic credit growth	0.2303	0.0121	0.0166	0.0779	0.6874	4
Budget Balance	0.1963	0.0005	0.0001	0.3824	0.5450	2
Public debt to GDP	0.1860	0.0037	0.0065	0.0569	0.6093	3
Average inflation 5 year	0.1627	-0.0715	-0.0197	0.3265	0.1107	20
Chin Ito index	0.1533	0.0309	0.0031	0.7487	0.6500	6

Table 3 – BMA results with binomial model priors and recoveries as dependent variable

	Posterior Inclusion Probability	Average Coefficient	Standardised average coefficient	Coeff.'s posterior standard deviation	Posterior probability of a positive coefficient	Original order
Exchange rate misalignment	0.5457	-14.6325	-0.2587	15.0546	0.0000	19
GDP.per capita 2007	0.3630	-0.0005	-0.1564	0.0008	0.0000	16
European to total liabilities	0.3563	-10.4947	-0.1572	15.9875	0.0000	7
Liabilities to GDP	0.3090	-4.8341	-0.1484	8.0311	0.0032	9
Assets and liabilities to GDP	0.1827	-1.5147	-0.0639	3.8117	0.0146	10
Trade Openness	0.1403	-0.0466	-0.1288	0.1546	0.0000	1
Leverage bank credit to deposits	0.1157	-0.2618	-0.0433	0.8654	0.0317	8
Current Account to GDP	0.1120	0.0627	0.0417	0.1975	1.0000	11
Exports to GDP	0.1110	5.5925	0.0773	26.9614	0.5345	14
Short term to total debt	0.0713	0.0104	0.0100	0.0626	0.9766	13
Domestic credit growth	0.0663	0.0027	0.0036	0.0397	0.7990	4
Share of exports to high income	0.0527	-0.0122	-0.0151	0.0617	0.0000	12
Average growth 2000 07	0.0450	0.0529	0.0082	0.3322	1.0000	15
Budget Balance	0.0303	0.0046	0.0010	0.1606	0.6264	2
Exchange rate regime Coarse	0.0227	0.0139	0.0009	0.3701	0.6912	18
Reserves to M2	0.0197	-0.0975	-0.0023	1.2713	0.1186	17
Public debt to GDP	0.0143	-0.0007	-0.0012	0.0163	0.2093	3
Chin Ito index	0.0033	-0.0033	-0.0003	0.1164	0.0000	6
Average inflation 5 year	0.0030	-0.0016	-0.0004	0.0434	0.0000	20
Domestic credit to private sector	0.0000	0.0000	0.0000	0.0000	NA	5

Table 4 – BMA results with uniform model priors and conditional recoveries as dependent variable

	Posterior Inclusion Probability	Average Coefficient	Standardised average coefficient	Coeff.'s posterior standard deviation	Posterior probability of a positive coefficient	Original order
Exchange rate misalignment	0.6767	-14.1953	-0.2828	12.7341	0.0222	19
Trade Openness	0.5823	-0.1507	-0.4688	0.2159	0.0006	1
Liabilities to GDP	0.5047	-10.9401	-0.3786	17.0348	0.0271	9
Short term to total debt	0.5013	0.1589	0.1723	0.2292	0.9541	13
European to total liabilities	0.4850	-10.8242	-0.1827	15.2585	0.0062	7
Leverage bank credit to deposits	0.4770	-1.0232	-0.1906	1.5462	0.0398	8
Exports to GDP	0.4473	10.1043	0.1574	39.1336	0.5179	14
Reserves to M2	0.4437	-4.2213	-0.1143	6.6884	0.0188	17
Share of exports to high income	0.3937	-0.0810	-0.1136	0.1365	0.0550	12
Assets and liabilities to GDP	0.3737	3.2315	0.1536	10.1056	0.5888	10
Average growth 2000 07	0.3597	0.4279	0.0745	0.8723	0.9166	15
Domestic credit to private sector	0.3437	-0.0406	-0.1231	0.0787	0.0466	5
Current Account to GDP	0.3397	0.1345	0.1007	0.2855	0.9205	11
GDP.per capita 2007	0.2763	-0.0001	-0.0366	0.0004	0.1761	16
Exchange rate regime Coarse	0.2593	-0.6696	-0.0513	1.7342	0.0566	18
Domestic credit growth	0.2287	0.0173	0.0267	0.0826	0.7493	4
Average inflation 5 year	0.2103	-0.0865	-0.0269	0.3526	0.1632	20
Budget Balance	0.1973	0.0051	0.0012	0.3601	0.5405	2
Public debt to GDP	0.1957	0.0076	0.0150	0.0634	0.6337	3
Chin Ito index	0.1760	0.1379	0.0154	0.9285	0.7140	6

Table 5 – BMA results with binomial model priors and conditional recoveries as dependent variable

