Journal of International Money and Finance 40 (2014) 21–41

Contents lists available at ScienceDirect

Journal of International Money and Finance

journal homepage: www.elsevier.com/locate/jimf

Exchange market pressures during the financial crisis: A Bayesian model averaging evidence☆

Martin Feldkircher [a], Roman Horvath [b,*], Marek Rusnak [b,c]

[a] Oesterreichische Nationalbank, Austria
[b] Charles University, Prague, Czech Republic
[c] Czech National Bank, Czech Republic

JEL codes:
F31
F37

Keywords:
Exchange market pressures
Financial crisis

A B S T R A C T

In this paper, we examine whether pre-crisis leading indicators help explain pressures on the exchange rate (and its volatility) during the global financial crisis. We use a unique data set that covers 149 countries and 58 indicators, and estimation techniques that are robust to model uncertainty. Our results are threefold: First and foremost, we find that price stability plays a pivotal role as a determinant of exchange rate pressures. More specifically, the currencies of countries that experienced higher inflation prior to the crisis tend to be more affected in times of stress. Second, we investigate potential effects that vary with the level of pre-crisis inflation. In this vein, our results reveal that an increase in domestic savings reduces the severity of pressures in countries that experienced a low-inflation environment prior to the crisis. Finally, we find evidence of the mitigating effects of international reserves on the volatility of exchange rate pressures.

1. Introduction

Beginning with the onset of the global financial crisis, exchange rate markets experienced dramatic developments in the years from 2009 to 2011. In this paper, we examine the determinants of the

☆ The views expressed in this paper are not necessarily those of the Oesterreichische Nationalbank or Czech National Bank. We would like to thank Peter Backé and Tomáš Havránek for valuable comments. We acknowledge the support from the Grant Agency of the Czech Republic 13-11983S.

* Corresponding author.
E-mail addresses: martin.feldkircher@oenb.at (M. Feldkircher), roman.horvath@gmail.com (R. Horvath), marek.rusnak@cnb.cz (M. Rusnak).

0261-5606/$ – see front matter
http://dx.doi.org/10.1016/j.jimonfin.2013.08.021

market movements in exchange rates by focusing on the exchange market pressure (EMP) index. The EMP measures the extent of exchange rate developments in terms of actual depreciations while controlling for policy actions brought about by changes in international reserves. Such an index is important from the perspective of a policymaker for at least two reasons: First, for countries that pursue a fixed exchange rate regime, exchange rate stability is a direct target. Second, exchange rate developments tend to have a sizable effect on the inflation outlook and therefore on price stability. The importance of monitoring the EMP is also reflected in the fact that it is one of five components that the IMF uses to measure financial stress (Balakrishnan et al., 2011). Exchange market pressure indexes are also used to estimate *de facto* exchange rate regimes (Frankel and Wei, 2008; Frankel and Xie, 2010) or assess a country's readiness to adopt a common currency (Van Poeck et al., 2007; Bayoumi and Eichengreen, 1998).

The analysis of shocks to foreign exchange markets was pioneered by Girton and Roper (1977). Bayoumi and Eichengreen (1998) focus on the determinants of these exchange market pressures and find that asymmetric shocks play a crucial role. Market pressures are also related to the economy's underlying financial structure such as the level of capital controls and the depth of financial markets. Tanner (2001) also stresses the role of domestic credit in reducing pressure on the currency. Pentecost et al. (2001) find that EMP fluctuations are related to money growth, long-term interest rates, real depreciation and budget and current account deficits. Van Poeck et al. (2007) find that current account and domestic credit growth determine exchange market pressures in eight Central and Eastern European countries.

Recently, there have been several attempts to study the determinants of exchange market pressures during the crisis. Using a sample of 28 emerging countries, Aizenman et al. (2012) find that per capita income prior to the financial crisis (as of 2007), inflation and the trade balance can explain differences across countries in the exchange market pressures experienced during the recent crisis reasonably well. Frankel and Saravelos (2012), using a large sample of roughly 150 countries, find that the pre-crisis level of reserves and preceding real exchange rate appreciation are robust leading indicators of exchange market pressures.

Empirical findings reviewed above point to mixed evidence about EMP determinants, which can be partially attributed to neglecting (regression) model uncertainty and the attendant omitted variable bias.[1] Model uncertainty in this context refers to the problem of choosing regressors from a vast set of potential explanatory variables proposed in the literature. To fill this gap, we revisit the findings presented in the literature on the determinants of exchange market pressure and its volatility during the crisis by employing Bayesian model averaging techniques that rigorously account for model uncertainty. More generally, we contribute to the literature on early warning mechanisms by focusing on a particular measure of crisis incidence – exchange rate pressures – in greater detail. While the literature on early warning is extensive, the role of model uncertainty, although crucial, has rarely been examined (notable exceptions are Babecky et al., 2013; Christofides et al., 2013).

Bayesian model averaging (BMA) was pioneered in the social sciences by Raftery (1995) and Raftery et al. (1997). It was employed heavily in the literature on the determinants of economic growth (Fernandez et al., 2001b; Sala-I-Martin et al., 2004; Durlauf et al., 2008). More recently, BMA has received substantial attention in other fields of economics (see Moral-Benito, 2011, for a survey).

In this study, we examine 58 different potential pre-crisis indicators and link them to the extent of exchange market pressures during the recent crisis period using a sample of 149 countries. We employ a unique data set that covers indicators previously examined in the literature and other macroeconomic variables that have thus far received less attention. More precisely, we include macroeconomic fundamentals, measures of trade, debt, reserves and capital flows, money, inflation, and financial variables, measures of institutional quality, globalization indicators and monetary policy regimes (the full list of explanatory variables is available in Table A2 in the Appendix).

We find that pre-crisis average inflation is the most robust determinant of exchange rate pressures during the crisis. Furthermore, we examine potential non-linear effects that vary with the level of pre-

[1] See Fratzscher (2009), who emphasizes that there is a great degree of model uncertainty regarding exchange rate determinants.

crisis inflation. Our results show that an increase in domestic savings given the economy is in a low-inflation environment is associated with a lower incidence of exchange rate pressures. Finally, the share of international reserves in GDP as of 2006 seems to be most robustly related to the volatility of exchange market pressures during crisis. Other variables that have been previously flagged as important determinants of exchange market pressure, such as imbalances in the current account or money growth – although having their expected signs – do not appear robust in our data. Clearly, this does not imply that, for other economies, country specifics do not play an important role in addition to these global results. The finding that only a handful of indicators matter for our global sample accords with Rose and Spiegel (2011), who find that macroeconomic and financial variables have limited ability to predict the crisis.

The remainder of the paper is organized as follows. Section 2 describes the data and the different measures of EMP we employ. Section 3 presents the empirical framework. Section 4 discusses our findings, while Section 5 concludes.

2. The data

We collected data on the macroeconomy such as GDP and investment rates, trade and its composition, current account and savings, money and inflation, credit and interest rate, institutional quality, debt and external debt, capital flows and trade exposure, population and unemployment, globalization, indicators of monetary independence and financial openness. Overall, we include 58 potential determinants of exchange market pressure for 149 countries (see Table A1 in the Appendix for the full list of countries). All indicators are measured in the period prior to the crisis. The definitions of the variables and the sources and summary statistics can be found in the Appendix (Table A2).

We follow Aizenman and Pasricha (2012) and define exchange market pressure as

$$\mathrm{EMP}_t = \left(\frac{e_t - e_{t-1}}{e_t} - \frac{ir_t - ir_{t-1}}{ir_t}\right) \times 100 \tag{1}$$

with e_t denoting the local nominal exchange rate per 1 unit of the IMF's SDR (an increase denotes depreciation) and ir_t denoting international reserves (minus gold) in U.S. dollar in time t.[2] The definition of the EMP is related to the movements in exchange rates as well as in the reserves. If the country maintains a pure floating exchange rate regime, as it is often the case for inflation targeters, exchange rates movements would fully capture the exchange rate pressures. Many countries, however, do not let their currencies float freely: either there is a direct exchange rate target (for example, in the Baltic countries) or some sort of managed float regime (for example, in many developing countries). In that case, a measure of EMP should also capture the policy efforts that aim to affect the exchange rates. Therefore, our measure also includes changes in reserves. The data that we use to construct the EMP are on a quarterly basis, and higher values of the index represent greater pressure. The explanatory variables refer to yearly, pre-crisis data, ending in 2006.

Fig. 1 presents the evolution of exchange market pressures during the global financial crisis in different regions. The EMP is expressed in terms of deviations from the world EMP, where regional aggregates and the world EMP are calculated as simple cross-country averages. The figure shows that most regions experienced rather strong exchange rate pressures in the period from 2008 to 2010. There is, however, considerable cross-country heterogeneity in the EMP. Some countries primarily relied on exchange rate depreciation to absorb shocks, especially to counter the impact of the crisis on the real economy, and

[2] See Klaassen and Jager (2011) for a discussion of the definition, limitations and extensions of EMP. Dominguez et al. (2012) discuss the measurement issues regarding international reserves and their development during the financial crisis. Our choice of EMP proxies is also motivated by the ability to employ a global sample of countries. As in Aizenman and Pasricha (2012), we do not include interest rates in the calculation of EMP. See Tanner (2001) on the theoretical arguments for why interest rates should not be included in calculating the EMP. Tanner (2001) argues that interest rates can be considered a response variable rather than an indicator. Frankel and Saravelos (2012) mention the measurement issues related to international reserves and argue for the use of nominal exchange rate changes as the measure of exchange rate pressures. This is appealing, but our sample includes, for example, the Baltic countries, which were the most severely affected by the financial crisis yet maintained fixed exchange rate regimes.

