# Monetary Policy after the Crisis

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# 1. Monetary Policy after the Crisis – Key Findings of a Conference Jointly Organised by SUERF and the National Bank of Poland in Warsaw on 4 March 2011

*Ernest Gnan, Ryszard Kokoszczynski, Tomasz Łyziak & Robert McCauley*

On 4 March 2011, SUERF – The European Money and Finance Forum and the National Bank of Poland jointly organised a conference on the theme of: "Monetary Policy after the Crisis". Following a call for papers with a large number of submissions, the scientific committee[1] selected 9 papers, which were grouped in three sessions addressing the following three research questions: First, what have we learnt from the crisis for the conduct of monetary policy? Second, what have we learnt from the crisis for the coordination of monetary, fiscal and macroprudential policies. And third, how did the Monetary Transmission Mechanism during the crisis function, and what can we expect for the future?

Governor *Marek Belka*, National Bank of Poland, opened the conference with a number of pointed observations, with his opening remarks following in the next chapter of this SUERF Study. Inflation targeting served Poland well. It stabilised inflation and inflation expectations. Poland's version of inflation targeting with a flexible exchange rate policy also helped the country to weather the crisis well. So, there is no need to change the policy in Poland. But this may be different for other countries: Inflation targeting neglected asset price developments, so in this sense it failed, given that the crisis was provoked by asset price bubbles.

Against this background, the Governor raised a number of important issues: Did monetary policy contribute to the crisis? How important was the "Greenspan put"? Was it a necessary but not sufficient cause, or was it THE main engine of the crisis? Will inflation targeting survive the crisis, will it be modified, and how? Can inflation help reduce public debt problems in advanced countries? How can Poland conduct its monetary policy well if monetary transmission is impaired by international spillovers? And how can the monetary policy mandate be squared

[1] The scientific committee comprised Ernest Gnan, SUERF and Oesterreichische Nationalbank, Ryszard Kokoszczynski, SUERF and National Bank of Poland, Tomasz Łyziak, National Bank of Poland, and Robert McCauley, SUERF and Bank for International Settlements.

with new financial stability concerns which have moved into the forefront since the crisis?

Governor Belka expressed concern about bringing financial stability into the central bank's mandate. Financial stability policy can only work well if used early on, in this case it can support and reinforce monetary policy. Poland is currently in such a phase, imbalances have not yet built up. So, in this phase, supervisory and regulatory instruments can be employed usefully to make monetary policy more efficient and less costly.

*Catherine Lubochinsky*, President of SUERF, thanked the National Bank of Poland for hosting the conference, the scientific committee for putting together an interesting programme, and all speakers and the audience for participating. At the current juncture, monetary policy is still in crisis mode, but is at the same time concerned with how to design the new norm after the crisis. Despite being very inventive in designing new, unconventional monetary policy instruments, central banks now have too many objectives with too few instruments: they set interest rates, manage the exchange rate, act as market makers, and are supposed to supervise and control commercial banks and financial markets. It is interesting to note though, that various countries and central banks have recently moved in differing directions with respect to central banks' responsibilities in banking regulation and supervision.

The first keynote speech was given by *Jens Thomsen*, former Vice-Governor Danmarks National Bank, on the topic "Monetary Policy after the Crisis – Ten Lessons from a Fixed-Exchange-Rate Regime", and co-authored by Kim Abildgren, and which appears as Chapter 3 of this SUERF Study. The Danish Krone has been held stable against the Deutsch Mark, and later the Euro, since 1987. Initially the exchange rate policy was supported by capital restrictions, which were, however, circumvented. Denmark is not a member of the euro area because a majority of the Danes voted no to the proposal of replacing the krone with the euro in a referendum in 2000. Inflation has been around 2% since 1990, exchange rate interventions have regularly been used to implement the exchange rate policy; in addition interest rates were used in specific situations of market nervousness to support the exchange rate peg. Economic fundamentals and bond yield spreads have compared favorably with other Nordic countries over the past two decades.

The Danish experience implies ten lessons: First, foreign exchange intervention is useful up to a certain point; in times of severe pressure, the interest rate needs to be used to support the peg. Second, the interest sensitivity of portfolio capital flows is regime dependent. During financial turmoil interest-rate sensitivity of capital flows can decline substantially. Third, the size of foreign reserves plays an important role in signalling commitment to a fixed-exchange-rate regime during

periods of foreign exchange rate turmoil. Fourth, the proper interest-rate response during crises is rarely convenient and popular. Fifth, when they are needed the most, foreign exchange reserves can be most difficult to obtain. Sixth, the cost of holding foreign reserves are low when the reserves are not needed (calm markets) and expensive when they are needed (currency turmoil). Seventh, swap arrangements between central banks during the crisis were successful. Eighth, the operational frameworks for monetary policy implementation must be sufficiently flexible to address extraordinary liquidity situations in the money market. Ninth, short-term financing through money and capital markets is more sensitive to banks' creditworthiness than deposits. Banks' dependence on money market financing thus makes them more vulnerable, also to spill-overs from banking problems in other countries. If the banking system relies heavily on short-term foreign funding, this can have systemic implications and make it necessary for the central bank to operate with large foreign-exchange reserves. Finally, there is a cost to Denmark of not joining the euro area; this cost is most visible during crises.

*Claudio Borio*, Bank for International Settlements, addressed the issue of "Central Banking Post-Crisis: What Compass for Unchartered Waters"[2]. Are central bankers the great winners of the crisis? They are seen to have saved the financial system. Beneath the surface, the picture is less reassuring: pre-crisis monetary policy certainties have gone. The line between fiscal and monetary policy has become blurred. Even the ability to control inflation has been questioned. Three challenges lie ahead: first, regarding the economic outlook, there are long-lasting scars of the crisis and signs of unsustainable booms in emerging markets; second, at an intellectual level, the benchmark analytical frameworks have failed; third, at an institutional level, central bank independence has become blurred and is under threat.

The pre-crisis consensus was that price stability is sufficient for macroeconomic stability – this was the intellectual basis for inflation targeting. Analytically, this was supported by the New-Keynesian paradigm, where price rigidities were the only frictions in the economy. There was also a clear separation between monetary and financial stability functions (except for the lender of last resort in crisis management). The short-term interest rate was seen to be sufficient to capture the impact of monetary policy on the economy, assuming perfect substitutability across asset classes and little perceived risk of the zero lower bound. Finally, the assumption was that if each central bank looked after its own economy, the global monetary policy stance would turn out to be appropriate, too. This was equivalent to the microprudential approach to regulation and supervision.

[2] C. BORIO, "Central banking post-crisis: What compass for uncharted waters?" (forthcoming in C. JONES & R. PRINGLE (eds.), *The Future of Central Banking*, Central Banking Publications, 2011.

The new post-crisis consensus is that low and stable inflation does not guarantee financial and macroeconomic stability. Cleaning up the debris through monetary policy is costly and interest rate policy is not enough. There is a need to shift from a purely micro to a macroprudential orientation in regulation and supervision, with a key role for central banks. But there are also areas of disagreement: Should monetary policy seek to lean against financial imbalances even if consumer price inflation is low and stable? How serious is the collateral damage of extraordinarily accommodative monetary policy (interest rate and balance sheet policies) in the wake of a crisis?

For his further analysis, Borio used three working hypotheses: First, monetary policy contributed significantly to the crisis by supporting the build-up of financial imbalances through low interest rates and the resulting increased risk-taking. Second, the aggressive and prolonged easing after the crisis has serious limitations: potential output has been permanently lost, and by now is potentially overestimated. The still existing private debt overhang may be aggravated by heavy public borrowing. Monetary policy easing delays necessary structural adjustments, raises financial stability risks and can compromise central bank independence. High public debt will raise pressure on central banks to inflate. Inflation may become to be seen as a solution rather than a problem. By purchasing large sums of private and public debt, central banks have become subject to huge potential losses, which may pose public and political pressure on them (see the current discussion about the large losses of the Swiss National Bank). Third, keeping one's own house in order is not enough: Floating exchange rates provide only limited insulation. There is a tendency to underestimate the role of global factors. This is not merely a question of spillovers, it is also the result of parallel policies which in the aggregate lead to unsustainable global results (e.g. global energy and food prices, very low interest rates in many countries prior to, and also now after the crisis).

Four implications follow from the above: First, to constrain the build up of financial imbalances needs to be done by macroprudential policies and monetary policies together. Second, monetary policy needed to be aggressive during crisis management but now the structural repair of balance sheets should take over as the key priority. There is an urgent need to strengthen CBI – this is also critical for macroprudential policies. Fourth, we need to find ways to internalise spillover effects of individual central bank policies and their contributions to global monetary conditions.

In conclusion, Borio pleaded for a change in macroeconomic paradigms. It is not adequate to explain monetary phenomena with basically real economic models (possibly supplemented with some additional financial frictions). Instead, the old monetary economics traditions following Wicksell should be rediscovered. The

fortunes of central banking have shifted over time: After Arthur Burns' "anguish of central banking", followed by Paul Volcker's "triumph of central banking" we nowadays have to cope with "the doubts of central banking". Particularly in a time of broadened responsibilities and more fragile central bank balance sheets, the crucial role of central bank independence needs to be emphasized, while at the same time the limitations of what central banks can achieve with monetary and macroprudential policies need to be recognized. The global dimension of central banks' tasks needs to be more explicitly and fully recognized.

Session 1, chaired by *Ernest Gnan*, SUERF and Oesterreichische Nationalbank, addressed the issue of "Conducting monetary policy – what have we learnt from the crisis?".

*Charles Brendon*, Exeter College, Oxford, presented a paper on "Optimal conventional and unconventional monetary policy in the presence of collateral constraints and the zero bound", co-authored by Matthias Paustian and Tony Yates. Using a sticky price business cycle model with collateral constrained entrepreneurs, the authors investigate how optimal monetary policy is affected by the presence of the zero lower bound to official interest rates. They also study the advantages of employing a second, unconventional monetary policy instrument such as "credit easing" and investigate the welfare differences between commitment and discretion. They find that using the unconventional monetary policy instrument improves welfare, because it helps relax the borrowing constraint. The model also illustrates that in a crisis commitment by the central bank to a future path of interest rates can improve welfare (as compared to discretionary policy without clear guidance on future policy), particularly if official interest rates have reached the zero lower bound: announcing the future path of policy rates, by managing the yield curve, in a way compensates for not being able to further cut short-term spot money market rates. If no such commitment is possible, the costs of non-commitment are shown to be reduced by the credit-easing instrument, both in case the zero lower bound has been reached and if interest rates are still above the lower bound. Thus, in a crisis such as the most recent one, in a sense the unconventional monetary policy instrument helped to make up for the disadvantages of discretionary policy at the zero lower bound.

*Patrizio Pagano*, Bank of Italy, addressed "The Role of Macroeconomic Policies in the Global Crisis" co-authored by Pietro Catte, Pietro Cova, and Ignazio Visco, with a shorter paper, "Macroeconomic Policies and the Roots of the Global Crisis" included in this SUERF Study as Chapter 4. Using NiGEM, a commercially available large global Neo-Keynesian (forward-looking agents, nominal rigidities) macro-economic model, the authors conduct simulations to answer the following questions: First, was US monetary policy too lax for too long after the

2001 recession? Could tighter policy have prevented or contained the housing bubble? Second, would stricter supervision and/or macro-prudential policies via higher credit costs have prevented/contained the bubble? Third, would a combination of these policies have helped to contain the bubble and US current account deficits? Fourth, would stronger potential growth in Europe and Japan and more reliance on domestic demand in China, have helped to contain the build up of global imbalances? The authors find that the combination of all these measures, while substantially dampening growth initially in the US, would also have at least mitigated the following Great Recession. All in all, the net effect of the alternative policy path would have been clearly positive; so, restrictive policies during the build up of the crisis could be regarded as an insurance premium well worth paying to avoid the much greater damage later on. It is worrying that the fundamental macroeconomic imbalances that were at the root of the recent crisis have not been removed by the Great Recession; so, the need for a coordinated effort to establish a more sustainable pattern of global growth remains.

*Roman Horváth*, Charles University of Prague, investigated the question "How Does Monetary Policy Respond to Financial Stress?" in a paper co-authored by Jaromír Baxa and Bořek Vašíček. Using data for the US, UK, Australia, Canada and Sweden over the past three decades, the authors investigate whether and how central banks reacted to financial instability in their interest rate policy, and which type of instability they responded to most strongly. To this end, they estimate monetary policy rules employing a novel time-varying parameter model with endogenous regressors and using comprehensive measures of financial stress developed by the IMF. The paper confirms that central banks loosen interest rates in the face of high financial stress, financial stress explains 10-50 percent of interest rate variations during the 2008-2009 crisis. Bank stress and stock market stress were empirically the dominant forms of financial stress triggering interest rate cuts, exchange rate stress was more important in more open economies. The recent crisis was unique in the sense that interest responses were highly synchronised across central banks, the response was substantial but in some countries similar to previous episodes of idiosyncratic financial stress.

Session 2, chaired by *Ryszard Kokoszczynski*, SUERF and National Bank of Poland, was devoted to the issue of "Coordination of monetary, fiscal and macroprudential policies – what have we learnt from the crisis?"

In the first paper, *Petar Chobanov*, University of National and World Economy in Sofia, investigated "Money Market Integration and Sovereign CDS Spreads Dynamics in the New EU States", co-authored by Amine Lahiani and Nikolay Nenosky, which appears in this SUERF Study as Chapter 5. Using high frequency panel data, the paper confirms for the eight new EU member states a link between

expectations about the condition of public finances (as approximated by sovereign CDS spreads) and liquidity risk (as measured by short-term money market rates). The crisis has changed the relationship between liquidity and fiscal risk, with interesting differences across countries depending on their exchange-rate/monetary policy strategies. Countries with a currency board show a significant link between CDS spreads and money market rates. Thus, fixed exchange rate regimes are apparently perceived as riskier when resorting to macroeconomic policies to cope with external shocks. By contrast, in inflation targeting countries, during the crisis the link between monetary and fiscal risk became weaker and insignificant, while spill-overs from euro area benchmark variables became significant.

*Cristina Badarau*, University Montesquieu Bordeaux 4, studied "Which policy-mix to mitigate the effects of financial heterogeneity in a monetary union" such as the euro area, co-authored by Grégory Levieuge, from which a shorter policy paper entitled "Financial asymmetries, national divergences and macroeconomic policy in a monetary union" appears in this Study as Chapter 6. Using a calibrated DSGE model with a heterogeneous bank capital channel, with financial shocks in addition to monetary policy, fiscal policy and technological shocks, the paper shows that a single monetary policy in a heterogeneous monetary union can worsen national divergencies. The authors conclude, among other things, that decentralized fiscal policies need to be more active in countries more sensitive to shocks, i.e. where the bank capital channel is stronger, to mitigate adverse asymmetric shocks. If structural heterogeneity is important, fiscal policy coordination can lead to less macroeconomic stabilisation at the individual national level, but it may reduce public spending divergence. During the financial crisis, a cooperative fiscal policy regime would, according to the authors, have entailed insufficient national policy reaction.

*Marco Lo Duca*, European Central Bank, presented a paper on "Risk, Uncertainty and Monetary Policy", co-authored by Gert Bekaert and Marie Hoerova. The paper starts from the frequently alleged link between loose monetary policy and excessive risk-taking in financial markets, and documents a strong correlation between the level of monetary policy rates and financial markets' risk aversion, as measured by stock market option-based implied volatility. Decomposing implied volatility into two components, risk aversion and uncertainty, and using a structural vector autoregressive methodology, the authors find interactions between each of the components and monetary policy to be rather different. Loose monetary policy increases risk appetite in the future, with the effect starting to become significant after five months and lasting about two years. At the same time, monetary policy is found to react to periods of high uncertainty by easing interest rates. The policy conclusions are potentially powerful: If monetary

policy significantly affects risk appetite in asset markets, monetary policy may turn out to be sufficiently potent to stop financial excesses. Conversely, in periods of crisis, when financial markets are "fearful", loose monetary policy may play a useful role in reducing these fears.