	PIP	Post Mean	Stand. Coeff.	Post SD	Cond.Pos. Sign	Idx
	Posterior Inclusion Probability	Average Coefficient	Standardised average coefficient	Coeff.'s posterior standard deviation	Posterior probability of a positive coefficient	Original order
Exchange rate misalignment	0.6373	16.3251	0.3253	14.0031	1.0000	17
Liabilities to GDP	0.2077	-2.7040	-0.0936	5.8784	0.0000	9
Current Account to GDP	0.1990	0.1085	0.0812	0.2493	1.0000	11
Assets and liabilities to GDP	0.1823	-1.2924	-0.0614	3.2370	0.0165	10
Trade Openness	0.1513	-0.0215	-0.0668	0.0750	0.0000	1
European to total liabilities	0.1353	-2.2889	-0.0386	7.0435	0.0000	7
Chin-Ito index	0.0713	-0.1471	-0.0165	0.6817	0.0000	6
Exports to GDP	0.0537	0.5068	0.0079	11.3842	0.2671	14
Leverage (bank credit to deposits)	0.0437	-0.0542	-0.0101	0.3727	0.1145	8
Share of exports to high income	0.0367	-0.0030	-0.0042	0.0330	0.2364	12
Public debt to GDP	0.0353	-0.0006	-0.0011	0.0196	0.4151	3
Average inflation 5-year	0.0297	-0.0074	-0.0023	0.1034	0.2022	18
Domestic credit growth	0.0293	0.0022	0.0034	0.0277	0.8523	4
Short-term to total debt	0.0253	0.0038	0.0041	0.0358	1.0000	13
Reserves to M2	0.0207	-0.1719	-0.0047	1.5689	0.1452	15
Budget Balance	0.0203	0.0007	0.0002	0.1181	0.6885	2
Domestic credit to private sector	0.0060	0.0000	-0.0001	0.0053	0.5000	5
Exchange rate regime (Coarse)	0.0047	0.0019	0.0001	0.1476	0.9286	16

Table 6. BMA results excluding outliers (recovery and conditional recovery)

Recovery

	PIP	Post Mean	Stand. Coeff.	Post SD	Cond.Pos. Sign	Idx
	Posterior Inclusion Probability	Average Coefficient	Standardised average coefficient	Coeff.'s posterior standard deviation	Posterior probability of a positive coefficient	Original order
Exchange rate misalignment	0.9547	49.1736	0.5938	18.3406	1.0000	19
Trade Openness	0.6103	-0.1036	-0.2893	0.1272	0.0022	1
Average growth 2000-07	0.5567	0.7871	0.1242	0.9877	0.9922	15
Exchange rate regime (Coarse)	0.4697	-1.5497	-0.1087	2.2974	0.0149	18
Liabilities to GDP	0.4247	-6.9593	-0.2089	14.1652	0.0008	9
Exports to GDP	0.4080	-7.4570	-0.1053	23.0742	0.1855	14
Short-term to total debt	0.3710	0.0844	0.0822	0.1743	0.9021	13
Current Account to GDP	0.3067	0.0570	0.0379	0.1890	0.8859	11
Domestic credit to private sector	0.3057	-0.0289	-0.0777	0.0638	0.0327	5
GDP per capita 2007	0.2860	-0.0002	-0.0479	0.0005	0.0641	16
Assets and liabilities to GDP	0.2687	1.5098	0.0659	8.3253	0.4342	10
Average inflation 5-year	0.2540	0.1081	0.0280	0.4052	0.8753	20
Leverage (bank credit to deposits)	0.2510	-0.3735	-0.0636	1.1247	0.1368	8
European to total liabilities	0.2357	-3.3547	-0.0413	10.9068	0.0693	7
Share of exports to high income	0.2347	-0.0259	-0.0318	0.0937	0.1520	12
Budget Balance	0.2217	-0.0474	-0.0097	0.3759	0.2165	2
Reserves to M2	0.2070	-1.6830	-0.0222	5.8682	0.0242	17
Chin-Ito index	0.1953	-0.1544	-0.0150	0.8779	0.1997	6
Domestic credit growth	0.1467	-0.0020	-0.0022	0.0713	0.4523	4
Public debt to GDP	0.1340	-0.0073	-0.0128	0.0488	0.2488	3

Residual

	PIP	Post Mean	Stand. Coeff.	Post SD	Cond.Pos. Sign	Idx
	Posterior Inclusion Probability	Average Coefficient	Standardised average coefficient	Coeff.'s posterior standard deviation	Posterior probability of a positive coefficient	Original order
Exchange rate misalignment	0.8503	31.7035	0.4406	18.2947	1.0000	17
Trade Openness	0.6037	-0.1132	-0.3639	0.1810	0.0326	1
Liabilities to GDP	0.6023	-15.0357	-0.5195	20.8751	0.0072	9
Leverage (bank credit to deposits)	0.5673	-1.1448	-0.2244	1.5486	0.0059	8
Exchange rate regime (Coarse)	0.5210	-2.1587	-0.1742	2.7426	0.0038	16
Exports to GDP	0.4477	-5.1002	-0.0829	34.1830	0.3090	14
Short-term to total debt	0.4457	0.1330	0.1492	0.1964	0.9835	13
Current Account to GDP	0.4083	0.1058	0.0809	0.2676	0.8955	11
Average inflation 5-year	0.3533	0.3093	0.0920	0.7413	0.8934	18
Domestic credit to private sector	0.3487	-0.0222	-0.0686	0.0775	0.1979	5
Assets and liabilities to GDP	0.3180	5.5176	0.2773	11.7421	0.8323	10
Share of exports to high income	0.3180	-0.0551	0.2773	0.1201	0.0356	12
Public debt to GDP	0.2790	-0.0347	-0.0704	0.0872	0.0753	3
Budget Balance	0.2487	-0.1145	-0.0269	0.5305	0.3137	2
European to total liabilities	0.2223	-4.4105	-0.0626	11.9016	0.1379	7
Chin-Ito index	0.2113	0.3161	0.0354	1.2755	0.8091	6
Domestic credit growth	0.1797	0.0042	0.0053	0.0756	0.6698	4
Reserves to M2	0.1770	-0.7254	-0.0110	4.8235	0.2316	15