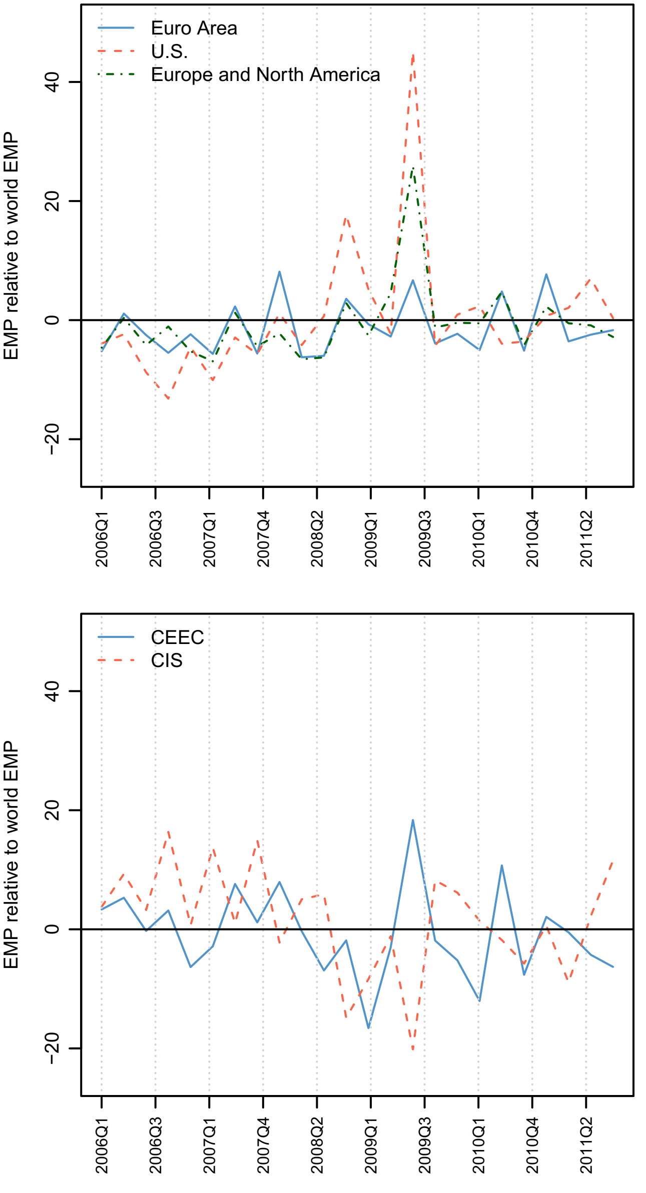


Fig. 1. Deviations of regional EMP from world EMP. Regional aggregates calculated using simple cross-country averages. Country aggregates are listed in Table A.2.

exhibited what Aizenman and Hutchison (2012) call the fear of reserve loss. Other countries, especially those with large balance sheet exposures, limited the scope of exchange rate depreciation. Looking at advanced economies first, the figure reveals that the EMP relative to world EMP peaked in 2009Q3[3] for

[3] To mitigate the effect of the crisis, the IMF decided to disburse two special drawing rights (SDR) allotments in 2009Q3 increasing international reserves. Evidence provided in the figures, however, is not affected qualitatively since we show the EMP in relative terms only. For more details on the allotments see International Monetary Fund (2011).

both, the U.S. and the euro area indicating strong pressure on the currencies. However, the peak was more pronounced for the U.S. than on average in other advanced economies. Looking at emerging economies, the currencies of Central and Eastern European Countries (CEEC) faced substantial pressure. In contrast, currencies in Latin America, Asia and Africa have been more shielded from the global turmoil, which is corroborated in Fig. 2, top panel. Finally, we have split our sample into countries that accumulated sizeable and modest international reserves in % of GDP prior to the crisis. We chose 20% as the cut-off value in order to closely match the sample mean (18%). The results are displayed in Fig. 2, bottom panel. As expected, countries that accumulated larger amounts of international reserves witnessed on average less pressure on their currencies in times of financial stress. By contrast, countries that entered the global crisis with low levels of international reserves faced more pressure on their currencies.

In the next section, we empirically investigate which pre-crisis indicators are able to explain these cross-country differences in the magnitudes of exchange rate pressures during the crisis period.

More specifically, we propose three versions of the *EMP* that have been frequently used in the literature (e.g., Aizenman and Pasricha, 2012)

- $EMPu_{\max} = \max(EMP_t), t \in \{2007Q3, \ldots, 2011Q4\}$
- $EMPu_{\max.0006} = EMPu_{\max} - (1/28) * \sum_{t=2000Q1}^{T=2006Q4} EMP_t$
- $EMPu_{ptt} = \max(EMP_t) - \min(EMP_t), t \in \{2007Q3, \ldots, 2011Q4\}$

The first measure ($EMPu_{max}$) captures the extent to which a country's currency came under pressure during the crisis, where we have defined the crisis period from 2007Q3 to 2011Q4, which is the last data point in our sample. The second measure ($EMPu_{max.0006}$) captures the distance between the maximum EMP during the crisis relative to the country's average EMP during the period from 2000 to 2006. This indicator should shed light on the extent to which the country's exchange rate came under pressure relative to the "normal times" experienced prior to the crisis. Finally, the third measure ($EMPu_{ptp}$) captures the volatility of the EMP during the crisis period (peak to trough measure).

3. Bayesian model averaging

For each of the exchange market pressure measures, we run the following linear regression model:

$$y = 1\alpha_s + X_s\beta_s + \varepsilon \tag{2}$$

where y denotes one of our three different market pressure measures, α_s is a model specific intercept, X_s is an $N \times k_s$ matrix of potential explanatory variables and ε is an N-dimensional vector of random shocks, assumed to be normally distributed, independent and homoskedastic. In our empirical analysis, we have $N = 149$ countries and a set of $K = 58$ potential explanatory variables. All of the candidate variables are measured prior to crisis (see Appendix) in order to limit potential endogeneity.

The large number of candidate variables creates problems related to model uncertainty that could lead to severely flawed inference. To overcome these problems, we apply model averaging techniques that avoid the necessity of selecting individual specifications. Instead, we base inference on a weighted average of individual regressions. In the Bayesian framework, these weights arise naturally as *posterior model probabilities* (PMP) of the corresponding individual specifications.

The set of complementary models can be denoted $\mathscr{M}=\{M_1, M_2, \ldots, M_2^K\}$, where K stands for the total number of explanatory variables. Inference on any parameter δ in Bayesian model averaging takes the form:

$$p(\delta|y) = \sum_{j=1}^{2^K} p(\delta|M_j, y)p(M_j|y) \tag{3}$$

with $p(\cdot|y)$ denoting posterior distributions and $p(\cdot|M_j, y)$ denoting posterior distributions under the assumption that M_j is the true model. Inference on some parameter or combination of parameters δ is based on individual inferences under models $M_j, j = 1, \ldots, 2^K$, where the individual estimates are weighted by their respective posterior model probabilities ($p(M_j|y)$). These (normalized) probabilities are obtained in a Bayesian setting using the integrated likelihood $p(y|M_j) = \int p(y|M_j, \theta_j)p(\theta_j|M_j)d\theta_j$ and the respective model prior $\overline{p}(M_l)$,

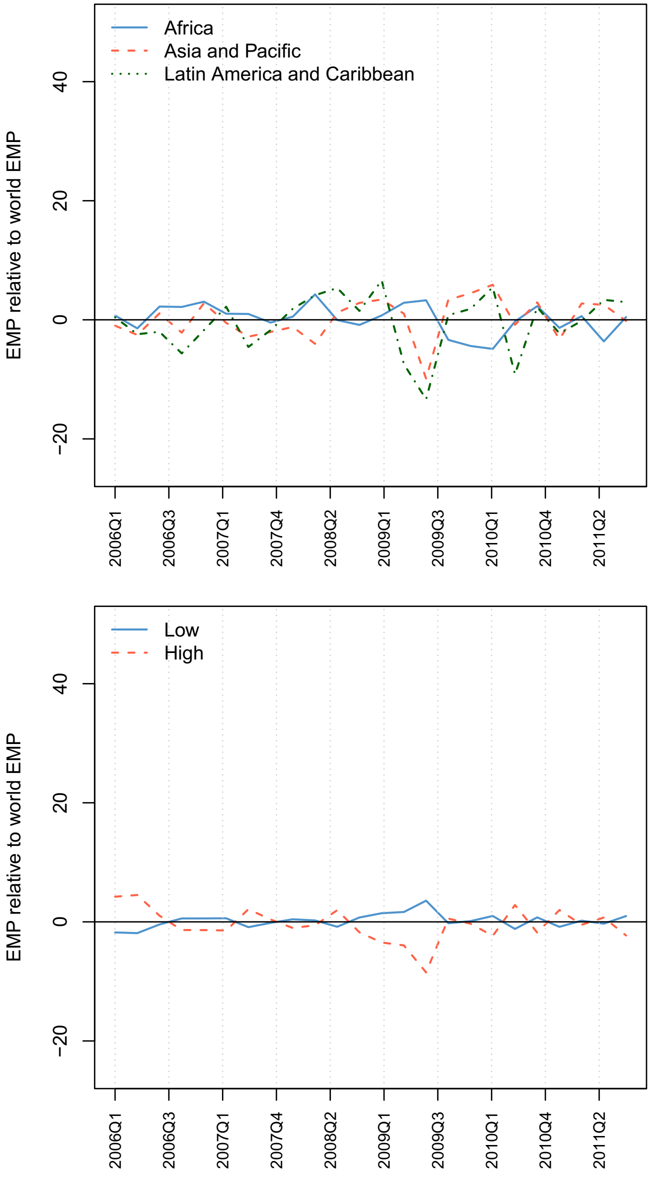


Fig. 2. Top panel: Deviations of regional EMP from world EMP. Regional aggregates calculated using simple cross-country averages. Bottom panel: Deviations of regional EMP from world EMP for countries with modest (<20%) and sizeable (>20%) levels of international reserves in % of GDP prior to the crisis. Country aggregates are listed in Table A.2.

$$p(M_j|y) = \frac{p(y|M_j)\overline{p}(M_j)}{\sum_{l=1}^{2^K} p(y|M_l)\overline{p}(M_l)}. \tag{4}$$

A key quantity in BMA is the posterior inclusion probability (PIP) of a covariate, defined as:

$$PIP_z \equiv \sum_{\mathcal{M}:m_z=1}^{2^K} p(M_i|y)$$

with $m_z = 1$ indicating that variable z is included in the model. Thus, the PIP attached to a particular variable is the sum of the posterior model probabilities of all models that include this variable. Broadly speaking, it indicates the probability that a covariate to be included in a model can explain the dependent variable - in our case cross-country differences in exchange market pressures - in a reasonable way. To ease the interpretation of the PIP, we draw on the scale proposed in Eicher et al. (2011). The PIP of a variable is characterized as weak (50–75% PIP), substantial (75–95%), strong (95–99%), or decisive (99%+) evidence. While the sum in equation (3) is not directly computable for large values of K, Markov Chain Monte Carlo (MCMC) algorithms (Madigan and York, 1995; Fernandez et al., 2001a) provide an approximation of the required statistic. More details on the MCMC sampler together with a discussion on convergence diagnostics are provided in the technical appendix.