Session 3, chaired by *Urs Birchler*, SUERF and University of Zurich, was concerned with "The Monetary Transmission Mechanism During and After the Crisis".

*Wayne Passmore*, Board of Governors, Federal Reserve System, studied the question: "Did the Federal Reserve's MBS Purchase Program Lower Mortgage Rates?" in a paper co-authored by Diana Hancock. On 25 November 2008, the Federal Reserve announced that it would purchase USD 500bn of agency mortgage backed securities (issued by Fannie Mae, Freddie Mac, and Ginnie Mae) over the next 16 months, in order to reduce the cost and increase the availability of credit for the purchases of houses. Using an empirical pricing model for mortgage backed securities yields and mortgage rates, the authors find that the announcement of the programme, by signalling strong and credible government backing for mortgage markets and the financial system as a whole, already reduced mortgage rates by 85 basis points by end-2008, although by that time no mortgage backed securities had yet actually been purchased. All in all, rates were lowered by 100-150 basis points. By end-May 2009, normal pricing conditions had returned to US primary and secondary mortgage markets. The successful reduction in rates may be attributed equally to two effects: first, improved market functioning due to clear government backing, and second, portfolio rebalancing effects. After the Fed's intervention had ended, portfolio rebalancing effects were experienced due to the permanent reduction in the stock of mortgage bonds available on the market. In summary, the authors conclude that the purchases were effective.

*Ewa Wróbel*, National Bank of Poland, presented a paper on "Monetary Policy Transmission Disturbances During the Financial Crisis: a Case of an Emerging Market Economy", co-authored by Tomasz Łyziak, Jan Przystupa and Ewa Stanisławska with a shorter version of this paper, "The Impact of the Financial Crisis on the Monetary Transmission Mechanism: the Case of Poland" appearing in this SUERF Study as Chapter 7. Using the case study of Poland, an inflation-targeting economy, the paper shows that the financial crisis affects monetary policy transmission through both a crisis-induced change in monetary policy and changes in the structural features of the economy. Against the risk of a deep decline in output, the central bank increased its responsiveness to both inflation and output shocks, thus taking into account disturbances in interest rate pass through to money market and retail rates, as well as in the credit channel. All in all, the

authors concluded that disturbances in monetary policy transmission rather reflected increased perception of risk and cyclical factors triggered by the financial crisis and to a lesser extent structural changes in the economy. However, in a medium-term perspective, the magnitude and duration of the crisis, combined with ongoing changes in the regulatory framework and macroeconomic policies, may, through learning by agents, trigger lasting changes also in monetary transmission.

*Urszula Szczerbowicz*, LUISS Guido Carli and Sciences Po-OFCE, investigated "Are Unconventional Monetary Policies Effective?", with a shorter version "Effectiveness of unconventional monetary policies and their impact on long-term inflation expectations" being included in this SUERF Study as Chapter 8. The paper evaluates the impact of non-conventional monetary policies on the Libor-OIS spread, long-term interest rates and long-term inflation expectations in the United States by studying the behaviour of selected asset yields on the days of policy statements. The author confirms that announcements of government bail-outs and recapitalisations and liquidity facilities other than the TAF reduced the 3-month Libor-OIS spread by an estimated 25 and 9 basis points respectively. The long-term Treasury securities purchases as well as the outright purchases of Agency debt and mortgage-backed securities in the context of "Quantitative Easing 1" lowered long-term interest rates by 17 and 22 basis points respectively. Finally, the Fed's rescue operations of several large financial institutions, "Quantitative Easing 2" and fiscal stimulus announcements raised long-term inflation expectations by 5-6 basis points.

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The around 130 conference participants bore witness to the timeliness and practical relevance of the issues raised in the conference program. Various central banks around the world have switched back from crisis mode into the "new normal", and also the European Central Bank had, on the day preceding the conference, indicated that a hike in official interest rates, after two years of historically low levels, might be imminent. At a deeper, more structural level, the crisis has triggered critical thinking on how to better capture financial friction and the monetary sector in economic models, how to modify monetary policy strategies to make them more robust against the build up of macroeconomic and financial imbalances, and on the role of central banks in areas outside of monetary policy, such as macro-prudential surveillance. While of course, in just one day, these complex questions could only be touched upon, the conference offered a good overview of the issues at stake and on the ongoing research in this field in academia and at central banks around the world. SUERF will certainly follow these issues up at future events.

# 2. Opening Remarks

*Marek Belka*

Ladies and Gentlemen,

The issue is extremely topical and I wish to go beyond the usual courtesy and say that we are looking forward to the conclusions, suggestions, remarks and discussion arising from today's conference which will hopefully make our job, that of conducting monetary policy in a small open economy, a little bit easier. Our small open economy is one that is fully integrated with the rest of the European economy, apart from the fact that we do not use the common currency adopted in the rest of the European economy. Apart from having a separate currency, all other features of our monetary policy are common to those of the rest of Europe, although this does, however, make it difficult on occasions – particularly in turbulent times – to conduct monetary policy. Having looked at the programme, I am particularly interested in the keynote speech to be given by Jens Thomsen from Danmarks Nationalbank, outlining some "Lessons from a Fixed-Exchange-Rate Regime", since the lessons from Denmark's experience could also be of particular relevance to Poland.

I now wish to reflect on a couple of further issues that are due to be discussed today, which are of great importance for Poland.

Inflation targeting has served Poland quite well, but it is necessary to look beyond our own boundaries to examine whether Inflation Targeting, adopted officially or only in practice, has been beneficial for economies that adopted this strategy. Inflation Targeting did not cover asset prices, and therefore was not entirely relevant, since the crisis was started by asset price bubbles. We can also ask whether monetary policy contributed to the crisis or was it one of the main causes if not the main cause behind the crisis? How important was the famous Greenspan Put as a cause? Was it just one of the necessary but not sufficient causes of the crisis or was it the main engine of the crisis? Its role in the crisis leads us to ask whether inflation targeting will survive the crisis – and if so, in its current form or in a modified form? In Poland's case, it has served us well over the last decade, and helped us to stabilise price levels and expectations, which is not easy in a country with an inflationary record like Poland's. The version of inflation targeting that Poland deployed, was one of inflation targeting with a flexible exchange-rate, which has also been quoted as being one of the factors that allowed us to come through the crisis in a reasonable shape. For us there is no reason to place doubt upon the benefits of inflation targeting, but this might not be the case with other

countries. The question arises of how can we continue with this policy in a world where quantitative easing is the issue of the day, and in which we suspect that inflation might be the way to get rid of, or at least attenuate the problems faced by advanced countries. This leads us to ask how we can conduct our monetary policy, knowing that the financial integration of our country with others basically impairs the monetary transmission mechanism of our monetary policy.

A second question, which of course will be debated here as it is everywhere, is the link between monetary policy and financial stability policy/issue. In fact financial stability is part of the mandate of central banks almost everywhere, but has not always necessarily been treated as seriously as it should have been. Now, when we look back to the Great Moderation the question arises of whether monetary policy could have prevented the crisis or made it less disruptive, and in this regard I have already mentioned the famous Greenspan Put. There are many that think that the two dimensions of the central bank's mandate – of price stability and financial stability – conflict with each other in conditions prevailing at certain moments. I must say, however, that I am very comfortable with the fact that financial stability has become a well-defined and prominent part of our mandate.

However, we have to remember that – like with fiscal policy – good financial stability policy is only possible in good times. I sometimes say that fiscal policy is bad in bad times, with good fiscal policy only possible to be initiated in good times. The same applies to financial stability policy, if you use instruments which you have only in the early phase of the cycle when the imbalances only start building up, then this can be a very helpful measure that reinforces monetary policy. We feel that we are currently in this phase of the cycle – the economy is growing, imbalances have yet to start building up and we are able to start using macroprudential and microprudential instruments, and supervisory and regulatory instruments can be used at an early phase of the cycle, which I think makes monetary policy more efficient, less costly, and makes the life of a central bank slightly less uncomfortable.

I cannot pretend, in conclusion, to have addressed all the issues of substance surrounding monetary policy, but these issues that I have highlighted are the ones that affect us here in the National Bank of Poland and if, which is certain, we hear and experience a good discussion here today, I am sure that this will be a very helpful event. Thank you very much.

# 3. Monetary Policy after the Crisis – Ten Lessons from a Fixed-Exchange-Rate Regime

*Jens Thomsen*[1] *and Kim Abildgren*[2]

## 3.1. A Short Review of the Rules of the Game in a Fixed Exchange-Rate Regime

Although there is a high degree of consensus in terms of monetary-policy objectives (price stability) and instruments (the short-term interest rate), central banks still apply different strategies and approaches in implementation of monetary policy.

Denmark has conducted a fixed-exchange-rate policy since the 1980s, with adjustments until 1987, *cf.* Chart 1 and 2. Several other small European countries also pursued a fixed-exchange-rate strategy in the 1980s and the early 1990s but have since then opted for regimes based on explicit inflation targets or joined the euro area. Due to the fixed-exchange-rate policy, the Danish monetary policy is aimed at keeping the krone stable against the euro within the European Exchange Rate Mechanism, ERM. The main objective of monetary policy in the euro area is to maintain an inflation rate of below, but close to, 2 per cent. Linking the Danish krone to the euro creates a basis for achieving the same level of inflation and inflation expectations in Denmark as in the euro area, *cf.* Chart 3.

A few words should be given regarding Denmark's position as an EU member state outside the euro area. Denmark's referendum on 2 June 1992 rejected the Maastricht Treaty by a narrow majority of 50.7 per cent. The Edinburgh Decision on 11-12 December 1992 comprised special Danish arrangements in four areas of the Maastricht Treaty, including EMU. In relation to EMU the arrangement implied that Denmark immediately exercised its right as laid down in the protocol to notify the Council that it would not participate in Stage 3 of EMU. A second Danish referendum on 18 May 1993 produced a majority of 56.7 per cent of the votes in favour of the Maastricht Treaty and the Edinburgh Decision. In March 2000 the Danish Prime Minister called a referendum for 28 September 2000 on Denmark's adoption of the euro. The bill was rejected by the referendum in September 2000, with 53.1 per cent of the votes against the adoption of the euro. Immediately after the referendum, the Danish government and Danmarks

[1] Ret. Danmarks Nationalbank.
[2] Danmarks Nationalbank.

Nationalbank issued a joint press release stating that Denmark would continue its fixed-exchange-rate policy within the framework of ERM II.

Having the exchange rate as the intermediate target provides a simple and unambiguous rule for monetary policy in Denmark (Danmarks Nationalbank, 2009). Danmarks Nationalbank's interest rates normally mirror those fixed by the ECB for the euro area. Minor fluctuations in the exchange rate is addressed by purchasing and selling foreign exchange against kroner (intervention), *cf.* Chart 4. If there is a prolonged tendency for the krone to strengthen or weaken, Danmarks Nationalbank unilaterally adjusts its interest rates. Weakening of the krone can be countered by raising Danmarks Nationalbank's interest rates relative to those of the ECB, since it is more attractive to invest in kroner when the rate of interest is higher, *cf.* Chart 5. Conversely, Danmarks Nationalbank may counter a tendency for the krone to strengthen by reducing its interest rates.

In a fixed-exchange-rate regime the monetary-policy interest rates are reserved for managing the exchange rate. In a world with free capital flows this leaves no scope for using the monetary policy interest rate as an instrument for stabilising the domestic business cycle (McKinnon, 1993; Obstfeld, Shambaugh & Taylor, 2005). Since monetary policy cannot be used for cyclical purposes, it is important that both fiscal policy and other economic policies are oriented towards economic stability so that both overheating and high unemployment is addressed.

Times of international financial turmoil often constitute an acid test of fixed exchange-rate regimes. This lesson was leaned the hard way during the crisis in the European Monetary System in the early 1990s where several countries had to abandon a fixed exchange rate regime and opt for inflation targeting.

The Danish fixed exchange rate policy survived the crisis in the early 1990 and has served the Danish economy well during the last couple of decades (Abildgren *et al.*, 2010). The paper at hand reviews the Danish monetary and foreign-exchange policy during the financial crisis in 2008 where the Danish fixed exchange-rate peg came under pressure.

There seems to be ten general lessons to learn from the crisis regarding the art of conducting a successful monetary policy in a fixed-exchange-rate regime. None of these lessons are new. However, since currency crises and banking crises are low probability events ("tail events") a review of the lessons might be of interest.

Before the review two more general issues should be mentioned. First, even though Denmark has chosen a different monetary-policy strategy from that of other smaller European countries, the outcome is not necessary significantly different. This can be illustrated by the economic development in the Nordic countries since the middle of the 1990s. During this period, the Nordic countries have pursued different monetary-policy strategies:

- Denmark has conducted a fixed-exchange-rate policy against the D-mark and, from 1999, the euro;
- Finland switched to an inflation target in 1993. In 1996 it joined the ERM, and in 1999 it adopted the single European currency, the euro;
- Sweden has chosen to operate within the framework of an inflation target regime since 1995;
- Norway operated with a trade-weighted exchange-rate index until 2001, when it also switched to an inflation target.

Despite the different strategies the outcome measured in terms of inflation and output volatility is comparable, *cf.* Christensen & Hansen (2003) and Chart 6. It is important to note that there does not seem to be any indications that Denmark's fixed-exchange-rate policy has led to more volatility in the economy compared with the other Nordic countries with other monetary-policy strategies. The development in the long-term interest rates in the four countries is also quite similar, *cf.* Chart 7.

Second, when comparisons are made between the recent financial crisis and the currency crisis in the ERM in the early 1990s one has to keep in mind that the period since 1990 has been characterised by declining significance of gross payments linked to the current account of the balance of payments compared with gross payments linked to the financial account, *cf.* Chart 8. In the late 1980s, "current" gross payments accounted for around 50 per cent of total gross payment flows across Denmark's borders. By the mid 2000s, this share had declined to 14 per cent. Consequently, today capital flows are all-important to the short-term development in the exchange rate of the krone.

## 3.2. REDUCED EFFECTIVENESS OF MONETARY- AND FOREIGN-EXCHANGE-POLICY INSTRUMENTS DURING THE FINANCIAL CRISIS

The international financial crisis escalated during the autumn of 2008. The Danish krone weakened in September and October 2008 after a period with a negative spread between Danmarks Nationalbank's lending rate and the ECB's allotment rate, *cf.* Chart 9 (left). The negative interest-rate spread reflected a strong demand from credit institutions in the euro area for liquidity in the ECB's weekly tenders, which led to an increase in the ECB's allotment rate. Towards the end of September the ECB's allotment rate was almost 50 basispoints higher than the ECB's minimum bid rate. Another factor contributing to the pressure on the krone was the tendency for investors to withdraw from minor currencies, including the Danish krone, as a result of the intensified financial crisis. There were also

rumours in the market that certain foreign investors were speculating against the krone, e.g. via FX options.

To stabilise the krone, Danmarks Nationalbank intervened in the foreign-exchange market for considerable amounts in the late September and early October 2008. However, this proved insufficient to withstand the pressure on the krone, and in accordance with the rules of the game in a fixed-exchange-rate policy Danmarks Nationalbank unilaterally raised its monetary-policy interest rates, whereby the spread to the euro area widened. With effect from 8 October 2008, the lending rate was raised by 0.4 percentage point, thereby increasing the spread to ECB's minimum bid rate to 0.75 percentage point.

However, Danmarks Nationalbank continued to intervene in the foreign-exchange market after the interest-rate increase. At midday on 8 October, the ECB announced its decision to lower interest rates by 0.5 percentage point, citing the intensifying financial crisis as the background. Since Danmarks Nationalbank maintained its monetary-policy interest rates, the spread between the monetary-policy interest rates in Denmark and the euro area widened further.

Despite this widening, the krone was still under pressure due to the outflow of foreign exchange. This prompted Danmarks Nationalbank to intervene again at the middle of October. The net intervention sale of foreign exchange with settlement in October 2008 totalled DKK 64 billion, *cf.* Chart 9 (right) and Table 1. As a memorandum item it can be mentioned that the net intervention sale of foreign exchange with trading day in July 1993 totalled DKK 50 billion.

