Journal of International Money and Finance 51 (2015) 409–431

Contents lists available at ScienceDirect

Journal of International Money and Finance

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

Monetary policy options for mitigating the impact of the global financial crisis on emerging market economies

Marek A. Dąbrowski [a, *], Sławomir Śmiech [b], Monika Papież [b]

[a] Cracow University of Economics, Department of Macroeconomics, Rakowicka 27, 31-510 Cracow, Poland
[b] Cracow University of Economics, Department of Statistics, Rakowicka 27, 31-510 Cracow, Poland

ARTICLE INFO

Article history:
Available online 3 January 2015

JEL classification:
C21
E52
F31
F41

Keywords:
Global financial crisis
Emerging market economies
Monetary policy
Exchange rate regime
Quantile regressions

ABSTRACT

Though the hypothesis that exchange rate regimes fully predetermine monetary policy in the face of external shocks hardly finds any advocates in the field of theory, it has crept into empirical research. This study adopts a careful and rigorous empirical approach that looks at monetary policy options used in order to accommodate the global financial crisis. We examine the GDP growth in 41 emerging market economies in the most intense phase of the crisis and confirm that there is no clear difference in the growth performance between countries at the opposite poles of the exchange rate regime spectrum. Moreover, we find that the monetary policy option of depreciation *cum* international reserves depletion outperforms other options, especially the rise in the interest rate spread. We also discover certain complementarities between information on policy option and on exchange rate regime. We use quantile regression, which provides a more complete picture of the relationships between the covariates and the distribution of the GDP growth.

* Corresponding author. Tel.: +48 12 293 56 68; fax: +48 12 293 51 48.
E-mail addresses: marek.dabrowski@uek.krakow.pl (M.A. Dąbrowski), slawomir.smiech@uek.krakow.pl (S. Śmiech), monika.papiez@uek.krakow.pl (M. Papież).

http://dx.doi.org/10.1016/j.jimonfin.2014.12.006
0261-5606/

1. Introduction

One of the most important arguments against a fixed exchange rate regime is the necessity of making the stabilization of an exchange rate a primary objective of monetary policy. By doing this, monetary authorities lose autonomy in the sense that monetary policy cannot be used in order to stabilize the output or employment (domestic objectives) unless capital flows are controlled. The reasoning is rooted in the so-called trilemma or the impossible macroeconomic trinity: one cannot have the exchange rate stability, unfettered capital flows and monetary policy oriented toward domestic objectives at the same time.[1] The opponents of a flexible exchange rate argue that such an arrangement contributes to uncertainty, which has an adverse effect on international trade and welfare.[2]

Frenkel (1999) aptly points out that, even in the face of a gradual process of international financial integration, the trilemma does not mean that a country has to choose between the exchange rate stability and monetary autonomy: "there is nothing in the existing theory, for example, that prevents a country from pursuing a managed float under which half of every fluctuation in the demand for its currency is accommodated by intervention and half is reflected in the exchange rate" (Frenkel, 1999). Taking his idea a step further, one can argue that thanks to an additional monetary policy instrument, i.e. foreign market intervention, it is possible to ease the conflict between domestic and external objectives. In other words, even if there are no barriers to capital flows, the exchange rate regime *per se* does not fully predetermine the stability of output and exchange rate.

The global financial crisis has entailed large economic and social costs but at the same time it has provided a unique opportunity (in a sense of a natural experiment) to investigate the effectiveness of monetary policy options adopted by emerging market economies to accommodate adverse external shocks. These economies have differed not only in the relative crisis resilience, but also in the policy option chosen to neutralize the impact of the crisis.[3]

The objective of this paper is to identify policy options used by monetary authorities in emerging market countries and to investigate their role in making the global financial crisis milder for their economies. The existing studies devoted to the role of monetary factors in shaping the relative crisis resilience have been focused on the type of exchange rate regime and not on the policy options actually adopted (e.g. see Berkmen et al., 2012, Blanchard et al., 2010a; Tsangarides, 2012).[4] Our empirical strategy consists of two complementary steps. Firstly, we look for similarities in monetary authorities' responses to the global financial crisis. The goal is to identify similar emerging market economies in terms of monetary policy tools used to accommodate external shocks. This stage of analysis is a missing link between theoretical considerations and empirical research, and it is meant to serve as a substitute for the commonly used exchange rate regime classifications. Secondly, we examine the differences in the economic growth performance during the most intense phase of the crisis between the groups of emerging market economies. This stage is more in line with the existing empirical literature, however, our approach is focused on the effectiveness of alternative policy options oriented at crisis mitigation rather than on a sophisticated comparison between countries that peg their currencies with those that float.

The paper is structured as follows. Section 2 reviews the literature on a role of exchange rate regime during the global financial crisis and elucidates our contribution. Section 3 outlines the two-step methodological approach adopted and describes the data. Estimation results are presented in Section 4, while Section 5 provides concluding remarks.

[1] For a traditional approach to the trilemma see Mundell (1963) and Fleming (1962). For the modern approach and economic consequences of the trilemma see, e.g., Aizenman et al. (2010), Obstfeld et al. (2005, 2010).

[2] The literature on a choice of exchange rate regime is ample. For a survey see Klein and Shambaugh (2010) or Rose (2011).

[3] For a thorough study on emerging markets' resilience to the global financial crisis see Didier et al. (2012).

[4] For the sake of clarity, it ought to be emphasized that a lot of other explanatory variables, like the magnitude of trade shock, crisis vulnerability, or internal imbalances, have been taken into account in these studies. However, they have no connections with the actual monetary policy during the most adverse stage of the crisis.

2. Exchange rate regimes, monetary policy options and the crisis

Policy options for emerging market economies during the recent crisis are analysed by Ghosh et al. (2009). Their overall conclusion is that "there is no one-size-fits-all prescription, and the appropriate policy mix depends on particular circumstances in each country, including a number of trade-offs". As far as monetary policy is concerned, they stress the importance of the trade-off between the benefits of lower interest rates and a depreciated currency for propping up domestic activity and exports against the contractionary effects of currency depreciation on unhedged balance sheets. The size of desirable currency depreciation depends on such factors as initial overvaluation, the exchange rate regime, balance sheet effects and possible regional contagion and systemic implications.

The empirical evidence regarding the role of exchange rate regimes during the recent financial crisis is mixed. Berkmen et al. (2012) search for an explanation of resilience diversity among emerging markets in four groups of factors: (i) trade linkages; (ii) financial linkages; (iii) underlying vulnerabilities and financial structure; and (iv) the overall policy framework. After examining a plethora of various variables and robustness tests, they identify four main variables that explain a substantial fraction of (unexpected) growth performance in emerging markets: leverage (defined as a ratio of domestic credit to domestic deposits), primary gap, short-term external debt and the exchange rate flexibility. On the one hand, they conclude that one of preliminary policy lessons from the global financial crisis is that "exchange rate flexibility proved important for emerging markets in dampening the impact of large shocks". And, on the other hand, they point out that "the benefits of exchange rate flexibility appear limited to moving from a peg toward a more flexible regime" and "distinguishing between crawls and floats does not improve the fit". Since this variable has been the only one that seemed to matter among alternative monetary policy indicators considered, one could conclude that monetary policy has not mattered during the most adverse phase of the crisis.

A similar conclusion referring to the significance of an exchange rate regime is drawn by Blanchard et al. (2010a). They check for an impact of the exchange rate arrangement on the unexpected GDP growth in 29 emerging markets over the last quarter of 2008 and the first quarter of 2009. Their theoretical model is not unambiguous on that issue, as it implies that the GDP growth in a country that pegged its currency depends also on whether the Marshall-Lerner condition is satisfied, on the strength of the balance sheet effect and on the policy tools used to maintain the peg (the policy rate and reserve decumulation). They find out that the growth is on average 2.7 percentage points lower in a country with a fixed rate regime than in a country that floats its currency, but this difference is statistically insignificant.

A different empirical strategy has been adopted by Tsangarides (2012) who focuses on the changes in actual GDP growth in 2008–2009 relative to 2003–2007 in a sample of 50 emerging market economies. His main finding is that after controlling for the trade exposure and financial linkages the choice of exchange rate regime has not been an important determinant of the growth performance of emerging market economies during the crisis. Peggers, however, were faring worse in the recovery period 2010–2011.

Hutchison et al. (2010) investigate the effects of monetary and fiscal policies on the GDP growth during earlier financial crises in developing and emerging market economies (83 "sudden stop" episodes in 66 countries over 1980–2003 are examined). They find that contractionary monetary and fiscal policies during a sudden stop exacerbate its recessionary consequences. Moreover, discretionary fiscal expansion alleviates adverse effects of a crisis, but monetary expansion has no discernible effect. Although at the time of sudden stops countries examined have had relatively rigid exchange rates on average, the exchange rate regime has no statistically significant effect on output costs of a sudden stop.

A related line of research is the one on the relation between foreign exchange reserves management and crisis resilience. It is also an area of substantial controversy.[5] Blanchard et al. (2010a) find that the emerging market economies with high ratio of foreign reserves to short-term external debt experienced smaller declines in economic growth during the crisis. It turned out, however, that this effect

[5] For a more thorough discussion of this issue see, e.g., Dąbrowski (forthcoming).

comes from the denominator, that is from low debt-to-GDP ratio, and the ratio of reserves-to-GDP is incorrectly signed and insignificant. Thus, they conclude that there is "little econometric evidence in support of the hypothesis that high reserves limited the decline in output in the crisis". Similar results are obtained by Berkmen et al. (2012). They, however, suggest that "the value of international reserves may diminish sharply once they move above a threshold considered sufficient to guard against risks". The hypothesis of non-linearity in the relations between reserves holding and output collapse during the crisis is exploited by Llaudes et al. (2010). They uncover that higher reserves had a significant payoff in terms of output loss at low levels of reserve coverage but much less so at high levels of coverage. Dominguez et al. (2012) make a similar argument: the counter-cyclical value of reserves should be measured relative to a benchmark which reflects "reserve adequacy" (they choose the reserves-to-GDP ratio in 2006Q4). They find "a negative relationship, indicating that countries with higher reserve adequacy prior to the crisis experienced greater output declines during the crisis."[6] Recently, Bussière et al. (2014), using a large sample of more than 100 emerging and developing economies, have shown that countries with higher reserves-to-short-term debt ratios fared better during the crisis than others and that this effect was amplified when the capital account was less open.