The Bayesian framework requires the specification of prior distributions on the model parameters α, β_s, and σ^2, as well as on the model space $\mathscr{M}$. We follow the standard convention in BMA, assuming a zero-centered normal distribution on the slope coefficients β_s, scaled by Zellner's g (Zellner, 1986) hyperparameter:

$$\beta_s|\sigma^2, M_s, g \sim N\left(0, \sigma^2 g (X_s' X_s)^{-1}\right). \tag{5}$$

The penalty for including new variables in the model can be regulated through the hyperparameter g in the marginal likelihood. Following Feldkircher and Zeugner (2009) and Ley and Steel (2012), we abstain from fixing g at a particular value. Instead, we make it data dependent and use a hyper-g prior.[4] This approach has been shown to lead to inferences that are less prone to noise in the data (Feldkircher and Zeugner, 2012). Improper priors on the intercept $p(\alpha) \propto 1$ and variance $p(\sigma) \propto \sigma^{-1}$ indicate a lack of prior information.

Finally, we have to make assumptions about the model space, that is, which type of models are a priori more likely. As in Ley and Steel (2009), we opt for an uninformative binomial-beta prior for the inclusion of a given variable, with a prior expected model size of $K/2$ regressors. This reduces to initially ascribing the same prior probability to all models. Below, we relax this assumption and elicit an informative prior on the models when linear interaction terms are part of the model space.

4. Drivers of exchange market pressure during the crisis

In this section, we present the results of the Bayesian model averaging.[5] For the sake of illustration, we only present the 10 most robust variables for each of the three EMP indicators, while the full results can be found in the Appendix. For each variable we show its associated posterior inclusion probability (PIP), posterior mean (Post Mean) and the posterior standard deviation (Post SD). As explained in the previous Section, the PIP indicates how important the variable under scrutiny is in explaining the different measures of exchange market pressure. The sign and size of the coefficient estimate can be assessed by its associated posterior mean. Finally, the posterior standard deviation allows to examine the precision of the coefficient estimate. All results are based on 3 million posterior draws after a burn-in phase of 1 million.

Table 1 presents the BMA results for the $EMPu_{\max}$ measure. This measure captures the extent to which a country's currency came under pressure during the crisis. The results of our baseline model (*Model 1*) indicate a very small model with only two out of the 58 variables receiving large posterior support in terms of inclusion probability. This is in line with Rose and Spiegel (2011), who show that it is difficult to obtain robust leading indicators of the recent financial crisis.

[4] We anchor the hyper-g prior such that the prior expected shrinkage factor $g/(1+g)$ matches that induced by the unit information prior $g/(1+g) = N/(1+N)$.

[5] All of the computations are performed using the R package BMS available at http://bms.zeugner.eu.

Table 1
What determines exchange market pressure during the crisis? BMA evidence.

Dependent variable: $EMPu_{max}$		Model 1			Model 2		
		PIP	Post mean	Post SD	PIP	Post mean	Post SD
1	euroAdopt	1.000	50.131	7.645	1.000	49.968	13.803
2	infl_0006	0.977	0.856	0.245	0.996	0.488	1.936
3	gross.savings_06	0.029	−0.003	0.028	0.579	−0.232	0.243
4	infl_0006#gross.savings_06	–	–	–	0.559	0.040	0.040
5	infl_0006#euroAdopt	–	–	–	0.257	−0.848	2.691
6	int.res.gdp_06	0.102	−0.017	0.060	0.196	−0.036	0.089
7	outputGap_06Exo	0.056	0.013	0.069	0.194	0.057	0.154
8	rgdpcap_06	0.027	0.024	0.305	0.189	0.597	1.847
9	creditInflndex_06	0.081	−0.093	0.367	0.178	−0.190	0.508
10	invRate.gdp_0006	0.032	0.006	0.049	0.164	0.051	0.169
…	…	…	…	…	…	…	…

Notes: The table represents a snapshot of the full results and presents the 10 most robust variables. PIP stands for posterior inclusion probability, Post Mean for posterior mean and Post SD for the posterior standard deviation. Model 1 refers to the baseline model without interaction terms, while model 2 includes, in addition to the regressors in Model 1, selected interaction terms, with pre-crisis inflation taking the strong-heredity prior on the model space. The results are based on 3 million iterations of the MCMC sampler after discarding 1 million burn-in iterations for convergence.

The first of the two variables that appear robust in the data is a dummy variable for those countries that adopted the euro during the crisis period (Malta, Cyprus, Slovakia, Slovenia and Estonia). The euro adoption dummy variable is positively related to exchange market pressure. Naturally, a large component of the international reserves held by these countries was denominated in euros, which after the adoption of the common currency no longer appears as a part of foreign currency denominated reserves. This mechanically increased the EMP for these countries, which is captured by the positive coefficient attached to the dummy.

Second, the countries that experienced higher rates of inflation prior to the crisis experienced, on average, stronger pressures on their currencies. The coefficient attached to the average pre-crisis inflation rate (**infl_0006**) implies that a 1-percentage point increase in average inflation translates to 0.9 percentage point increase in the EMP. As a consequence, our results highlight the importance of price stability in curbing financial pressures. Although the recent financial crisis documents that price stability is not sufficient for financial stability (see also White, 2006), our results nevertheless demonstrate the positive role the price stability plays. Other variables reported in the literature as important drivers of exchange market pressure, such as the level of GDP per capita or the trade balance (Aizenman et al., 2012) – although having coefficients with the expected signs – do not appear robust in the data.

In a second step, we aim to determine whether non-linear effects play a role in explaining cross-country differences in the EMP. For this purpose, we linearly interact (i.e., multiply) pre-crisis average inflation with selected candidate regressors, such as a measure for trade exposure to the EU-15 (**tradeExposureEU15.gdp_0006**), the euro adoption dummy (**euroAdopt**), two measures of the pre-crisis output gap (**dGap_0006Exo, outputGap_06Exo**), the average investment rate as a share of GDP (**invRate.gdp_0006**), gross savings (**gross.savings_06**) and the level of international reserves expressed as a share of external debt in 2006 (**int.res.ext.debt_06**). Adding these interaction terms to our set of candidate regressors allows us to investigate whether there are robust drivers of EMP, the effects of which vary with the level of the average pre-crisis inflation rate.

To ensure the interpretability of the estimated non-linear effects, we employ the strong heredity prior akin to Chipman (1996). More specifically, under strong heredity, we only assign positive prior inclusion probabilities to models that (1) do not include interaction terms or (2) include all variables related to the interactions. This prior implies that we are removing the prior probability mass from all the models where interactions are present but the corresponding linear terms are not part of the model. For a recent application of the strong heredity prior to the determinants of the global financial crisis, see Feldkircher (2012).

The results of *Model 2* presented in Table 1 corroborate the findings of the baseline model: The dummy variable for euro-adopters and pre-crisis inflation both receive strong empirical support. Moreover, the model reveals some evidence for the interaction of pre-crisis inflation with domestic gross savings (**infl_0006#gross.savings_06**). We illustrate the marginal effect of gross savings on the EMP in Fig. 3.

The top panel of the figure shows that an increase in gross savings (i.e., countries need to borrow relatively less from the rest of the world) reduces pressure on the exchange market in a low-inflation environment. By contrast, for countries that experienced pronounced inflation prior to the crisis, gross savings constitute a waste of resources for the economy, subsequently amplifying the pressure on the exchange market. The results demonstrate that an increase in gross savings only reduces pressure if the inflation rate is below approximately 5 percent.

Table 2 presents the results of the Bayesian model averaging with $EMPu_{max.0006}$ as the dependent variable. This measure captures the extent to which a country's exchange rate came under pressure relative to pressure on the currency experienced during "normal" times. The results of *Model 1* corroborate the robustness of average inflation in explaining exchange market pressures and the dummy variable for euro adopting countries. In addition, we find evidence that countries that had already faced strong pressure prior to the crisis were less affected in relative terms during this crisis (**EMP_0006**).

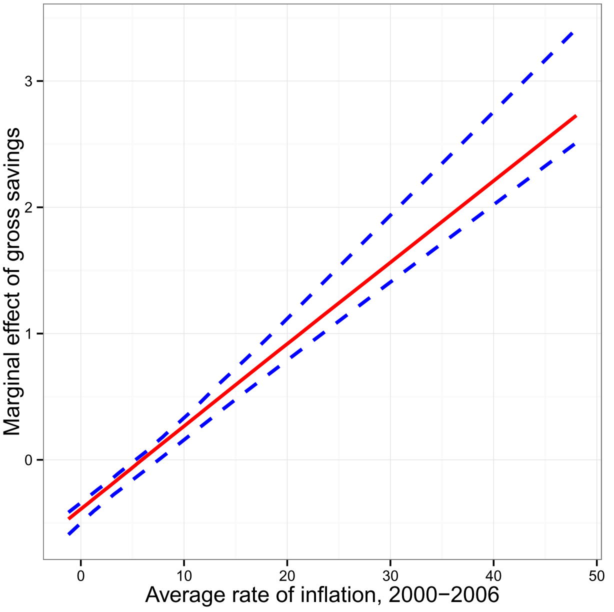
The results of the conditional model (*Model 2*) indicate that, in addition to the variables reported as robust in *Model 1*, the interaction of pre-crisis inflation and gross savings is an important determinant of the exchange market pressures during the crisis. The non-linear effect is illustrated in the bottom panel of Fig. 3 and is in line with our previous findings: a rise in domestic savings cushions pressure on the exchange market, provided pre-crisis average inflation was low. For larger values, the marginal effect of domestic gross savings becomes positive, implying an increase in the EMP. In contrast to the results for $EMPu_{\max}$, however, the posterior distribution of the marginal effect widens for larger values of pre-crisis inflation. That is, the effect is not as well estimated as for the results reported in Table 1.