ANNEX 1. DESCRIPTION OF VARIABLES

Variable	Definition	Source
Recovery	Difference of quarterly GDP between the last quarter of 2011 and the peak before 2008	Authors' calculations, based in Central Banks' quarterly data
Conditional recovery	Recovery conditional (residual after controlling controlling for) 2007 GDP per capita and the average economic growth since the beginning of the decade until 2007.	Authors' calculation, based in Central Banks' quarterly data and World Development Indicators
Trade Openness	Exports/(Exports + Imports)	UN Comtrade
Budget Balance	Cash surplus/deficit (% of GDP)	World Development Indicators
Public debt to GDP	Central government debt, total (% of GDP)	World Development Indicators
Domestic credit growth	Percentage change in bank lending to public and private sectors, plus bank lending in domestic currency overseas. Line 32 in IFS.	Financial development database (World Bank and Beck et al.)
Domestic credit to private sector	Domestic credit to private sector (% of GDP)	
Chin Ito index	Index measuring a country's degree of capital account openness.	Chinn, Menzie D. and Hiro Ito (2006). "What Matters for Financial Development? Capital Controls, Institutions, and Interactions," Journal of Development Economics, Volume 81, Issue 1, Pages 163-192 (October).
European to total liabilities	Ratio of European to total liabilities	Bank of International Settlements (BIS)
Leverage bank credit to deposits	The financial resources provided to the private sector by domestic money banks as a share of total deposits. Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits. Total deposits include demand, time and saving deposits in deposit money banks.	Global Financial Development Database (World Bank)
Liabilities to GDP	Total liabilities over GDP	Lane and Milesi database. External Wealth of Nations Mark II database (see Lane and Milesi-Ferretti, "The External Wealth of Nations Mark II", Journal of International Economics, November 2007).
Assets and liabilities to GDP	(Assets+liabilities)/GDP	Lane and Milesi database. External Wealth of Nations Mark II database (see Lane and Milesi-Ferretti, "The External Wealth of Nations Mark II", Journal of International Economics, November 2007).
Current Account to GDP		World Development Indicators
Share of exports to high income	Total exports to OECD economies (Comtrade group)	UN Comtrade
Short term to total debt	Ratio of short term to total debt	World Bank
Exports to GDP		World Development Indicators
Average growth 2000 07	Average GDP growth 2000-2007	World Development Indicators
GDP per capita 2007	GDP per capita	World Development Indicators
Reserves to M2	Total reserves ratio to money and quasi money (M2)	World Development Indicators and Central Banks'
Exchange rate regime Coarse	De facto exchange rate regimes for exchange rates in 15 categories, including fixed, limited flexibility, managed floating, freely floating or freely failing.	Ilketzi, Reinhart and Rogoff database (2011)
Exchange rate misalignment	Over (under) valuation of the real exchange rate	Authors calculations based on Rodrik (2008)
Average inflation 5 year	Average Consumer Price Index 2003-07	World Development Indicators

ANNEX 2. CORRELATIONS AND SCATTERPLOTS

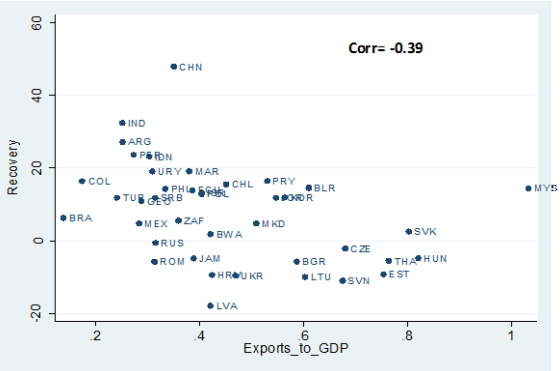
Annex 2a. Simple correlations and scatterplots

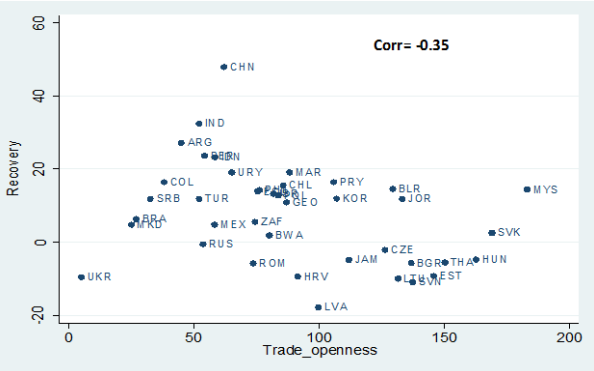
Correlations of covariates with recovery and conditional recovery

