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**Working paper**

**DID THE CRISIS CHANGE IT ALL? EVIDENCE FROM MONETARY AND FISCAL  
POLICY**

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**ABSTRACT**

The recent financial and economic crisis has triggered bold and diverse policy responses to prevent further, sharper and prolonged adverse effects to the financial and the real sector. The measures for alleviating the cycle were a feature both of the advanced and the emerging and developing economies, albeit less pronounced in the latter. The bulk of extraordinary measures undertaken refers to providing monetary and fiscal stimulus, implying possible change within the monetary and the fiscal policy reaction function. Hence, in this study we estimate monetary and fiscal policy reaction function, on a sample of 61 advanced and emerging and developing countries, using panel techniques. Since the purpose is to assess the potential change in the reaction functions during the recent crisis, estimates are done for the period prior and during the crisis. More precisely, we have analyzed whether monetary and fiscal policies have been more focused on closing the output gap during the recent crisis vis-à-vis the period before the crisis. Our findings prove that the magnitude of the reaction has been much stronger during the crisis period. In addition to this key research question, the analysis investigates whether policy responses in the advanced economies have been stronger compared to the ones in developing economies. Advanced economies appear to have been much more aggressive in stabilizing output during crisis compared to their emerging and developing counterparts. Finally, the role of the constraints - the exchange rate regime, the initial conditions in context of external position (the current account balance and the level of external indebtedness), as well as the fiscal space (public debt) - is also explored. We find that the pegged exchange rate regime, the high current account and the high external indebtedness have constrained monetary authorities to respond to inflation and output during crisis, while there is mixed evidence for the constraining role of the high level of public debt to the fiscal policy reaction.

**Key words:** global crisis, monetary policy, fiscal policy, policy change, policy constraints, panel

JEL classification: E43, E52, E58, E61, E62, E63

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## I. INTRODUCTION

After the default of Lehman Brothers in mid-September 2008, the financial markets turmoil, which started in August 2007, turned into one of the most severe and synchronized global economic downturn since 1930s. Against the background of appalling state of the financial system and perceived urgency of preventing a very deep recession, monetary and fiscal authorities responded with bold and decisive interventions, including measures that were unprecedented in nature, scope and timing. The bulk of the extraordinary measures undertaken refers to providing monetary and fiscal stimulus, implying possible changes within the monetary and the fiscal policy reaction function. Furthermore, policy responses have differed markedly among different economies. Differences may reflect the initial conditions in terms of international exposure, financial and external vulnerabilities, as well as heterogeneity in macroeconomic setups. For example, the lower stage of development and the relatively low integration in the world financial market, has most likely helped emerging and developing economies to avoid turmoil on their financial markets, while at the same time advanced economies were facing severe disorders, with important financial institutions collapsing or "pleading" for bailouts. On the other hand, the greater external vulnerability has very much narrowed the scope for emerging and developing economies to take more vigorous monetary and fiscal measures.

In this study we try to evaluate the potential change in the policy reaction functions triggered by the latest crisis. Hence, we estimate the conventional monetary and fiscal policy reaction function prior and during the crisis, on a sample of 61 advanced and emerging and developing countries, using panel technique. We restrict our empirical analysis to the conventional policy instruments. More precisely, our research is focused to answer: whether monetary and fiscal policies have put more weight on the output gap during the recent crisis, vis-à-vis the period before the crisis? In addition to this key research question, the analysis investigates whether policy responses in the advanced economies were stronger compared to the ones in emerging and developing economies. Finally, the role of the potential constraints - the exchange rate regime, the initial conditions in context of external position (current account balance and level of external indebtedness) as well as the fiscal space (constrained by public debt) - for more vigorous policy responses are also explored.

The paper is organized as follows. Section II provides a chronological overview of policy responses employed by advanced and emerging and developing economies during crisis. Section III discusses the data and methodology. Section IV documents the empirical results. Section V concludes.

## II. POLICY RESPONSES TO THE RECENT CRISIS

The 2007-09 global economic and financial crisis caused hardship around the world, posing complex challenges for central banks, both in advanced and emerging and developing economies. In order to cope with the crisis, the most severe one since the Great Depression, central banks were compelled to *clearly depart from the conventional monetary policy implementation framework* (Ishi et al, 2009), by employing unprecedented easing measures and developing new innovative tools. This particularly refers to central banks in advanced economies (hereafter referred to as AE), which on the backdrop of systemic financial stress and rapidly weakening economic fundamentals, aggressively cut interest rate and heavily engaged themselves in so-called balance sheet policies. Emerging and developing economies (hereafter referred to as EDE) also eased monetary conditions at large. However, due to their characteristics, the specific macroeconomic context that they are operating in and the varied degrees of external and financial vulnerabilities, EDE response to the crisis considerably differed from that of AE as in timing, type, magnitude and novelty.