Finally, Table 3 presents the results for $EMPu_{ptt}$. This measure aims to capture the volatility of exchange rate market pressure during the crisis period. In line with our previous findings, the results of *Model 1* reveal large posterior support for the euro adoption dummy variable, while inflation does not seem to explain cross-country differences in the volatility of the EMP. However, the level of international reserves prior to the crisis appears robust in the data. The positive coefficient attached to international reserves implies that a 1% increase in the level of international reserves as a share of GDP mitigates the EMP by approximately 1 percentage point. The conditional model (*Model 2*) shows evidence for four variables: the euro adoption dummy (**euroAdopt**), international reserves in 2006 (**int.res.gdp_06**), the average rate of pre-crisis inflation (**infl_0006**) and the interaction of pre-crisis inflation with the euro dummy (**infl_0006#euroAdopt**). Having accumulated international reserves prior to the crisis again mitigates pressure on the currency. Note that the negative coefficient attached to the euro adoption dummy variable reflects the (stylized) situation in which pre-crisis inflation was zero. Evaluated at the mean of pre-crisis inflation (5.8%), the euro area adoption dummy is again positively associated with pressure on the exchange market. As mentioned previously, the positive coefficient arises by construction, as the foreign exchange sub-component of international reserves was primarily denominated in euros and thus dramatically declined following the adoption of the euro.

5. Concluding remarks

This paper studies the determinants of the exchange rate pressures experienced during the recent global financial crisis. Employing a unique data set with extensive global coverage and a rich set of potential explanatory variables, we analyze three versions of the exchange market pressure (EMP) index advanced by, e.g., Aizenman et al. (2012). Our measures of pressure on the currencies capture the maximum EMP during the crisis, the maximum EMP normalized to the average pre-crisis EMP

(a) Posterior distribution of the marginal effect of gross savings on $EMPu_{max}$ given different pre-crisis inflation rates.



(b) Posterior distribution of the marginal effects of gross savings on $EMPu_{max.0006}$ given different pre-crisis inflation rates.

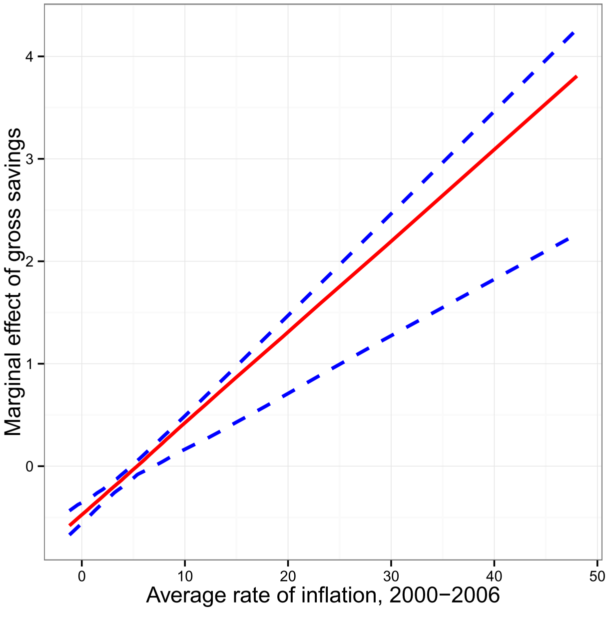


Fig. 3. Posterior distribution of the marginal effects of gross savings on $EMPu_{max}/EMPu_{max.0006}$ given different pre-crisis inflation rates. The figure is based solely on the posterior means of models which included all three variables that compose the marginal

Table 2
What determines the severity of exchange market pressure during the crisis? BMA evidence.

Dependent variable: $EMPu_{max.0006}$		Model 1			Model 2		
		PIP	Post mean	Post SD	PIP	Post mean	Post SD
1	euroAdopt	1.000	50.984	7.652	1.000	51.472	13.142
2	EMP_0006	1.000	−1.231	0.192	0.999	−1.265	0.204
3	infl_0006	0.987	0.881	0.231	0.998	0.729	2.483
4	gross.savings_06	0.036	−0.004	0.032	0.668	−0.291	0.254
5	infl_0006#gross.savings_06	–	–	–	0.654	0.051	0.043
6	rgdpcap_06	0.038	0.040	0.382	0.234	0.928	2.202
7	infl_0006#euroAdopt	–	–	–	0.230	−0.717	2.523
8	infl_0006#rgdpcap_06	–	–	–	0.184	−0.122	0.285
9	int.res.gdp_06	0.133	−0.024	0.070	0.177	−0.033	0.084
10	kof_persCont_06	0.072	0.008	0.035	0.154	0.022	0.066
…	…	…	…	…	…	…	…

Notes: The table represents a snapshot of the full results by presenting the 10 most robust variables. PIP stands for posterior inclusion probability, Post Mean for posterior mean and Post SD for the posterior standard deviation. Model 1 refers to the baseline model without interaction terms, while Model 2, in addition to the regressors in Model 1, includes selected interaction terms with pre-crisis inflation, employing the strong-heredity prior on the model space. The results are based on 3 million iterations of the MCMC sampler after discarding 1 million burn-in iterations for convergence.

Table 3
What determines the volatility of exchange market pressure? BMA evidence.

Dependent variable: $EMPu_{ptt}$		Model 1			Model 2		
		PIP	Post mean	Post SD	PIP	Post mean	Post SD
1	euroAdopt	0.998	121.130	28.469	1.000	−171.444	66.892
2	int.res.gdp_06	0.906	−0.993	0.451	0.748	−0.620	0.443
3	infl_0006	0.220	0.274	0.610	1.000	1.399	3.379
4	infl_0006#euroAdopt	–	–	–	1.000	67.473	14.446
5	ext.debt.gdp_06	0.064	0.002	0.017	0.308	0.035	0.061
6	Floater	0.169	−2.650	7.074	0.284	−4.730	8.800
7	genGovDebt.gdp_06	0.126	0.020	0.066	0.251	0.048	0.099
8	adv.claims.gdp_06	0.060	0.002	0.035	0.251	0.060	0.123
9	outputGap_06Exo	0.100	0.059	0.243	0.185	0.145	0.401
10	genGovBal.gdp_0006	0.162	−0.265	0.734	0.175	−0.258	0.698
…	…	…	…	…	…	…	…

Notes: The table represents a snapshot of the full results by presenting the 10 most robust variables. PIP stands for posterior inclusion probability, Post Mean for posterior mean and Post SD for the posterior standard deviation. Model 1 refers to the baseline model without interaction terms, while Model 2, in addition to the regressors in Model 1, includes selected interaction terms, with pre-crisis inflation employing the strong-heredity prior on the model space. Results are based on 3 million iterations of the MCMC sampler after discarding 1 million burn-in iterations for convergence.

and the volatility of the EMP during the crisis. Furthermore, we employ Bayesian model averaging because the set of potential variables proposed by the existing literature on exchange market pressure is vast. In contrast to the empirical literature on EMP determinants, our results are robust to model uncertainty.

Our main results are threefold: First and foremost, we find strong empirical evidence for the pivotal role of pre-crisis inflation in determining exchange market pressure for our global

effect. Out of the 500 models with highest posterior model probabilities these are 194 models in case of $EMPu_{max}$ and 189 models in case of $EMPu_{max.0006}$. The solid (red) line corresponds to the median and the dotted (blue) lines to the 5th and 95th percentiles. (a) Posterior distribution of the marginal effect of gross savings on $EMPu_{max}$ given different pre-crisis inflation rates. (b) Posterior distribution of the marginal effects of gross savings on $EMPu_{max.0006}$ given different pre-crisis inflation rates. (a) Posterior distribution of the marginal effect of gross savings on given different pre-crisis inflation rates. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

sample. In particular, a 1 percentage point increase in the average inflation rate prior to the crisis implies a deterioration (i.e., an increase) in both EMP measures of approximately 0.9 percentage points. The impact of inflation on the volatility of the EMP is also positive but significantly smaller in magnitude. This result is well in line with Aizenman et al. (2012), who find a significant role of inflation in explaining differences in exchange market pressures across countries during the recent financial crisis. Therefore, our findings highlight the importance of price stability. Although it has been forcefully argued that low and stable inflation is not necessarily sufficient for maintaining financial stability (see, e.g., White, 2006), our results nonetheless demonstrate that price stability reduces vulnerability to adverse financial shocks. However, other variables that appear important in Aizenman et al. (2012), such as the level of GDP per capita or the trade balance, do not seem to be robust determinants of EMP once one controls for a large set of potential explanatory variables. This complies with Rose and Spiegel (2011), who show that the set of robust leading indicators for the financial crisis is in general rather small. Second, we find evidence for the accumulation of international reserves prior to the crisis acting as a buffer for the pressure on the exchange market. More specifically, a 1 percentage point increase in international reserves expressed as a percentage of external debt decreases the volatility of the EMP by approximately the same magnitude. This finding is in line with Frankel and Saravelos (2012). In contrast to their findings, misalignments in the exchange rate do not seem to play a role in the global sample we employed in this study.

Finally, we investigate the existence of non-linear effects that vary with the rate of pre-crisis inflation. We find empirical evidence that gross domestic savings prior to the crisis explains cross-country differences in both EMP measures but not in the EMP's volatility. More specifically, in a low-inflation environment, an increase in domestic savings absorbs depreciation pressure on the currency by about 0.6–0.7 percentage points of the EMP. This effect, however, is reversed for countries with a pre-crisis rate of inflation above 5 percent, where hoarding domestic savings might constitute a waste of economic resources.

Appendix

A.1 MCMC sampler

While exploring the model space can be done via a range of search algorithms, in this paper we employ Markov Chain Monte Carlo methods, which have been widely applied in the framework of BMA. The Markov chain is designed to wander efficiently through the model space, where it draws attention solely to models with non-negligible posterior mass.