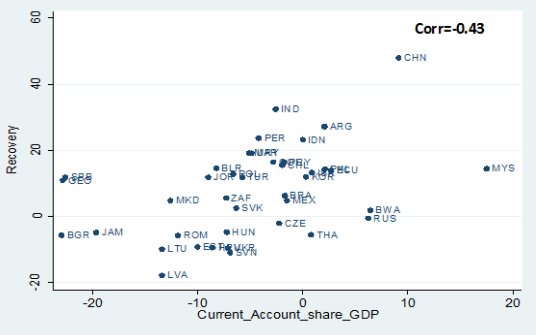
Variable	Recovery
Trade openness	-0.35
Budget Balance % GDP	0.07
Public debt % GDP	0.21
Domestic credit growth	-0.30
Domestic credit to private sector	-0.13
Chin Ito Index (Financial openness)	-0.41
European liabilities over total liabilitie	-0.59
Leverage (credit to deposits)	0.09
Liabilities over GDP	-0.53
Assets and liabilities over GDP	-0.49
Current account % GDP	0.43
Export to high income as % total	-0.23
Short term debt over total debt	-0.03
Exports to GDP	-0.39
Annual average growth 2000 2007	0.03
Average inflation 5-year	0.02
GDP per capita 2007	-0.45
Reserves to M2	-0.02
Exchange rate Coarse	0.16
Ex. Rate misalignment	-0.60