AE were the first to be affected by the financial turbulence, since it erupted in mid-summer 2007, provoking their central banks to have an early reaction with anti-crisis intervention measures. Still, even as signs of stress appeared in the financial system, during the initial stage in late 2007 and the first half of 2008, shocks seemed to be isolated and limited to liquidity strains on AE money and short-term credit markets. The events that followed later on, with the financial disorder progressively evolving into the deepest and broadest financial and economic crisis since the 1930s, were hard to imagine at that time. In such circumstances, major central banks generally reacted through their conventional means by raising the scale of their liquidity-providing operations. Besides the U.S. Federal Reserve (FED), which almost instantaneously engaged in aggressive interest rate cut\*, during the first year of the crisis, the rest of the AE central banks did not ease their interest rates much. In mid 2008, the European Central Bank (ECB) even raised its main refinancing rate because of concerns related to the ongoing inflation pressures within the euro zone. One year later, in its 79th Annual Report, BIS will note that policymakers have *underappreciated the extent of the slowdown in mid-2008 and the strength of the associated disinflationary forces*, so they reacted the way they reacted, by increasing the policy rates or keeping them unchanged (BIS 79th Annual Report, pp.92).

With the events of September 2008, the crisis entered into a new stage, far more challenging for monetary policy and world economy overall. The failure of Lehman Brothers and intervention of AIG led to hoarding liquidity by financial and nonfinancial companies and severely disrupted monetary policy transmission channels. Economic activity started to collapse, which along with the apparent prospects of deflation made aggressive monetary easing critical. Against this background, AE central banks responded by decreasing policy rates and more ample liquidity-providing interventions, both in domestic and foreign currency. As of the beginning of 2009, as economic contraction was proceeding with alarmingly progressive pace, AE central banks continued to ease their monetary policy stance more forcefully. They cut policy interest rates to

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\* Federal funds rate was reduced by 325 bps to 2 percent between July 2007 and June 2008.

historical lows, near the effective lower-bound, and several publicly committed to maintaining them at these levels for prolonged periods (FED, Bank of Canada). However, given the size of the shocks, the severely impaired monetary policy transmission channels and appalling state of the financial sector and the economy at large, it became clear that the well-known traditional monetary policy instrument, i.e. the policy rate, though effective in the pre-crisis period, would not be sufficient for AE to bridge over this crisis episode. Bearing this in mind and constrained by the zero bound on the interest rates, most of the AE central banks shifted their focus to "balance sheet policies", thus hiring some "unconventional" measures in the form of quantitative and qualitative easing. The role of these balance sheet policies was to target particular segments of the transmission mechanism, involving initiatives to alleviate strains in wholesale interbank markets and supporting specific credit markets (BIS, 2009). However, as noted by Gerlach (2010), many of the facilities employed by the central banks were not that novel in their essence, as they had actually been in place before the crisis, although the terms and conditions have been changed in response to the new environment (Gerlach, 2010, pg.52). Repo-operations have already been well established as standard monetary instrument for providing the financial sector with liquidity. During the crisis they had only modified their role with central banks considerably increasing the scale and extending the maturity of these operations. Lending facilities were also in place before, even though during the crisis central banks had considerably enhanced access, increased the number of counterparts and expanded eligible collateral. Several central banks provided liquidity by purchasing large amounts of securities directly. FED and the Bank of England introduced a few new facilities such as the Term Auction Facility in the US, while with the purpose of meeting foreign exchange liquidity shortfalls FX swaps were employed. As a result, AE central banks' balance sheets considerably expanded in size and modified in composition, urging for appropriate exit-strategies as soon as the crisis fades away.

EDE central banks also responded to the crisis, though their measures differed from those of AE in timing, type and magnitude. EDE central banks generally started to implement anti-crisis measures later. These measures were of a smaller magnitude compared to AE's and were mainly focused on foreign exchange liquidity. As noted in several studies exploring the crisis (Fujita et al, 2010; Ishi et al, 2009), these differences can be related to the varied degrees of financial stress and external vulnerability in EDE compared to AE, as well as the varied macroeconomic context that the two groups of countries are operating in. Thus, due to their lower stage of development and the relatively lower degree of financial integration into the global market, the first stage of the crisis with financial turmoil hitting the AE, had limited or no effects on EDE. EDE financial systems remained sound and stable with their liquidity markets staying functional at large. In such circumstances there was no need for EDE central banks to react early on the crisis by easing their monetary policy stance. Actually, before September 2008, alike ECB, several EDE also raised their policy rates in response to the inflationary pressures prevailing at that time. However, September 2008 marked the turning point for EDE with crisis starting to spill-over on their territories as well. As Lehman brothers bankruptcy tensions sky-rocketed, markets froze and global liquidity dried up. This was instantaneously felt on EDE foreign exchange markets, posing strong pressures for EDE domestic currencies to depreciate. In order to mitigate tensions, EDE central banks largely focused on foreign exchange liquidity measures. So, access to foreign liquidity facilities was relaxed at large and in some countries new tools were introduced, such as foreign exchange repo-transactions, credits and swaps. Guided by their domestic markets position, several central banks raised the scale of their liquidity-providing operations in domestic

currency as well. Reactions with interest rate cuts came in the crisis later on, with economic activity being slumping and inflation expectations being stabilized at large. Still, this was done cautiously and at a considerably lesser extent compared to AE. Thus, EDE policy rates remained well above the effective lower bound on interest rates. The potential risks of repeated deterioration of the external imbalances limited the room for maneuver precluding more aggressive counter-cyclical adjustments in EDE monetary policy stance. EDE did not resort to unconventional monetary policy tools as much, which can be explained by the less disrupted monetary transmission that their central banks had to deal with and the monetary policy not been constrained by zero lower bound on interest rates. The near absence of quantitative and credit easing measures caused the sizes of EDE central banks' balance sheets to increase by much less compared to AE.