The sampler uses a birth/death MC^3 (Madigan and York, 1995) search algorithm to explore the model space. In each iteration step a candidate regressor is drawn from $k_c \sim U(1, K)$. A *(birth step)* is adding the candidate regressor to the current model M_j if that model did not already include k_c. On the other hand, the candidate regressor is dropped if it is already contained in M_j *(death step)*. This is in the vein of Madigan and York (1995) with the new model always being drawn from a neighborhood of the current one differing only by a single regressor. To compare the sampled candidate model M_i to the current one, the posterior odds ratio is calculated implying the following acceptance probability,

$$\tilde{p}_{ij} = \min\left[1, \frac{p(M_i)p(Y|M_i)}{p(M_j)p(Y|M_j)}\right]. \tag{6}$$

Our results in the empirical section are based on 3 million iterations after a burn-in phase of 1 million draws. We follow Fernandez et al. (2001a) and assess convergence of the MCMC sampler by looking at the correlation between PMPs based on iteration counts and analytical PMPs. The analytical PMPs are calculated for the 500 best models encountered during the model search. For all results presented in this study, correlations are >0.99 pointing to excellent convergence (Fernandez et al., 2001a).

A.2 Tables

Table A1
List of countries used in the empirical analysis.

Europe	**CIS**		
Austria (AUT)	Armenia (ARM)	Sierra Leone (SLE)	Australia (AUS)
Belgium (BEL)	Azerbaijan, Rep. of (AZE)	South Africa (ZAF)	Fiji (FJI)
Cyprus (CYP)	Belarus (BLR)	Sudan (SDN)	New Zealand (NZL)
Denmark (DNK)	Georgia (GEO)	Swaziland (SWZ)	Papua New Guinea (PNG)
Finland (FIN)	Kazakhstan (KAZ)	Tanzania (TZA)	Samoa (WSM)
France (FRA)	Kyrgyz Republic (KGZ)	Togo (TGO)	Solomon Islands (SLB)
Germany (DEU)	Russian Federation (RUS)	Tunisia (TUN)	Tonga (TON)
Greece (GRC)	Ukraine (UKR)	Uganda (UGA)	Vanuatu (VUT)
Iceland (ISL)		Zambia (ZMB)	
Ireland (IRL)	**Africa**		**Latin America & Caribbean**
Italy (ITA)	Algeria (DZA)	**Asia & Pacific**	Antigua and Barbuda (ATG)
Luxembourg (LUX)	Benin (BEN)	Bangladesh (BGD)	Argentina (ARG)
Malta (MLT)	Botswana (BWA)	Bhutan (BTN)	Bahamas, The (BHS)
Netherlands (NLD)	Burkina Faso (BFA)	Brunei Darussalam (BRN)	Barbados (BRB)
Norway (NOR)	Burundi (BDI)	Cambodia (KHM)	Belize (BLZ)
Portugal (PRT)	Cameroon (CMR)	China, P.R.: Hong Kong (HKG)	Bolivia (BOL)
Spain (ESP)	Cape Verde (CPV)	China, P.R.: Mainland (CHN)	Brazil (BRA)
Sweden (SWE)	Central African Rep. (CAF)	Egypt (EGY)	Chile (CHL)
Switzerland and Liechtenstein (CHE)	Comoros (COM)	India (IND)	Colombia (COL)
United Kingdom (GBR)	Cŏte d'Ivoire (CIV)	Indonesia (IDN)	Costa Rica (CRI)
	Eritrea (ERI)	Israel (ISR)	Dominica (DMA)
North America	Ethiopia (ETH)	Japan (JPN)	Dominican Republic (DOM)
United States (USA)	Gabon (GAB)	Jordan (JOR)	Ecuador (ECU)
Canada (CAN)	Gambia, The (GMB)	Korea, Republic of (KOR)	El Salvador (SLV)
	Ghana (GHA)	Kuwait (KWT)	Grenada (GRD)
CEEC	Guinea-Bissau (GNB)	Lebanon (LBN)	Guatemala (GTM)
Albania (ALB)	Kenya (KEN)	Malaysia (MYS)	Guyana (GUY)
Bosnia & Herzegovina (BIH)	Lesotho (LSO)	Mongolia (MNG)	Honduras (HND)
Bulgaria (BGR)	Madagascar (MDG)	Oman (OMN)	Jamaica (JAM)
Croatia (HRV)	Malawi (MWI)	Pakistan (PAK)	Mexico (MEX)
Czech Republic (CZE)	Mali (MLI)	Philippines (PHL)	Nicaragua (NIC)
Estonia (EST)	Mauritania (MRT)	Saudi Arabia (SAU)	Panama (PAN)
Hungary (HUN)	Mauritius (MUS)	Singapore (SGP)	Paraguay (PRY)
Latvia (LVA)	Morocco (MAR)	Sri Lanka (LKA)	Peru (PER)
Lithuania (LTU)	Mozambique (MOZ)	Syrian Arab Republic (SYR)	St. Kitts and Nevis (KNA)
Macedonia, FYR (MKD)	Namibia (NAM)	Thailand (THA)	St. Lucia (LCA)
Moldova (MDA)	Niger (NER)	Turkey (TUR)	Suriname (SUR)
Poland (POL)	Nigeria (NGA)	United Arab Emirates (ARE)	Trinidad and Tobago (TTO)
Romania (ROM)	Rwanda (RWA)	Vietnam (VNM)	Uruguay (URY)
Serbia, Republic of (SRB)	São Tomé & Príncipe (STP)	Yemen, Republic of (YEM)	Venezuela, Rep. Bol. (VEN)
Slovak Republic (SVK)	Senegal (SEN)		
Slovenia (SVN)	Seychelles (SYC)		

Table A2
Data description and summary statistics.

Variable	Description	Source	Mean	Std. dev.	Min	Max
Exchange market pressure indicators						
EMPu_max	Exchange market pressure: maximum over 2007Q3-2010Q2 period	Authors' calculations	21.62	17.85	−3.03	131.76
EMPu_max.07	Exchange market pressure: distance between maximum during crisis and EMP in 2007Q2	Authors' calculations	13.92	14.86	0.02	71.31

(*continued on next page*)

Table A2 (*continued*)

Variable	Description	Source	Mean	Std. dev.	Min	Max
EMPu_PtT	Exchange market pressure: peak to through measure	Authors' calculations	61.00	58.39	7.55	545.43
GDP and investment rate						
rgdpcap_06	2006 GDP per capita in PPP	Penn World Tables 7.0	8.83	1.25	5.92	10.85
chg_rgdpcap0006	Percentage change in GDP per capita in PPP 2000–2006	Penn World Tables 7.0	122.86	22.19	81.75	219.39
real.gdp.gr_0006	Average annual growth rate of real GDP 2000–2006	IMF WEO April 2011	4.30	2.47	−0.05	14.47
invRate.gdp_0006	Investment rate in % of GDP, 2000–2006 average	IMF WEO April 2011	22.49	7.00	7.31	54.38
Trade and trade composition						
exp_0206	Exports of goods in % of GDP, 2000–2006 average	UN Comtrade	29.09	23.33	1.65	162.91
imp_0206	Imports of goods in % of GDP, 2000–2006 average	UN Comtrade	37.03	20.88	6.72	156.00
openness_0206	Exports and imports of goods in % of GDP	UN Comtrade	66.12	40.38	13.35	305.60
trade.balance_0206	Trade balance in % of GDP, 2000–2006 average	UN Comtrade	−8.01	18.22	−60.28	52.09
merchTrade.gdp_0006	Merchandise trade in % of GDP, 2000–2006 average	World Bank WDI	68.71	40.89	19.39	313.79
manuf.to.totExp_0006	Exports of manufactured goods in % of total exports, 2000–2006 average	UN Comtrade	13.60	13.65	0.00	78.97
petrol.to.Exp_0006	Exports of petroleum, petroleum products and related materials in % of total exports, 2000–2006 average	UN Comtrade	12.90	22.29	0.00	96.57
food.to.Exp_0006	Exports of food and live animals in % of total exports, 2000–2006 average	UN Comtrade	17.70	19.70	0.05	97.60
Current account and savings						
gross.savings_06	Gross savings in % of GDP, 2006	World Bank & IMF IFS	21.84	12.15	−9.39	64.72
ca.gdp_0006	Current account in % of GDP, 2000–2006 average	IMF WEO April 2011	−2.06	9.09	−26.53	50.85
Money and inflation						
infl_0006	Inflation, 2000–2006 average	IMF WEO April 2011	5.84	6.43	−1.20	48.02
money.gdp_06	Money and quasi money (M2) in % of GDP, 2006	World Bank WDI	64.39	49.01	13.78	260.47
chg.money.gdp_0006	Percentage change in money and quasi money (M2) in % of GDP 2000–2006	World Bank WDI	26.94	44.26	−100.00	212.35
Credit and interest rate						
dom.credit_06	Domestic credit provided by banking sector in % of GDP, 2006	World Bank WDI	65.92	59.72	−13.42	304.96
chg.dom.credit_0006	Domestic credit provided by banking sector in % of GDP, percentage change from 2000 to 2006	World Bank WDI	15.60	65.83	−202.82	353.74
creditInfIndex_06	Credit depth of information index from 0 (low) to 6 (high)	World Bank WDI	2.89	2.20	0.00	6.00
depRate_06	Deposit rate in % per annum, 2006	IMF IFS	5.35	3.52	0.57	22.30
Institutional quality						
legRightsIndex_06	Strength of legal rights index from 0 (weak) to 10 (strong)	World Bank WDI	5.43	2.35	1.00	10.00
cpi_corruption_06	CPI (Transparency International's Corruption Perceptions Index)	Transparency Int.	4.24	2.11	2.00	9.60
Debt and external debt						
genGovDebt.gdp_06	General government debt in % of GDP, 2006	IMF WEO April 2011	54.63	40.42	1.89	213.79

Table A2 (*continued*)