On 24 October, Danmarks Nationalbank raised the lending rate by a further 0.5 percentage point, thus widening the spread to the ECB's fixed allotment rate to 1.75 percentage points. This proved sufficient to stabilise the krone again. The krone strengthened from the end of October, and Danmarks Nationalbank was able to buy back foreign exchange over the subsequent months. This enabled Danmarks Nationalbank gradually to reduce its monetary-policy interest rates again, thus narrowing the spread to the ECB.

> *Lesson 1: FX interventions can only be used to smooth out minor fluctuations in the exchange rate when the foreign exchange markets are calm. When faced with a strong pressure on the currency in a fixed-exchange-rate regime a swift and sizeable increase in the interest-rate spread vis-à-vis the currency anchor is required.*

The large amounts of interventions in support of the Danish krone and the sizable increase in the interest-rate spread via-à-vis the euro area that was necessary to stabilise the krone clearly illustrates that the interest sensitivity of portfolio capital flows was very low during the crisis in the autumn of 2008. In times without

turmoil on the foreign-exchange markets the interest-rate sensitivity is usually substantial higher. A recent example occurred in February 2006, where the Nationalbank raised its lending rate by just 0.1 percentage point. This unilateral interest-rate increase was modest but nevertheless sufficient to stabilise the krone even though the Nationalbank prior to the interest-rate hike had sold foreign exchange for substantial amounts (DKK 34 billion) in order to stabilise the krone.

*Lesson 2: The interest sensitivity of portfolio capital flows is regime dependent. During financial turmoil interest-rate sensitivity of capital flows can decline substantially.*

At the peak of the crisis in October 2008 the size of the Nationalbank's foreign-exchange reserve also came into focus. Rumours were circulating in the market that the Nationalbank had insufficient reserves to maintain the fixed-exchange-rate peg. In the month after October 2008 the Nationalbank chose to increase the size of the foreign exchange reserve in order to send a strong signal to the market regarding the commitment to the fixed exchange rate peg, *cf.* Chart 10. In this connection it should also be noted that the Nationalbank since the second half of the 1990s has chosen to stabilise the krone-rate at a level close to its central rate within the ERM. The ERM rules on automatic and unlimited intervention credit apply only at the intervention limits.

*Lesson 3: The size of the foreign-exchange reserves plays an important role in signalling commitment to the fixed-exchange-rate regimes during periods with turmoil on the FX markets.*

History has shown that banking crisis and currency crisis often occur together as "twin crisis" (Allen & Gale, 2007; Reinhart & Rogoff, 2009). This was also the case for Denmark in October 2008, and naturally it presented a challenge to communicate the need to raise interest rates in Denmark at a time when other central banks around the world were lowering theirs to support the financial sector in order to address the international financial crisis.

*Lesson 4: The proper interest-rate response in a fixed-exchange-rate regime during times of crisis is rarely a convenient and popular move.*

## 3.3. DYSFUNCTIONAL INTERNATIONAL FINANCIAL MARKETS

The substantial intervention sales in October 2008 drained the foreign-exchange reserve. In previous crises, it had been possible immediately to increase the reserves by issuing short-term Kingdom of Denmark commercial papers and later

replacing these by longer-term loans if necessary, *cf.* Chart 11 for a case study of 1993.

However, the experience from the autumn of 2008 showed that it was not always possible to raise large amount of foreign exchange within a short timeframe via the CP market. Furthermore, it took quite a while before the government was able to raise longer-term foreign loans at acceptable prices. Borrowings at a too high interest rate entailed a risk of signaling an urgent need for foreign exchange and thereby intensify the pressure on the krone.

> *Lesson 5: When they are needed the most foreign exchange reserves can be difficult to obtain.*

The foreign-exchange reserve is, in principle, an expense to Danmarks Nationalbank. The reason is that the foreign-exchange reserve is offset by interest-bearing deposits in Danish kroner – either from banks or from the central government – while most of the foreign-exchange reserve is remunerated at the short-term euro rate, which is lower than the short-term rate of interest in Denmark. During time of pressure on the krone the short-term interest-rate differential widens. This increases the cost of holding FX reserves and the sizable increase of the foreign-exchange reserve has reduced the net profit of the Nationalbank substantially. In May 2009, it was therefore decided temporary (until end-2010) to reduce the interest payable on the central government's deposit at the Nationalbank.

> *Lesson 6: The costs of holding foreign exchange reserves are low when the reserves are not needed (times without currency turmoil) and expensive when the are needed (during periods of currency turmoil).*

The dysfunctional international financial markets made it also difficult for private banks in Denmark and other countries to obtain the necessary dollar and euro liquidity. In September and October 2008 Danmarks Nationalbank intervened in the FX swap market in order to ease the access to liquidity in foreign currency in the Danish banking sector. On 18 September dollars were offered against kroner for a total of DKK 3 billion with a maturity of 7 days. Likewise, in early October, Danmarks Nationalbank intervened in the euro market, offering euro for a total of DKK 17 billion with maturities of 7 days and 1 month (Bernstein, 2010).

The intervention in the FX swap market turned out to have only a temporary impact on the market. The Danish market for euro and dollar liquidity is considerable, and intervention in the FX swap market also reduces the foreign-exchange reserve.

Danmarks Nationalbank was able to establish a swap line (fully collateralised) with the US Federal Reserve on 24 September 2008. The needs for this facility was highlighted by the fact that volumes offered at dollar auctions were drawn upon in full. On 27 October 2008, Danmarks Nationalbank and the ECB established an equivalent swap line for EUR 12 billion. Although this limit was not reached, it eased the access to euro liquidity for Danish banks significantly. The swap facilities were thus very helpful in addressing the banks' needs for liquidity in dollars and euro. Furthermore, the swap-line with the ECB in October sent a strong signal to the market regarding the commitment to the fixed exchange rate peg vis-à-vis the euro.

*Lesson 7: The swap arrangements between the central banks during the crisis were a success.*

## 3.4. THE FUNCTIONING OF THE MONEY MARKET, UNCONVENTIONAL MONETARY-POLICY INSTRUMENTS AND GOVERNMENT GUARANTEES

The financial crisis generated tensions in the money market in several countries, including Denmark. Loss of confidence between the banks led to restraint on uncollateralised lending in the money markets. The market players sought to safeguard their own liquidity and hesitated to grant loans to counterparties, particularly at long maturities. The spread between collateralised and uncollateralised 3-month money market interest rates multiplied, *cf.* Chart 12.

In connection with the financial turmoil Danmarks Nationalbank expanded its collateral base to facilitate pledging of collateral by monetary-policy counterparties, thereby providing increased access to monetary-policy loans. Furthermore, temporary emergency lending facilities were established. Most of these measures were implemented during the spring and summer of 2008 and eased the bank's access to krone liquidity, especially prior to the establishment of government guarantees for the banking sector, *cf.* below. At the end of February 2011 most of these temporary measures ceased.

The experience seems to have been similar in other countries. The Financial Stability Forum, which comprises, among others, the ministries of finance, central banks and financial supervisory authorities of the major economies, has conducted an analysis of the factors and the underlying weaknesses in the financial system that led to the outbreak of financial turmoil in the summer of 2007. In its report, it encouraged central banks to ensure that their operational frameworks are sufficiently flexible to address extraordinary situations (Financial Stability Forum, 2008a and 2008b).

*Lesson 8: The operational framework for monetary policy implementation must be sufficiently flexible to address extraordinary liquidity situations in the money market.*

However, the financial crisis escalated in September 2008 when the US government took control of the mortgage giants, Freddie Mac and Fannie Mae, and the investment bank Lehman Brothers filed for bankruptcy (Chapter 11). This sent shockwaves through the financial markets as they had expected a bailout along the same lines as the Bear Stearns case in the spring of 2008.

It became clear that the international financial crisis was a real threat to financial stability worldwide. At the same time, it had moved beyond a liquidity crisis that central banks could alleviate by providing liquidity to the markets. The crisis had deeper roots, the banks' capital adequacy was called into question, and quite extraordinary measures were needed in order to restore stability and confidence in the financial markets.

In Europe, Ireland was the first country to provide a government guarantee for the banking sector. The Irish government guarantee created a snowball effect throughout Europe, and the other EU member states, including Denmark, had to issue guarantees for their banking sectors – wholly or partially, *cf.* Danmarks Nationalbank (2008).

On 5 October 2008, the Danish Contingency Association[3] concluded an agreement on financial stability (Bank Rescue Package) with the Danish government. Under the agreement, the government provided an unlimited guarantee to all depositors and other unsecured creditors in banks in the Kingdom of Denmark. The guarantee was not a free lunch for the banks, however. The payments from the Danish Contingency Association under Bank Rescue Package constituted up to DKK 35 billion. Participation in the government guarantee under Bank Rescue Package was voluntary, but all Danish banking institutions except a few very small institutions joined the scheme.

The need for this initiatives should be viewed against the background of the large deposit deficit (customer funding gap) that had been build up in the Danish banking sector prior to the crisis, *cf.* Chart 13, mainly reflecting Danish bank's expansion abroad. This funding gap had to a large extent been financed via foreign lending, including short-term loans from foreign credit institutions.

However, the government guarantees was also very considerably in terms of duration (two years) as well as institutions and claims covered (DKK 4,200 billion or around 2.5 times Denmark's GDP). These guarantees could potentially make large claims on the foreign-exchange reserve increased in case of the failure of a

[3] A private contingency facility for winding-up of ailing banks.

bank with large foreign liabilities. The measures to safeguard financial stability therefore also made a substantial increase in the foreign exchange reserve necessary.

*Lesson 9: Short-term financing through the money and capital markets is generally more sensitive to changes in the banking institutions' own credit standing than deposits are. The banks' dependence on money market financing thus make them vulnerable, particularly to changes in foreign banks' ability and willingness to finance them during times of crisis. If the banking system relies heavily on short-term foreign funding it can have systemic implications and make it necessary for the central bank to operate with a large foreign-exchange reserve, particularly in a fixed-exchange-rate regime.*

## 3.5. THE CHALLENGES AND COST OF BEING OUTSIDE THE EURO IN TIMES OF FINANCIAL CRISIS

In calm periods, interest rates in Denmark will be only marginally higher than in the euro area due to the fixed-exchange-rate regime. In turbulent periods such as during the recent financial crisis, the spread tends to widen. Often this widening occur at a rather inopportune time where other negative factors are affecting the real economy. This visualises part the costs of being outside the euro area.

The financial crisis has also highlighted a number of other costs that Denmark has to bear due to the status as a non-euro area EU member state (Bernstein, 2009). At an early stage of the financial crisis the ECB was able to conclude an agreement with the Federal Reserve in order to provide dollar liquidity to euro area banks. It took some time before the Nationalbank was able to present a similar agreement for the Danish banks.

During the crisis the members of the euro area also agreed on standard-setting recommendations for the structure and pricing of government guarantees and capital injections in the banking sector. Denmark was not part of these negotiations and the Danish guarantee scheme did therefore not follow the same standard as in most other EU countries. This made it more difficult to communicate the content and design of the Danish guarantees to international market participants. It could also be mentioned that Denmark does not participate in the European Financial Stability Facility.

The euro area is the second-largest currency in global terms and the ECB is therefore represented in all the important international forums. The regulatory follow-up on the financial crisis is currently being debated in these forums such as the Basel Committee, the Financial Stability Forum, G20, etc. The outcome of these

discussions will have a major impact on the structure of the financial markets and regulation and supervision of financial institution in the years to come. Due to its status as a non-euro area EU member state Denmark's influence on these international negotiations is more limited than is the case for the euro area member states.

*Lesson 10: There is a cost to Denmark of being outside the euro. The cost is most visible during times of crisis.*

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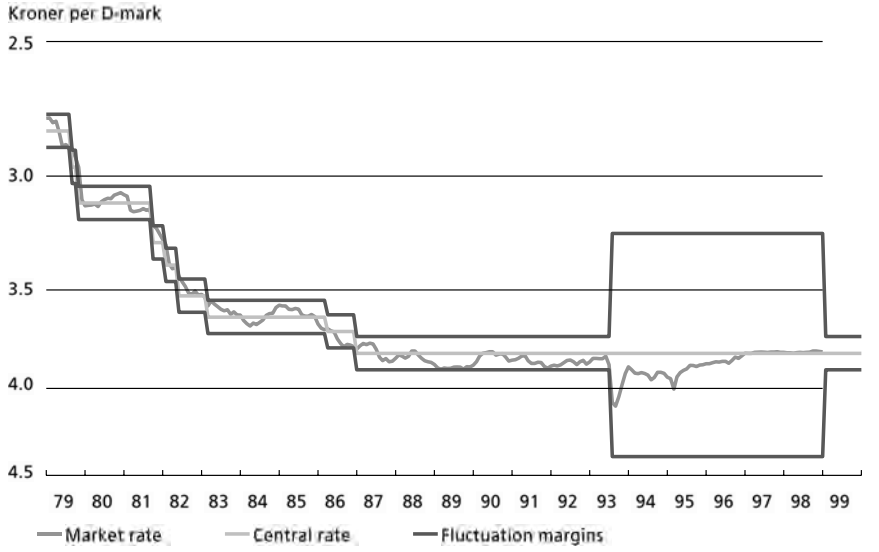
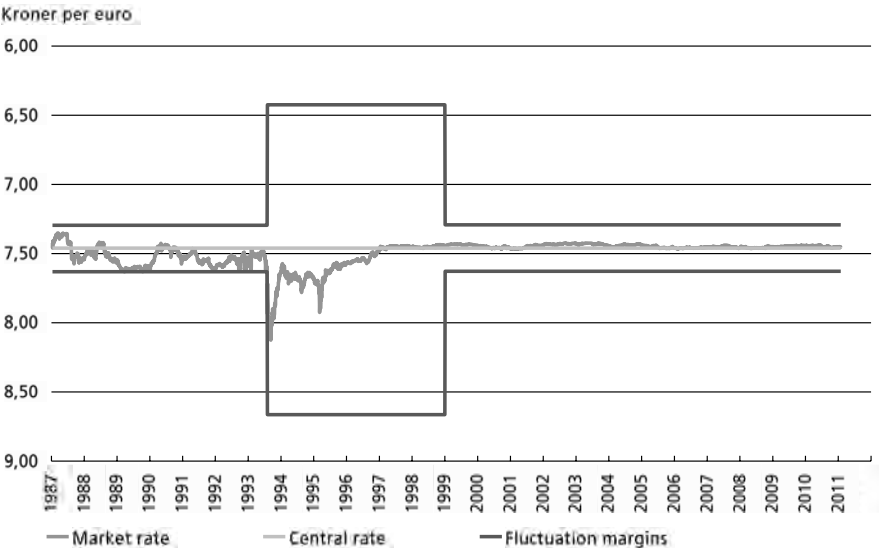
# Charts

EXCHANGE RATE OF THE KRONE VIS-À-VIS THE D-MARK Chart 1



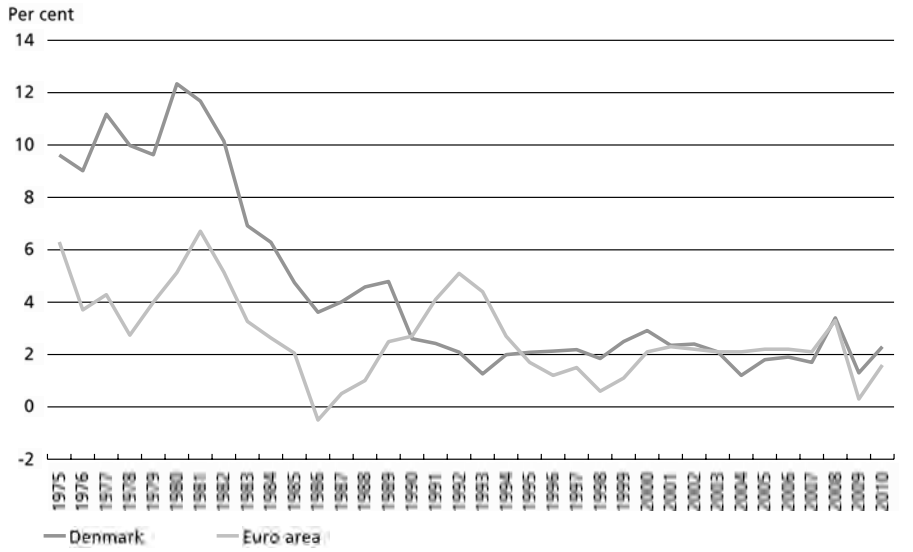

Note: Reverse logarithmic scale.
Source: Danmarks Nationalbank.