Summing up, central banks, both in AE and EDE have heavily intervened during the recent crisis, though the effectiveness of the measures that were undertaken is hard to measure, particularly with respect to the balance sheet policies. Still, what matters is that they considerably contributed towards alleviating the liquidity strains, thus enhancing the state of the key markets. Beginning from the third quarter of 2009, economic activity also started to resurge at large, principally in AE, which is an additional fact in favor of monetary policy effectiveness. Still, what is indisputable is that monetary policy was only one way of stabilizing the economy. Without fiscal policy supporting the monetary policy to a large extent, the necessary stabilization would have hardly been achieved, meaning that during this crisis fiscal policy has certainly witnessed its revival as potent macroeconomic tool.

As the space for further monetary easing was diminishing, and the collapsed financial system impaired monetary transmission channels as well, the role for the fiscal policy in stimulating aggregate demand and restoring confidence was increasing. Many advanced economies employed bold and diverse fiscal stimulus packages, giving the discretionary component a large weight. Hence, despite the previous consent for the discretionary fiscal policy not to be used as a countercyclical tool, the depth and the length of the crisis asked for a more aggressive fiscal approach. The emphasis on the discretionary fiscal measures became even more prominent and viable at the same time, as in the later stage of the crises it was certain that the current recession would be long lasting. Hence, the well known shortcoming of the fiscal measures, the long internal lags, in a longer recession was more probable not to be an obstacle.

The first involvement of the fiscal authorities refers to the recapitalization of banks and government guarantees aimed at stabilizing the impaired financial system and regaining the confidence. Yet, as the financial crisis unfolded and transformed itself into a serious economic recession, a wider and stronger set of fiscal measures was required for alleviating the cycle. By the end of May, 2009, many OECD and non-OECD emerging economies announced fiscal stimulus packages (BIS, 2009). The size of the fiscal stimulus varies greatly among countries. The differences are not conditioned on the severity of the output drop, but mostly on the effectiveness of the automatic stabilizers. The largest stimulus was seen in US (gravitating at around 2% of GDP in 2009 and 2010, each), Korea (with cumulative stimulus at around 3.5% of GDP in 2009 and 2010) and Germany (with cumulative stimulus at around 3% of GDP in 2009 and 2010), while in countries like France and Italy the size of the fiscal stimulus was below 1% of GDP. Apart of the built-in automatic stabilizers, the difference in the magnitude of the

discretionary fiscal impulse was driven to a large extent by certain country specifics. This mainly refers to the initial “fiscal space”, i.e. the cyclical position of the fiscal policy prior to the crisis. For most of the AE, the fiscal policy prior to the crisis followed the countercyclical pattern, by saving in “good” times and spending in “bad” times, thus alleviating the business cycle. Hence, there was enough room for employing bold fiscal stimulus measures in these economies. For those economies where a pro cyclical fiscal pattern was followed prior to the crisis, a large discretionary package could lead to serious endangering of the fiscal sustainability. Furthermore, economies with accumulated public debt were also heavily constrained, as the widening of the budget deficit could yield in jeopardizing the debt sustainability. The proactive fiscal policy was also hampered by the policy frameworks in certain economies. This mainly refers to countries with an exchange rate peg, where currency pressures driven by the falling external demand and reversal in the capital inflows, did not allow for growth supporting fiscal policy stance.

The fiscal response to the recent crisis, in almost all countries followed the traditional recipes of utilizing, both the revenue and expenditure policies for boosting the aggregate demand. In many economies, the poor economic outlook was driven by the fall in the personal consumption, on the backdrop of slacked labor market and gloomy expectations. Aiming at stimulating the consumption, the bulk of the revenue measures were concentrated in alleviating the personal tax burden (close to 0.8% of GDP, cumulative 2009 and 2010). Albeit important, the other tax reliefs (business taxes, consumption and other taxes) jointly did not exceed the personal tax measures. As for the expenditures measures, albeit it is believed for the government consumption stimulus to have the outmost effect in shortening the length of the crisis, much of the emphasis within this crisis was put on public investment measures. “Fifteen of the G20 have announced plans to increase spending on infrastructure, largely on transportation networks (Canada, France, Germany, and Korea, among others), either in the form of direct central government spending, or through capital transfers to local authorities. According to Horton et al (2009), the emerging G20 countries have announced somewhat larger stimulus packages for 2009, on average, than the advanced G20 countries. This reflects smaller automatic stabilizers and consequently, greater need, as well as substantial fiscal space in key emerging market countries. China, Russia, Saudi Arabia, and South Africa have introduced large packages. Emerging market discretionary measures are also more heavily weighted to infrastructure investment and less focused on income tax cuts” (Bontas et al, pg. 10).

The fiscal implications of the fiscal responses during the recent crisis have been the largest ones since the Second World War (IMF, 2010). According to the IMF, in a sample of 32 advanced economies, 44 emerging economies and 49 developing countries, 40% of the countries were running overall surpluses in 2007, while in 2009 this share has been envisaged to drop to 10%. At the same time, the percentage of countries with budget deficit exceeding 3% of GDP has increased from 20% to 70%. In the AE (G-20) the budget deficit increased from 2% of GDP in 2007 to 10% of GDP in 2009, not only being driven by the expenditure policies, but also from the lasting effect of the crisis on the revenue collection from the falling assets prices, financial services and lowered potential output. At the same time, a sharp increase in the public debt is expected to be seen, from around 70% of GDP in 2007 to above 100% of GDP in 2014. Although the debt burden for EDE is perceived to be much lesser than in AE, still, the associated risks are seen as larger. “These economies face important risks, especially from possible

international spillovers. Indeed, large debt build-up in the advanced economies could lead to higher borrowing costs and crowding out of emerging markets' borrowers" (IMF, pg.9).