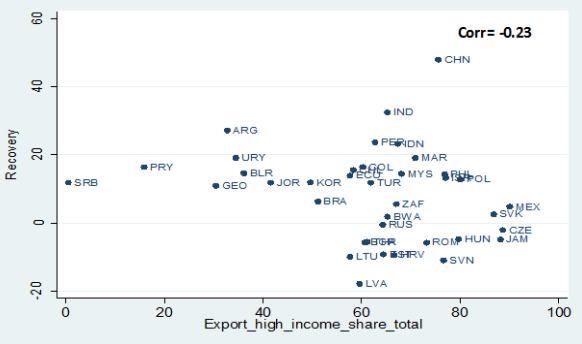
Scatterplots Recovery

Trade Linkages

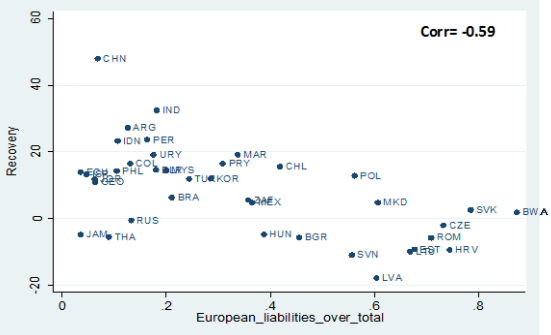


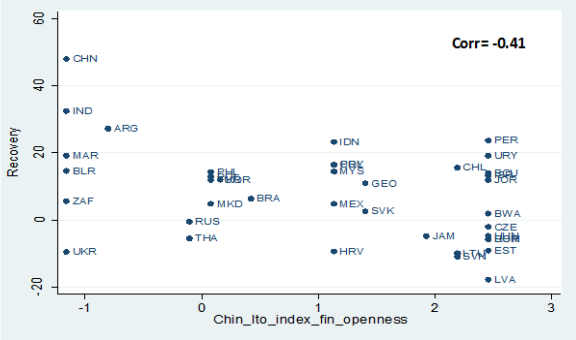


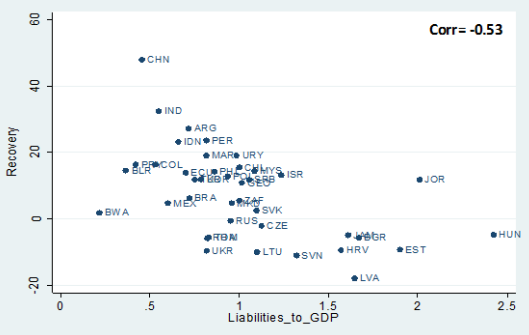


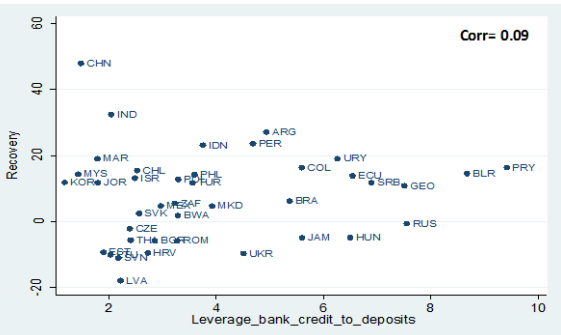


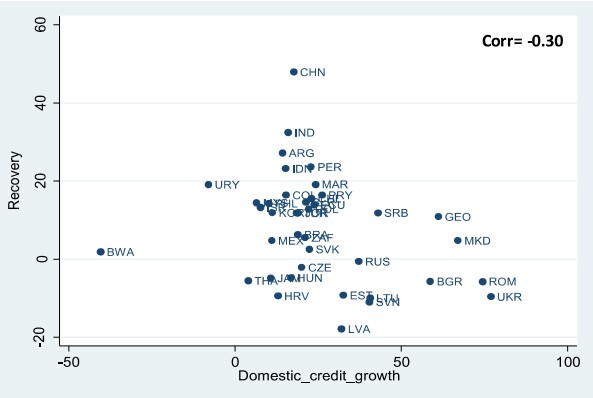
Financial linkages

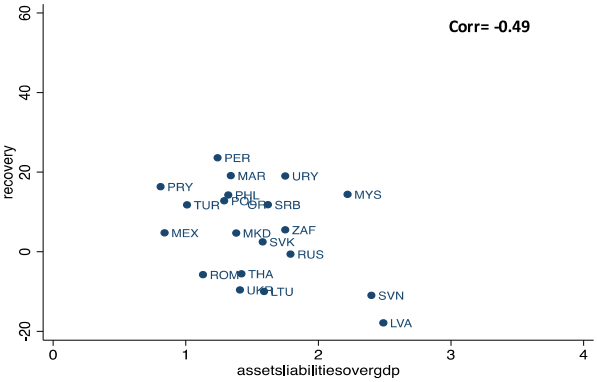












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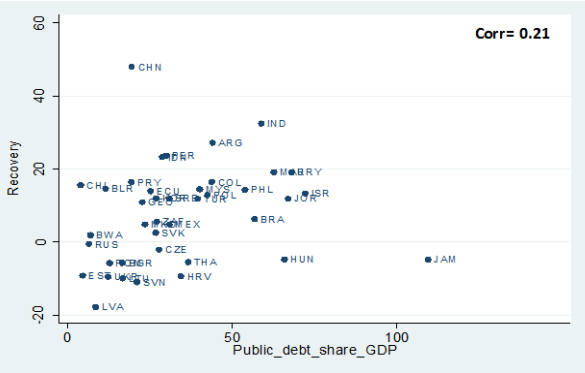