EXCHANGE RATE OF THE KRONE VIS-À-VIS THE EURO Chart 2



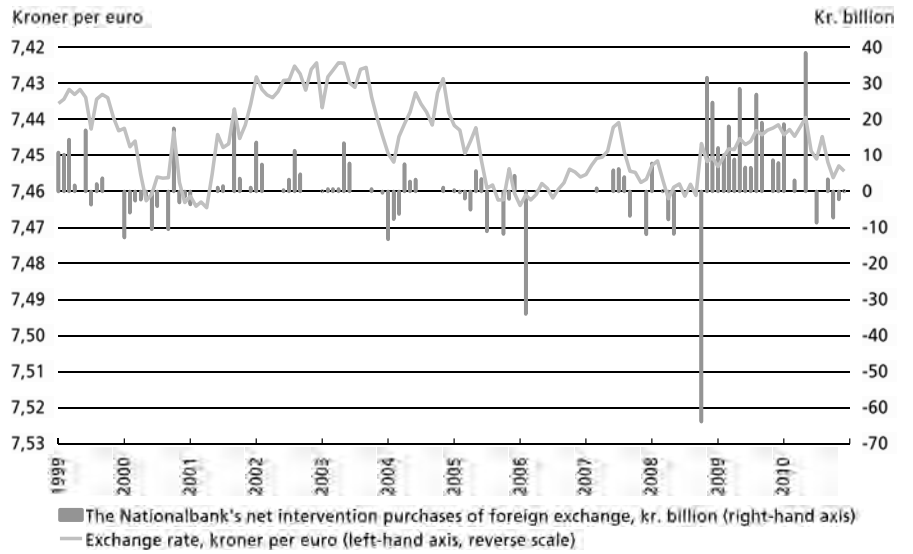

Note: Reverse scale. Prior to 1999 a synthetic exchange rate of the krone vis-à-vis the euro has been calculated on the basis of the krone/D-mark rate and the conversion rate between the euro and the D-mark fixed as at 1 January 1999. The earliest observation is from 12 January 1987.
Source: Danmarks Nationalbank.

CONSUMER PRICE INFLATION Chart 3



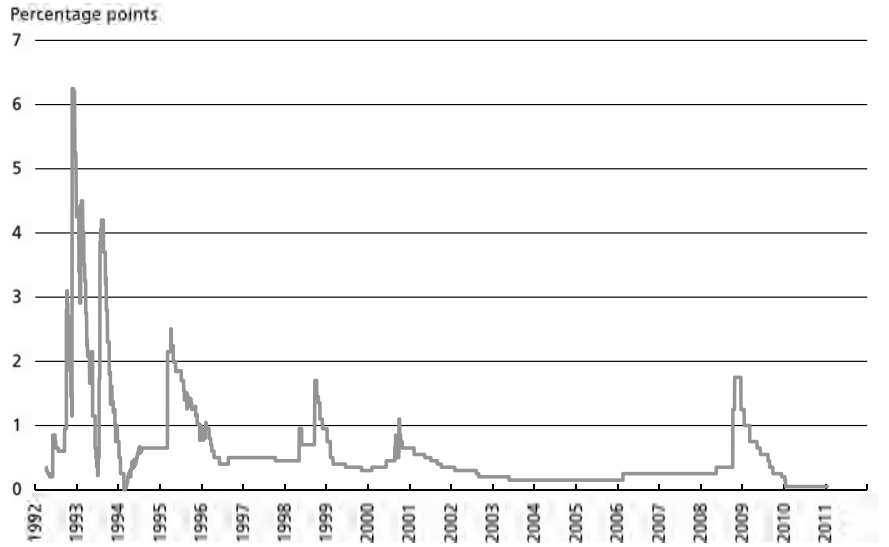

Note: Inflation in the euro area is represented by inflation in West Germany 1975-89 and in Germany 1990-98.
Source: Statistics Denmark, ECB and OECD.

EXCHANGE RATE OF THE KRONE AND INTERVENTION Chart 4




Note: Monthly data. Interventions have been accrued according to the value date. Exchange rate at month-end. All interventions were performed by Danmarks Nationalbank.
Source: Danmarks Nationalbank.

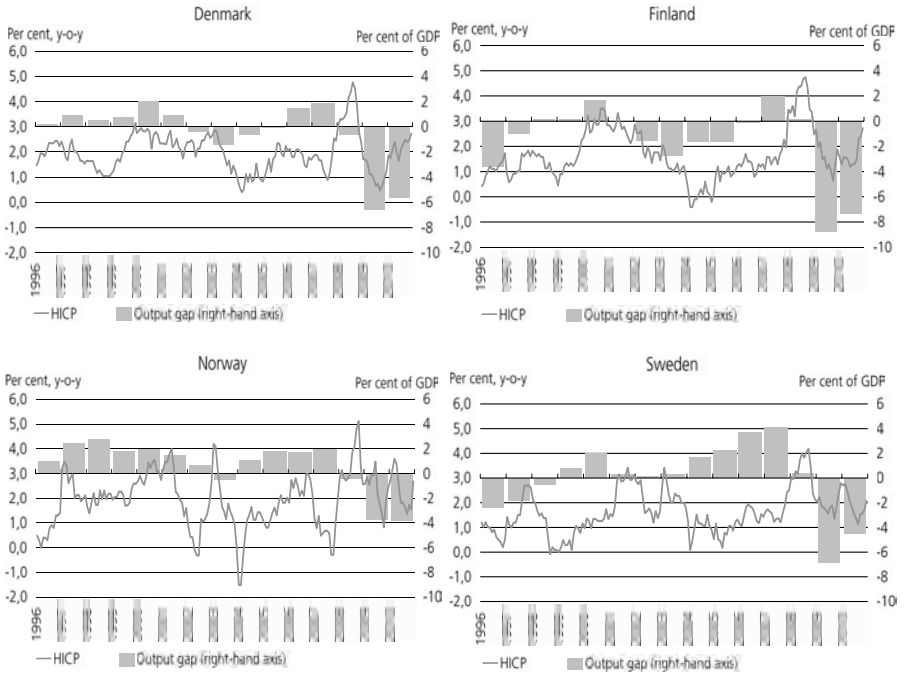
MONETARY-POLICY INTEREST-RATE SPREAD BETWEEN DENMARK AND GERMANY (1992-98)/THE EURO AREA (SINCE 1999) Chart 5




Note: For Denmark, Danmarks Nationalbank's lending rate has been used for the entire period. For Germany, the Bundesbank's repo rate has been used. For the euro area, for the period from 1999 to 27 June 2000 the ECB's fixed allotment rate in the main refinancing operations has been used. After this time, the ECB's minimum bid rate has been used until 14 October 2008, followed by the ECB's fixed allotment rate.

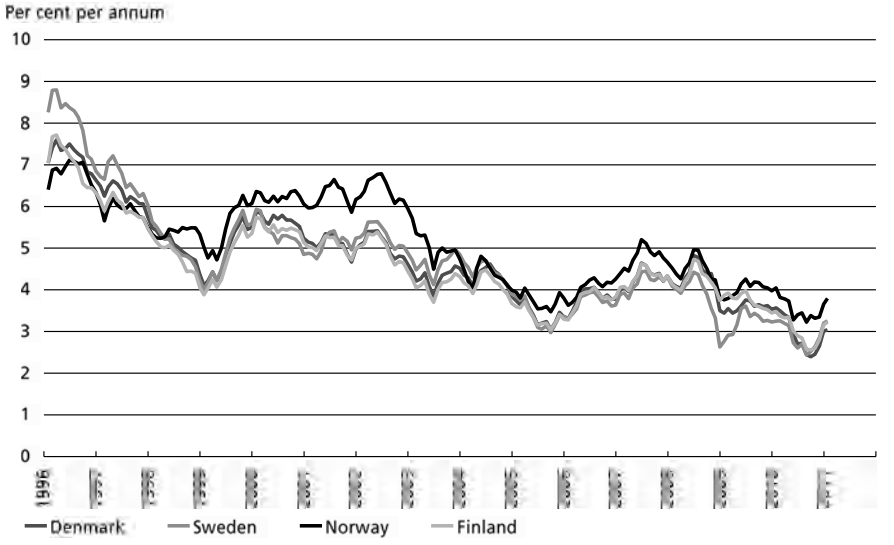
Source: Deutsche Bundesbank, ECB and Danmarks Nationalbank.

INFLATION (HICP) AND OUTPUT GAPS Chart 6



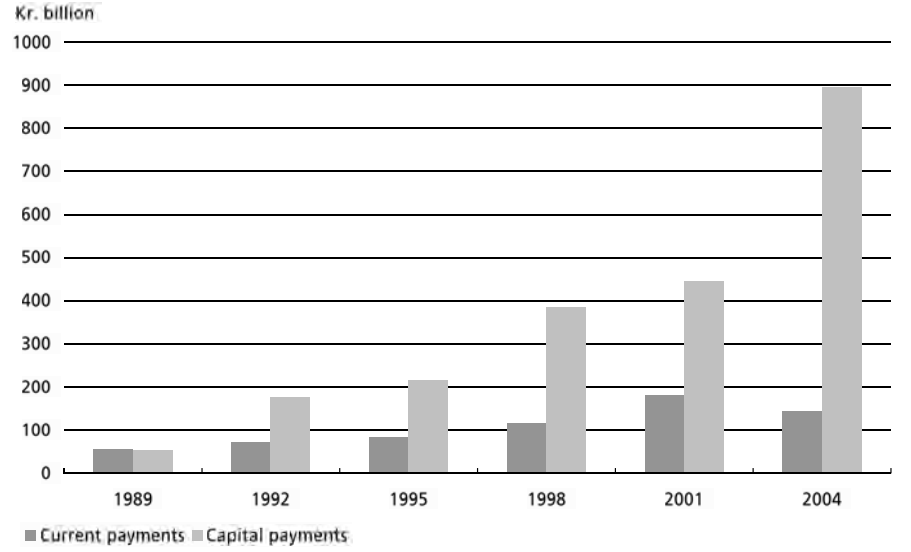

Note: The output gap is a measure of actual GDP less potential GDP as a percentage of potential GDP. Output gaps for 2010 are forecasts.
Source: Reuters EcoWin and OECD.

YIELDS ON 10-YEAR GOVERNMENT BONDS Chart 7




Source: Danmarks Nationalbank.

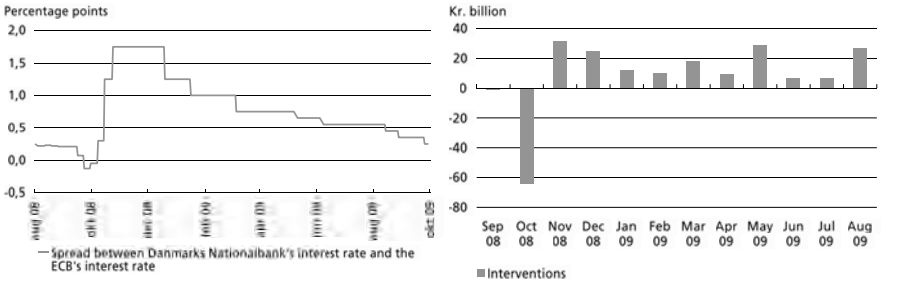
REGISTERED GROSS PAYMENTS TO AND FROM DENMARK Chart 8




Note: Due to restructuring of the statistics, it is not possible to include years after 2004. Capital payments include derivatives from 2001 onwards. Registered capital payments underestimate the actual volume of capital payments as the statement does not include transactions between residents and non-residents that do not affect the external position of the banking sector (after 1999: of a bank), e.g. purchase of foreign securities by a Danish bank.

Source: Danmarks Nationalbank.

INTEREST-RATE SPREAD AND INTERVENTIONS Chart 9




Note: Left: The ECB's interest rate is the variable allotment rate (the marginal rate on the ECB's main refinancing operations) until 14 October 2008, after which time the fixed allotment rate has been used. Right: Danmarks Nationalbank's net purchases of foreign exchange for intervention purposes, calculated on settlement days.

Source: Danmarks Nationalbank and ECB.

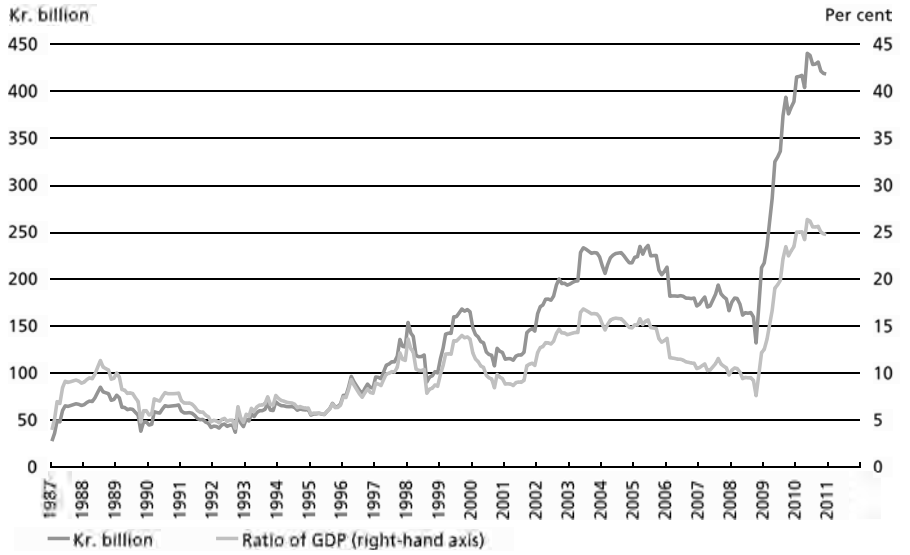
INTERVENTION IN THE FOREIGN-EXCHANGE MARKET FOR DANISH KRONER Table 1

| | Purchase of foreign exchange | Sale of foreign exchange | Net purchase of foreign exchange | Number of intervention days |
|---|---|---|---|---|
| | Kr. billion | | | |
| 1990 | 30 | 1 | 29 | 84 |
| 1991 | 1 | 3 | -2 | 19 |
| 1992 | 23 | 39 | -16 | 33 |
| 1993 | 54 | 84 | -31 | 73 |
| 1994 | 11 | 0 | 11 | 21 |
| 1995 | 37 | 5 | 32 | 84 |
| 1996 | 46 | 22 | 23 | 96 |
| 1997 | 40 | 6 | 34 | 63 |
| 1998 | 42 | 71 | -30 | 86 |
| 1999 | 62 | 5 | 56 | 65 |
| 2000 | 21 | 58 | -37 | 55 |
| 2001 | 27 | 4 | 24 | 11 |
| 2002 | 41 | 0 | 41 | 35 |
| 2003 | 25 | 1 | 24 | 20 |
| 2004 | 15 | 28 | -12 | 34 |
| 2005 | 16 | 34 | -18 | 35 |
| 2006 | 0 | 34 | -34 | 13 |
| 2007 | 17 | 19 | -2 | 17 |
| 2008 | 66 | 86 | -20 | 48 |
| 2009 | 154 | 0 | 154 | 46 |
| 2010 | 64 | 18 | 46 | 22 |

Note: Interventions have been accrued according to the value date, except for interventions in the forward foreign-exchange market in 1990-91, which have been included at the trade date. Some of the large interventions in support of the krone during the currency unrest in 1992-93 were made by other ERM central banks, not by Danmarks Nationalbank. Such intervention is also included in the table. From August 1993 all interventions were performed by Danmarks Nationalbank.