Our paper contributes to the literature focusing on emerging market economies' resilience to the global financial crisis and the role of the exchange rate regime. We agree with Blanchard et al. (2010a) who argue that in order to find out whether maintaining the exchange rate by a country hit by a trade or financial shock is expedient, one needs to look at the policy tools used, i.e. the policy rate or reserve decumulation and the strength of balance sheet effects the country is trying to avoid.[7] We develop this argument further and argue that it is not the exchange rate regime *per se* that matters for the crisis resilience, but the specific set of policy tools actually adopted to mitigate the contractionary pressure. Though we do not deny the fact that the exchange rate regime can have a certain impact on the monetary policy tools used to accommodate external shocks, by no means it fully predetermines the policy response.

Our hypothesis is consistent with the well-known fear of floating syndrome (Calvo and Reinhart, 2002) or a more recently identified fear of losing international reserves behaviour (Aizenman and Sun, 2012).[8] It seems, however, that the underlying causes of these syndromes are neglected in the empirical research on a link between the exchange rate regime and crisis resilience: empirical analyses are preformed as if the exchange rate regime fully predetermined the policy reactions. The hardly surprising consequence is that exchange rate regimes do not matter empirically in explaining the resilience to financial crises. Our study departs from such an approach and looks at the policy tools used to accommodate adverse external shocks. We develop and apply an empirical strategy that is consistent with theoretical findings and contributes to the explanation of diversity among emerging market economies' resilience to the global financial crisis. Moreover, it allows us to solve the puzzle of small, if any, significance of exchange rate regime for growth performance during the crisis.

3. Methodology and data

3.1. Methodology

Statistical methods of unsupervised classification are used to identify the actual monetary policy options for crisis mitigation. The groups of countries obtained are expected to include economies that have adopted similar monetary policy options. It is assumed that although the number of groups is unknown a priori, it should be neither too small nor too large. In the former case, the within group heterogeneity would be unduly large, whereas in the latter case, the regression analysis would become

[6] Unfortunately they have not provided the details of the regression of GDP growth performance during the crisis on reserves adequacy ratio, so it is not clear whether the relation is statistically significant.

[7] A similar conclusion has been drawn by Ghosh et al. (2009).

[8] See also Blanchard et al. (2010b), who state that the central banks actions in the emerging market economies "were more sensible than their rhetoric". Their point is that central banks which adopted inflation targeting paid attention to the exchange rate that went beyond its impact on the declared primary objective, i.e. inflation.

impossible. Under such conditions, it is expedient to use various tools to classify the countries and to compare the results. Clustering is conducted by means of hierarchical methods in which groups are created recursively by linking together the most similar objects (different forms of linkage and different measures of distance are taken into consideration). Other methods of division, i.e. k-means method and partitioning around medoids (PAM) method proposed by Kaufman and Rousseeuw (1990), are also used. In both cases, after making the initial decision about the desired number of groups, objects are allocated in such a way that the relevant criterion is met. For the k-means method the allocation of objects should minimize a within-group variance. In the PAM method at each step of the analysis the representatives of groups (medoids) are selected, and then the remaining objects are allocated to the group which includes the closest medoid. This method is more robust to outliers than the k-means method, because it minimizes a sum of dissimilarities instead of a sum of squared Euclidean distance. In order to evaluate optimal number of clusters in the data we use internal validity indexes: Calinski Harabasz pseudo F statistics (Calinski and Harabasz, 1974), the average silhouette width (Kaufman and Rousseeuw, 1990), the Dunn index (Dunn, 1974), and Xie and Beni's (1991) index.[9] The final classification of objects is, therefore, the result of the comparison of the results of respective grouping algorithms.

To evaluate the effectiveness of policy options for crisis mitigation the magnitude of the unexpected decline in the GDP growth is used as a dependent variable. Statistical inference about relations is carried out within a framework of quantile regression analysis proposed by Kroenker and Bassett (1978). In order to sketch out the idea behind quantile regression and the estimation method, let us consider the following linear regression model:

$$y_i = x_i'\beta + \varepsilon_i \quad \text{for} \quad i = 1, \ldots, n, \tag{1}$$

where y_i is a dependent variable, $x_i' = (1, x_{i1}, \ldots, x_{ip})$ is a vector of explanatory variables, $\beta = (\beta_0, \beta_1 \ldots, \beta_p)'$ is a vector of unknown parameters of the model, and ε_i's are independent stochastic variables with identical distribution.

Let $r_i(\widehat{\beta}) = y_i - x_i'\widehat{\beta}$ stand for residuals of the regression model (1). In the case of classical regression, the OLS estimator is obtained by a choice of parameters that minimizes the conditional distribution of the expected value of the response variable, i.e. $E(Y|X)$. In the quantile regression parameters are chosen in such a way that conditional quantiles of dependent variables $q_\tau(Y|X) = inf\{y: F_{Y|X}(y) \geq \tau\}$ are minimized. For each quantile $0<\tau<1$ a vector of parameters $\beta(\tau)$ is obtained by minimizing the following criterion:

$$\min_{\beta} \left[\sum_{r_i(\beta) > 0} \tau r_i\left(\widehat{\beta}\right) + \sum_{r_i(\beta) < 0} (1-\tau) r_i\left(\widehat{\beta}\right) \right]. \tag{2}$$

The result is the parametric quantile regression:

$$y_i = x_i'\widehat{\beta}^{\tau} + \varepsilon_i^{\tau}, \tag{3}$$

where $\widehat{\beta}^{\tau} = (\widehat{\beta}_0^{\tau}, \ldots, \widehat{\beta}_p^{\tau})'$ is a vector of coefficients that depend on the quantile τ, and $q_\tau(\varepsilon_i^{\tau}|x_i) = 0$. Parameters of the model can be interpreted as the marginal change in the τ th conditional quantile of Y associated with a unit change in the appropriate covariate. Kroenker (2005) emphasizes that a quantile regression in comparison to an OLS regression attains a higher robustness and enables natural interpretation.

3.2. Data description

Our sample covers 41 emerging market economies (see Table A1 in the on-line Appendix). There is no single commonly accepted definition of emerging market economies. Generally, they include

[9] We thank an anonymous referee for suggesting the Dunn index and Xie and Beni's index.

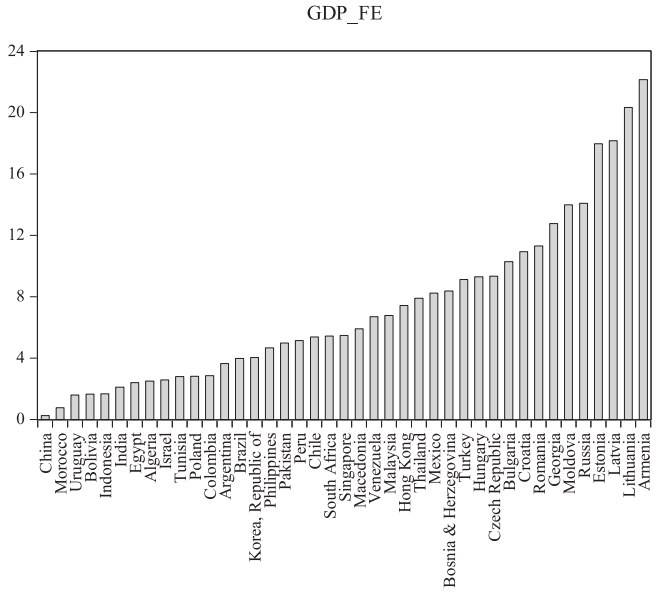

Fig. 1. Unexpected GDP growth performance in emerging market economies, 2009.

countries which have reached a certain minimum level of GDP, have exhibited a relatively high rate of growth of GDP, but have small and not very deep financial markets and are vulnerable to internal and external forces.[10] These criteria are met by middle income economies to the first approximation. Several high income countries, however, are also classified as emerging markets, e.g. MSCI Emerging Markets Index covers 21 countries out of which four are classified by the World Bank as high income economies. According to the World Bank classification based on GNI per capita in 2009, our sample consists of 13 lower middle income economies, 18 upper middle income economies and 10 high income economies. European emerging market economies that adopted the euro before or in 2009 are not included in the sample, since, as members of the monetary union, they did not pursue independent monetary policies at the time of the crisis.

In all our specifications the growth performance is measured as a difference between forecast and actual GDP growth in 2009, hereafter referred to as a GDP forecast error (GDP_FE), unexpected growth performance or loss in GDP growth. It is supposed to measure macroeconomic effects of the crisis. To construct this variable, we have used the IMF's GDP growth forecasts that were published in the spring 2008 edition of *World Economic Outlook*, that is before the global loss of confidence had spread through the financial markets (IMF, 2008, 2012).[11] With the variable of this kind, it is easier to assess the effectiveness of monetary policy options used to mitigate the adverse impact of the crisis. It was these policies that were changed during the global downturn, thus the difference between projected and actual GDP growth remained in a relatively strong relation to the effectiveness of the policy option chosen. Another important factor that potentially contributed to that difference was the magnitude of

[10] See Pearson website for an interesting comment on the definition of emerging markets or the *Economist* for a felicitous and humorous statement that: "'Emerging markets' is a useful term precisely because it is imprecise … it covers a bewildering range of economies with little in common, except that they are not too rich, not too poor and not too closed to foreign capital" (Economist, 2012).

[11] In using terms "global loss of confidence" and "global downturn" (see below) we follow terminology proposed by the Bank of International Settlements to describe stages of the crisis: 1. prelude to the crisis (pre-March 2008), 2. events leading up to the Lehman bankruptcy (mid-March to mid-September 2008), 3. global loss of confidence (15 September to late October 2008), 4. global downturn (late October 2008 to mid-March 2009), and 5. downturn deepens but loses speed (BIS, 2009).

an external economic shock and the economy's vulnerability to such shocks. A set of controls, discussed below, is included in the regression to take care of the size of and vulnerability to external shocks.

Two other important arguments in favour of the chosen dependent variable are as follows. First, it automatically corrects for anticipated adjustments in growth, e.g. those stemming from the fact that different countries were in different phases of their business cycles or those related to the level of the economic development. Second, as we use the data on annual GDP growth in 2009, we allow for differences in transmission of the global shocks to various economies.[12] Though Blanchard et al. (2010a) also focus on the difference between the actual and forecast growth, they use the quarterly data. Their sample, however, covers barely 29 countries since the data of such frequency are not available for a large number of emerging market economies.

Data on unexpected GDP growth performance in emerging market economies in 2009 are depicted in Fig. 1.[13] The difference between forecast and actual growth is positive for all countries in the sample, but it is quite varied even for pairs of similar (not only in terms of the exchange rate regime) economies like Brazil and Mexico, Indonesia and Thailand or the Czech Republic and Poland. The difference ranges from less than 1 percentage point for China and Morocco to 18 percentage points or more for the Baltic States and Armenia.