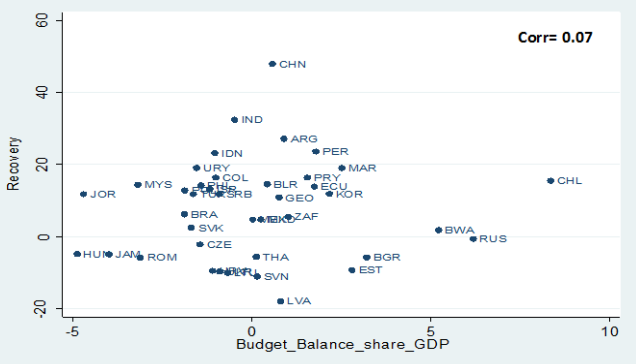

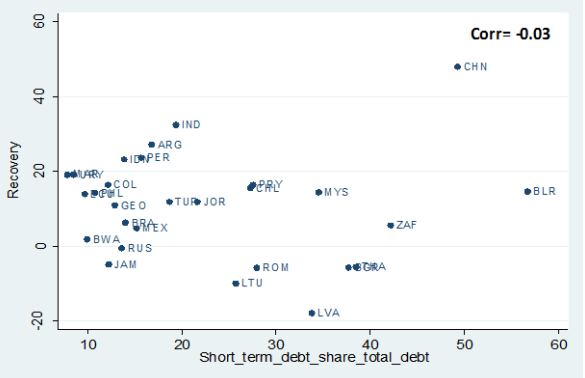

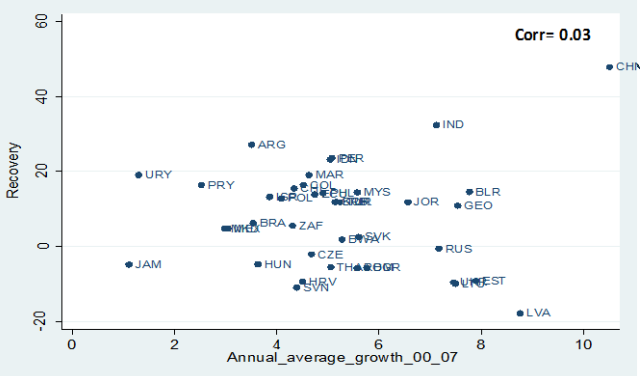

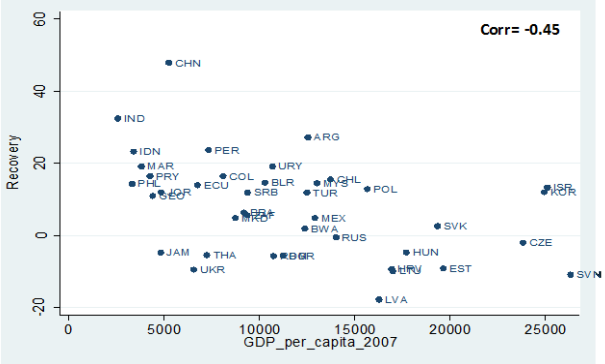

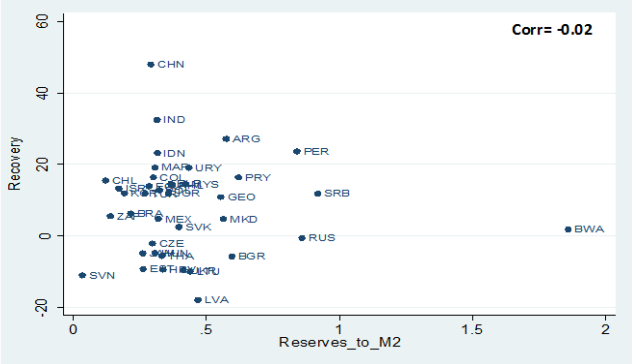

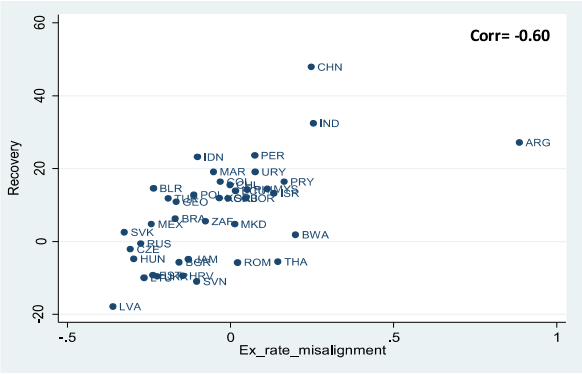
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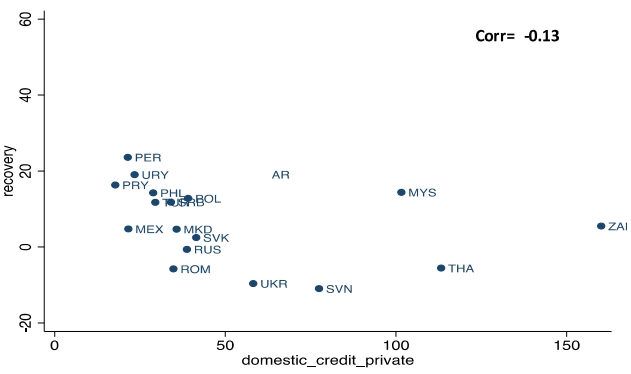
LVA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recovery
domestic_credit_private
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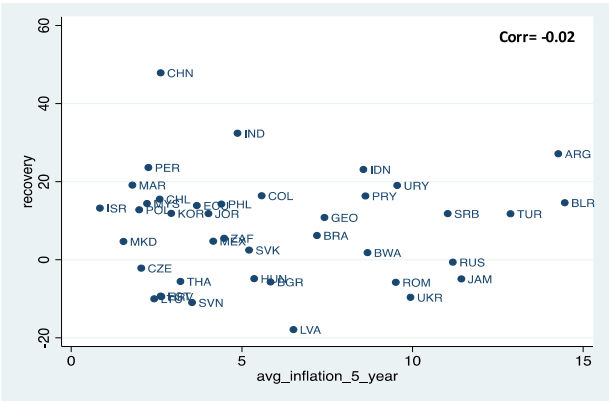
PRY
AR
MYS
MEX
MKD
SVK
RUS
ROM
THA
UKR
SVN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recovery
avg_inflation_5_year
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IND
ARG
PER
IDN
MAR
URY
COL
PRY
BLR
ISR
SRB
TUR
GEO
BRA
MKD
SVK
BWA
CZE
RUS
THA
BGR
ROM
JAM
UKR
SVN
LVA

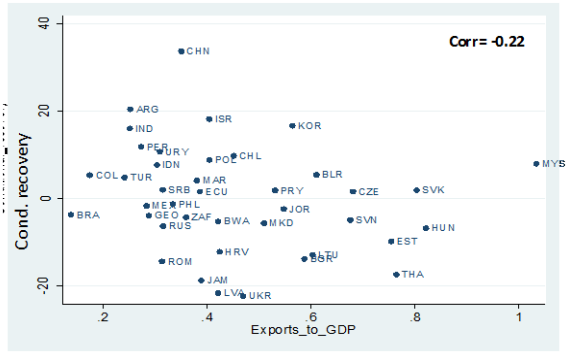

Corr= 0.16
recovery
ex_rate_coarse
PER
URY
PRY
MYS
SRB
PHL
POL
SVK
RUS
UKR
SVN

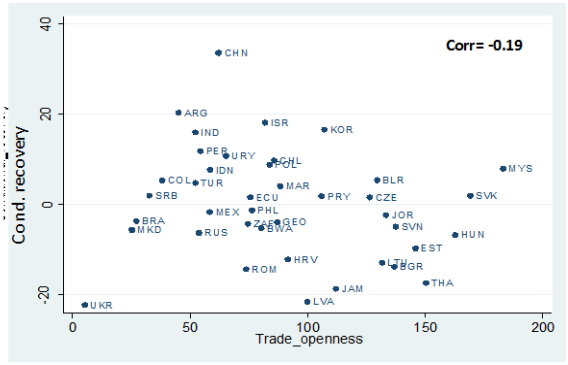
Annex 2b. Scatterplots - *Conditional Recovery*