Although the size of the fiscal packages unquestionably was of a magnitude hardly seen before, the economic impact in mitigating the slack in the economy is difficult to be estimated precisely. Inevitably, policy stimulus is set as one of the main drivers of the gradual economic recovery in the second half of 2009. Yet, the quantitative estimates are difficult to be given. For instance, based on the previous episodes, it is estimated for the American Recovery and Reinvestment Act to have boosted GDP by 1.4 - 3.8 pp in 2009, and less in 2010 (BIS, 2009). Still, as the magnitude of the fiscal multipliers is difficult to be gauged, it is also difficult to estimate the fiscal impact to GDP. Furthermore, there is a high probability for the multipliers to have significantly changed during the recent crisis. On one hand, the argument in favor of larger multipliers is the limited access to credits, which can increase the propensity to spend out of each additional income, provided through fiscal measures. On the other hand, the increased risks and the uncertainty might provoke higher propensity to save, thus reducing the strength of the multipliers. In general, it is believed that although the fiscal stimulus was large, the effects are seen to be temporary, asking for more profound changes (to a large extent addressing the core problems in the financial system) yielding to a more sustainable growth path.

### III. DATA AND METHODOLOGY

The study covers 61 countries and employs quarterly data for the Q1.2000 – Q3.2009 period. Following the IMF's World Economic Outlook classification, countries are grouped as "advanced economies" and "emerging and developing economies" (AE and EDE, respectively; see Appendix, Table A.1. for the list of countries).

The variables used in the study are INTEREST, GAP, CPI\_YOY, GOV\_BALANCE\_CA, GOV\_EXP\_CA, FIXED, HIGH\_CA, HIGH\_EXT\_DEBT, HIGH\_PUB\_DEBT. INTEREST represents the central banks' official interest rate, GAP is the output gap and CPI\_YOY represents the annual CPI inflation rate. GOV\_EXP\_CA indicates the expenditures of General or Central Government, *cyclically adjusted*, and GOV\_BALANCE\_CA represents the balance between the *cyclically adjusted* revenues and expenditures of General or Central Government<sup>†</sup>. FIXED is a dummy variables for countries that have a fixed exchange rate, HIGH\_CA is a dummy variable standing for high current account deficit, HIGH\_EXT\_DEBT is a dummy representing countries with high gross external debt, while HIGH\_PUB\_DEBT represents countries with high public debt.

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<sup>†</sup> The cyclically adjusted government expenditure and budget balance represent the expenditure, i.e. balance, that would emerge if the economy was on the potential. They are calculated according to the following standard formulas:

$\text{cyclically adjusted revenues} = \text{revenues} - (\text{elasticity of revenues to output} - 1) * \text{output gap} * \text{revenues}$

$\text{cyclically adjusted expenditures} = \text{expenditures} - (\text{elasticity of expenditures to output} - 1) * \text{output gap} * \text{expenditures}$

$\text{cyclically adjusted balance} = \text{cyclically adjusted revenues} - \text{cyclically adjusted expenditures}$ .

For the elasticity of expenditures to output, we assume elasticity of 0, which implies that government expenditures do not change with the level of economic activity (i.e. a very weak social security net), whereas for the revenues, we assume elasticity of 1, which implies that government revenues increase by 1% when output grows by 1%. I



Table 1: Variables and sources of data

Variable	Description	Source
INTEREST	The official interest rate of the central bank (the bank rate or the discount rate) at the end of the given period (i.e. the quarter) on annual basis. For some countries, the money market rate, refinancing rate or Lombard rate.	International Financial Statistics
CPI_YOY	Annual CPI inflation rate, derived from the CPI inflation index number, 2005=100.	International Financial Statistics
GAP	Output gap, derived using HP filter, factor 1600.	International Financial Statistics
GOV_EXP	General or Central Government expenditure	International Financial Statistics
GOV_BALANCE	General or Central Government Budget balance	International Financial Statistics
FIXED	Dummy for a country with a fixed exchange rate	IMF De Facto Classification of Exchange Rate Regimes
HIGH_CA	Dummy for a country with high current account deficit. It takes value of one for countries whose current account deficit/GDP is beyond 5% in 2007.	International Financial Statistics
HIGH_EXT_DEBT	Dummy for a country with high external debt. Equals 1 for countries with gross external debt above 50% of GDP, for 2005-2007, on average.	Quarterly External Debt Statistics - The World Bank
HIGH_PUB_DEBT	Dummy for a country with high public debt, exceeding 60% of GDP, for 2005-2007, on average.	International Financial Statistics

Our empirical analysis is restricted to conventional policy instruments. Much of the monetary policy responses involved alternative measure to the interest rate, using the standard monetary reaction function might be a partial approach to the policy responses evaluation. Still, as we are trying to estimate differences prior and during the crisis and the balance sheet policies were not dominant when trying to meet monetary targets, our approach seems reasonable. In answering our research questions, we employ standard policy reaction functions. For the monetary policy, the standard instrument is the main interest rate of the central bank or the policy interest rate. For the fiscal policy, there are more instruments that can be used, thus we employ two of them - the budget expenditure and the budget balance, both of them cyclically-adjusted. As explanatory variables, in the monetary policy reaction function we use the year-on-year inflation rate and the output gap, whereas for the fiscal policy reaction function we use only the output gap. Alongside these variables, the policy rules include lags of the dependent variable, for the purpose of better explanation of the dynamics. The three basic policy rules are given below:

*Reaction function for the monetary policy*       $interest\ rate = \alpha_1 * interest\ rate(-1) + \alpha_2 * output\ gap + \alpha_3 * y-o-y\ inflation$

*Reaction function for the fiscal policy 1*       $budget\ balance = \beta_1 * budget\ balance(-1) + \beta_2 * output\ gap$

*Reaction function for the fiscal policy 2*       $budget\ expenditure = \gamma_1 * budget\ expenditure(-1) + \gamma_2 * output\ gap$

For the purpose of investigating whether monetary and fiscal policies have behaved differently *during the crisis in comparison to the period before*, we estimate the policy rules for two sub-periods. For investigation of the *differences between policies in AE and EDE*, we estimate the policy rules separately, for both groups of countries. Here, one notable distinction is the

specification of the monetary policy reaction function. For AE, the specification is forward-looking, i.e. we include two leads of the inflation and the output gap, while for EDE (and for whole sample of countries) it is backward-looking, i.e. it includes the current value of the inflation and the output gap, and two lags as well. Whether interest rate rules are forward- or backward-looking is an empirical question, and depends on the manner in which expectations are formed. Thus, for developing countries, it does not seem implausible that their future expectations are formed in adaptive manner, i.e. on the grounds of past inflation. Finally, to answer *whether certain factors have acted as constraints to the policies during the crisis*, we estimate the policy rules for the crisis sub-period, including interaction dummies that represent the constraint in the regression (e.g. cross product between the dummy for the *fixed exchange rate* and the output gap).

However, it is worth noting that our interest rate rule deviates from the rules that are usually met in the literature. Instead of the deviation of the inflation from the target, we include the actual inflation rate. The main argument for this is that we could not find data on targeted inflation for all the countries for the whole period. Not all the countries that are included in the analysis are inflation targeters (despite the fact that they might still respond to inflation), and even data for the target for some of the inflation targeting countries is not available for the whole period. Thus, by introducing the actual inflation rate we solve for these problems: we use the same specifications for all of the countries, which implicitly assumes that the target for all countries for the whole period is stable (if the target is stable, results would be the same, whether the target is included or not). Regarding the fiscal policy reaction functions, they are all backward-looking, i.e. include one lag of the output gap.

We estimate the policy rules using dynamic panel methods, more precisely, the Arellano-Bover method (Arellano and Bover, 1995). Dynamic panel methods are appropriate when the relationship between the variables is dynamic in nature (see Baltagi, 2005, p.135), which is almost always the case with policy rules, which usually include a lag of the dependent variable amongst the independent variables, to capture the smoothing behavior of the policies. The Arellano-Bover method uses forward orthogonal deviations to transform the data, i.e. to remove the individual effects (for details, see Arellano and Bover, 1995 or Baltagi, 2005, Chapter 8). We chose the Arellano-Bover and not the Arellano-Bond method (which uses differencing for removing the individual effects) since the former is shown to perform better (see Hayakawa, 2009). After the transformation, the Arellano-Bover method uses the Generalized Method of Moments (GMM) for estimating the coefficients of the regression.

Regarding the instruments, the dynamic instruments for the dependent variable, for computational reasons, are limited to the fourth lag. As for the independent variables, the instruments in the forward-looking specifications are the first, the second and the third lag, whereas in the backward-looking specifications, the third, the fourth and the fifth lag are used as instruments. As a method for assessing the validity of the instruments, we apply the J test, which actually tests whether the over-identifying restrictions for the instruments hold. We show the p values of the J test, and p values higher than 0.05 imply that the hypothesis that the instruments are valid, cannot be rejected.

Although dynamic panel methods are considered to be appropriate for panels with short time dimension, and our time dimension in some cases is rather long (up to 31), we still applied dynamic panel techniques and not panel cointegration models, since our data seemed to be stationary (see Appendix, Table A.2.).

## IV. EMPIRICAL RESULTS

### Monetary Policy Reaction Function

The summarized results of the monetary policy reaction functions are presented in Table 2<sup>‡</sup>. The coefficients in the table refer to the sum of the coefficients of all lags and leads of a given variable (e.g. the coefficient of 0.07 for the output gap in the AE specification, for the pre-crisis period, is a sum of the coefficients of the two leads, which are 0.04 and 0.03, respectively). The significance, by analogy, refers to the joint significance of the respective coefficients.