Three policy tools are used to extract policy options from the actual behaviour of monetary authorities: interest rate spread (SPREAD), exchange rate (E_RATE) and international reserves excluding gold (RESERVES). A detailed description of variables and sources is presented in Table 1. Since almost all central banks cut their policy rates during the crisis, we focus on the changes in a difference between the domestic interest rate and the interest rate in the euro area.[14] Three-month money market interest rates are used. It is assumed that the degree to which the exchange rate was used was reflected in the magnitude of depreciation at the most intense stage of the crisis. Nominal effective exchange rates are used to calculate the currency depreciation. The depletion of reserves is treated as a variable describing the intensity of reserves utilisation to neutralize an external shock.

Since the unexpected GDP growth performance in 2009 was not only the result of the policy option adopted at the end of 2008, a set of macroeconomic control variables – including those that are most often used in the empirical literature – is added as explanatory variables. The following controls are used (all in per cent of GDP): export volume (EXPORT), short-term external debt (DEBT), current account (CA), net domestic credit (CREDIT), financial openness (KAOPEN or LMF). We also include three variables that measure the condition of the domestic financial sector (all in per cents), i.e. return on assets (ROA), return on equity (ROE), and the inverse of the probability of insolvency (Z_SCORE).

A detailed description of variables is provided in Table 1. Since these variables are supposed to reflect crisis vulnerability, we use their values at the end of 2007 (an additional advantage is that we avoid potential endogeneity problems).[15] The more important the exports in a given economy, the more it is exposed to disturbances coming from the world economy (trade shocks). Both short-term external debt and current account deficit can be treated as proxies for economy's dependence on the inflow of foreign capital. The greater they are, the more the economy is susceptible to financial shocks. Financial openness indices are supposed to account for heterogeneity across countries with respect to capital controls. The more closed capital account (low KAOPEN or/and low LMF), the less vulnerable the economy to external financial shocks. Net domestic credit, which is the sum of financial sector's claims both on the central government and other sectors of domestic economy, is used to take care of countries' variation with respect to an internal balance. Since the financial sector played an important role in the crisis, we add controls that measure profitability of banks (ROA and ROE) and the

[12] These two arguments have been put forward by Berkmen et al. (2012) in the working paper version of their article. See also Llaudes et al. (2010) who point to similar problems.

[13] For the descriptive statistics of both the dependent and independent variables see Table A2 in the Appendix.

[14] Three-month money market interest rates in all major advanced economies sharply decreased in the last quarter of 2008 and the first quarter of 2009. To a great extent it was the result of coordinated monetary policy loosening undertaken by the major central banks. Thus, we think that treating the euro interest rate as a benchmark does not limit our analysis. Moreover, since it was slightly higher than the U.S. rate, a potential switch to the latter would simply result in a uniform increase in interest rate spreads analysed.

[15] For financial sector controls 2008 averages are used.

Table 1
Variable description.

Variable	Full name	Description	Source
GDP_FE	GDP forecast error	Forecast GDP growth in 2009 (based on projection in April 2008) minus actual GDP growth in 2009	World Economic Outlook, IMF.
SPREAD	Interest rate spread	3-month money market interest rate minus 3-month EURIBOR; Construction: mean spread for October 2008 −February 2009 minus median spread in January 2008 −August 2008 in percentage points	IMF; for China, Hungary, Israel, Macedonia, FYR Bosnia and Herzegovina, Egypt national central banks
E_RATE	Exchange rate	Nominal effective exchange rate (BIS broad measure); for Egypt national currency per SDR; Construction: mean value for Oct. 2008–Feb. 2009 as a percentage of maximal value in Jan. 2008–Aug. 2008	Bank of International Settlements; for Armenia, Bolivia, Egypt, Georgia, Morocco, Macedonia, FYR, Pakistan, Tunisia IMF; for Bosnia and Herzegovina, Colombia, Venezuela, Rep. Bol.
RESERVES	International reserves	Total reserves minus gold (in US. dollars); Construction: mean value for October 2008-Febraury 2009 as a percentage of maximal value in January 2008 −August 2008	International Financial Statistics, IMF
EXPORT	Export	Share of total exports in GDP in percent in 2007	World Development Indicators, World Bank
DEBT	Short term external debt	Share of short term external debt in GDP in percent, end of 2007	World Development Indicators, World Bank
CA	Current account	Share of current account in GDP in percent in 2007	World Development Indicators, World Bank
CREDIT	Net domestic credit	Share of net domestic credit in GDP in percent in 2007	World Development Indicators, World Bank
ROA	Return on Assets	Profitability of banking sector; computed as unweighted average across all banks in 2008	Beck et al. (2009).
ROE	Return on Equity	Profitability of banking sector; computed as unweighted average across all banks in 2008	Beck et al. (2009).
Z_SCORE	Financial stability	The inverse of the probability of insolvency in 2008	Beck et al. (2009).
EMP	Exchange market pressure	$EMP = \ln(1 + SPREAD/100) + \ln(100/E\_RATE) + \ln(100/RESERVES)$	See sources for SPREAD, E_RATE, and RESERVES
KAOPEN	Chinn-Ito index	A de jure measure of financial openness	Chinn and Ito (2008) and their website: web.pdx.edu/~ito/Chinn-Ito_website.htm
LMF	Lane and Milesi-Ferretti index	A de facto measure of financial openness; sum of foreign assets and liabilities to GDP in percent	Lane and Milesi-Ferretti (2007) and their website: www.philiplane.org/EWN.html
GDP_REG	Regional GDP forecast error	Forecast of regional GDP growth in 2009 (based on projection in April 2008) minus actual regional GDP growth in 2009	World Economic Outlook, IMF
H_PEG	Hard peg	Dummy: 1 for countries with no separate legal tender or on currency board; 0 otherwise	IMF (2008).
S_PEG	Soft peg	Dummy: 1 for countries with other conventional fixed peg arrangement, pegged exchange rate within horizontal bands, crawling peg or crawling band; 0 otherwise	IMF (2008).
M_FLOAT	Managed float	Dummy: 1 for countries on managed floating with no pre-determined path for the exchange rate; 0 otherwise	IMF (2008).
FLOAT	Independent float	Dummy: 1 for countries under independent floating; 0 otherwise	IMF (2008).
MPF_1	Exchange rate-targeting	Dummy: 1 for countries with exchange rate anchor; 0 otherwise	IMF (2008).
MPF_2	Monetary-targeting	Dummy: 1 for countries with monetary aggregate target; 0 otherwise	IMF (2008).
MPF_3	Inflation-targeting	Dummy: 1 for countries under inflation-targeting framework; 0 otherwise	IMF (2008).

Table 1 (*continued*)

Variable	Full name	Description	Source
MPF_4	Other framework	Dummy: 1 for countries with no explicitly stated nominal anchor (or those for which no relevant information is available); 0 otherwise	IMF (2008).
AFRICA		Dummy: 1 for African countries; 0 otherwise	–
ASIA		Dummy: 1 for Asian countries; 0 otherwise	–
EUROPE		Dummy: 1 for European countries; 0 otherwise	–
LATIN	AMERICA		Dummy: 1 for Latin American countries; 0 otherwise
–			

stability of the sector (Z_SCORE).[16] One would expect both profitability and stability to increase resilience to financial disturbances coming from the world economy.

The size of an external shock is proxied by an additional control variable, i.e. a simple index of exchange market pressure (EMP).[17] One can reasonably expect that the economies subjected to more adverse shocks experience more pronounced decline in the economic growth. Monetary policy response could be related to the expected economic performance and the severity of the shock. Thus, having no control for the size of the shock would likely result in the reverse causality problem, i.e. the estimates would reflect the impact of GDP growth perspective on monetary policy option rather than the effectiveness of the latter in crisis mitigation. In order to avoid the reverse causality problem, we include the EMP index into our regressions. Moreover, since the EMP index could be argued to reflect financial shocks only, we also use the proxy for trade shocks, i.e. a difference between forecast and actual GDP growth rates in the region (GDP_REG) in the robustness analysis.

A set of dummies for de facto exchange rate arrangements is included in the regression analysis. To that end the IMF de facto classification is used (IMF, 2008).[18] It reports the actual exchange rate regimes at the end of April of 2008. Exchange rate regimes are divided into four types (the IMF's categories included in a respective type are given in brackets): hard peg arrangement (no separate legal tender, currency board) (H_PEG), soft peg arrangement (other conventional fixed peg, pegged exchange rate within horizontal bands, crawling peg, crawling band) (S_PEG), managed floating (managed floating with no predetermined path for the exchange rate) (M_FLOAT) and freely floating (independently floating) (FLOAT) (Table 1).

4. Empirical results

4.1. Monetary policy options and country groups

The objective of this part of the analysis is to discover similarities between countries with respect to monetary policy options adopted in order to mitigate the effects of the crisis. Groups are identified by comparing three variables: nominal effective exchange rate (E_RATE), interest rate spread (SPREAD), and international reserves (RESERVES). Since RESERVES have greater variability (see Table A2) and, therefore, greater discriminatory power than the other two variables, all variables are standardized.

The rationale behind looking for groups of countries with similar monetary policy response is that, once they are identified, it is possible to compare them with respect to their effectiveness in mitigating the impact of the crisis. It is worth emphasizing that policy options should be viewed as combinations (sets) of changes in the interest rate spread, nominal effective depreciation and international reserves

[16] We thank an anonymous referee for pointing out this issue and for suggesting the source of data.

[17] For more on this index and problems involved in its construction see Klassen and Jager (2011) and Li et al. (2006). In this study we use a simple EMP index which has the same weights for all components. Moreover, changes in international reserves are scaled by their initial level and not by monetary base.

[18] The IMF changed the de facto classification taxonomy in February 2009. This, however, has no impact on our taxonomy since it is less refined. For details on new classification see IMF (2009, pp. xliv-l).

Table 2
Country groups (based on Ward's method).

GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
10	10	10	3	8
Argentina	Bosnia & Herzegovina	Brazil	Korea, Republic of	Algeria
Armenia	Bulgaria	Chile	Pakistan	China
Bolivia	Estonia	Colombia	Poland	Egypt
Croatia	Georgia	Czech Republic		Hong Kong
India	Latvia	Hungary		Israel
Moldova	Lithuania	Indonesia		Singapore
Romania	Macedonia, FYR	Mexico		Thailand
Russia	Malaysia	Philippines		Tunisia
Uruguay	Morocco	Turkey		
Venezuela	Peru	South Africa		

depletion. Regression analyses make it possible to discover differences between these policy options and to interpret them in a straightforward way, which would not be possible if original variables and their interaction were included in the regression.