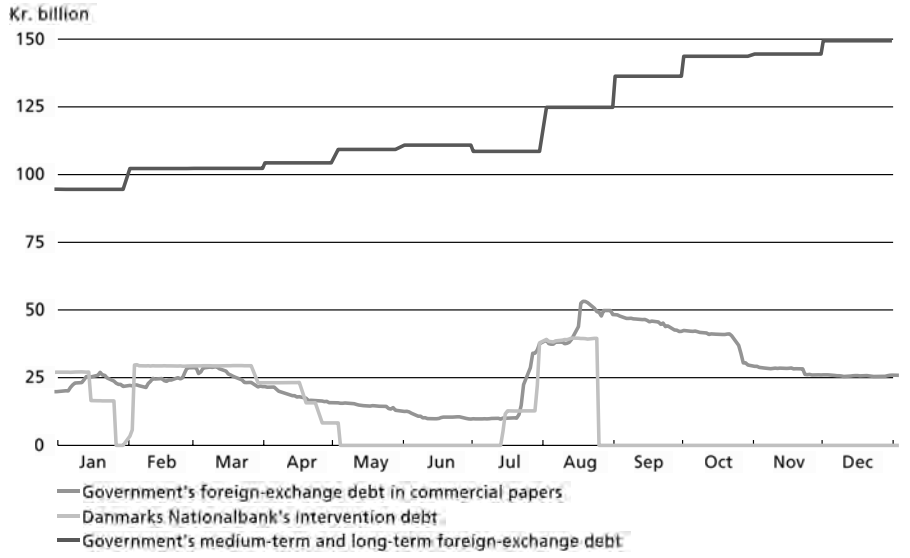
Source: Danmarks Nationalbank.

DANMARKS NATIONALBANK'S FOREIGN-EXCHANGE RESERVE Chart 10



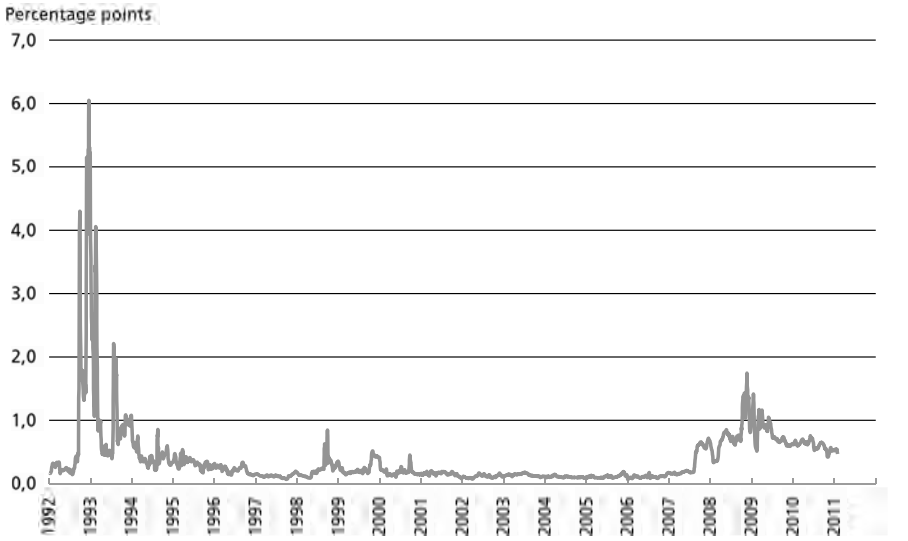

Note: Net assets, end of month.
Source: Danmarks Nationalbank.

DANMARKS NATIONALBANK'S INTERVENTION DEBT AND THE DANISH GOVERNMENT'S FOREIGN-EXCHANGE DEBT IN 1993 Chart 11



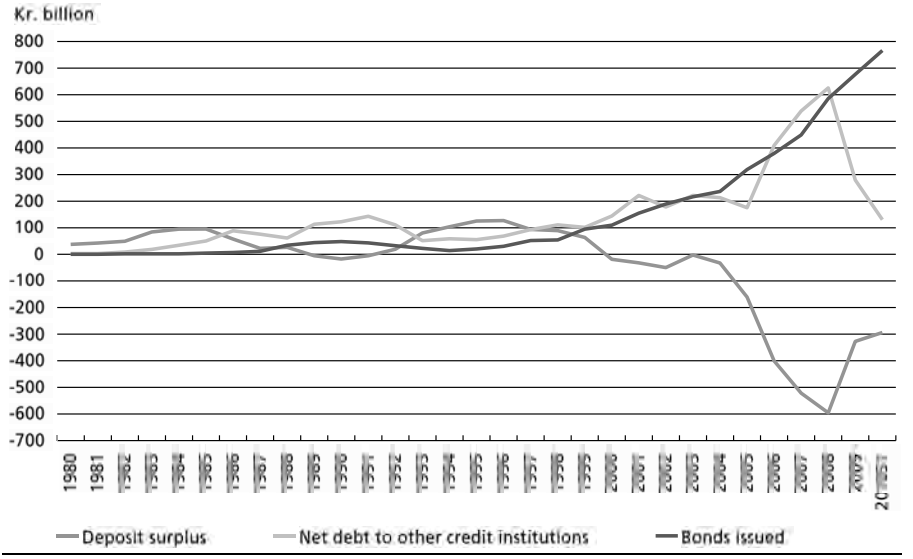

Note: The government's foreign-exchange debt in commercial papers and Danmarks Nationalbank's intervention debt are stated on a daily basis, while the government's medium-term and long-term foreign-exchange debt is stated on a monthly basis.
Source: Danmarks Nationalbank.

SPREAD BETWEEN UNCOLLATERALISED AND COLLATERALISED 3-MONTH MONEY-MARKET INTEREST RATES Chart 12




Note: 5-day moving average of daily observations. The collateralised money-market interest rate concerns repos, while the uncollateralised rate is CIBOR.
Source: Danmarks Nationalbank.

THE BANKS' DEPOSIT SURPLUS, NET DEBT TO OTHER CREDIT INSTITUTIONS AND BOND ISSUES Chart 13




Source: Danish Financial Supervisory Authority.

# 4. Macroeconomic Policies and the Roots of the Global Crisis

*Pietro Catte, Pietro Cova, Patrizio Pagano and Ignazio Visco*[1]

## 4.1. Introduction

While the trigger and the proximate causes of the crisis that has rocked the global economy since the summer of 2007 were essentially financial, it has become increasingly clear that macroeconomic imbalances were a central part of the complex set of circumstances that lay at its root. In particular, the financial excesses that led to the piling up and underestimation of risks could not have become so widespread if the macroeconomic environment had not been characterized by large saving-investment imbalances, very low interest rates and substantial asset price misalignments. In the general climate of hype that those macroeconomic conditions permitted, supervisory and regulatory failures allowed financial innovations to generate serious dysfunctions in the US and global financial systems. Moreover, the lopsided composition of global final demand in the years preceding the crisis, with most of the world ultimately relying on US consumer spending, essentially financed by growing mortgage debt, made the world economy extremely vulnerable to a shock – the downturn in the US housing market – that called this central factor of the global expansion into question. If this key source of fragility is not borne in mind, it is difficult to explain fully the sharp and highly synchronized contraction of world trade and the collapse of global confidence that characterized the propagation of the global recession.

We argue that the lack of timely and sufficiently decisive policy reactions to the domestic and external imbalances was crucial: if those imbalances had been corrected, the financial turmoil would have had lesser far-reaching consequences. Over the 10-15 years that preceded the crisis it was indeed already possible to identify a number of signals of macroeconomic stress, which over time interacted with flaws in the financial system to create very significant, though at the time partly hidden, financial fragilities[2].

These signals were: the dramatic fall in the US household saving rate, from around 7 per cent in the early 1990s to close to zero in 2005-07; a sharp increase in US and global liquidity, which largely reflected the generally accommodating

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[2] See Visco, 2009, 2010.

monetary conditions in the United States; the continuous widening of global imbalances, already recognized as hard to sustain in the late 1990s; an enormous increase in official reserves, mainly in emerging Asia and the oil-exporting countries, which mostly pegged their currencies to the US dollar; very low levels of long-term interest rates and asset price volatility after 2003; and a sequence of asset price bubbles in the United States and globally, starting with the dot-com bubble of the late 1990s, followed by an unusually synchronized global housing price boom.

Essentially, these disequilibria reflected rapid and sustained growth in final demand, especially consumption demand, in the United States, financed by overborrowing, primarily from abroad. This occurred in a global context of excess saving that compressed real interest rates to abnormally low levels compared with average GDP growth. If the United States served as a sort of "consumer of last resort", other large advanced and emerging economies implicitly or explicitly followed an export-led growth strategy, which is difficult to maintain indefinitely but also difficult to abandon.

Various arguments have been put forward to explain the emergence of such disequilibria. Some focus on the role of US monetary policy (see e.g. Taylor, 2007, and the response of Bernanke, 2010), others emphasize the role of excess saving outside the United States and the channelling of foreign saving into Treasuries, which put downward pressure on interest rates (e.g. Bernanke, 2005, IMF, 2005).

More recently, it has been suggested that only a much broader set of interrelated factors – macroeconomic as well as financial – could have generated a crisis of such magnitude (Visco, 2009). Along similar lines, Bean (2009) concludes that it would be a mistake to look for a single culprit. Optimistic views of the extent to which the Great Moderation had reduced underlying risk, loose monetary policy in the United States and a perverse pattern of international capital flows together provided fertile territory for the emergence of a credit/asset-price bubble. Similarly, Obstfeld and Rogoff (2009) argue that the global imbalances of the 2000s and the global crisis are intimately connected, both having their origins in the economic policies followed in a number of countries in the 2000s and in distortions that influenced the transmission of these policies through the United States and ultimately global financial markets.

In this more eclectic interpretation, which is also the one taken up here, interactions among the Fed's monetary stance, global real interest rates, credit market distortions, and financial innovation created the toxic mix of conditions that made the United States the epicentre of the global financial crisis. Outside the United States, exchange rate and other economic policies followed by emerging markets such as China helped allow the United States to borrow cheaply abroad and thereby finance its unsustainable housing bubble.

In this paper, a more extended version of which is Catte *et al.* (2011), we focus on the period 2002-07, before the start of the financial turmoil that evolved into the global crisis, and perform counterfactual simulations to investigate two central elements of the story, namely: (a) an overly expansionary monetary policy and lax supervisory policy in the United States, which may have permitted a prolonged expansion of debt-financed consumer spending; (b) the choice by China and other emerging countries to pursue an export-led growth strategy supported by pegging their currencies to the US dollar, in conjunction with sluggish domestic demand in other advanced economies characterized by low potential output growth. Model simulations are conducted to provide a quantitative assessment of the effects of the different policy choices mentioned above.

Overall, our results highlight the complementarity of policy actions in the United States and in surplus countries for the correction of both internal US and global imbalances. In this sense, they support the fundamental assumption underlying the current efforts to rebalance global demand in the context of the G-20 Framework for strong, sustainable and balanced growth (G-20, 2009). The results lend support to the view that if substantial and globally coordinated demand rebalancing had been undertaken early on, the imbalances would not have accumulated to the extent that they did. Although it is hard to say whether in that scenario the financial crisis might have been avoided, its propagation would probably have been less destructive because both the US financial system and the global economy would have been less vulnerable to it.

## 4.2. OVERVIEW OF THE SIMULATION RESULTS

To carry out the simulations, we use the National Institute of Economic and Social Research's large-scale global macroeconomic model (NiGEM). NiGEM is an estimated model, whose framework is "neo-Keynesian" in the sense that agents' choices may be assumed to be forward-looking, but with nominal rigidities that slow the process of adjustment to shocks. Financial asset prices are normally assumed to be forward-looking, and affect consumer demand via wealth effects. Monetary policy can be set according to alternative interest rate feedback rules[3].

We concentrate on the period 2002-07 to investigate whether a different set of policy actions in various areas of the world would have avoided the build-up of domestic imbalances in the US and current account imbalances in the US and other major areas[4].

[3] The main model properties of NiGEM are discussed in Barrell *et al.* (2004). The structure of the main equations of the model can be found on the Niesr website (www.niesr.ac.uk).

[4] By contrast, BARRELL *et al.*, 2008, who also use the NiGEM to simulate a scenario of global imbalances correction via demand rebalancing, take 2007 as the starting point. Their scenario is centred on a large US dollar depreciation driven by a rise in risk premia on US assets, with no exogenous change in US monetary policy.

The counterfactual scenario that we propose combines a monetary tightening and a credit tightening via macro-prudential policy tools in the United States with a large increase in potential output in Japan and the larger euro area countries and a rebalancing towards domestic demand, accompanied by an exogenous currency appreciation, in China and other Asian surplus economies that peg to the dollar. Furthermore, given the tighter monetary policy stance in the United States and the reduced demand for US Treasuries coming from foreign official authorities, we assume also an increase in the term premium on long-term bonds

### 4.2.1. Policy Assumptions

In the US the monetary policy tightening is assumed to begin in 2003Q1, with the federal funds target starting from a lower initial level (1.5 per cent) and reaching 3.75 per cent in 2005Q2; the policy rate is then allowed to remain constant for two more quarters, when it crosses the baseline, and to be determined afterwards by a Taylor rule. Until 2005Q4, this path for the federal funds rate is very similar to the path that would have been obtained had the Fed followed a Taylor rule using real-time data on changes in the GDP deflator as the inflation measure (as in the original Taylor rule specification), as suggested by Papell (2010).

Furthermore, the credit spread incorporated in mortgage rates is raised progressively by 1.5 percentage points in 2003Q1-2004Q2, and by an additional 0.5 percentage point until 2006Q1; it is then assumed to return to the baseline by early-2007.

This policy shock is calibrated so as to keep the cost of mortgages in 2002-07 close to the average recorded in the 1990s, while in reality it declined markedly. As in the analysis conducted by the IMF (2009), the model is insufficiently rich to specify the nature of banking supervisory or macro-prudential tools explicitly (banks are not explicitly modelled, for example). So we assume that the policy-maker had access to an instrument that affects mortgage credit spreads directly. This is a simple shortcut intended to mimic the effects of, say, regulations that require banks to set limits on housing loan-to-value ratios. Alternatively, we may want banks to set aside more capital as asset prices rise, thus raising the margin that banks have to charge over funding costs, yet this would also affect the cost of business capital.

For the rest of the world, we assume that major advanced economies suffering from particularly sluggish growth enact supply-side reforms that enhance their potential output; this would also endogenously boost their domestic demand. Specifically, in Japan and the three major euro-area countries (Germany, France and Italy) we would ideally want to assume a productivity enhancement in non-tradables (e.g. Koske and Wörgötter, 2010). This, in turn, would boost domestic

demand via wealth effects. However, since NiGEM is a one-good model, we take a short-cut and increase potential output directly. The size of the shock is calibrated so as to raise potential output growth to 2.5 per cent in 2002-07, which is roughly equal to potential output growth in the United States in the same period. Thereafter, counterfactual potential growth is assumed to stabilize gradually at an average between the United States' and the country's baseline potential growth. Ultimately, over the entire period, potential output growth exceeds the baseline by 0.7 percentage points in Japan, 0.5 points in Germany and 0.3 points in France and Italy.

In emerging countries, instead, we assume a broad range of economic reforms – macro-fiscal management, governance – that directly rebalance the overall composition of demand towards the domestic component. In particular, in China and other surplus emerging Asian economies, domestic demand is assumed to shift upwards between 2002Q1 and 2007Q4 by an amount equal to net exports; after that, it is allowed to revert very gradually to the baseline. These assumptions are meant to capture a genuine rebalancing towards domestic demand, carried out through enhanced welfare state reforms aimed at reducing precautionary saving (Blanchard and Giavazzi, 2006, Baldacci *et al.*, 2010) as well as corporate governance reforms able to reduce firms' retained earnings.

At the same time, in China and other surplus emerging Asian economies the path of the exchange rate is calibrated so as to ensure that the counterfactual path of output and inflation remains as close as possible to the baseline[5].