Table 2: Results of the monetary policy reaction function

	All countries		Advanced economies		Emerging and developing economies	
	<i>pre-crisis</i>	<i>crisis</i>	<i>pre-crisis</i>	<i>crisis</i>	<i>pre-crisis</i>	<i>crisis</i>
INTEREST(-1)	0.75 ***	0.74 ***	0.82 ***	0.80 ***	0.78 ***	0.58 ***
GAP	0.00	0.12 ***	0.07 ***	0.40 ***	-0.03	0.17 ***
CPI_YOY	0.10 ***	-0.02	0.17 ***	-0.32	0.05 ***	0.04
Cross-sections included	44	43	18	18	26	25
Total panel observations	954	290	432	87	558	173
R-squared	0.74	0.43	0.90	0.23	0.72	0.44
Adjusted R-squared	0.73	0.42	0.90	0.20	0.72	0.42
J test p value	0.39	0.11	0.41	0.44	0.43	0.27

\*\*\* significant at 1%, \*\* significant at 5%

Looking at the sample of all countries, the change in the monetary policy reaction is noticeable - in the pre-crisis period the response to the output gap is insignificant, contrary to the crisis period, when the response is highly significant. Regarding inflation, before the crisis, monetary policy had significantly reacted to inflation developments, whereas during the crisis it did not. The analysis of the results of the sub-groups shows that the response of the monetary policy to the output gap in AE is significant in both periods, but considerably stronger during the crisis (five times stronger<sup>§</sup>) and that AE tackled inflation before the crisis, but "forgot" about it during the crisis period. On the contrary, output developments before the crisis had not appeared as an important factor for the monetary policies in EDE, whereas during the crisis, monetary policy

<sup>‡</sup> The detailed results are not shown due to space limitations, but are available upon request.

<sup>§</sup> The magnitude of the response is given by the long-run coefficients. The long-run coefficients are calculated when the sum of all the coefficients in front of one variable is divided by (1-coefficient in front of the lagged dependent variable). For illustration, the long-run coefficient for the output for the crisis period, for AE, is 2 (0.4/(1-0.8)).

had started responding to output. Regarding inflation, EDE reacted in the same manner as AE, before and during the crisis.

Comparing the size of the response to output in AE and EDE, the former group of countries reacted much more aggressively to prevent further decline of economic activity. The size of the reaction, given by the long-run coefficients, for AE is around 2, whereas for EDE, it is only 0.4.

Next research question that we turn to is the degree to which the fixed exchange rate, the high current account deficit, and the high level of external indebtedness before the crisis, have constrained monetary policy during the crisis. Although we are aware about the potentially different role of these factors for AE and EDE, the analysis is done on the whole sample. The examination of the constraints is made by introduction of interaction variables.

Table 3: Results of the monetary policy reaction function with the constraining factors

	All countries, crisis period		
	fixed ER	high CA	high ext. debt
INTEREST(-1)	0.46 ***	0.80 ***	0.58 ***
GAP	0.25 ***	0.34 **	0.27 ***
CPI_YOY	0.24 ***	0.06	0.15 ***
FIXED*INTEREST(-1)	-0.13		
FIXED*GAP	-0.12†		
FIXED*CPI_YOY	-0.54† **		
HIGH_CA*INTEREST(-1)		-0.50 ***	
HIGH_CA*GAP		-0.30†	
HIGH_CA*CPI_YOY		-0.07†	
HIGH_EXT_DEBT*GAP			-0.34† ***
HIGH_EXT_DEBT*CPI_YOY			-0.25† ***
Cross-sections included	43	43	31
Total panel observations	290	290	209
R-squared	0.30	0.08	0.41
Adjusted R-squared	0.27	0.04	0.38
J test p value	0.24	0.66	0.29

\*\*\* significant at 1%, \*\* significant at 5%

† indicates that the coefficients of the interaction terms, summed with the coefficients without the interaction dummies, are **jointly insignificant**

insignificant, which implies that countries that had high CA deficit before the crisis, compared to countries that did not have high CA deficits, did not respond differently to output and inflation. However, if we look at the joint significance of the coefficients with and without interaction dummies, they are insignificant both for the inflation and the output, implying that *countries with*

Looking at the specification with the fixed ER, only one interaction variable, between the fixed ER and the inflation, appears significant (-0.54). This implies that the reaction of the countries with fixed ER to inflation is significantly different (smaller) during the crisis period in comparison to countries with flexible ER. However, if we look at the joint significance of the variables with and without dummies (e.g. the coefficient in front of *cpi\_yoy* and the coefficient in front of *fixed\*cpi\_yoy*), which gives the response of the countries with fixed ER to inflation, we will see that their response towards inflation is insignificant<sup>\*\*</sup>. For comparison, the response of the countries with flexible ER, which is given by the coefficients without the interaction dummies, is significant both for inflation and output. *Thus, we interpret this as an evidence that the fixed ER constrained monetary authorities to respond to inflation and output during the crisis.*

Looking into the role of high CA, the interaction variables with inflation and output are

<sup>\*\*</sup> This looks odd, indeed, but it might be due to the sample size (290 observations), which is arguably small for GMM estimation.

*high CA did not respond to output and inflation during the crisis. In contrast, countries that did not have high CA deficits before the crisis responded to movements in output, but not in inflation.*

The situation is more clear-cut regarding the role of the high external indebtedness. The interaction dummies are significant and negative both for the output and the inflation, implying that countries that had high level of external debt before the crisis responded differently to output and inflation from countries that were not heavily indebted. The joint significance of the coefficients with and without interaction dummies confirms that *the countries that were heavily indebted did not react to inflation and output during the crisis, whereas countries that were not heavily indebted did react.*

To summarize, the change in monetary policy reaction during the crisis period in comparison to the period before, in both AE and EDE, is evident. The results show that during the crisis, monetary policy was actively used as instrument for output gap smoothing, while the traditional reaction to inflation did not take place. In addition, the results demonstrate that there was a difference in the conduct of the monetary policy during the crisis between AE and EDE with regards to the size of the response to output, with AE reacting much more aggressively to economic activity decline<sup>††</sup>. Finally, we find some evidence that the fixed exchange rate, the high CA deficits before the crisis and the high external indebtedness have constrained monetary policy reaction during the crisis.