Groups of countries are determined with the use of hierarchical methods (Ward linkage), the k-means method and partitioning around medoids (PAM) method (Euclidean distance). The division is made under the assumption that the number of groups is not greater than five. This assumption has been adopted due to the fact that the dummies for policy options (groups) are supposed to be used in the regression analyses. Since our sample consists of 41 countries, a large number of groups would lead to an excessive loss in degrees of freedom. Additionally, existing classifications, with which we intend to compare the partitioning obtained in our study, have fewer than five categories (e.g. the exchange rate classifications applied in empirical studies usually have two or three categories, and the IMF has four monetary policy frameworks[19]). The point is that the relatively simple and intuitively clear comparison is possible if the number of categories in classifications compared is not too different. Thus, it is assumed that the number of groups is between two and five.

In order to identify the optimal number of clusters, four validation criteria were used: the average silhouette width, the Calinski Harabasz index, the Dunn index and Xie-Beni index.[20] The quality of data partition is increasing in all criteria (except the Xie-Beni index for which the lower the index, the higher the quality). The validation criteria for clustering results are reported in Table A3 in the Appendix. The first three criteria attain their maximal values for the five-cluster classification, while Xie-Beni index has the lowest value. This finding was also common across alternative methods of data partitioning (Ward, k-means, and PAM).

Classification results for all three methods turn out to be quite similar. This is reflected in the almost equal average silhouette width across all the methods applied (for the five-cluster classification it ranges from 0.35 to 0.37) and high values of adjusted Rand index (see Table A4 in the Appendix). The latter ranges from 0.65 to 0.86 implying that classifications obtained from alternative methods are relatively close to one another.

In spite of the relatively clear-cut results of the division into groups, it should be noticed that the groups identified are not strongly homogeneous from a statistical point of view: the average silhouette width is not very high.[21] This, however, does not make it unreasonable to check if the groups identified have sensibly clear economic interpretation. After all, we look for distinctive features of monetary policy options and will test formally within the regression framework whether options are significant in explaining the cross-country variation in crisis resilience.

The final division into five groups of countries is presented in Table 2. Descriptive statistics for original variables across the groups are provided in Table A5 in the Appendix. Box plots of interest rate

[19] For instance Tsangarides (2012) classifies exchange rates into “fixed” and “non-fixed”.
[20] See also Tsangarides and Qureshi (2008).
[21] Kaufman and Rousseeuw (1990) argue that the clear structure is present in the data if the average silhouette width is greater than 0.50.

spread (SPREAD), exchange rate (E_RATE) and international reserves (RESERVES) across groups of countries are illustrated in Fig. 2. The distributions of growth performance (GDP_FE) and exchange market pressure (EMP) index across country groups are presented in Figs. 3 and 4 respectively.

A distinctive feature of the first group of countries (Table 2) is a relative increase in the interest rate spread (the median is 5.7%), a small depletion of international reserves and no clear pattern for exchange rate change (in fact, on average a slight appreciation took place). This group includes countries under either soft peg (Argentina, Bolivia, Croatia, Russia, and Venezuela) or managed float (others), i.e. exchange rate arrangements that are called intermediate regimes (see Fig. 2 and Table A5 and Table A6 in the Appendix).

Countries in the second group (Table 2) have used their international reserves to make the adjustment to external shocks less costly in terms of output (Fig. 2). A median drop in reserves is more than 20%. While this line of defence was characteristic mainly for countries under hard peg arrangements, two economies with soft peg (Morocco, Macedonia, FYR) and three under managed float

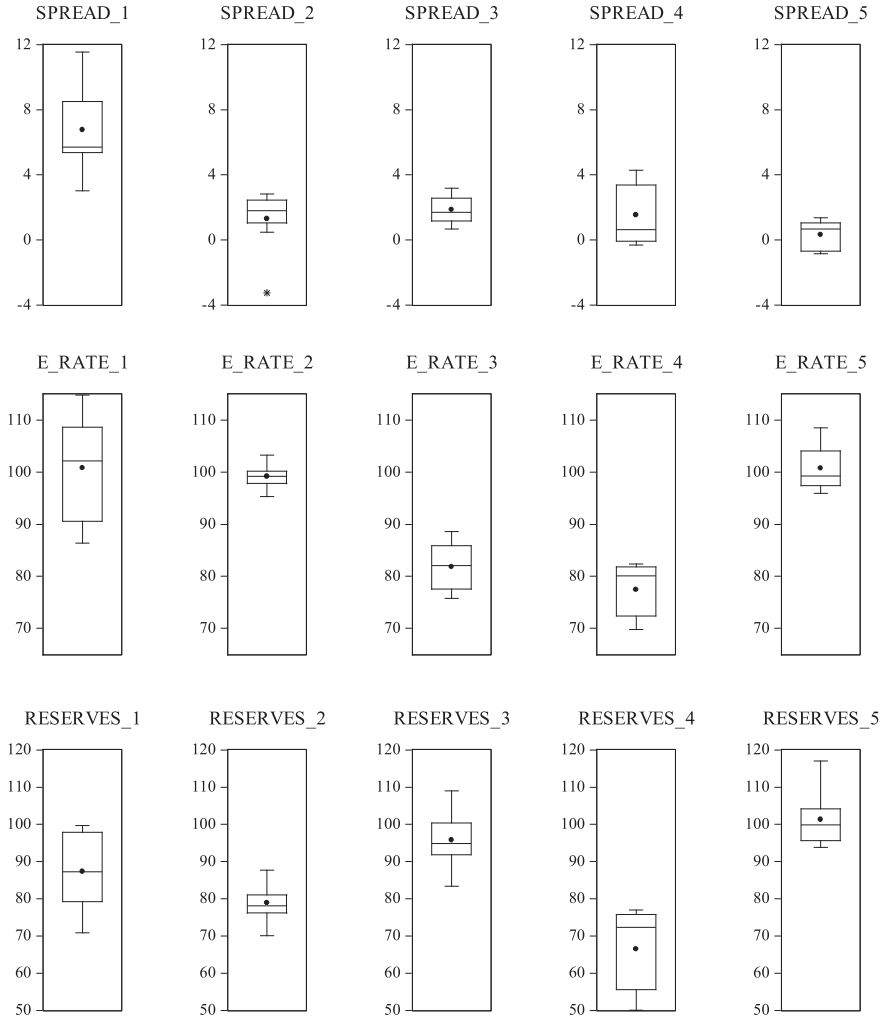

Fig. 2. Box plot of interest rate spread (SPREAD), exchange rate (E_RATE) and international reserves (RESERVES) across groups of countries.

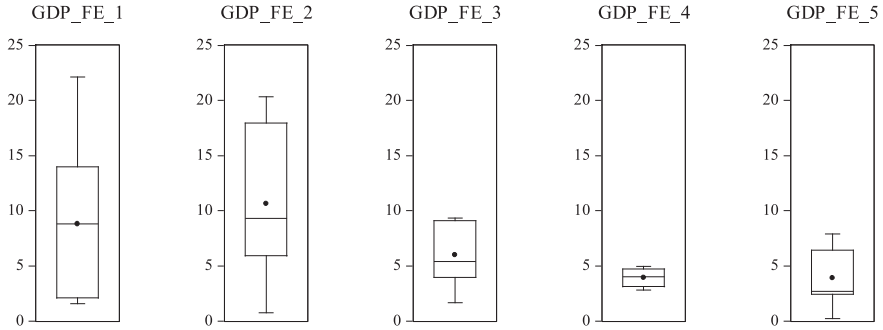

Fig. 3. Box plot of GDP growth loss (GDP_FE) across groups of countries.

(Georgia, Malaysia, Peru) are also included in this group. All of them, however, have been quite reluctant to allow for changes in exchange rates.

The third group includes countries with independent float and two managed floaters (Colombia and Indonesia). One can intuitively expect them to allow for depreciation of their currencies and this intuition turns out to be correct (a median depreciation was 18.1%). At the same time, they were reluctant to use their reserves (a median drop is 5.1%). Using the term coined by Aizenman and Sun (2012), one can conclude that monetary authorities in these countries revealed the "fear of losing international reserves", which was stronger than the "fear of floating". Interestingly, as many as six countries in this group (Chile, Colombia, Czech Republic, Mexico, Philippines, South Africa) out of ten are also included by Aizenman and Sun (2012) in their group of countries unwilling to allow for reserves depletion.[22]

A common feature of countries in the fourth group, the smallest one, is the policy of reserves depletion and depreciation of domestic currency (medians for reserves loss and depreciation are 37.7% and 22.5% respectively; see Fig. 2). There are two independent floaters (Korea and Poland) and one managed floater (Pakistan) in this group. Since this variant of policy response is a mixture of two "pure" responses observed in the second and third groups, it is worth pointing at some similarities and differences between these three groups. Monetary authorities in all these countries have not allowed for a substantial rise in interest rate spreads, which is in contrast to countries in the first group. All experienced a considerable rise in an exchange market pressure index, which makes them different from countries in the fifth group. The distinctive feature of the fourth group, however, is that the exchange market pressure is more than twice as strong as in two other groups (median indices are 61.8% in the fourth group versus slightly above 25% in two others).

The last group identified comprises of economies that experienced relatively weak external shocks. The exchange market pressure index is by a wide margin the lowest for this group with its median value close to zero and small variability (Fig. 4 and Table A5 in the Appendix). Monetary authorities in these countries were not forced to accommodate adverse external shocks with monetary policy tools: interest rate spreads hardly changed, depreciation was absent or its magnitude was limited, and there was no international reserves depletion; in fact, in several economies reserves even went up and some currencies slightly appreciated. It is also interesting that this group, unlike the others, covers either economies with closed financial accounts (Algeria, China, Thailand and Tunisia) or very open ones (Egypt, Hong Kong, Israel, and Singapore).[23]

[22] The other four are either classified as countries with depreciated currencies (Brazil, Indonesia, and Turkey) or absent in Aizenman and Sun's sample (Hungary). Differences can partly be explained by different methodologies: Aizenman and Sun (2012) assume a threshold level for reserves depletion (10 per cent), whereas we use statistical methods to identify country groups. The differences result also from the sample size: Aizenman and Sun's sample covers 21 emerging markets, whereas our sample is almost twice as numerous as theirs.

[23] Financial openness is measured with Chinn-Ito index (Chinn and Ito, 2008).

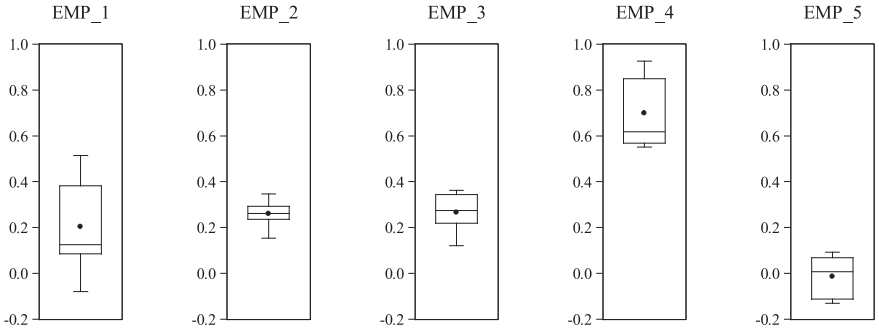

Fig. 4. Box plot of exchange market pressure (EMP) across groups of countries.