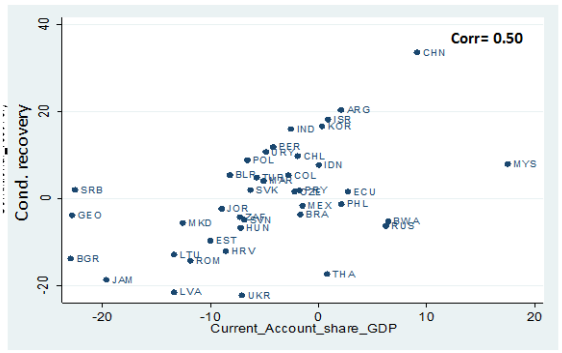
Variable	Conditional recovery
Trade openness	-0.19
Budget Balance % GDP	0.10
Public debt % GDP	0.14
Domestic credit growth	-0.38
Domestic credit to private sector	0.00
Chin Ito Index (Financial openne	-0.27
European liabilities over total liał	-0.40
Leverage (credit to deposits)	-0.07
Liabilities over GDP	-0.42
Assets and liabilities over GDP	-0.31
Current account % GDP	0.50
Export to high income as % total	-0.11
Short term debt over total debt	0.02
Exports to GDP	-0.22
Annual average growth 2000 20	0.00
Average inflation 5-year	-0.12
GDP per capita 2007	0.00
Reserves to M2	-0.11
Exchange rate Coarse	0.22
Ex. Rate misalignment	-0.54