## Fiscal Policy Reaction Function

The other instrument of the macroeconomic policy that was highly utilized during the crisis was fiscal policy. Thus, we next turn to compare the behavior of the fiscal policy before the crisis vis-à-vis during the crisis and in AE vis-à-vis in EDE, as well as to see if it has been constrained by some factors. The results of the two fiscal policy rules are presented in Tables 4 and 5.

Table 4: Results of the fiscal policy reaction function, with the budget expenditure as an instrument

	All countries		Advanced economies		Emerging and developing economies	
	<i>pre-crisis</i>	<i>crisis</i>	<i>pre-crisis</i>	<i>crisis</i>	<i>pre-crisis</i>	<i>crisis</i>
GOV_EXP_CA(-1)	0.12 ***	-0.22 ***	0.71 ***	0.02 ***	0.06 ***	-0.57 ***
GAP	0.02 ***	-0.24 ***	-0.02 ***	-0.29 ***	0.25 ***	-0.13 ***
Cross-sections included	49	46	27	27	22	19
Total panel observations	1200	304	666	177	534	127
R-squared	0.03	-0.01	0.51	-0.05	0.02	0.09
Adjusted R-squared	0.03	-0.02	0.50	-0.07	0.01	0.07
J test p value	0.62	0.62	0.58	0.77	0.59	0.76

\*\*\* significant at 1%, \*\* significant at 5%

<sup>††</sup> The size of reaction, given by the long-run coefficients, for AE is around 2, whereas for EDE, it is only 0.4.

At all-countries level, budget expenditures before the crisis were even pro-cyclical (though only weakly 0.02), but during the crisis, fiscal policy turned to be counter-cyclical. For the AE sample, the budget expenditures appear counter-cyclical for both sub-periods (which complies with the most of the empirical studies), but the magnitude is much stronger for the crisis period (the long run coefficient is -0.30, compared with -0.07 before the crisis). The most remarkable change is observed in the EDE sample. Fiscal policy is significantly pro-cyclical before the crisis (0.3), but turns to be counter-cyclical during the crisis period (-0.1). This confirms that the fiscal policy was used actively as a stabilization tool, in both, AE and EDE during the crisis. As regards the size of the reaction to the output gap, fiscal authorities in AE responded much stronger than authorities in EDE during the crisis (-0.3, compared to -0.1).

Table 5: Results of the fiscal policy reaction function, with the budget balance as an instrument

	All countries		Advanced economies		Emerging and developing economies	
	<i>pre-crisis</i>	<i>crisis</i>	<i>pre-crisis</i>	<i>crisis</i>	<i>pre-crisis</i>	<i>crisis</i>
GOV_BALANCE_CA(-1)	0.15	0.02	0.20 ***	-0.02 ***	0.29 ***	-0.09
GAP	0.06 ***	0.19 ***	0.12 ***	0.45 ***	0.06 ***	0.10 ***
Cross-sections included	49	46	27	27	22	19
Total panel observations	1200	301	666	174	534	127
R-squared	-0.07	-0.09	-0.05	-0.07	-0.02	-0.04
Adjusted R-squared	-0.07	-0.09	-0.05	-0.08	-0.03	-0.06
J test p value	0.55	0.97	0.58	0.67	0.54	0.58

\*\*\* significant at 1%, \*\* significant at 5%

Similar results are found when fiscal policy is measured by the budget balance (instead of the budget expenditure). These results show that the fiscal policy is counter-cyclical before and during the crisis, for all groups of countries<sup>††</sup> (at aggregate level, and separately). For all the countries, the reaction during the crisis is slightly stronger than before the crisis (0.19, vis-à-vis 0.06). For AE, the magnitude of the reaction to the output gap during the crisis is much stronger than before the crisis (nearly four times; 0.45 compared to 0.12), while the reaction of the fiscal policy in EDE is marginally stronger (0.10 compared to 0.06).

<sup>††</sup> In the specifications with the budget balance, counter-cyclicity is observed when the sign is positive, since this implies that higher output is followed by more positive budget balance (i.e. lower deficit).

Table 6: Results of the two fiscal policy reaction functions with a constraining factor

	All countries, crisis period expenditure	All countries, crisis period balance
GOV_EXP_CA(-1)	-0.25 ***	
GAP	-0.16 ***	
HIGH_PUB_DEBT*GOV_EXP_CA(-1)	0.66†	
HIGH_PUB_DEBT*GAP	-0.15	
GOV_BALANCE_CA(-1)		-0.07
GAP		0.30 ***
HIGH_PUB_DEBT*GOV_BALANCE_CA(-1)		0.94†
HIGH_PUB_DEBT*GAP		-0.63†
Cross-sections included	46	46
Total panel observations	304	301
R-squared	-0.06	-0.18
Adjusted R-squared	-0.07	-0.20
J test p value	0.76	0.81

\*\*\* significant at 1%, \*\* significant at 5%

† indicates that the coefficients of the interaction terms, summed with the coefficients without the interaction dummies, are **jointly insignificant**

Regarding the role of the constrains to fiscal policy during the crisis, we only explore the role of the high public debt (Table 6). Looking at the specification with the budget expenditure, the insignificant coefficient in front of the interaction dummy with the output gap indicates that governments with high level of public debt before the crisis did not respond differently to output fluctuation from governments that were not heavily indebted. Furthermore, the coefficients of the variables with and without the interaction dummy (e.g. the coefficient in front of *gap* and the coefficient in front of *high\_pub\_debt\*gap*), are jointly significant, just like the coefficients in front of the gap, which demonstrate that the *high public debt was not a constraint for the fiscal policy*. The results of the specification with the budget balance are slightly different. The interaction term between the high debt and the output is insignificant, as well, and suggest that governments with high level of public debt did not differ from those with low level of debt in terms of their response to output developments, but the coefficients of the output and the output times the interaction dummy are jointly insignificant, *suggesting that highly indebted governments did not respond to output developments, in contrast to governments that were not highly indebted*.