Since we propose a new classification of countries, which is based on de facto monetary policy options adopted, one could ask whether it is indeed different from the existing classifications. It could be that our groups match the exchange rate classification or mimic the division based on monetary policy frameworks identified by the IMF. The latter includes: exchange rate anchor, monetary aggregate targeting, inflation targeting and framework with no explicitly stated nominal anchor.[24] Thus, we have looked at our groups critically in the sense that we compare them with the two IMF's classifications and their geographical location. Table A3 in the Appendix reports adjusted Rand indices that measure the degree of coherence among alternative classifications.

One can argue that our groups, except for the first group, are homogeneous with respect to a monetary policy framework: exchange rate anchor dominates in the second and fifth groups, whereas inflation targeting is characteristic for the remaining groups. This, however, is not the same as saying that our groups mimic the IMF's classification because of at least three reasons. First, the adjusted Rand index is 0.01, which suggests that the two classifications are almost independent and definitely less similar than the two IMF's classifications (0.31). Additionally, the first group is strongly diversified with respect to monetary policy framework: it includes countries with all types of frameworks and none seems to dominate. The last, perhaps the most important reason, is that the countries with the *same* monetary policy framework are in *different* groups, e.g. exchange rate anchor is almost equally "distributed" across the first, second, and fifth groups.

Similar arguments can be formulated with respect to other two classifications. Adjusted Rand indices for exchange rate arrangements and geographical location are 0.04 and 0.03 respectively. Thus, one can hardly argue that, for instance, floaters or Latin American economies are concentrated in a single group or more generally that the groups identified capture the same information as provided by other classifications.

4.2. Regression analyses

The magnitude of unexpected GDP growth loss is used to evaluate the effectiveness of monetary policy options for crisis mitigation identified in the previous subsection. To that end, alternative versions of quantile regression are constructed. There are two reasons that induce us to apply quantile regression framework rather than the classical OLS approach. First, the OLS estimates are sensitive to outliers in the dependent variable whereas the nonlinearity of the quantile regression estimator makes the estimates robust to the presence of outliers (Koenker and Hallock, 2001). Second, and more importantly, quantile equality test and symmetric quantiles test, whose results are reported in Table A11 in the Appendix, reject the hypothesis that the coefficients are equal across all quantiles. This could be an indication of potential nonlinearities in parameter estimation. Thus, to get a complete

[24] A more thorough description can be found in IMF (2009, p. xii).

Table 3
OLS and median regression results using the logarithm of the GDP forecast error as a dependent variable.

Specification	Reg. (1) – OLS	Reg. (2)	Reg. (3)	Reg. (4)	Reg. (5)	Reg. (6)	Reg. (7)
EXPORT	0.020***	0.017***	0.013**	0.024***	0.021***	0.015**	0.016***
	(0.006)	(0.005)	(0.006)	(0.007)	(0.007)	(0.006)	(0.005)
DEBT	−0.005*	−0.006***	−0.002	−0.006**	−0.006*	−0.004	−0.005**
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
CA	−0.027*	−0.013	−0.033***	−0.030**	−0.032**	−0.024*	−0.020*
	(0.014)	(0.010)	(0.012)	(0.013)	(0.013)	(0.013)	(0.011)
CREDIT	−0.008*	−0.006*	−0.004	−0.011**	−0.012**	−0.014***	−0.003
	(0.004)	(0.003)	(0.005)	(0.005)	(0.004)	(0.04)	(0.003)
ROA	0.621**	0.722***	0.286	0.450*	0.431*	0.562**	0.677***
	(0.228)	(0.176)	(0.235)	(0.244)	(0.224)	(0.216)	(0.197)
ROE	−0.079***	−0.099***	−0.045*	−0.073**	−0.058**	−0.079***	−0.086***
	(0.024)	(0.018)	(0.027)	(0.029)	(0.026)	(0.024)	(0.021)
Z_SCORE	−0.017	−0.023***	−0.016	−0.009	−0.005	−0.003	−0.031***
	(0.010)	(0.008)	(0.011)	(0.011)	(0.010)	(0.010)	(0.008)
EMP	2.879***	2.868***		0.916	0.709	0.796	2.728***
	(0.974)	(0.733)		(0.618)	(0.591)	(0.561)	(0.765)
KAOPEN	0.037	0.188***			0.149	0.181**	0.185***
	(0.084)	(0.062)			(0.088)	(0.083)	(0.064)
H_PEG	−0.410	0.141				0.739*	
	(0.517)	(0.373)				(0.376)	
S_PEG	−0.969**	−0.575				−0.131	
	(0.452)	(0.339)				(0.313)	
M_FLOAT	−0.767*	−0.159				0.011	
	(0.386)	(0.282)				(0.254)	
GROUP_1	2.286***	1.957***					1.661***
	(0.691)	(0.539)					(0.499)
GROUP_2	1.993***	1.674***					1.599***
	(0.698)	(0.538)					(0.488)
GROUP_3	1.431**	1.487***					1.510***
	(0.533)	(0.431)					(0.455)
GROUP_5	2.461**	2.316***					2.145***
	(0.891)	(0.676)					(0.659)
C	−0.256	−0.212	1.776***	1.417***	1.482***	1.791***	−0.367
	(0.776)	(0.614)	(0.349)	(0.450)	(0.428)	(0.434)	(0.666)
Observations	41	41	41	41	41	41	41
Pseudo R^2	0.771	0.586	0.355	0.368	0.403	0.441	0.530
Adjusted R^2	0.618	0.310	0.218	0.210	0.230	0.201	0.304

Standard errors are in parentheses. Quantile regression standard errors are based on bootstrap with 1000 replications. The sparsity function is computed with a Kernel (Epanechnikov) method. ***, **, and * indicate significance at the 1, 5, and 10 per cent levels, respectively.

picture of conditional distribution of the dependent variable, the quantile regression framework is used.

Our benchmark regression model is given by equation (4). It relates the logarithm of unexpected decline in GDP growth in emerging market economy with a set of control variables, groups identified in the first stage of our analysis, and other classifications:

$$\ln GDP\_FE_j = \beta_0 + \beta_{\text{Control}}\text{CONTROL}_j + \beta_{\text{Shock}}\text{SHOCK}_j + \beta_{\text{Class}}\text{CLASS}_j + \beta_{\text{Group}}\text{GROUP}_j + \varepsilon_j \quad (4)$$

where GDP_FE_j stands for the GDP forecast error for country j, CONTROL_j is a vector of control variables (EXPORT, DEBT, CA, CREDIT, ROA, ROE, Z_SCORE, KAOPEN, LMF) for country j, SHOCK_j is a vector of proxies for severity of financial and trade shocks (EMP, GDP_REG) for country j, CLASS_j is a vector of alternative sets of dummies (one set is used at a time) and includes de facto exchange rate regimes, monetary policy frameworks, and regional locations of country j, and GROUP_j is a vector of dummies for groups for country j.

The analysis is divided into two complementary steps. First, alternative specifications of equation (4) are analysed and compared in order to assess the impact of various sets of explanatory variables on

Table 4
Robustness of median regression results using the logarithm of the GDP forecast error as a dependent variable.

Specification	Reg. (8)	Reg. (9)	Reg. (10)	Reg. (11)	Reg. (12)	Reg. (13)	Reg. (14)
EXPORT	0.019***	0.019***	0.017***	0.016**	0.015***	0.013*	0.018**
	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)	(0.007)	(0.006)
DEBT	−0.004	−0.005**	−0.006***	−0.002	−0.004*	−0.004	−0.005*
	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
CA	−0.024**	−0.005	−0.013	−0.046***	−0.014	−0.002	−0.020
	(0.011)	(0.014)	(0.013)	(0.014)	(0.012)	(0.016)	(0.016)
CREDIT	−0.008**	−0.003	−0.006	−0.014***	−0.007*	−0.001	−0.001
	(0.003)	(0.005)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
ROA	0.361*	0.451**	0.730***	0.497**	0.821***	0.295	0.594*
	(0.200)	(0.215)	(0.190)	(0.224)	(0.201)	(0.226)	(0.220)
ROE	−0.058***	−0.072***	−0.100***	−0.075***	−0.112***	−0.040	−0.080***
	(0.020)	(0.024)	(0.019)	(0.025)	(0.021)	(0.026)	(0.024)
Z_SCORE	−0.017*	−0.005	−0.024***	−0.037***	−0.032***	−0.010	−0.037***
	(0.008)	(0.010)	(0.008)	(0.011)	(0.009)	(0.300)	(0.010)
EMP	2.755***	1.214**	2870***	−0.488	2.217**	0.975	3.226***
	(0.756)	(0.566)	(0.777)	(0.687)	(0.834)	(0.577)	(0.876)
KAOPEN		0.068	0.191***	0.043	0.159*	0.091	0.109
		(0.077)	(0.067)	(0.088)	(0.078)	(0.084)	(0.075)
LMP	−0.025						
	(0.056)						
LnGDP_REG		0.459**	−0.010				
		(0.203)	(0.185)				
H_PEG	0.038		0.144				
	(0.434		(0.417)				
S_PEG	−1.062***		−0.562				
	(0.328)		(0.357)				
M_FLOAT	−0.648**		−0.148				
	(0.290)		(0.319)				
MPF_1				−0.113	−0.390		
				(0.252)	(0.278)		
MPF_2				−0.730	−0.452		
				(0.525)	(0.466)		
MPF_4				0.704	0.022		
				(0.414)	(0.385)		
ASIA						−1.063**	−0.230
						(0.409)	(0.379)
LATIN AMERICA						−0.746**	−0.091
						(0.355)	(0.319)
AFRICA						−1.036**	0.378
						(0.426)	(0.441)
GROUP_1	2.441***		1967***		1.651***		1.975***
	(0.546)		(0.571)		(0.561)		(0.553)
GROUP_2	1.872***		1684***		1.749***		1.723***
	(0.600)		(0.583)		(0.543)		(0.530)
GROUP_3	1.490***		1510***		1.451***		1.723***
	(0.447)		(0.442)		(0.475)		(0.498)
GROUP_5	2.197***		2337***		1.988***		2.308***
	(0.005)		(0.704)		(0.675)		(0.740)
C	−0.110	0.480	−0.206	2.700***	0.385	1.904***	−0.721
	(0.631)	(0.562)	(0.683)	(0.504)	(0.730)	(0.460)	(0.768)
Observations	41	41	41	41	41	41	41
Pseudo R^2	0.585	0.445	0.586	0.424	0.545	0.454	0.531
Adjusted R^2	0.309	0.260	0.280	0.177	0.241	0.220	0.218

Standard errors are in parentheses. Quantile regression standard errors are based on bootstrap with 1000 replications. The sparsity function is computed with a Kernel (Epanechnikov) method. ***, **, and * indicate significance at the 1, 5, and 10 per cent levels, respectively.

unexpected GDP growth performance. The objective of this part is to evaluate the sensitivity of regression models to changes in a vector of explanatory variables and comparison of alternative specifications in terms of goodness of fit. The results of this part are presented for the median regression which is a special case of quantile regression. Next, we focus on the complete set of explanatory variables in equation (4) given by the baseline regression and carry out the full analysis of quantile regressions. The results are reported for 0.1, 0.25, 0.50, 0.75, 0.90 quantiles of conditional distribution of the dependent variable. Using the bootstrap method 90 per cent confidence intervals for parameters are calculated. This allows us to assess whether the effect of explanatory variables is stable and significant at different points of the unexpected GDP growth conditional distribution.