In other words, a real appreciation is engineered to ensure that the excess domestic demand is directed towards imports and domestic macroeconomic balance is maintained. In Japan and the euro area, which like all advanced economies have a fully modeled monetary policy reaction function in NiGEM, the reaction of the exchange rate occurs endogenously, though with some lags, via the induced changes in monetary policy rates.

One crucial issue is how to deal with the "conundrum" of the apparent lack of sensitivity of US long-term interest rates to the gradual rise in short rates after June 2004, which surprised many observers for being in sharp contrast with interest rate behaviour during past policy tightening cycles (Greenspan, 2005). Many interpretations (see Rudebusch, Sack and Swanson, 2007, for a survey) have traced it to a decline in the term premium. For instance, Kim and Wright (2005) estimated a three-factor affine model of the yield curve and found that the risk premium on ten-year bonds fell by 0.8 percentage points between 2004 and 2005[6].

[5] This allows, among other things, for an appreciation of the renminbi vis-à-vis the US dollar by an amount cumulatively slightly larger than 20 per cent.

[6] This estimate is remarkably similar to that obtained by Bernanke, Reinhart and Sack (2004). It is slightly higher than the estimate by Rudebusch and Wu (2007) and lower than that by Cochrane and Piazzesi (2005).

As noted by Kohn (2005), the decline in term premia in the Treasury market may have contributed to keeping long-term interest rates relatively low and, consequently, may have supported the housing sector and consumer spending more generally.

Overall, given the tighter policy stance in the United States and the reduced demand for US Treasuries coming from foreign official authorities, in our counterfactual we assume that from 2004 onwards the term premium on long-term bonds increases everywhere by 0.8 percentage points.

In particular, we follow Craine and Martin (2009) and attribute half of the 0.8 percentage points change in the term premium to foreign holdings of Treasury debt. This may be viewed as a conservative assumption with respect to the findings of Warnock and Warnock (2006), who estimate that increased foreign demand in 2004-05 kept the ten-year Treasury yield 0.9 percentage points lower than it would otherwise have been. But other studies find that foreign official purchases of Treasury securities play little or no role in explaining the decline in long-term Treasury yields (e.g. Wu, 2008). As suggested by Rudebusch (2010), with the benefit of hindsight it now appears that the "conundrum" was part of a broader global credit boom characterized by an underpricing of many types of risk, especially for fixed-income securities. Indeed, monetary policy actions may have affected the risk-taking capacity of banks, leading to shifts in the supply of credit (Adrian and Shin, 2008, 2009). Therefore, we also assume that tighter liquidity conditions would have reduced the appetite for risk (or the search for yield), resulting in higher term premia.

### 4.2.2. Results

In the United States, the contractionary effect of tighter monetary policy is compounded by the increase in real interest rates due to the global demand shock and the higher term premium. Accordingly, output falls by about 3 per cent relative to the baseline by 2005. The increase in the price level is transitory and disappears after the third year of the simulation.

The effect on real house prices is substantial: by end-2006 they are 8 per cent lower than the baseline. Their cumulative increase between end-2001 and the peak (2006Q4) is cut by 11 percentage points relative to the baseline (from 31 to 20 per cent). This means that while real house prices actually increased by almost 4 per cent per year in the six years between 2002 and 2007, according to the counterfactual in the same period they would have increased by 2.7 per cent per year, which is much closer to the average annual growth in the previous decade (2.2 per cent, Figure 1, left-hand panel).

The improvement in the US current account deficit comes to 1.6 percentage points of GDP by end-2007. The implied real depreciation of the dollar amounts to less than 5 per cent by end-2007. The improvement in the current account also continues in the remaining years of the simulation exercise, when it exceeds 2 percentage points of GDP.

In Japan, the higher potential output deepens deflation on impact, but just slightly. The expansionary effect of the increase in domestic demand is only partially offset by the fall in equity prices due to expectations of a long-lasting monetary tightening (even though the actual policy tightening occurs only several years later, since policy rates were initially above the desired level owing to the zero lower bound). Thus, the deviation of output from the baseline is substantial. The large increase in domestic absorption causes the current account surplus to shrink relative to the baseline by around 2.5 percentage points of GDP by 2007.

In Germany too, the shock to potential output pushes inflation slightly below the baseline. Output growth jumps above the baseline on impact and then slows down, but remains persistently above the base. For the euro area as a whole, the net effects are more limited (output rises permanently above the baseline, by 1 per cent by end-2007). Germany's external surplus shrinks by 1.3 percentage points of GDP by 2007. The euro area's external balance changes very little.

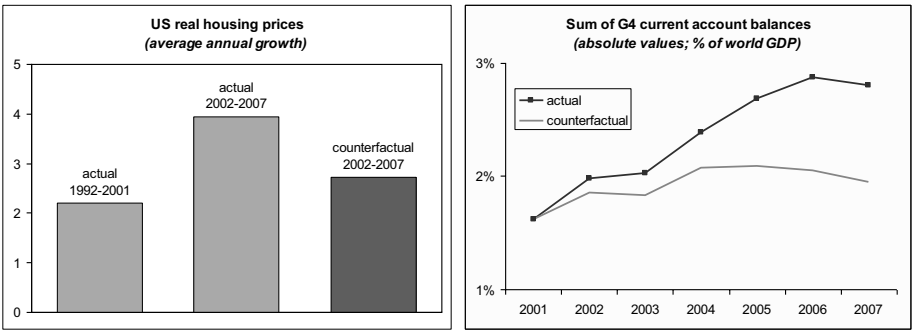
In China, output remains close to the baseline, as the domestic demand shock is offset by the exchange rate appreciation; the (calibrated) renminbi appreciation required to do that is of the order of 6 per cent on impact, relative to the baseline, vis-à-vis the US dollar and a little more than 20 per cent by end-2007 (but just 11 per cent in real effective terms). The reduction in China's current account surplus is small initially, but increases progressively after 2004 and exceeds 5 percentage points of GDP by 2007.

As a consequence, in 2001-07 the dispersion of current account balances – measured as the sum of the absolute values of the current account balances of the US, Japan, Germany and China (G4) scaled by world GDP – would have remained almost flat, whereas it actually doubled (Figure 1, right-hand panel).

In order to separately identify the contribution of each of the different policy choices mentioned above, we also conducted policy simulations imposing one shock at a time (see Catte *et al.*, 2011, for details). Overall, the results indicate that none of those policy changes, considered in isolation, would have been sufficient to address both the US domestic and global imbalances to a substantial extent. In fact, a tighter US monetary policy would not have been enough to dampen the housing bubble, without a simultaneous tightening of credit standards. Combining both policies would have had a significant effect on house prices, but only a modest one on the US current account deficit. That would have

required a simultaneous demand expansion in surplus countries resulting from significant structural reforms and accompanied by exchange rate adjustment. On the other hand, policy changes in surplus countries alone would have induced only modest endogenous policy changes in the United States, and therefore would have had a negligible impact on that country's domestic imbalance.

**Figure 1: Actual and counterfactual US real housing prices and dispersion in current account balances**




## 4.3. GOING FORWARD

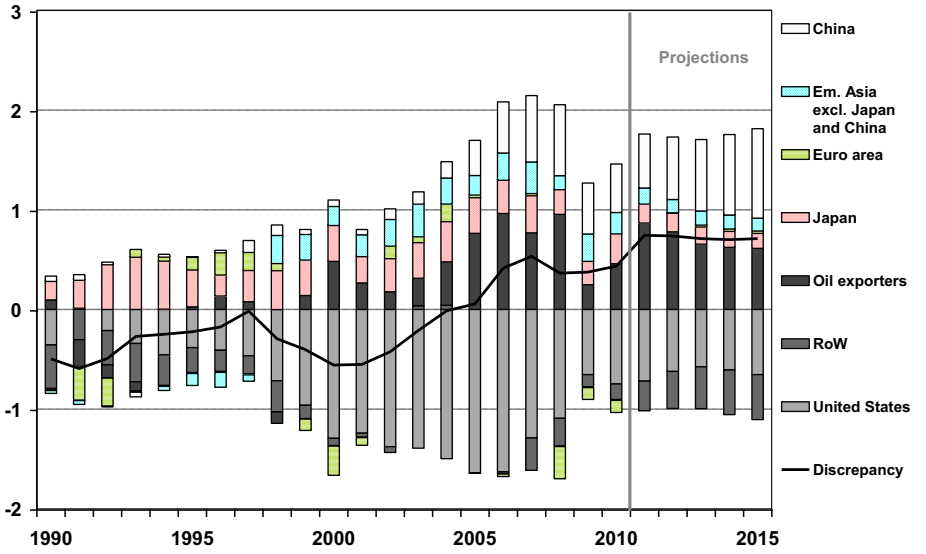
Was the Great Recession avoidable? It is probably impossible to tell, but this paper shows that with a different set of economic policies in various areas of the world the global environment could have been substantially different. In particular, had monetary and financial supervision policies been tighter in the United States, had productivity-enhancing structural policies been implemented in Japan and Europe, and had policies conducive to rebalancing towards domestic demand been pursued in emerging Asian economies, in combination with enough exchange rate flexibility to maintain domestic balance, the pattern of current accounts would have been considerably more balanced and US housing prices would have grown at a much slower pace. For the United States, the cost of these policies would have been lower output and temporarily higher inflation, but the loss in output (less than 3 percentage points below the baseline in 2006) is half as big as the output loss at the trough of the recession (6 percentage points relative to the pre-crisis trend in 2009Q2). Furthermore the output "loss" is truly a loss only if the baseline output level can be regarded as sustainable. But, in fact, part of the lower output would have simply reduced the positive output gap, estimated by the OECD at 1.7 per cent in 2006 (OECD, 2010b). The remaining part may be interpreted as a reduction in potential output deriving from maintaining real interest rates at more normal levels instead of the unusually low levels experienced during the period of easy credit over much of 2000s (OECD, 2010a). For

the other major economies the rebalancing of global demand, through a shift towards greater reliance on domestic demand in China and an increase in potential output growth in Europe and Japan, would have compensated the slowdown induced by tighter US monetary and supervision policies, helping markedly to mitigate the international distortions that facilitated the build-up of the crisis.

The fundamental macroeconomic imbalances that lay at the root of the financial turmoil have not being righted by the consequent global recession. After a temporary narrowing induced by the rise in US private sector saving and the sharp fall in investment, partly offset by a larger public sector deficit, the US current account deficit is again on the rise according to IMF projections (Figure 2). Underlying this is the only limited rebalancing between domestic demand and exports that has occurred in both deficit and surplus economies. Figure 3 suggests that, in the absence of structural policy changes supporting the necessary rebalancing, the pre-crisis pattern of growth drivers is now re-emerging.

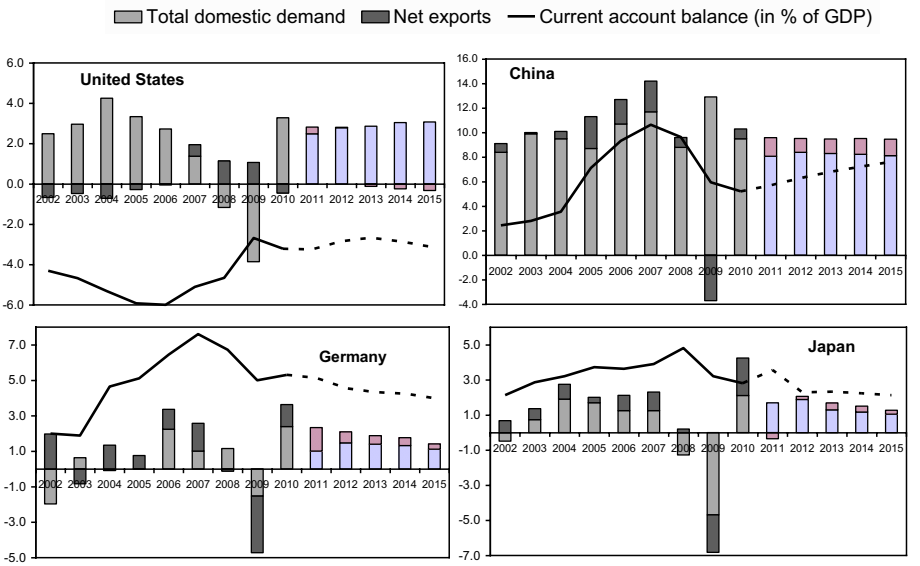
This scenario is further complicated by the huge accumulation of public debt, which could lead to higher borrowing costs if markets became concerned about its sustainability, and the protracted period of very low policy interest rates and abundant liquidity, which could end up fuelling new asset price bubbles, thus creating the conditions for the next crisis.

**Figure 2: Current account balances (in percent of world GDP)**




*Source* : World Economic Outlook, April 2011.

**Figure 3: Contribution to GDP growth and current account balances**




Source: IMF WEO April 2011; projections after 2010

The need to achieve a major rebalancing of global demand through policies aimed at a more sustainable pattern of growth has not been eliminated by the crisis. In order to reduce the risk that macroeconomic imbalances and distortions in the financial system might again combine to produce large-scale, devastating financial crises in the future, it is essential to address systemic fragilities. Important changes in financial market regulation and banking supervision are already being introduced. In the macroeconomic field, an effort is being made to strengthen economic policy coordination in the context of the G-20. However, it is also necessary to review how macroeconomic policies are conducted in light of the experience of the crisis. Two areas where a rethinking is already under way are monetary policy frameworks – and, in particular, how and to what extent they should take into account asset market developments and associated financial fragilities – and exchange rate arrangements.

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# 5. Money Market Integration and Sovereign CDS Spreads Dynamics in the New EU States

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## Abstract

When the first phase of the crisis focused primarily on the interbank market volatility, the second phase spread on the instability of public finance. Although the overall stance of public finances of the new members is better than the old member countries, the differences within the new group are significant (from the performer Estonia to the laggard Hungary). Sovereign CDS spreads have become major variables focused on risks and expectations about the fiscal situation of different countries. In the paper we investigate, first, whether there is a link in the new member states (NMS) between the expectations about the condition of their public finances and the dynamics of money markets, including integration of national money markets with the euro area. In others word we contribute to clarify the relationship between fiscal and liquidity risks as major components of systemic risk. Second, we look on the particularities of this relationship through the different phases of the crisis and across the different countries using different monetary regimes. This concerns mostly two opposite extreme monetary regimes, namely, currency boards – Bulgaria, Estonia, Lithuania, or inflation targeting – Poland, Czech Republic, Hungary and Romania. The results obtained form the high frequency panel data models support the theoretical hypotheses and policy intuition that exists strong relationship between the liquidity risk (measured by the short term money markets) and fiscal risk (measured by CDS) and that this link is extremely unstable and in some sense nonlinear during the financial crisis. Our study confirm that the strong link between monetary and public finance risk as apart of total systemic risk increase during the crisis especially for currency boards regimes, when the link becomes stronger and pronounced. For the inflation targeting countries the link became weaker and less pronounced.

*Keywords*: money markets, sovereign CDS spreads, EU enlargement, monetary regimes, financial crisis

*JEL Codes*: E43; G10; P20; F31; F34

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## 5.1. INTRODUCTION

The crisis placed again in the center of attention on the EU stability and expansion of the euro area, on monetary and fiscal integration of new countries and their resistance to various types of shocks.

In the few years before the onset of the crisis, the EU enlargement moved without significant disruptions and according to the institutional frameworks needed for the next step – the enlargement of the euro zone. The main theoretical discussion was limited generally to the question of how different types of monetary and exchange rates regimes are able to fulfil criteria for nominal and real convergence and to protect against asymmetric shocks. As a rule, the monetary policies of the NMS closely followed the ECB policy, either in the discretionary regime (inflation targeting), or passively (currency boards or quasi fixed exchange rate). The convergence of monetary variables, particularly interest rates was relatively well developed, and generally satisfactory nominal integration was observed. This concerned especially the interbank money market, which is not only a key element in the transmission of monetary policy, but also serves as an indicator for the liquidity stance, for interbank risk and for overall confidence in the banking system.