To summarize, our findings point to a change in the fiscal policy during the crisis, in terms of much stronger response to output developments. Fiscal policy was counter-cyclical during the crisis in both AE and EDE, but the reaction to output fluctuation was much stronger in AE than in EDE. Finally, regarding the constraining role of the high public debt there is a mixed evidence for the ability of the fiscal authorities to support the economy during the crisis.

## V. CONCLUSION

The depth and the length of the crisis has provoked sizeable and innovative policy measures, both in terms of monetary and fiscal policy. They were aimed at stabilizing the economic cycle and lessening the wide negative output gap. The manner and aggressiveness in which both policies were used as a countercyclical tools during the recent crisis, were for sure different compared to the prior to the crisis period. Although their very effects are difficult to be gauged, and probably are of a temporary nature, still it is more than certain that they have prevented larger and prolonged output drop.

In our paper we try to give a modest contribution to the literature on the recent crisis, by assessing the change in the magnitude of the monetary and fiscal reaction to the output gap, before and after the crisis. The results of the panel estimate on 61 AE and EDE, do confirm our prior for stronger countercyclical reaction of the monetary and fiscal policy during the recent crisis, compared to the period before. As evidenced in many other empirical studies, we also find much stronger policy reaction in AE, compared to EDE. Furthermore, our tests on the role of the fixed exchange rate, wide current account deficit and high external debt in the monetary policy reaction, verify their constraining power for stronger countercyclical reaction. On the other hand, we were not able to clarify the constraining role of the high public debt on the fiscal countercyclicity. As during the recent crisis public debt in many countries went beyond our chosen threshold, these results might not deviate largely from the practice.

This research does offer intuitive results in terms of the policy reaction, on the backdrop of the recent crisis. Yet, it contains flaws which can sketch the future avenues for research improvement. This mainly refers to the inclusion of the non-interest rate monetary stimulus within the monetary policy reaction function, which can provide a more comprehensive picture on the policy responses within the latest crisis.



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## APPENDIX

Table A.1.: Groups of countries

Advanced economies	Emerging and developing economies	Countries with: fixed exchange rate	Countries with: high current account	Countries with: high external debt	Countries with: high public debt
Australia	Argentina	Argentina	Armenia	Austria	Austria
Austria	Armenia	Belarus	Australia	Belgium	Belgium
Belgium	Belarus	Bolivia	Belarus	Bulgaria	Croatia
Canada	Bolivia	Bulgaria	Bulgaria	Croatia	eurozone
Czech Republic	Brazil	China	Croatia	Denmark	France
Denmark	Bulgaria	Croatia	Estonia	Estonia	Germany
eurozone	Chile	Denmark	Georgia	Finland	Greece
Finland	China	Estonia	Greece	France	Hungary
France	Colombia	Iran	Hungary	Germany	Italy
Germany	Croatia	Jordan	Iceland	Greece	Portugal
Greece	Estonia	Kazakhstan	Jordan	Hungary	Singapore
Iceland	Georgia	Latvia	Kyrgyz Republic	Ireland	
Ireland	Hungary	Lithuania	Latvia	Israel	
Israel	India	Macedonia	Lithuania	Italy	
Italy	Indonesia	Slovakia	Macedonia	Kazakhstan	
Japan	Iran		New Zealand	Kyrgyz Republic	
Korea	Jordan		Portugal	Latvia	
Luxembourg	Kazakhstan		Romania	Lithuania	
Netherlands	Kyrgyz Republic		Slovakia	Luxembourg	
New Zealand	Latvia		Slovenia	Netherlands	
Norway	Lithuania		Spain	Norway	
Portugal	Macedonia		Turkey	Portugal	
Singapore	Mexico			Slovakia	
Slovakia	Peru			Slovenia	
Slovenia	Philippines			Spain	
Spain	Poland			Sweden	
Sweden	Romania			Switzerland	
Switzerland	Russia			United Kingdom	
United Kingdom	Serbia				
USA	Thailand				
	Turkey				

Table A.2.: Results of the unit root tests

	output gap	y-o-y inflation	interest rate	gov. balance	gov. expenditure
Levin, Lin & Chu $t^*$	1.000	0.111	0.042	0.000	0.000
<i>Assumes common unit root</i>					
Im, Pesaran and Shin W-stat	0.001	0.367	0.369	0.000	0.000
ADF - Fisher Chi-square	0.000	0.025	0.016	0.000	0.000
PP - Fisher Chi-square	0.000	0.000	0.004	0.000	0.000
<i>Assumes individual unit root</i>					
<i>The table shows the p values of the corresponding unit root test. Null hypothesis in all cases that there is a unit root, i.e. that a series is non-stationary</i>					