Regression results are summarized in Tables 3 and 4. All regressions are based on variants of equation (4). Parameter estimates and their standard errors (given in parentheses) are for the median regressions.

Our starting specification is regression (3) in Table 3. It includes seven control variables only and a constant. Ratios of exports-to-GDP and current account balance to GDP are both correctly signed and statistically significant: higher exposure to foreign trade and greater dependence on foreign capital (more negative current account) result in a greater reduction in unexpected economic growth. Out of controls measuring of the condition of financial sector only return on equity is significant indicating that the higher the profitability of the sector, the lower the GDP growth loss. Both net domestic credit-to-GDP ratio and short-term external debt-to-GDP ratio are wrongly signed and insignificant. It is slightly surprising in the case of the latter ratio since it has been found to be statistically significant in other studies (e.g. Berkmen et al., 2012 or Blanchard et al., 2010a). It is probably because both current account balance and short-term external debt measure, at least to a certain extent, a similar thing, namely external vulnerability. Moreover, though Berkmen et al. (2012) do not include current account in their preferred specification, they admit that "the current account balance is statistically significant even when the exchange rate regime or net open position in foreign assets is controlled for, implying that while leverage was the crucial financial linkage, the degree of external imbalances was important". The third reason is that we adopt a different estimation technique. The variability of net domestic credit across countries seems to have a negligible effect, both statistically and economically, on their growth performance.

Adding exchange market pressure index to the regression seems to sharpen the picture: now more controls are significant, though net domestic credit and debt remain to be incorrectly signed (regression 4). Two indices of profitability, i.e. ROA and ROE, have opposite signs which might be a bit confusing. This, however, can be interpreted by making a reference to the median profitability: using data on median ROA and ROE from Table A2, one can find out that the overall impact of profitability is about −0.47 (=0.45*1.13−0.073*13.39). Thus, the higher the financial sector profitability, the smaller the unexpected growth decline. The EMP index has a positive impact on the loss in GDP growth as expected, but its effect is quite weak and insignificant. These results hardly change if the set of controls is extended to include the financial openness measure (regression 5).

The results of a regression with dummies for the de facto exchange rate regime are presented as regression 6. The relevant parameters should be interpreted in terms of a difference between a given exchange rate regime and a free floating which is treated as a reference exchange rate arrangement. The effect of exchange rate regime on GDP growth performance during the crisis seems to be quite weak. Performance of economies with managed float or soft peg did not diverge from that of floaters at any conventionally adopted statistical significance levels. Only for countries under hard peg was the growth decline relatively deeper, although from the economic point of view this disadvantage was moderate. Its magnitude can be illustrated with the following experiment:[25] were Poland under a hard peg arrangement, instead of a free floating, at the time of the crisis, then *ceteris paribus* economic growth would be lower by 3.1 percentage point. It is interesting to observe that our general conclusion that the relation between exchange rate regime and growth performance is relatively weak is in

[25] The results of this and similar experiments should not be interpreted in terms of a forecast. They are only supposed to describe the difference between groups.

accordance with the empirical literature, e.g. Berkmen et al. (2012) also find that the benefits of exchange rate flexibility seem to be limited.

Regression with dummies for groups of countries identified in the previous step of our empirical strategy looks more promising (regression 7). The fourth group of countries is treated as a reference group. Differences with respect to that group are significant both statistically and economically. Again, to illustrate these differences one can carry out a familiar experiment of moving Poland from the reference group to another group and check for the effects. Therefore, were Poland shifted to the group of countries that allowed for an increase in the interest rate spread (the first group), the GDP growth would fall by 12 percentage points. If the "target group" is either countries that used their international reserves (the second group) or those that depreciated their currencies (the third group), the economic growth would deteriorate by 11.2 and 10.0 percentage points respectively. A shift to the fifth group would result in a huge additional growth loss of 21.3 percentage point. This could be puzzling at first glance. The problem is that the experiment is conducted under the *ceteris paribus* assumption. From the previous subsection we know, however, that the exchange market pressure was the most intensive in the fourth group, medium in the first, second, and third group, and the weakest in the fifth group. Thus, it could be reasonable to modify the experiment slightly and set the EMP index for Poland to be equal to the median index in the "target group". In other words, not only is its group status changed when Poland is moved to another group, but the EMP index is adjusted accordingly to match the median in the "target group". Under such assumptions, the loss in GDP growth, that results from the shift, shrinks to 1.8 percentage point if Poland is moved to the first group and to 3.5, 3.2 or 2.6 percentage point when Poland is moved to the second, third or fifth group respectively.[26]

Regression with country groups has an advantage over regression based on de facto classification of exchange rate regimes not only on economic grounds but also from a statistical point of view. An important feature of a model with country groups is the statistical significance of dummies for groups. Thus, information on similarities between countries as to the monetary policy options for crisis mitigation is important to explain variability of the GDP growth performance. Moreover, higher pseudo R-squared and adjusted R-squared for the regression with country groups than the one with exchange rate regimes lend support for the former. One has to admit, however, that the regression (7) shows that the fourth group is different in its impact on the loss in GDP growth from other groups but does not settle whether there are differences between other groups. In order to check for such differences, the Wald tests are performed: group coefficients are tested both pair by pair and jointly for equality. In all cases the null is not rejected at 5 per cent level, which leaves some room for exchange rate regimes as explanatory variables.[27]

A more thorough picture of monetary policy options for crisis mitigation can be recovered from the regression that includes both exchange rate regimes and groups of countries (regression 2). Two key conclusions can be drawn from it. First, while economic significance of coefficients for dummies for exchange rate regimes remains essentially unchanged (the results of the experiment with a change of exchange rate arrangement in Poland do not differ from those based on regression (6) by more than 0.9 percentage point[28]), coefficients that reflect differences between groups have increased (the only exception is the coefficient for the third group, which virtually has not changed). In other words, the inclusion of information on exchange rate regimes has contributed to an enhancement of differences between groups. For example, if Poland were to be moved to a group of countries that allowed on a relative increase in the interest rate spread (the first group), then the GDP growth would collapse by as much as 17.2 percentage points (and not by 12 p.p.). If the "target group" is the one with countries that lose reserves (the second group) or had low EMP (the fifth group), the growth loss would be 12.2 or 25.8 p.p. respectively. Only for the "target group" of countries with depreciated currencies (the third

[26] We have also run a somewhat counterintuitive regression without the EMP index and found out that the differences between groups are not significant at conventional levels of significance. This result lends support to our conjecture that the size of the shock (proxied by the EMP index) should be taken into account in order to correctly identify the impact of monetary policy options on the GDP growth performance.

[27] The only difference that turns out to be significant at 10% level is the one between the third and fifth groups.

[28] For hard peg the difference is 2.7 p.p., but the coefficient becomes statistically insignificant.

group), the GDP growth loss would be slightly smaller than the one implied by regression (7), i.e. 9.7 versus 10 p.p.[29]

Second, although "the informational value added" by exchange rate arrangement dummies may look unimportant when assessed from the perspective of statistical significance, one should be circumspect about drawing such a conclusion because of three reasons. First, the differences between all groups are more palpable than in the regression without exchange rate regime dummies. This time a joint hypothesis of equality of all group coefficients is strongly rejected with p-value of 0.04. Moreover, when group coefficients are tested for equality pair by pair, six out of a total of ten pairs are found to be statistically different at 5 per cent level and one at 10 per cent level. Third, the exchange rate regime dummies are statistically significant in the regressions with slightly modified set of controls, which are run to examine the robustness of our findings. Thus, when an alternative measure of financial openness – i.e. the sum of foreign assets and liabilities to GDP proposed by Lane and Milesi-Ferretti (2007) – is used (see regression 8 in Table 4), two out of three exchange rate regime dummies turn out to be significant. Other coefficients are quite similar to those obtained in regression 2, and especially those for our groups are significant. The same picture emerges from regressions with alternative proxies for the dependence on an inflow of foreign capital, that is loans from non-resident banks to GDP, total foreign liabilities to GDP, and net foreign assets to GDP (see regressions A1–A3 in Table A8 in the Appendix). A plausible interpretation of these findings is that information on exchange rate regime is rather complementary to and not substitutionary for information on groups of countries identified.

4.3. Additional robustness checks

Several additional robustness checks are performed. First, a proxy for the severity of a trade shock is included in the baseline specification. It is defined as a difference between forecast and actual GDP growth rates in the region, e.g. for Chile it is the unexpected GDP loss in Latin America. Such a proxy is correctly signed and significant in the regression with controls only (regression 9) implying that a one percentage point decline in the regional GDP growth contributes to an increase in the GDP loss equal to 0.5 percentage point. The proxy for a trade shock does not change the results obtained in the baseline regression: monetary policy options (groups) are still significant and coefficients are almost the same (regression 10).

Two other checks are based on the conjecture that the "group effect" may be just an offshoot of some other classification that is imperfectly reflected in monetary policy options. Thus, we use monetary policy frameworks identified by the IMF and the geographic location as explanatory variables. Monetary policy frameworks are insignificant no matter whether groups are included in the regression (see regressions 11 and 12). The similar conclusion holds for regressions (13) and (14) in which regional dummies are used: though emerging markets outside Central and Eastern Europe (which is treated as a reference region) experienced on average smaller unexpected loss in GDP growth (coefficients are negative and significant), geographical variation turns out to be insignificant when monetary policy options are included in the regression. Overall, alternative classifications seem to convey less information on GDP growth performance during the crisis than the one that groups countries with respect to monetary policy options adopted. Thus, the least stringent interpretation would be that alternative classifications can be treated similarly as exchange rate arrangements, i.e. as conveying complementary information to that provided by monetary policy options.