Variable	Description	Source	Mean	Std. dev.	Min	Max
genGovBal.gdp_0006	General government budget balance in % of GDP, 2006	IMF WEO April 2011	−1.52	4.99	−22.15	28.50
ext.debt.gdp_06	External debt in % of GDP, 2006	IMF, IFS and IIP	73.00	85.15	0.00	665.40
ext.debt.exp_06	External debt in % of total exports, 2006	IMF, IFS and IIP	458.88	778.54	0.00	5727.27
adv.claims.gdp_06	Claims of foreign banks (advanced countries) in % of GDP, 2006	BIS	31.27	41.07	0.41	230.30
Reserves						
int.res.gdp_06	International reserves (excl. gold) in % of GDP, 2006	IMF IFS	17.83	14.78	0.20	90.49
int.res.ext.debt_06	International reserves (excl. gold) in % of external debt, 2006	IMF IFS	61.57	135.21	0.00	1423.65
forEx.gdp_06	Foreign exchange in % of GDP, 2006	IMF IFS	17.63	14.75	0.15	90.20
forEx.extDebt_06	Foreign exchange in % of external debt, 2006	IMF IFS	53.97	79.37	0.00	610.34
Capital flows						
net.fdi.infl_0006	Net FDI inflows in % of GDP, 2000–2006 average	IMF IFS	5.67	5.73	−5.24	35.85
Trade exposure						
tradeExposureUS_0206	Goods imports from and exports to the U.S.A. in % of total exports, 2002–2006 average	UN Comtrade	13.52	16.78	0.00	96.94
tradeExp.US.gdp_0006	Goods imports from and exports to the U.S.A. in % of GDP, 2000–2006 average	UN Comtrade	8.58	10.28	0.00	45.61
tradeExposureEU15. gdp_0006	Goods imports from and exports to the EU-15 in % of GDP, 2000–2006 average	UN Comtrade	19.47	18.06	0.53	113.81
tradeExposureEU15_ 0006	Goods imports from and exports to the EU-15 in % of total exports, 2000–2006 average	UN Comtrade	106.98	183.10	4.30	1546.82
Population and unemployment						
unempl_06	Unemployment rate, 2006	IMF IFS & WEO	11.02	10.43	0.60	77.00
pop_06	Population in millions	IMF WEO April 2011	1.93	1.94	−2.98	7.18
pop.gr_0006	Population growth, percentage change 2000–2006	IMF WEO April 2011	8.73	8.01	−9.33	43.57
Monetary regime						
Floater	Dummy variable for countries with no exchange rate anchor	IMF classification (2008)	0.34	0.47	0.00	1.00
Exchange rate misalignment and output gap						
emp_chg_0006	Exchange market pressure index covering changes in the nominal exchange rate and changes in international reserves, in %, 2006; negative values indicate pressure in the exchange market.	Authors' calculations based on Aizenman et al. (2012)	−0.06	0.11	−1.03	0.08
reerm_06	Measure for overvaluation of the real exchange rate based on a panel regression on macro fundamentals, in %, 2006	Authors' calculations based on the IMF's CGER assessment, fully described in Aizenman et al. (2012)	12.15	54.77	−110.55	376.17
dGap_0006		Authors' calculations	34.76	18.39	0.00	85.71

(*continued on next page*)

Table A2 (*continued*)

Variable	Description	Source	Mean	Std. dev.	Min	Max
outputGap_0006Exo	Deviation from trend output in % in 2000–2006; calculation based on yearly GDP data up to 2006 using the Hodrick-Prescott Filter with the smoothness parameter $\lambda = 1600$	Authors' calculations	−1.98	2.29	−11.62	3.86
outputGap_06Exo	Deviation from trend output in % in 2006; calculation based on yearly GDP data up to 2006 using the Hodrick-Prescott Filter with the smoothness parameter $\lambda = 1600$	Authors' calculations	10.94	9.06	−7.87	41.07
dGap_0006Exo	Ratio of how often a country was above trend growth in the period from 2000 to 2006	Authors' calculations	46.36	13.25	0.00	85.71
EMP_0006	Exchange market pressure average over the period from 2000 to 2006	Authors' calculations	−4.77	7.28	−49.70	7.58
Oil production						
oilExp	Dummy variable for oil exporting countries	Authors' calculations	0.17	0.37	0.00	1.00
oilProd	Total oil produced per day in % of total worldwide oil production in 2008.	Authors' calculations	0.57	1.78	0.00	12.62
Globalization indicators						
kof_persCont_06	KOF Globalization Index, personal contact, 2006 (subcomponent of the Social Globalization Index)	KOF Globalization Index	51.75	22.63	11.27	93.38
kof_infFlows_06	KOF Globalization Index, information flows, 2006 (subcomponent of the Social Globalization Index)	KOF Globalization Index	68.67	18.27	34.70	97.95
kof_cultProx_06	KOF Globalization Index, cultural proximity, 2006 (subcomponent of the Social Globalization Index)	KOF Globalization Index	35.60	28.57	1.00	95.43
kof_poltGlob_06	KOF Political Globalization Index, 2006	KOF Globalization Index	68.16	20.51	1.54	98.01
kof_overallGlob_06	KOF Overall Globalization Index (economic, political and social), 2006	KOF Globalization Index	59.83	15.76	28.64	92.42
Trilemma indicators						
monInd_06	Monetary independence index (1 = most independent)	Aizenman et al. (2008)	0.68	0.32	0.00	1.00
er.stab_06	Exchange rate stability index (1 = most stable)	Aizenman et al. (2008)	0.38	0.23	0.00	0.94
FinOpenn_06	Financial Openness Index, measuring a country's degree of capital account openness (Chinn-Ito index, 1 = most open)	Aizenman et al. (2008)	0.56	0.38	0.00	1.00
Country dummies						
adv	Dummy variable for advanced countries.	IMF definition	0.21	0.41	0.00	1.00
euroAdopt	Dummy variable for countries that adopted the euro over the period from 2000 to 2011.	Authors' calculations	0.04	0.20	0.00	1.00

Table A3
Full results – dependent variable: $EMPu_{max}$.

	PIP	Post mean	Post SD	PIP	Post mean	Post SD
euroAdopt	1.000	50.131	7.645	1.000	49.968	13.803
infl_0006	0.977	0.856	0.245	0.996	0.488	1.936
gross.savings_06	0.029	−0.003	0.028	0.579	−0.232	0.243
infl_0006#gross.savings_06	–	–	–	0.559	0.040	0.040
infl_0006#euroAdopt	–	–	–	0.257	−0.848	2.691
int.res.gdp_06	0.102	−0.017	0.060	0.196	−0.036	0.089
outputGap_06Exo	0.056	0.013	0.069	0.194	0.057	0.154
rgdpcap_06	0.027	0.024	0.305	0.189	0.597	1.847
creditInfIndex_06	0.081	−0.093	0.367	0.178	−0.190	0.508
invRate.gdp_0006	0.032	0.006	0.049	0.164	0.051	0.169
dGap_0006Exo	0.020	0.000	0.015	0.159	−0.028	0.098
EMP_0006	0.037	−0.008	0.056	0.156	−0.050	0.148
real.gdp.gr_0006	0.051	−0.063	0.365	0.150	−0.203	0.629
kof_persCont_06	0.043	0.004	0.024	0.149	0.023	0.073
tradeExp.US.gdp_0006	0.044	−0.008	0.050	0.147	−0.037	0.124
adv.claims.gdp_06	0.069	0.004	0.019	0.147	0.009	0.027
petrol.to.Exp_0006	0.047	0.004	0.025	0.142	0.014	0.044
openness_0206	0.023	0.010	1.091	0.141	−0.270	13.644
infl_0006#rgdpcap_06	–	–	–	0.130	−0.070	0.213
reerm_06	0.024	0.000	0.004	0.127	−0.003	0.017
chg_rgdpcap0006	0.045	0.006	0.037	0.126	0.015	0.058
FinOpenn_06	0.027	−0.088	0.846	0.121	−0.575	2.167
tradeExposureEU15.gdp_0006	0.037	0.004	0.025	0.117	0.009	0.045
int.res.ext.debt_06	0.033	0.000	0.003	0.112	0.000	0.005
infl_0006#dGap_0006Exo	–	–	–	0.109	0.004	0.015
kof_poltGlob_06	0.026	0.001	0.017	0.104	0.013	0.061
tradeExposureUS_0206	0.027	−0.001	0.019	0.100	−0.001	0.053
emp_chg_0006	0.025	−0.213	2.579	0.097	−0.808	5.853
food.to.Exp_0006	0.031	0.002	0.018	0.096	0.007	0.033
kof_infFlows_06	0.030	0.002	0.022	0.093	−0.006	0.058
kof_overallGlob_06	0.026	0.002	0.028	0.092	−0.007	0.111
money.gdp_06	0.026	−0.001	0.007	0.091	−0.002	0.015
imp_0206	0.023	−0.008	1.090	0.091	0.279	13.620
legRightsIndex_06	0.024	0.010	0.113	0.090	0.031	0.222
merchTrade.gdp_0006	0.023	0.000	0.010	0.090	−0.008	0.048
trade.balance_0206	0.029	−0.002	0.053	0.089	−0.021	0.371
pop_06	0.030	−0.021	0.190	0.088	−0.021	0.392
dom.credit_06	0.024	0.000	0.005	0.088	−0.002	0.012
genGovBal.gdp_0006	0.029	−0.007	0.069	0.088	−0.018	0.127
oilExp	0.025	0.062	0.733	0.087	0.234	1.468
chg.dom.credit_0006	0.030	0.001	0.005	0.087	0.001	0.008
exp_0206	0.026	−0.011	1.093	0.087	0.294	13.688
ca.gdp_0006	0.037	−0.006	0.046	0.086	−0.003	0.078
manuf.to.totExp_0006	0.025	0.002	0.019	0.086	0.006	0.038
monInd_06	0.027	0.084	0.870	0.085	0.235	1.599
net.fdi.infl_0006	0.023	0.002	0.043	0.084	−0.008	0.105
unempl_06	0.022	−0.001	0.021	0.082	−0.007	0.044
pop.gr_0006	0.024	−0.001	0.031	0.082	0.005	0.067
outputGap_0006Exo	0.019	0.003	0.088	0.081	0.013	0.230
kof_cultProx_06	0.024	0.000	0.010	0.081	0.002	0.028
cpi_corruption_06	0.022	−0.003	0.135	0.079	−0.010	0.325
Floater	0.023	−0.026	0.478	0.079	0.086	1.018
adv	0.022	−0.011	0.668	0.079	−0.064	1.566
ext.debt.gdp_06	0.022	0.000	0.003	0.079	0.000	0.006
tradeExposureEU15_0006	0.021	0.000	0.001	0.078	0.000	0.003
er.stab_06	0.021	−0.027	0.929	0.078	0.040	1.954
infl_0006#outputGap_06Exo	–	–	–	0.078	−0.002	0.011
ext.debt.exp_06	0.020	0.000	0.000	0.078	0.000	0.001
chg.money.gdp_0006	0.020	0.000	0.004	0.078	0.001	0.009
dGap_0006	0.023	0.001	0.012	0.077	−0.001	0.025

(*continued on next page*)

Table A3 (*continued*)

	PIP	Post mean	Post SD	PIP	Post mean	Post SD
depRate_06	0.021	0.001	0.065	0.077	0.003	0.119
oilProd	0.021	−0.003	0.117	0.077	−0.012	0.240
genGovDebt.gdp_06	0.021	0.000	0.005	0.076	0.000	0.011
infl_0006#openness_0206	–	–	–	0.074	−0.001	0.003
infl_0006#invRate.gdp_0006	–	–	–	0.060	−0.002	0.021
infl_0006#reerm_06	–	–	–	0.043	0.000	0.001
infl_0006#int.res.ext.debt_06	–	–	–	0.034	0.000	0.001

Notes: The PIP stands for posterior inclusion probability, Post Mean for posterior mean and Post SD for the posterior standard deviation. Model 1 refers to the baseline model without interaction terms included, model 2 includes on top of the regressors in Model 1 selected interaction terms with pre-crisis inflation employing the strong-heredity prior on the model space. Results are based on 3 million iterations of MCMC sampler after discarding 1 million burn-in iterations for convergence.