Current crisis that started during the 2007 has gone through two phases, which are reflected on the NMS, especially after September 2008 (Gardo and Martin, 2010). When the first phase of the crisis focused primarily on the interbank market volatility, the second phase spread on the instability of public finance. Although the overall stance of public finances of the new members is better than the old member countries, the differences within the new group are significant (from the performer Estonia to the laggard Hungary). In this second phase, of sovereign CDS spreads have become a major variable for observation, focused on risks and expectations about the fiscal situation of different countries.

Several interesting theoretical and practical issues appear. First one is, whether there is a link in the NMS between expectations about the condition of the public finances and the dynamics of money markets, including integration of their money markets with the euro area. This means investigating the links between fiscal and liquidity risks as major components of systemic risk, or, which is another manifestation of the above – a correlation between the macro (public), and micro (bank) dimensions of the systemic risk. Second, how the above mentioned link, if exists and a priori it should exist, will develop in time and in different phases of a crisis and how it evolves according to different countries monetary regimes. This concerns mostly two opposite extreme monetary regimes, namely, currency boards – Bulgaria, Estonia, Lithuania, or inflation targeting – Poland, Czech Republic, Hungary and Romania. We also include in our study

Latvia as a country with fixed-exchange rate, but not a currency board. Thus, our study is comparative in nature and allows opposing various monetary and exchanging rate regimes[4].

After exposing our theoretical motivations and objectives (part 1), and briefly presenting the related studies and empirical strategies (part 2), we discussed the results form the daily data panels models and we stress some limitations and possible developments of our study.

## 5.2. THEORETICAL MOTIVATION: INTEGRATION OF MONEY MARKETS AND FISCAL RISKS

In the current global and European crisis several phases emerged, two of them are of particular importance. The first one is money market crisis when confidence between banks ultimately led to deep changes in the principles and techniques of central bank monetary policies (quantitative easing, non-standard measures, abandonment of the so called separation principle etc...). The second phase concerns the crisis of public finances and public debt, which appears later and was largely cumulative result of massive fiscal stimulus taken at the outset and designed to help the banking sector and to compensate for the ineffectiveness of monetary measures[5].

In the first phase the attention of investors, bankers, and businesses interested in European economy was nailed on the state of money market, although a theoretical perspective, such markets have been in same respects forgotten and unexplored (Holthausen and Pill (2010)[6]. After a long period of convergence and stability these markets started to experience sharp fluctuations (mainly increases) and pronounced divergence of national interest rates dynamics[7]. Short-term interest rates (unsecured overnight interest rates, and 3 months rates) were of particular importance because they reflect not only changes in short-term liquidity of the banking sector, but also confidence in the banking system as a whole. Shorts term interest rates are closely related to the formation of a term structure of the yield curve, indicator of current and anticipated economic development, and they represented a major signal for future interventions by central banks. On the charts 1 and 2 are presented the respectively the overnight interest rates dynamics

[4] For details see review articles of BALL, 2010 and FRANKEL, 2010, and for Eastern Europe see GARDO and MARTIN, 2010.

[5] See details for Ecofin (2009), BNB (2010), ECB, (2010), Berglof *et al.* (2009), Gardo and Martin (2010), Cerisier (2010), Bordes and Clerc (2010).

[6] According to Di Fiore and Tristani (2010, p. 10): "Some of the links between financial markets and the macroeconomy remain imperfectly understood, notably the link between interbank markets and aggregate economic dynamics".

[7] Key turning points were in August 2007 and September 2008, when they were coordinated and sharply reduced key interest rates of leading central banks to arrive in June 2009 when the ECB injected a huge amount of 442 billion euros.

and 3 month money market rate dynamics, compared to the ECB credit and deposit facilities interest rates.

**Chart 1. Dynamics of overnight interest rates in New Member States**

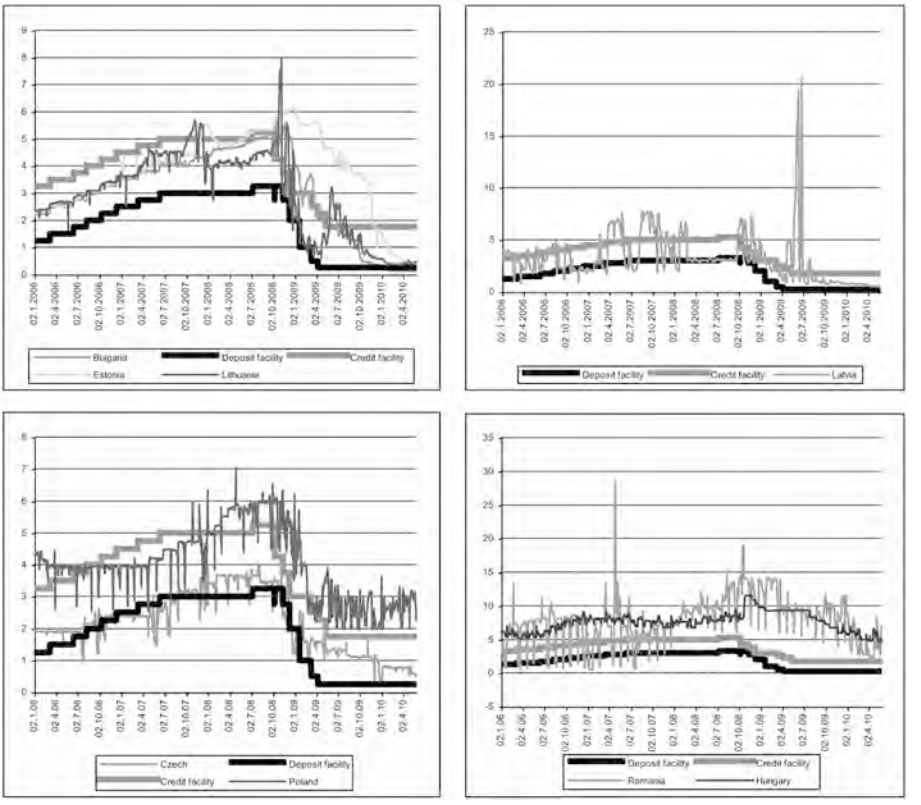
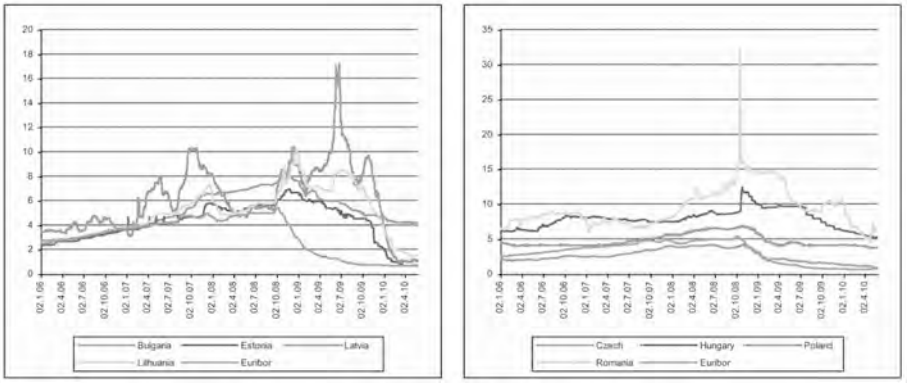
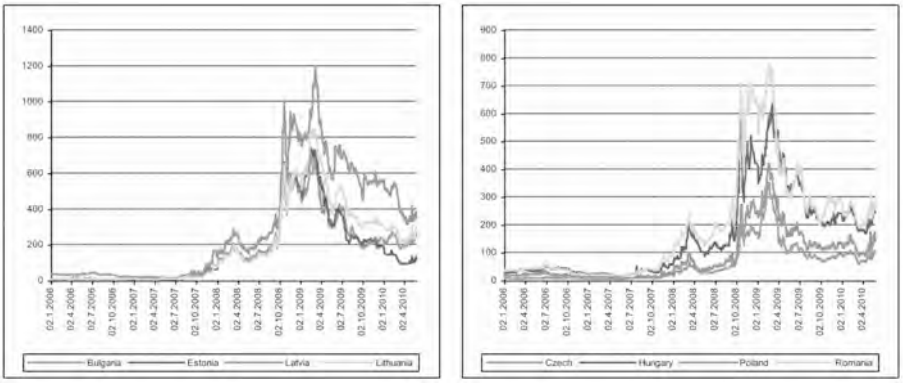



**Chart 2 Dynamics of 3 months interest rates in new member states**



As to the second phase of the crisis, the attention of investors, bankers and politicians was focused on different indicators for fiscal risks (default, payment arrears on sovereign bonds, etc.), including spreads of CDS[8] which highs reached in March 2009 and mid-April 2010 (see Chart 3). When the interest spreads in the interbank market, showing the state of confidence in the banking system and micro-level risks, CDS is indicator for the confidence and the sustainability of fiscal and debt policy, i.e. macro-risks. Although CDS spreads, and the risk premiums on the sovereign debt of EU member states clearly include speculative component, CDS spreads are important indicators and should be in the focus of analyses[9].

**Chart 3 Dynamics of the CDS to the new member states**




There is no doubt that different links exist between the state of confidence in the interbank market and confidence in public finances as integral parts of systemic risk and financial stability.

First, the impact of fiscal risks on the money market is going through changes in bank balance sheets where sovereign securities are presented. Any worsening of expectations for a moratorium or debt restructurings automatically reflected on the state of the banking system, the CDS of individual banks is rising, and hence influenced the dynamics of interest rates at the money market. The CDS spreads even became an important factor in price setting mechanism of the banking liquidity during the second phase of the crisis, thus directly influencing the behaviour of interbank interest rates[10]. During the crises overnight interest rates at the interbank market could be seen even as a measure for credit risk of banks (not

[8] The market for CDS (credit default swap) as part of the market in credit derivatives has grown particularly rapidly in the last decade, resulting in standardized and certain technical innovations which continue today, see for details (PACKER and SUTHIPHONGCAHI, 2003, *ICE* 2010).

[9] See for more details PROUTAT, 2011.

[10] Anecdotal evidences show that foreign banks while providing liquidity to their daughter-banks in NMS during the crisis used CDS spreads as a part of the price of the funding.

only liquidity) because of the loss of confidence between banks. This increased the importance of the link between CDS spreads and interest rates.

Second, opposite influence exists, from money market interest rates to fiscal imbalances, and is expressed primarily in the fact that the government is the guaranty of the stability of the banking sector, evidenced by a series of measures of bank capitalization and restructuring. Thus, any disturbance of the money market and more expensive resources, leads to accumulation of costs for the budget and ultimately worsen the solvency of governments.

In the NMS, the links already mentioned are interwoven theoretical and practical problems associated with the dynamics of convergence and comparative effectiveness of different monetary regimes.

First, as mentioned in the introduction, before the crisis the main issue for the comparative analysis concerned the choice of monetary and currency exchange regimes for achieving monetary and real convergence. Monetary convergence, i.e. similar movement of interest rates with that in the euro area members was considered and is considered the minimum requirement for a successful adoption of the common monetary policy. In this sense, the interest rate channel and interbank interest rates are leading link in the chain of transmission mechanism. Crisis change things or at least put them in new conditions. It not only cast doubt on the sustainability of the trend towards monetary integration in the NMS, but also gave impetus to the destruction of the monolithic behavior of the new countries, allowing identifying different individual trajectories, depending on the state of public finance, banking systems, and overall structural reforms. Roughly crisis gave a new opportunity for expression of the diversity of transition, which has long been subject to thorough analysis and numerous publications[11].

Second, the dynamics of monetary convergence especially that of the interbank market, considered within the broader discussion on optimality of the European currency zone, and allows the benchmarking of monetary regimes performance in the NMS. This concern the current state of the almost bipolar choice of monetary regimes, on the one side Currency boards and quasi-fixed rates in Estonia, Latvia, Lithuania, Bulgaria and on the other side inflation targeting and floating rates in the Republic, Hungary, Poland and Romania[12]. The bipolar situation provides opportunities for almost a natural experiment for the success of the two different monetary systems[13]. In fact this polarity was reached through a

[11] See KORNAI, 2000, ASLUND, 2002, COLOMBATTO, 2002, WINIECKI, 2004, CSABA, 2007, BOHLE and GRESKOVITS, 2007, HAVRYLYSHIN, 2009 and others.

[12] Slovakia and Slovenia are not subject to analysis; they are full members of the eurozone.

[13] See e.g. the discussion about the comparative success of different countries in combating the crisis made in ASLUND, 2009 and GARDO and MARTIN, 2010. Aslund said the main reason for the crisis is the course currency regime and the crisis is particularly serious where the scheme is rigid (Currency boards) and relatively mild pass to inflation targeting. Although Aslund's theoretical considerations are interesting, the facts, however, do not confirm his claim, even opposite. Telling evidence is the comparative situation of Estonia and Hungary, considered the first member of the eurozone by 2011, and the second – the boundaries of financial collapse.

long evolution, in which stood out different trends and groupings (Nenovsky, 2009).

Third, disputes between supporters of the CBA and inflation targeting in post-communist countries have a long history, which acquires real practical terms. It is generally believed that Currency boards give greater opportunities for rapid monetary integration, because the interest rates passively follow the euro area, due to the effects of credibility and discipline[14]. Credibility and discipline effects provide an opportunity for a tight fiscal policy and low public debt. For its part, proponents of inflation targeting indicate that this arrangement allows for greater autonomy and monetary response to asymmetric shocks, and that the Currency boards are highly vulnerable. According to them, the effects of credibility and discipline are not weaker under the regime of monetary discretion than under the rigid monetary rule. Experience shows, however, that the state of the MNS and certain preconditions for the integration of the euro area, the opportunities for independent monetary policy are small and almost insignificant. This is confirmed by the behavior of interest rates before the start of the crisis, which had similar convergence dynamics.

## 5.3. RELATED STUDIES AND EMPIRICAL MODELS

For the purposes of empirical measurement general theoretical relationship between bank and fiscal risks is limited to an analysis of the relationship between short-term interest rates on money market (overnight interest rates and three-month interest rates) and spreads on sovereign CDS premiums in different phases of the crisis, as well as two main monetary regime. We could use as well government bond spreads as a proxy for fiscal risks, but there are limitations in the data availability for this indicator. Countries are examined in two main groups in terms of the monetary regime- three with currency board arrangements and four with inflation targeting. The first group included two Baltic countries, which at the beginning of 90 years chose a currency board arrangement (Estonia, 1992, Lithuania, 1994) associated with geo-strategic choice for separation from the Soviet zone and monetary integration in Europe system. They add Bulgaria, which in 1997 introduced a currency board. The second group of countries is that inflation targeting selected. Here are the countries of Central Europe (Czech Republic, 1998, Poland, 2000, Hungary, 2001) and Romania (2005).

We also included in the analysis Latvia which chose fixed exchange rate in 1993. Although it has similarities to countries with currency boards, the developments in this country during the crisis were different mainly regarding the stability and

[14] See for the functioning of currency boards GULDE, NENOVSKY and HRISTOV, 2002, NENOVSKY, HRISTOV and MIHAYLOV, 2002. For the inflation targeting experience in Eastern Europe see ().

performance of the fiscal sector. Some of the NMS are characterized by high volatility in its monetary variables, high budget deficits, and vulnerability to shocks that force them to seek assistance from IMF and EU. Due to similarities in their behavior we separated them into the third group called "deficit countries", and put here Hungary, Latvia and Romania.

Several studies may be useful for our analysis, although most of them did not deal with or directly tested our dependencies. The dynamics of the whole multitude of interest rates in new member states has been studied thoroughly and in detail by Egert and al. (2007) in connection with problems of interest rate pass through in 5 countries of Central Europe, and Cuaresma and Wojcik (2006) to measure the monetary independence of Hungary, Poland and Czech Republic, in different periods of exchange rate regimes (1993-2003). Using DCC-MGARCH modeling of the second study the authors found confirmation of the hypothesis of greater independence at a floating rate and more in fixed. At the same bed and same parties is the study of Habib (2002), which concentrate on short-term interest rates, and finds a lack of dependence of interest rates in Germany.