Taking into account the point raised by Eichengreen and Razo-Garcia (2013), namely that disagreements over de facto exchange-rate-regime classifications are not uncommon and most prevalent in emerging market and developing economies, we have examined Reinhart and Rogoff's de facto classification and official (de jure) IMF's classification. Following Eichengreen and Razo-Garcia (2013), we have mapped 14 categories in the original Reinhart and Rogoff's classification into: pegs, intermediate regimes and floats (for details see Reinhart and Rogoff, 2004 and Table A7 in the Appendix). De jure classification has been treated similarly. Regression results are presented in Table A9 in the

[29] With the correction for the EMP index the numbers would be: 3.4, 4.0, 3.0, 3.6 p.p. for groups 1-3 and 5.

Appendix. Though the coefficients for monetary policy options (groups) are slightly lower than in the benchmark specification (regression 2), they remain highly statistically significant, whereas those for exchange rate regimes are insignificant.[30]

The additional regression is run in order to test for the relevance of fiscal space: it could be that due to high public debt the central bank has to bear the burden of stabilization (Obstfeld, 2013), and, therefore, the monetary policy option is selected with an eye on fiscal space. After controlling for public debt to GDP ratio, however, our main results remain unchanged (regression A4 in Table A8).

Several emerging market economies entered swap agreements with major central banks.[31] Thus, it seems reasonable to explore whether our results are robust to the existence of a swap line. We run four regressions with dummy variable(s) for the swap lines (see regressions A5–A8 in Table A8 in the Appendix). Coefficients have expected signs, i.e. having a swap line during the crisis made the GDP loss lower (the only exception are swaps under Chiang Mai Initiative). None of these dummies, however, turned out to be significant. More importantly, these dummies have no effect on other coefficients, i.e. their inclusion in the regression does not change our results in any significant way.

The final check is done with an actual decrease in GDP growth as a dependent variable instead of the difference between forecast and actual growth. It can be argued that the former is free of forecast errors associated with the IMF forecast models whereas the latter could potentially be plagued by this problem.[32] The problem with the actual decrease in GDP growth is that it would require a potentially large set of additional explanatory variables that would control for variation in growth rates due to differences in levels of development or cyclical positions.[33] In order to cut speculation about this issue, a new dependent variable is defined as a (log of) difference between average GDP growth in 2003–2007 and growth observed in 2009. Regression results are presented in Table A10 in the Appendix. The main finding is that monetary policy options remain significant with similar influence on the dependent variable as in the benchmark specification.[34]

The results presented above are based on median regressions. In order to present a more complete picture of the effects of explanatory variables on the unexpected GDP growth loss, the regressions are run for four more quantiles, i.e. the 10th, 25th, 75th, and 90th. In principle, it is possible that the impact of a given explanatory variable is not the same at different points of the conditional distribution of the loss of GDP growth. For instance, it could be the case that reserve depletion is the policy response that matters only when the loss of economic growth is the highest, i.e. for the 90th quantile of conditional distribution of dependent variable. One can also treat results from the quantile regressions as a supplementary robustness check because they allow to test whether monetary policy options are significant for quantiles other than a median. In addition, we also run interquantile regressions that enable us to test whether coefficients at various quantiles are different from those for the median (quantile slope equality tests) and whether coefficients are symmetric with respect to the median (symmetric quantiles test).

Table 5 reports results from the quantile regressions. A large portion of the quantile estimates is statistically significant and coefficients have the same signs as those in the median regression unless they are insignificant (the only exception is KAOPEN). This observation holds for exchange rate arrangements as well and thus it lends support to our argument for having such dummies in the baseline regression even if they are insignificant in the median regression. The estimates across different quantiles with 90 per cent confidence intervals around them are depicted in Fig. 5. One can see that the exchange rate regime is important at the first two quantiles of the conditional distribution of the loss in GDP growth: both peggers (hard and soft) and managed floaters come out better than independent floaters. At other quantiles, economic and statistical significance of these dummies decreases. Similar

[30] We have also tried the alternative mapping with four categories very much like the Reinhart and Rogoff's coarse classification. The results have been very similar to those in Table A9 and are available upon request.

[31] Flagship examples are Brazil, Korea, Mexico and Singapore. More on swap lines see, e.g., Aizenman et al. (2011).

[32] We thank an anonymous referee for pointing at this issue.

[33] This is, in fact, a point raised by Berkmen et al. (2012), with which we agree.

[34] In a related study Llaudes et al. (2010) examine the relation between the impact of the crisis on emerging market economies and their initial fundamentals and financial and trade linkages. They use four alternative measures of output loss during the crisis and find that "the results are robust to using either of these measures."

Table 5
Quantile regressions with the logarithm of the GDP forecast error as a dependent variable.

Specification	Quantile 10th	Quantile 25th	Quantile 50th	Quantile 75th	Quantile 90th
EXPORT	0.031*** (0.005)	0.027*** (0.005)	0.017*** (0.005)	0.018*** (0.004)	0.012*** (0.004)
DEBT	−0.006** (0.003)	−0.006** (0.003)	−0.006*** (0.002)	−0.005** (0.002	−0.003 (0.002)
CA	−0.040*** (0.014)	−0.032** (0.0.14)	−0.013 (0.010)	−0.035*** (0.011)	−0.024** (0.011)
CREDIT	−0.005 (0.004)	−0.007 (0.004)	−0.006* (0.003)	−0.005 (0.003)	−0.004 (0.003)
ROA	0.666*** (0.222)	0.549** (0.221)	0.722*** (0.176)	0.624*** (0.182)	0.533*** (0.170)
ROE	−0.090*** (0.022)	−0.068*** (0.023)	−0.099*** (0.018)	−0.066*** (0.017)	−0.062*** (0.016)
Z_SCORE	−0.029*** (0.010)	−0.036*** (0.011)	−0.023*** (0.008)	−0.008 (0.007)	−0.018** (0.008)
EMP	4.629*** (0.957)	3.952*** (0.970)	2.868*** (0.733)	3.002*** (0.717)	2.398*** (0.771)
KAOPEN	−0.158** (0.076)	−0.100 (0.083)	0.188*** (0.062)	−0.025 (0.060)	0.020 (0.061)
H_PEG	−1.390** (0.496)	−1.198** (0.504)	0.141 (0.373)	−0.504 (0.376)	0.020 (0.384)
S_PEG	−1.717*** (0.455)	−1.441*** (0.438)	−0.575 (0.339)	−1.501*** (0.335)	−0.716** (0.332)
M_FLOAT	−1.690*** (0.389)	−1.359*** (0.376)	−0.159 (0.282)	−0.785** (0.295)	−0.392 (0.296)
GROUP_1	3.543*** (0.679)	3.254*** (0.686)	1.957*** (0.539)	2.902*** (0.506)	2.581*** (0.522)
GROUP_2	3.203*** (0.680)	2.974*** (0.694)	1.674*** (0.538)	2.464*** (0.519)	1.959*** (0.513)
GROUP_3	2.419*** (0.516)	2.237*** (0.497)	1.487*** (0.431)	1.500*** (0.379)	1.510*** (0.391)
GROUP_5	3.914*** (0.855)	3.567*** (0.888)	2.316*** (0.676)	2.758*** (0.643)	2.237*** (0.684)
C	−1.972** (0.769)	−1.410* (0.744)	−0.212 (0.614)	−0.524 (0.573)	−0.046 (0.587)
Observations	41	41	41	41	41
Pseudo R^2	0.709	0.597	0.586	0.627	0.690
Adjusted R^2	0.516	0.328	0.310	0.378	0.483

Standard errors are in parentheses. Quantile regression standard errors are based on bootstrap with 1000 replications. The sparsity function is computed with a Kernel method. ***, **, and * indicate significance at the 1, 5, and 10 per cent levels, respectively.

observation can be made for monetary policy options: their effect also abates as one moves to higher quantiles although it remains highly statistically significant across all quantiles.

The confidence intervals for the quantile and OLS regressions seem to be relatively similar (Fig. 5). This observation, however, should be interpreted cautiously as the formal tests of differences between estimated coefficients across quantiles of the conditional distribution of the dependent variable point to important dissimilarities (see Table A11 in the Appendix). The null hypothesis of slope equality (with respect to the median) is rejected for exchange rate regime dummies at the 10th, 25th, and 75th quantiles. For monetary policy options the differences across quantiles are significant for the first and second group. Using symmetry quantiles tests, we reject the null of conditional symmetry for all the exchange rate arrangements and for the first and second groups. Extracting more economic content from these results, one can argue that: (1) monetary policy options have a significant impact on the loss of GDP growth across all quantiles; (2) in the case of the first and second group the effect is stronger for the 10th and 25th quantiles than for the others (nonlinearity), whereas in the case of the third and fifth group the impact is more stable and symmetric across quantiles; (3) on the one hand, exchange rate regimes are not significant in all points of distribution of GDP growth performance, and, on the other hand, their impact is more diversified across different quantiles than that of monetary policy responses.

5. Conclusions

One should not be surprised by inconclusive empirical results obtained in studies of the effects of exchange rate regime on relative resilience of emerging market economies to the global financial crisis. After all, the macroeconomic theory does not imply that an exchange rate regime puts firm and strict binding constraints on the macroeconomic policy. Neither does it fully predetermine which policy option of adjustment to an external economic shock will be chosen by the monetary authorities.

Our empirical findings make us even more sceptical about the hypothesis that exchange rate regimes, in and of themselves, fully predetermine monetary policy in the face of an external shock. Though this hypothesis hardly finds any advocates in the field of theory, it has crept into numerous empirical researches. We depart from that line of empirical research and propose a careful and rigorous approach that is based on an analysis of monetary policy options used in order to accommodate external shocks.