Table A4
Full results – dependent variable: $EMPu_{\max.0006}$.

	PIP	Post mean	Post SD	PIP	Post mean	Post SD
euroAdopt	1.000	50.131	7.645	1.000	49.968	13.803
infl_0006	0.977	0.856	0.245	0.996	0.488	1.936
gross.savings_06	0.029	−0.003	0.028	0.579	−0.232	0.243
infl_0006#gross.savings_06	–	–	–	0.559	0.040	0.040
infl_0006#euroAdopt	–	–	–	0.257	−0.848	2.691
int.res.gdp_06	0.102	−0.017	0.060	0.196	−0.036	0.089
outputGap_06Exo	0.056	0.013	0.069	0.194	0.057	0.154
rgdpcap_06	0.027	0.024	0.305	0.189	0.597	1.847
creditInfIndex_06	0.081	−0.093	0.367	0.178	−0.190	0.508
invRate.gdp_0006	0.032	0.006	0.049	0.164	0.051	0.169
dGap_0006Exo	0.020	0.000	0.015	0.159	−0.028	0.098
EMP_0006	0.037	−0.008	0.056	0.156	−0.050	0.148
real.gdp.gr_0006	0.051	−0.063	0.365	0.150	−0.203	0.629
kof_persCont_06	0.043	0.004	0.024	0.149	0.023	0.073
tradeExp.US.gdp_0006	0.044	−0.008	0.050	0.147	−0.037	0.124
adv.claims.gdp_06	0.069	0.004	0.019	0.147	0.009	0.027
petrol.to.Exp_0006	0.047	0.004	0.025	0.142	0.014	0.044
openness_0206	0.023	0.010	1.091	0.141	−0.270	13.644
infl_0006#rgdpcap_06	–	–	–	0.130	−0.070	0.213
reerm_06	0.024	0.000	0.004	0.127	−0.003	0.017
chg_rgdpcap0006	0.045	0.006	0.037	0.126	0.015	0.058
FinOpenn_06	0.027	−0.088	0.846	0.121	−0.575	2.167
tradeExposureEU15.gdp_0006	0.037	0.004	0.025	0.117	0.009	0.045
int.res.ext.debt_06	0.033	0.000	0.003	0.112	0.000	0.005
infl_0006#dGap_0006Exo	–	–	–	0.109	0.004	0.015
kof_poltGlob_06	0.026	0.001	0.017	0.104	0.013	0.061
tradeExposureUS_0206	0.027	−0.001	0.019	0.100	−0.001	0.053
emp_chg_0006	0.025	−0.213	2.579	0.097	−0.808	5.853
food.to.Exp_0006	0.031	0.002	0.018	0.096	0.007	0.033
kof_infFlows_06	0.030	0.002	0.022	0.093	−0.006	0.058
kof_overallGlob_06	0.026	0.002	0.028	0.092	−0.007	0.111
money.gdp_06	0.026	−0.001	0.007	0.091	−0.002	0.015
imp_0206	0.023	−0.008	1.090	0.091	0.279	13.620
legRightsIndex_06	0.024	0.010	0.113	0.090	0.031	0.222
merchTrade.gdp_0006	0.023	0.000	0.010	0.090	−0.008	0.048
trade.balance_0206	0.029	−0.002	0.053	0.089	−0.021	0.371
pop_06	0.030	−0.021	0.190	0.088	−0.021	0.392
dom.credit_06	0.024	0.000	0.005	0.088	−0.002	0.012
genGovBal.gdp_0006	0.029	−0.007	0.069	0.088	−0.018	0.127
oilExp	0.025	0.062	0.733	0.087	0.234	1.468
chg.dom.credit_0006	0.030	0.001	0.005	0.087	0.001	0.008
exp_0206	0.026	−0.011	1.093	0.087	0.294	13.688
ca.gdp_0006	0.037	−0.006	0.046	0.086	−0.003	0.078
manuf.to.totExp_0006	0.025	0.002	0.019	0.086	0.006	0.038

Table A4 (*continued*)

	PIP	Post mean	Post SD	PIP	Post mean	Post SD
monInd_06	0.027	0.084	0.870	0.085	0.235	1.599
net.fdi.infl_0006	0.023	0.002	0.043	0.084	−0.008	0.105
unempl_06	0.022	−0.001	0.021	0.082	−0.007	0.044
pop.gr_0006	0.024	−0.001	0.031	0.082	0.005	0.067
outputGap_0006Exo	0.019	0.003	0.088	0.081	0.013	0.230
kof_cultProx_06	0.024	0.000	0.010	0.081	0.002	0.028
cpi_corruption_06	0.022	−0.003	0.135	0.079	−0.010	0.325
Floater	0.023	−0.026	0.478	0.079	0.086	1.018
adv	0.022	−0.011	0.668	0.079	−0.064	1.566
ext.debt.gdp_06	0.022	0.000	0.003	0.079	0.000	0.006
tradeExposureEU15_0006	0.021	0.000	0.001	0.078	0.000	0.003
er.stab_06	0.021	−0.027	0.929	0.078	0.040	1.954
infl_0006#outputGap_06Exo	–	–	–	0.078	−0.002	0.011
ext.debt.exp_06	0.020	0.000	0.000	0.078	0.000	0.001
chg.money.gdp_0006	0.020	0.000	0.004	0.078	0.001	0.009
dGap_0006	0.023	0.001	0.012	0.077	−0.001	0.025
depRate_06	0.021	0.001	0.065	0.077	0.003	0.119
oilProd	0.021	−0.003	0.117	0.077	−0.012	0.240
genGovDebt.gdp_06	0.021	0.000	0.005	0.076	0.000	0.011
infl_0006#openness_0206	–	–	–	0.074	−0.001	0.003
infl_0006#invRate.gdp_0006	–	–	–	0.060	−0.002	0.021
infl_0006#reerm_06	–	–	–	0.043	0.000	0.001
infl_0006#int.res.ext.debt_06	–	–	–	0.034	0.000	0.001

Notes: The PIP stands for posterior inclusion probability, Post Mean for posterior mean and Post SD for the posterior standard deviation. Model 1 refers to the baseline model without interaction terms included, model 2 includes on top of the regressors in Model 1 selected interaction terms with pre-crisis inflation employing the strong-heredity prior on the model space. Results are based on 3 million iterations of MCMC sampler after discarding 1 million burn-in iterations for convergence.

Table A5
Full results – dependent variable: $EMPu_{ptt}$.

	PIP	Post mean	Post SD	PIP	Post mean	Post SD
euroAdopt	1.000	50.131	7.645	1.000	49.968	13.803
infl_0006	0.977	0.856	0.245	0.996	0.488	1.936
gross.savings_06	0.029	−0.003	0.028	0.579	−0.232	0.243
infl_0006#gross.savings_06	–	–	–	0.559	0.040	0.040
infl_0006#euroAdopt	–	–	–	0.257	−0.848	2.691
int.res.gdp_06	0.102	−0.017	0.060	0.196	−0.036	0.089
outputGap_06Exo	0.056	0.013	0.069	0.194	0.057	0.154
rgdpcap_06	0.027	0.024	0.305	0.189	0.597	1.847
creditInflIndex_06	0.081	−0.093	0.367	0.178	−0.190	0.508
invRate.gdp_0006	0.032	0.006	0.049	0.164	0.051	0.169
dGap_0006Exo	0.020	0.000	0.015	0.159	−0.028	0.098
EMP_0006	0.037	−0.008	0.056	0.156	−0.050	0.148
real.gdp.gr_0006	0.051	−0.063	0.365	0.150	−0.203	0.629
kof_persCont_06	0.043	0.004	0.024	0.149	0.023	0.073
tradeExp.US.gdp_0006	0.044	−0.008	0.050	0.147	−0.037	0.124
adv.claims.gdp_06	0.069	0.004	0.019	0.147	0.009	0.027
petrol.to.Exp_0006	0.047	0.004	0.025	0.142	0.014	0.044
openness_0206	0.023	0.010	1.091	0.141	−0.270	13.644
infl_0006#rgdpcap_06	–	–	–	0.130	−0.070	0.213
reerm_06	0.024	0.000	0.004	0.127	−0.003	0.017
chg_rgdpcap0006	0.045	0.006	0.037	0.126	0.015	0.058
FinOpenn_06	0.027	−0.088	0.846	0.121	−0.575	2.167
tradeExposureEU15.gdp_0006	0.037	0.004	0.025	0.117	0.009	0.045
int.res.ext.debt_06	0.033	0.000	0.003	0.112	0.000	0.005
infl_0006#dGap_0006Exo	–	–	–	0.109	0.004	0.015
kof_poltGlob_06	0.026	0.001	0.017	0.104	0.013	0.061
tradeExposureUS_0206	0.027	−0.001	0.019	0.100	−0.001	0.053

(*continued on next page*)

Table A5 (*continued*)