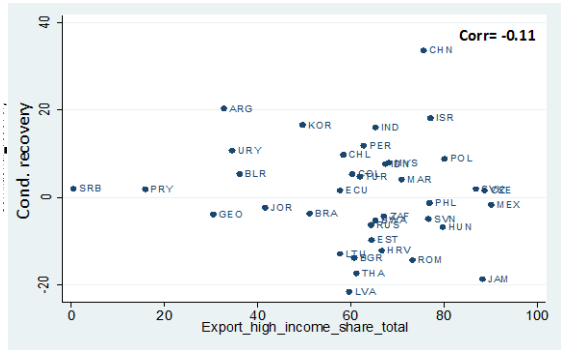
Scatterplots conditional recovery

Trade linkages

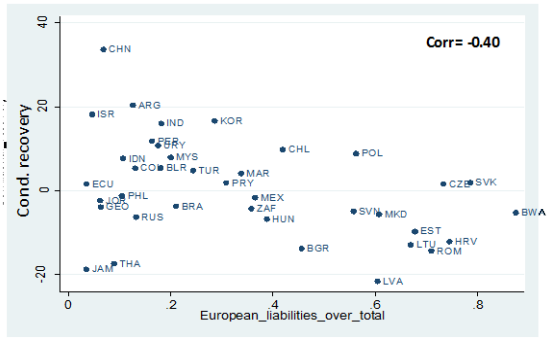


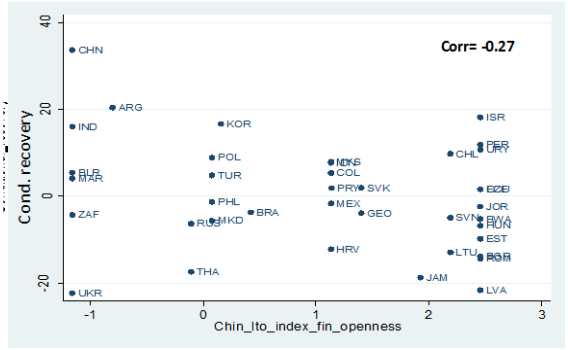


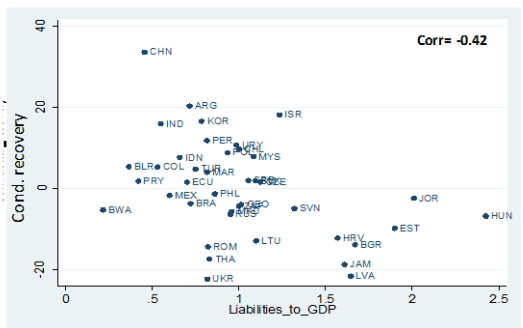


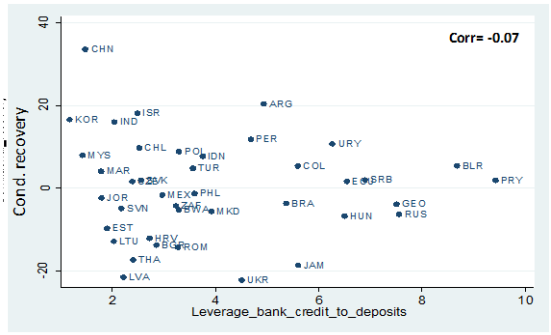


Financial linkages









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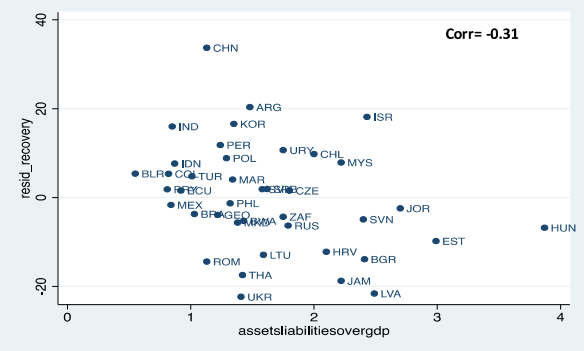
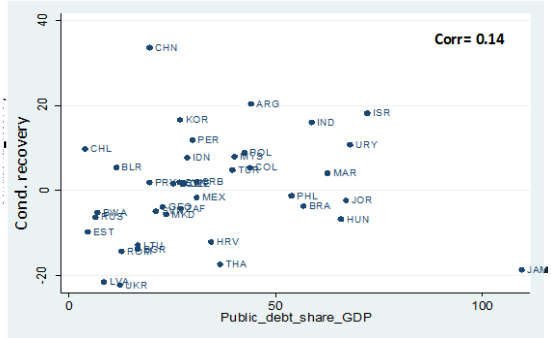
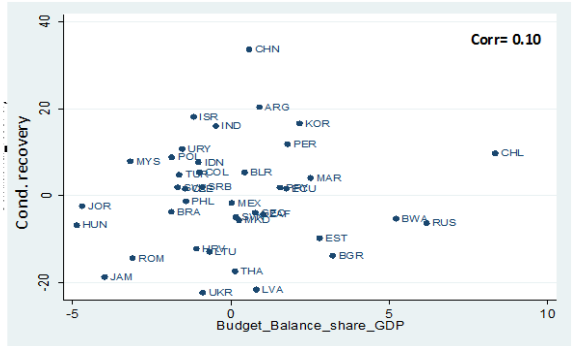
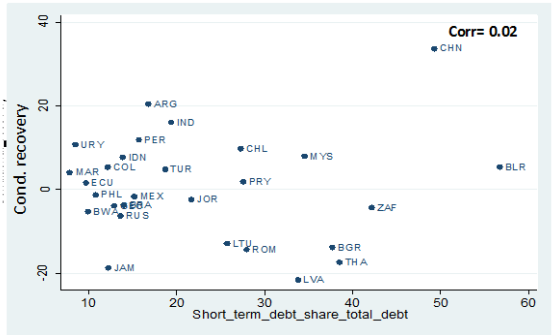
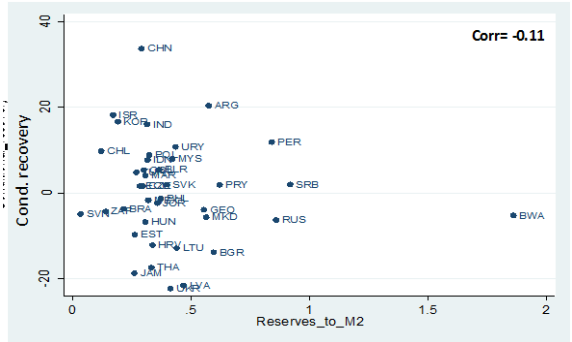


Domestic and fundamentals



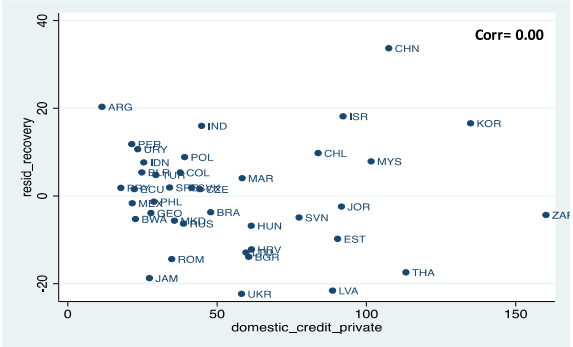


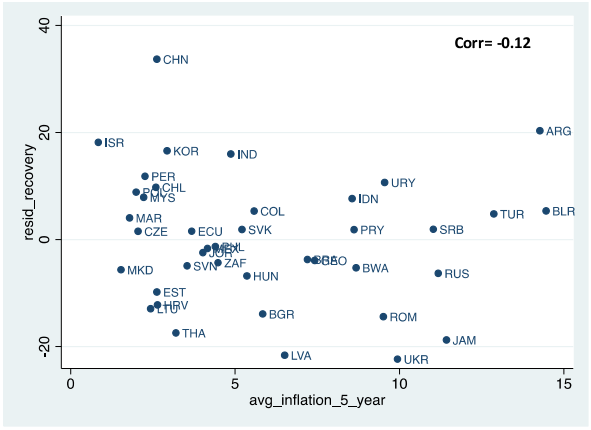




54

Cond. recovery

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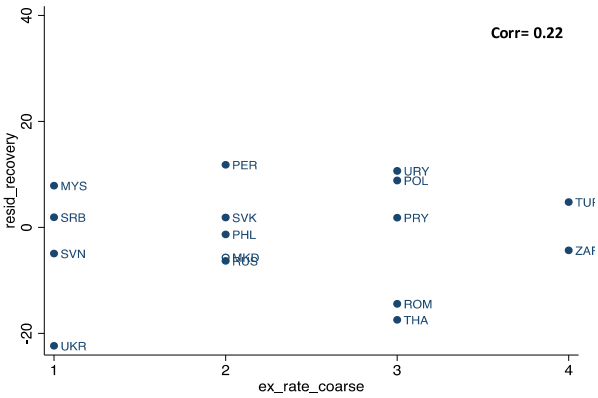
avg_inflation_5_year
CHN
ARG
ISR
KOR
IND
URY
PER
CHL
MYS
IDN
COL
TUR
BLR
MAR
CZE
ECU
SVK
PRY
SRB
MKD
SVN
ZAF
HUN
BWA
RUS
EST
HRV
BGR
ROM
THA
JAM
LVA
UKR


Corr= 0.22
resid_recovery
ex_rate_coarse
PER
URY
POL
MYS
SRB
SVK
PRY
PHL
SVN
ROM
THA
UKR