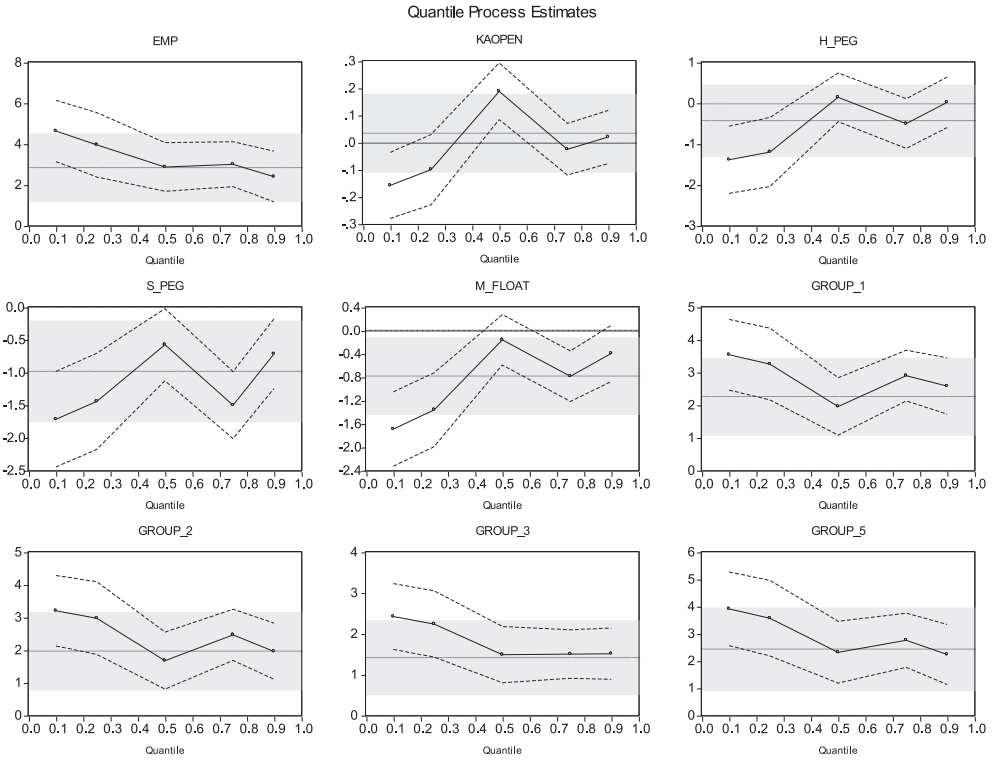

Fig. 5. Quantile coefficients process. Note: Figure is based on the OLS regression (1) in Table 3 and the quantile regressions in Table 5. The solid line illustrates the coefficient estimates across the quantiles (holding all other variables constant). The dashed lines above and below it show the borders of the 90% confidence interval. The dashed straight line depicts the OLS estimate. The shaded area represents the 90% confidence interval for the OLS estimate.

The main conclusions are as follows. First, as predicted by the macroeconomic theory, we find out that the monetary authority in a country with a fixed exchange rate is more reluctant to allow for the depreciation of domestic currency when the crisis hits than the monetary authority of a floater. There is, however, no clear (statistical) difference in the growth performance during the most intense phase of the crisis between countries at the opposite poles of exchange rate regime spectrum. Thus, our second conclusion is that it is not enough to look at the exchange rate regime when making comparisons between economies' resilience to external shocks. Countries should be rather allocated to a given category according to the policy option actually adopted in order to mitigate the crisis. We have constructed five such groups. After controlling for the size of a shock and external vulnerability, the option of depreciation *cum* international reserve depletion turns out to outperform other policy options, i.e. either depreciation or reserves depletion, and, in particular, the rise in the interest rate spread, which has been the most costly line of defence.

Third, there are complementarities between information on group membership and on exchange rate regime adopted. Including the latter into the regression analysis allows us to sharpen the impact of groups on the GDP growth performance. It is possible that there is something like a premium for consistency between the policy option selected by monetary authority and the prevailing exchange rate regime. This issue, however, requires a more extensive treatment and we leave it for future research.

Fourth, using quantile regressions we demonstrate that our results are relevant not only to a mean of the conditional distribution of the GDP growth loss but to almost all of its quantiles. This is especially pertinent to the impact of monetary policy options on the GDP growth performance: it remains highly significant and relatively stable across all quantiles.

Acknowledgements

We are very grateful to the editor, Menzie Chinn, and two anonymous referees for their constructive comments. We thank conference participants at the 7th Professor Aleksander Zelias International Conference on Modelling and Forecasting of Socio-Economic Phenomena, for their helpful suggestions. All remaining errors are ours.

Appendix A. Supplementary data

Supplementary data and regression results related to this article can be found at http://dx.doi.org/10.1016/j.jimonfin.2014.12.006.

References

Aizenman, J., Chinn, M.D., Ito, H., 2010. The emerging global financial architecture: tracing and evaluating new patterns of the trilemma configuration. J. Int. Money Finance 29, 615–641.
Aizenman, J., Jinjarak, Y., Park, D., 2011. International reserves and swap lines: substitutes or complements? Int. Rev. Econ. Financ. 20, 5–18.
Aizenman, J., Sun, Y., 2012. The financial crisis and sizable international reserves depletion: from 'fear of floating' to the 'fear of losing international reserves'? Int. Rev. Econ. Financ. 24, 250–269.
Beck, T., Demirgüc-Kunt, A., 2009. Financial Institutions and Markets across Countries and over Time: Data and Analysis. World Bank Policy Research Working Paper No. 4943.
Berkmen, S.P., Gelos, G., Rennhack, R., Walsh, J.P., 2012. The global financial crisis: explaining cross-country differences in the output impact. J. Int. Money Finance 31, 42–59.
BIS, 2009. 79th Annual Report. Bank for International Settlements, Basel.
Blanchard, O., Faruqee, H., Das, M., 2010a. The initial impact of the crisis on emerging market countries. Brookings Pap. Econ. Activity 263–323. Spring.
Blanchard, O., Dell'Ariccia, G., Mauro, P., 2010b. Rethinking macroeconomic policy. J. Money, Credit Bank. 42 (Supplement s1), 199–215.
Bussière, M., Cheng, G., Chinn, M.D., Lisack, N., 2014. For a Few Dollars More: Reserves and Growth in Times of Crises. NBER Working Paper No. 19791.
Calinski, T., Harabasz, J., 1974. A dendrite method for cluster analysis. Commun. Statistics 3, (1), 1–27.
Calvo, G.A., Reinhart, C.M., 2002. Fear of floating. Q. J. Econ. 117 (2), 379–408.
Chinn, M.D., Ito, H., 2008. A new measure of financial openness. J. Comp. Policy Anal. 10 (3), 309–322.
Dąbrowski, M.A., 2014. Czy kryzysy finansowe zmieniają optymalny poziom rezerw dewizowych w gospodarkach wschodzących? Ekonomista forthcoming.
Didier, T., Hevia, C., Schmukler, S.L., 2012. How resilient and countercyclical were emerging economies during the global financial crisis? J. Int. Money Finance 31, 2052–2077.
Dominguez, K.M.E., Hashimoto, Y., Ito, T., 2012. International reserves and the global financial crisis. J. Int. Econ. 88, 388–406.
Dunn, C.J., 1974. Well-separated clusters and optimal fuzzy partitions. J. Cybern. 4, 95–104.
Eichengreen, B., Razo-Garcia, R., 2013. How reliable are de facto exchange rate regime classifications? Int. J. Finance Econ. 18, 216–239.
Economist, April 21, 2012. It may no longer be wise to group these disparate countries together. Economist.
Fleming, J.M., 1962. Domestic Financial Policies under Fixed and Floating Exchange Rates, pp. 369–379. IMF Staff. Pap. 9.
Frenkel, J.A., 1999. No Single Currency Regime Is Right for All Countries at All Times. Essays in International Finance No. 215.
Ghosh, A.R., Chamon, M., Crowe, C., Kim, J.I., Ostry, J.D., 2009. Coping with the Crisis: Options for Emerging Market Countries. IMF Staff Position Note SPN/09/08.
Hutchison, M.M., Noy, I., Wang, L., 2010. Fiscal and monetary policies and the cost of sudden stops. J. Int. Money Finance 29, 973–987.
IMF, 2008. Annual Report on Exchange Arrangements and Exchange Restrictions. International Monetary Fund, Washington, D.C.
IMF, 2009. Annual Report on Exchange Arrangements and Exchange Restrictions. International Monetary Fund, Washington, D.C.
IMF. World Economic Outlook Database. April 2008 and October 2012 editions.
Kaufman, L., Rousseeuw, P.J., 1990. Finding Groups in Data: an Introduction to Cluster Analysis. Wiley & Sons, New York.
Klassen, F., Jager, H., 2011. Definition-consistent measurement of the exchange market pressure. J. Int. Money Finan 30, 74–95.
Klein, M.W., Shambaugh, J.C., 2010. Exchange Rate Regimes in the Modern Era. MIT Press, Cambride, MA – London.
Koenker, R., 2005. Quantile Regression. Cambridge University Press.
Koenker, R., Basset Jr., G., 1978. Quantile regression. Econometrica 46, 33–50.
Koenker, R., Hallock, K., 2001. Quantile regression: an introduction. J. Econ. Perspect. 15 (4), 43–56.
Lane, P.R., Milesi-Ferretti, G.M., 2007. The external wealth of nations mark II: revised and extended estimates of foreign assets and liabilities, 1970–2004. J. Int. Econ. 73, 223–250.
Li, J., Rajan, R.S., Willett, T., 2006. Measuring Currency Crises Using Exchange Market Pressure Indices: the Imprecision of Precision Weights. Claremont Graduate University Working Paper No. 2006-09.
Llaudes, R., Salman, F., Chivakul, M., 2010. The Impact of the Great Recession on Emerging Markets. IMF Working Papers, WP/10/237. IMF, Washington.
Mundell, R.A., 1963. Capital mobility and stabilization policy under fixed and flexible exchange rates. Can. J. Econ. Political Sci. 29 (4), 475–485.

Obstfeld, M., 2013. On keeping your powder dry: fiscal foundations of financial and Price stability. Monetary Econ. Stud. 31.
Obstfeld, M., Shambaugh, J.C., Taylor, A.M., 2010. Financial stability, trilemma, and international reserves. Am. Econ. J. Macroecon. 2 (2), 57–94.
Obstfeld, M., Shambaugh, J.C., Taylor, A.M., 2005. The trilemma in history: tradeoffs among exchange rates, monetary policies, and capital mobility. Rev. Econ. Stat. 87 (3), 423–438.
Pearson. Emerging Markets Defined. www.pearsoned.co.uk/.
Reinhart, C.M., Rogoff, K.S., 2004. The modern history of exchange rate arrangements: a reinterpretation. Q. J. Econ. 119, 1–48.
Rose, A.K., 2011. Exchange rate regimes in the modern era: fixed, floating, and flaky. J. Econ. Lit. 49 (3), 652–672.
Tsangarides, C.G., Qureshi, M.S., 2008. Monetary Union membership in West Africa: a cluster analysis. World Dev. 36, 1261–1279.
Tsangarides, C.G., 2012. Crisis and recovery: role of the exchange rate regime in emerging market countries. J. Macroecon. 34, 470–488.
Xie, X., Beni, G., 1991. Validity measure for fuzzy clustering. IEEE Trans. Pattern Anal. Mach. Intell. 13, 841–847.