	PIP	Post mean	Post SD	PIP	Post mean	Post SD
emp_chg_0006	0.025	−0.213	2.579	0.097	−0.808	5.853
food.to.Exp_0006	0.031	0.002	0.018	0.096	0.007	0.033
kof_infFlows_06	0.030	0.002	0.022	0.093	−0.006	0.058
kof_overallGlob_06	0.026	0.002	0.028	0.092	−0.007	0.111
money.gdp_06	0.026	−0.001	0.007	0.091	−0.002	0.015
imp_0206	0.023	−0.008	1.090	0.091	0.279	13.620
legRightsIndex_06	0.024	0.010	0.113	0.090	0.031	0.222
merchTrade.gdp_0006	0.023	0.000	0.010	0.090	−0.008	0.048
trade.balance_0206	0.029	−0.002	0.053	0.089	−0.021	0.371
pop_06	0.030	−0.021	0.190	0.088	−0.021	0.392
dom.credit_06	0.024	0.000	0.005	0.088	−0.002	0.012
genGovBal.gdp_0006	0.029	−0.007	0.069	0.088	−0.018	0.127
oilExp	0.025	0.062	0.733	0.087	0.234	1.468
chg.dom.credit_0006	0.030	0.001	0.005	0.087	0.001	0.008
exp_0206	0.026	−0.011	1.093	0.087	0.294	13.688
ca.gdp_0006	0.037	−0.006	0.046	0.086	−0.003	0.078
manuf.to.totExp_0006	0.025	0.002	0.019	0.086	0.006	0.038
monInd_06	0.027	0.084	0.870	0.085	0.235	1.599
net.fdi.infl_0006	0.023	0.002	0.043	0.084	−0.008	0.105
unempl_06	0.022	−0.001	0.021	0.082	−0.007	0.044
pop.gr_0006	0.024	−0.001	0.031	0.082	0.005	0.067
outputGap_0006Exo	0.019	0.003	0.088	0.081	0.013	0.230
kof_cultProx_06	0.024	0.000	0.010	0.081	0.002	0.028
cpi_corruption_06	0.022	−0.003	0.135	0.079	−0.010	0.325
Floater	0.023	−0.026	0.478	0.079	0.086	1.018
adv	0.022	−0.011	0.668	0.079	−0.064	1.566
ext.debt.gdp_06	0.022	0.000	0.003	0.079	0.000	0.006
tradeExposureEU15_0006	0.021	0.000	0.001	0.078	0.000	0.003
er.stab_06	0.021	−0.027	0.929	0.078	0.040	1.954
infl_0006#outputGap_06Exo	–	–	–	0.078	−0.002	0.011
ext.debt.exp_06	0.020	0.000	0.000	0.078	0.000	0.001
chg.money.gdp_0006	0.020	0.000	0.004	0.078	0.001	0.009
dGap_0006	0.023	0.001	0.012	0.077	−0.001	0.025
depRate_06	0.021	0.001	0.065	0.077	0.003	0.119
oilProd	0.021	−0.003	0.117	0.077	−0.012	0.240
genGovDebt.gdp_06	0.021	0.000	0.005	0.076	0.000	0.011
infl_0006#openness_0206	–	–	–	0.074	−0.001	0.003
infl_0006#invRate.gdp_0006	–	–	–	0.060	−0.002	0.021
infl_0006#reerm_06	–	–	–	0.043	0.000	0.001
infl_0006#int.res.ext.debt_06	–	–	–	0.034	0.000	0.001

Notes: The PIP stands for posterior inclusion probability, Post Mean for posterior mean and Post SD for the posterior standard deviation. Model 1 refers to the baseline model without interaction terms included, model 2 includes on top of the regressors in Model 1 selected interaction terms with pre-crisis inflation employing the strong-heredity prior on the model space. Results are based on 3 million iterations of MCMC sampler after discarding 1 million burn-in iterations for convergence.

References

Aizenman, J., Chinn, M.D., Ito, H., 2008. Assessing the Emerging Global Financial Architecture: Measuring the Trilemma's Configurations over Time. NBER Working Papers 14533. National Bureau of Economic Research, Inc.

Aizenman, J., Hutchison, M.M., 2012. Exchange market pressure and absorption by international reserves: emerging markets and fear of reserve loss during the 2008–2009 crisis. J. Int. Money Finan. 31 (5), 1076–1091.

Aizenman, J., Lee, J., Sushko, V., 2012. From the great moderation to the global crisis: exchange market pressure in the 2000s. Open Econ. Rev. 23 (4), 597–621.

Aizenman, J., Pasricha, G.K., 2012. Determinants of financial stress and recovery during the great recession. Int. J. Finan. Econ. 17 (4), 347–372.

Babecky, J., Havranek, T., Mateju, J., Rusnak, M., Smidkova, K., Vasicek, B., 2013. Leading indicators of crisis incidence: evidence from developed countries. J. Int. Money and Finan. 35 (0), 1–19.

Balakrishnan, R., Danninger, S., Elekdag, S., Tytell, I., 2011. The transmission of financial stress from advanced to emerging economies. Emerg. Markets Finan. Trade 47 (0), 40–68.

Bayoumi, T., Eichengreen, B., 1998. Exchange rate volatility and intervention: implications of the theory of optimum currency areas. J. Int. Econ. 45 (2), 191–209.

Chipman, H., 1996. Bayesian variable selection with related predictors. Can. J. Stat. 24, 17–36.
Christofides, C., Eicher, T., Papageorgiou, C., 2013. Did Established Early Warning Signals Predict the 2008 Crises. Technical Report. University of Washington.
Dominguez, K.M., Hashimoto, Y., Ito, T., 2012. International reserves and the global financial crisis. J. Int. Econ. 88 (2), 388–406.
Durlauf, S., Kourtellos, A., Tan, C., 2008. Are any growth theories robust?". Econ. J. 118 (527), 329–346.
Eicher, T.S., Papageorgiou, C., Raftery, A.E., 2011. Default priors and predictive performance in Bayesian model averaging, with application to growth determinants. J. Appl. Econ. 26 (1), 30–55.
Feldkircher, M., 2012. The Determinants of Vulnerability to the Global Financial Crisis 2008 to 2009: Credit Growth and Other Sources of Risk. BOFIT Discussion Papers 26/2012. Bank of Finland, Institute for Economies in Transition.
Feldkircher, M., Zeugner, S., 2009. Benchmark Priors Revisited: on Adaptive Shrinkage and the Supermodel Effect in Bayesian Model Averaging. IMF Working Papers 09/202. International Monetary Fund.
Feldkircher, M., Zeugner, S., 2012. The impact of data revisions on the robustness of growth determinants – a note on 'determinants of economic growth: will data tell?'. J. Appl. Econ. 27 (4), 686–694.
Fernandez, C., Ley, E., Steel, M.F.J., 2001a. Benchmark priors for Bayesian model averaging. J. Econ. 100 (2), 381–427.
Fernandez, C., Ley, E., Steel, M.F.J., 2001b. Model uncertainty in cross-country growth regressions. J. Appl. Econ. 16 (5), 563–576.
Frankel, J., Saravelos, G., 2012. Can leading indicators assess country vulnerability? Evidence from the 2008–09 global financial crisis. J. Int. Econ. 87 (2), 216–231.
Frankel, J., Wei, S.-J., 2008. Estimation of De Facto exchange rate regimes: synthesis of the techniques for inferring flexibility and basket weights. IMF Staff Paper. 55 (3), 384–416.
Frankel, J., Xie, D., 2010. Estimation of De Facto flexibility parameter and Basket weights in evolving exchange rate regimes. Am. Econ. Rev. 100 (2), 568–572.
Fratzscher, M., 2009. What explains global exchange rate movements during the financial crisis?". J. Int. Money and Finan. 28 (8), 1390–1407.
Girton, L., Roper, D., 1977. A monetary model of exchange market pressure applied to the Postwar Canadian experience. Am. Econ. Rev. 67 (4), 537–548.
International Monetary Fund, 2011. Factsheet: Special Drawing Rights (SDRs). Technical report. International Monetary Fund. Available at: http://www.imf.org/external/np/exr/facts/sdr.HTM.
Klaassen, F., Jager, H., 2011. Definition-consistent measurement of exchange market pressure. J. Int. Money and Finan. 30 (1), 74–95.
Ley, E., Steel, M.F., 2009. On the effect of prior assumptions in Bayesian model averaging with applications to growth regressions. J. Appl. Econ. 24 (4), 651–674.
Ley, E., Steel, M.F., 2012. Mixtures of g-priors for Bayesian model averaging with economic applications. J. Econ. 171 (2), 251–266.
Madigan, D., York, J., 1995. Bayesian graphical models for discrete data. Int. Stat. Rev. 63, 215–232.
Moral-Benito, E., 2011. Model Averaging in Economics. Banco de Espana Working Papers 1123. Banco de Espana.
Pentecost, E.J., Van Hooydonk, C., Van Poeck, A., 2001. Measuring and estimating exchange market pressure in the EU. J. Int. Money and Finan. 20 (3), 401–418.
Raftery, A.E., 1995. Bayesian model selection in social research. Sociol. Method. 25, 111–163.
Raftery, A.E., Madigan, D., Hoeting, J.A., 1997. Bayesian model averaging for linear regression models. J. Am. Stat. Assoc. 92, 179–191.
Rose, A.K., Spiegel, M.M., 2011. Cross-country causes and consequences of the crisis: an update. European Econ. Rev. 55 (3), 309–324.
Sala-I-Martin, X., Doppelhofer, G., Miller, R.I., 2004. Determinants of long-term growth: a bayesian averaging of classical estimates (BACE) approach. Am. Econ. Rev. 94 (4), 813–835.
Tanner, E., 2001. Exchange market pressure and monetary policy: Asia and Latin America in the 1990s. IMF Staff Paper. 47 (3), 2.
Van Poeck, A., Vanneste, J., Veiner, M., 2007. Exchange rate regimes and exchange market pressure in the new eu member states. J. Common Market Stud. 45 (2), 459–485.
White, W.R., 2006. Is Price Stability Enough?. BIS Working Papers 205 Bank for International Settlements.
Zellner, A., 1986. On assessing prior distributions and bayesian regression analysis with g-prior distributions. In: Bayesian Inference and Decision Techniques: Essays in Honor of Bruno de Finetti. North-Holland: Amsterdam.