As for NMS sovereign CDS spreads lack independent studies of their dynamics. Indeed, the attention of researchers on the behavior of the CDS spreads is recent, and directions for future research are numerous. Several authors establish empirically that these spreads reflect quite well the state of fiscal risks and in a sense give more and better information than sovereign ratings (Shino and Takahashi, 2010). These authors suggest that the relationship between CDS spreads and public debt was especially shown for the countries of Southern Europe (Greece, Portugal, Spain, and Italy). For its part Ismailescu and Kazemi (2010) examined the response of the CDS spreads in emerging markets in terms of changes in ratings during 2001-2008 and found that positive changes in ratings have a stronger effect on CDS that negative changes. An interesting empirical analysis of shocks on the return on bank assets of major US and European banks caused by the bank CDS indices is represented in Calice and Ioannidis (2009).

As for modeling of overnight interest rates, it has a long tradition (Hamilton, 1996; Hamilton and Jorda, 2002) and is subject to numerous and interesting attempts to account a number of institutional and organizational factors in the EU money market (Nautz and Offermanns, 2006; Bartolini and Prati, 2006; Cassola and Mmorana, 2008; Linzert and Schmidt, 2008), and the effects of the crisis Holthausen and Pill (2010). Modeling of overnight interest rates under a Currency board, in the case of Bulgaria was made by Nenovsky and Chobanov (2004).

The main channels of influence of the CDS sovereign spreads to the banks' balance sheets are presented in Fontana and Scheicher (2010). The study finds that before the crisis market information shows low volumes in CDS trading. After

September 2008 situation changes significantly and the active trading and higher volumes are observed. Therefore, the importance of the information obtained from the CDS spreads increased significantly. Moreover, for the southern countries that are members of the eurozone CDS spreads are leading and influence the bond spreads. For the northern countries is vice versa – the bond spreads are leading and influence CDS spreads. Southern countries are perceived as more vulnerable and in this case CDS spreads matter a lot.

The main novelty of the present study is to investigate the direct link between monetary and liquidity risk from one side and fiscal and country risk from others side. Our empirical strategy is to run the panel models, linking overnight interest rate and sovereign CDS spreads of new member states (taken either as level, or deviation from European level). The original database we use includes daily observations for short-term interest rates and sovereign CDS rates for the period January, 2006, to June 2010, eighth countries (Estonia, Latvia, Lithuania, Bulgaria, Poland, Hungary, Czech Republic and Romania) for Eonia (Euro Overnight Index Average) and 3-month Euribor (Euro Interbank Offered Rate), and sovereign CDS for Germany[15]. We run the panel firstly for the entire period, and later we split the period into two parts, prior to the crisis, and during the crisis.

The first group of model (equation 1 and 2 below) present the equations of the panel model, where NMS interest rates are taken as deviation from EU benchmark:

$$d(io_{it} - io_t^*) = \alpha_{it} + \alpha_{1i} d(i_{it} - i_t^*) + \alpha_{2i} d(i3_{it} - i3_t^*) + \alpha_{3i} d(s_{it} - s_t^*) + \varepsilon_{it} \quad (1)$$

$$d(io_{it} - io_t^*) = \alpha_{it} + \alpha_{2i} d(i3_{it} - i3_t^*) + \alpha_{3i} d(s_{it} - s_t^*) + \varepsilon_{it} \quad (2)$$

In (1) and (2) *io* denotes overnight interest rates in the new members sates and *io** – denotes Eonia, *i3* presents short 3 months rates, *i3** presents 3-month Euribor, *i* and *i** presents the policy rates and finally *s* and *s** denote respectively sovereign CDS spreads to new countries and those of Germany. The subscript *i* is for country effect, and *t* – for the time effect. The model (1) was used for countries with inflation targeting regime where the policy rate is discretionary formulated, as well as for "deficit countries" In the case of Currency boards countries, there is not discretionary policy rate, and where this rate is announced it is of purely administrative, statistical and judiciary objectives, therefore the equation (1) becomes (2).

The second group deals with the same relation between fiscal and liquidity risk, and the variables are taken independently (not as a spread) and the EU short term rates appear as explanatory variables. In this case we run the following two pan-

[15] The main sources of the data are: Bloomberg, web pages of central banks, European Banking Federation.

els, (3) for inflation targeters and "deficit countries" and (4) for currency boards countries:

$$d(io_{it}) = \alpha_{it} + \alpha_{1i}d(i_{it}) + \alpha_{2i}d(i3_{it}) + \alpha_{3i}d(s_{it}) + \alpha_{4i}d(io^*) + \alpha_{5i}d(i3^*) + \varepsilon_{it} \quad (3)$$

$$d(io_{it}) = \alpha_{it} + \alpha_{2i}d(i3_{it}) + \alpha_{3i}d(s_{it}) + \alpha_{4i}d(io^*) + \alpha_{5i}d(i3^*) + \varepsilon_{it} \quad (4)$$

The results obtained are presented in the tables 1 and 2.

**Table 1 Models in spreads (equations 1 and 2)**

| | Entire period 01/2006:05/2010 | Prior to the crisis 01/2006:09/2008 | Crisis period 10/2008:05/2010 |
|---|---|---|---|
| Currency boards (Bulgaria, Estonia, Lithuania) | α=0.0002 (0.94)<br>α2 =0.7325 (79.69)*<br>α3 =0.0009 (13.29)*<br>Weighted statistics<br>$R^2$= 0.66<br>DW= 1.83<br>Obs 3435 | α=0.0008 (9.75)*<br>α2 =0.4365 (26.15)*<br>α3 =0.0001 (0.82)<br>Weighted statistics<br>$R^2$= 0.24<br>DW= 1.86<br>Obs 2133 | α=-0.0008 (-1.48)<br>α2 =0.7492 (30.97)*<br>α3 =0.0009 (11.22)*<br>$R^2$=0.45<br>DW=1.79<br>Obs 1302 |
| Inflation targeting (Poland, Hungary, Czech Republic, Romania) | α=-0.0023 (-2.50)**<br>α1 =0.5750 (16.95)*<br>α2 =0.5180 (22.89)*<br>α3 =-0.0005 (-3.07)*<br>Weighted statistics<br>$R^2$=0.18<br>DW=1.82<br>Obs 4580 | α=0.0008 (0.49)<br>α1 =1.1523 (19.97)*<br>α2 =2.3018 (46.89)*<br>α3 =-0.0099 (-12.15)*<br>Weighted statistics<br>$R^2$= 0.49<br>DW= 1.85<br>Obs 2844 | α=-0.0029 (-1.8)***<br>α1 =0.4132 (9.57)*<br>α2 =0.4666 (14.0)*<br>α3 =0.00004 (0.17)<br>Weighted statistics<br>$R^2$=0.18<br>DW= 1.83<br>Obs 1736 |
| Deficits countries (Hungary, Latvia Romania) | α=-0.0019 (-2.41)**<br>α1 =0.3114 (9.39)*<br>α2 =0.7333 (45.36)*<br>α3 =0.0004 (2.47)*<br>Weighted statistics<br>$R^2$=0.40<br>DW=1.68<br>Obs 3435 | α=-0.0018 (-1.15)<br>α1 =1.0252 (16.66)*<br>α2 =1.5431 (33.12)*<br>α3 =-0.0084 (-12.15)*<br>Weighted statistics<br>$R^2$=0.41<br>DW=1.74<br>Obs 2133 | α=-0.0035 (-1.86)***<br>α1 =0.1068 (2.17)**<br>α2 =0.6147 (25.56)*<br>α3 =0.0011 (5.40)*<br>Weighted statistics<br>$R^2$=0.37<br>DW=1.69<br>Obs 1302 |

* – significant at 1%; **-significant at 5%; *** – significant at 10%

**Table 2 Models in levels (equations 3 and 4)**

| | Entire period 01/2006:05/2010 | Prior to the crisis 01/2006:09/2008 | Crisis period 10/2008:05/2010 |
|---|---|---|---|
| Currency boards (Bulgaria, Estonia, Lithuania) | α= -0.0001 (-1.35)<br>α2 =0.7537 (108.03)*<br>α3 =0.0004 (12.28)*<br>α4 =0.0217 (7.82)*<br>α5 =0.1990 (6.92)*<br>Weighted statistics<br>$R^2$= 0.78<br>DW= 1.73<br>Obs 3435 | α= -0.000004 (-0.07)<br>α2 =0.4869 (45.61)*<br>α3 =-0.0002 (-4.16)*<br>α4 =0.0384 (8.31)*<br>α5 =0.0869 (4.67)*<br>Weighted statistics<br>$R^2$= 0.52<br>DW= 1.82<br>Obs 2133 | α=0.0037 (6.30)*<br>α2 =0.7512 (36.13)*<br>α3 =0.0004 (6.93)*<br>α4 =0.0161 (2.71)*<br>α5 =0.3650 (4.61)*<br>Weighted statistics<br>$R^2$=0.51<br>DW=1.57<br>Obs 1302 |
| Inflation targeting (Poland, Hungary, Czech Republic, Romania) | α= -0.0017 (-2.87)*<br>α1 =0.42439 (11.96)*<br>α2 =0.5284 (25.29)*<br>α3 = -0.0005 (-3.26)*<br>α4 =0.0216 (1.98)**<br>α5 =0.0198 (0.30)<br>Weighted statistics<br>$R^2$=0.18<br>DW=1.76<br>Obs 4580 | α=-0.0063 (-4.16)*<br>α1 =0.6895 (7.86)*<br>α2 =2.3884 (53.24)*<br>α3 =-0.0095 (-12.11)*<br>α4 =0.0018 (0.14)<br>α5 =-0.6145 (-4.78)*<br>Weighted statistics<br>$R^2$= 0.52<br>DW= 1.81<br>Obs 2844 | α=0.0011 (0.43)<br>α1 =0.3190 (5.52)*<br>α2 =0.5081 (15.47)*<br>α3 =0.0001 (0.61)<br>α4 =0.0502 (2.19)**<br>α5 =0.3841 (2.61)*<br>Weighted statistics<br>$R^2$=0.17<br>DW= 1.74<br>Obs 1736 |
| Deficits countries (Hungary, Latvia Romania) | α= -0.0020 (-2.66)*<br>α1 =0.1135 (3.13)*<br>α2 =0.7603 (59.43)*<br>α3 =0.0001 (0.80)<br>α4 = -0.1537 (-7.12)*<br>α5 =0.4045 (3.67)*<br>Weighted statistics<br>$R^2$=0.52<br>DW=1.60<br>Obs 3435 | α= -0.0069 (-5.30)*<br>α1 =0.7698 (16.58)*<br>α2 =1.5934 (38.33)*<br>α3 =-0.0076 (-11.26)*<br>α4 = -0.0760 (-3.68)*<br>α5 =0.2133 (3.23)*<br>Weighted statistics<br>$R^2$=0.47<br>DW=1.69<br>Obs 2133 | α=0.0013 (0.55)<br>α1 =0.0885 (1.04)<br>α2 =0.6361 (29.25)*<br>α3 =0.0005 (2.57)**<br>α4 = -0.1586 (-3.09)*<br>α5 =0.9214 (4.17)*<br>Weighted statistics<br>$R^2$=0.41<br>DW=1.61<br>Obs 1302 |

* – significant at 1%; **-significant at 5%; *** – significant at 10%

## 5.4. DISCUSSION OF THE RESULTS AND CONCLUDING REMARKS

According to the results we can observe that inflation targeting and currency board NMS demonstrate significant differences in terms of monetary integration and the perception of fiscal risk. Overnight interest rate spread under fixed exchange rate in normal times depends on monetary factors mainly on expectations about future behavior of interest rates and an assessment of the liquidity situation presented by the three-month spread. In the same period for inflation targeting countries the spread in policy rates and the spread in three-month rates are significant and with expected positive signs. The relationship with CDS is significant but negative, which at first glance does not confirm the theoretical assumption of the link between the monetary and fiscal risk. In fact the pre-crisis period is characterized by a cycle of rising interest rates by the ECB, accompanied by plenty of liquidity for countries with inflation targeting. And when the tries to tighten monetary policy were observed, this is not the case in respect of the fiscal efforts. There were budget deficits regardless of the upward phase of the cycle. Pro-cyclical fiscal policy is not always reflected by an adequate change of the CDS

spread due to high economic growth and the underestimation of the inherent risks. Therefore, both risks – monetary and fiscal move together, but the relationship with CDS has not expected sign.

"Deficit countries" are characterized by high volatility in its monetary variables, high budget deficits, and vulnerability to shocks. Before the crisis the behavior of spreads is similar to that of inflation targeting countries, with the same significant factors, and again the negative relationship with CDS.

The crisis has changed the relationship between liquidity and fiscal risks. Fiscal risks approximated by the CDS spreads become statistically significant with the expected positive sign in the group of currency board NMS, which mean that higher fiscal risk leads to further rise of the liquidity risks, i.e. short term interest rates. However, for inflation targeting countries CDS spreads are insignificant, as is could be observed also on the Chart 3, when they remain at the lower levels than for fixed NMS. This is another illustration of the fact that the fixed exchange rates are *perceived* as riskier when using macro policy for coping with the external shocks. But such risk assessment finds no real confirmation in practice, since the countries with currency board are not turned to international institutions during the crisis, and moreover, Estonia was admitted to the eurozone (January, 2011) by satisfying the necessary Maastricht criteria.

Regarding inflation targeting countries CDS spreads are no more significant, but the remaining two factors are significant with the expected signs, although the influence of the factors is weaker.

The crisis changes the relationship with CDS spreads for "deficit countries" and they become significant with positive sign. The other two factors remain significant with the expected signs, although the influence of the factors is weaker.

In terms of equations for overnight interest rates the expected relationships were confirmed. The hypotheses of greater degree of monetary integration with the euro before the crisis for the NMS with currency boards, and the importance of the proper monetary policy for countries with inflation targeting regime were supported. Deficits countries have similar behavior as inflation targeting, but the relationship with EONIA has the negative sign, which means that the developments in their money markets have their own dynamics, which go in opposite direction than the eurozone.

The crisis again shows the difference between currency board countries and inflation targeters regarding the relationship with CDS. In the case of the currency board countries the importance of external perception of fiscal risks increases and CDS were statistically significant with the expected sign. In the case of countries with inflation targeting the relationship is not significant. In the inflation targeting countries Eonia become significant with the expected sign, while before the

crisis it is insignificant. The importance of external perception of fiscal risks increases and CDS were statistically significant with the expected sign. The crisis leads to a reduction of the impact of its own monetary policy on overnight interest rates for inflation targeting and deficits countries, and in the case of deficit countries it became even statistically insignificant. Concerning deficits countries the overnight interest rates continue to move in the opposite direction from that of the Eonia, but the relationship with the CDS is significant with the expected sign.

In conclusion we can say that the results obtained form the high frequency panel data models support the theoretical hypotheses and policy intuition that strong relationship exists between the liquidity risk (measured by the short term money market rates) and fiscal risk (measured by CDS), especially in currency board countries during the crisis. The relative performance of different monetary regimes concerning the liquidity-fiscal risk connection is debatable, and although the countries with currency boards is perceived as more vulnerable, the recent practice shows that they are more stable, and did not resorts to foreign financial assistance, at least for now.

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# 6. Financial Asymmetries, National Divergences and Macroeconomic Policy in a Monetary Union

*Cristina Badarau*[1] *and Grégory Levieuge*[2]

## Abstract

The euro area constitutes without doubt a heterogeneous monetary union. This paper particularly analyzes the banking sector as source of structural asymmetries and discusses their harmful implications inside a monetary union. The analysis relies on a DSGE model of a two-country monetary union with heterogeneous bank capital channel and wonders how macroeconomic policies could help to mitigate the perverse effects of this heterogeneity. It is found that a centralized monetary policy, seeking to stabilize the union-wide inflation rate, dominates a strategy that is simultaneously concerned by the stabilization of inflation divergences in the union. This is true whatever the budgetary regime (cooperative or non-cooperative), supporting the current orientation of the European Central Bank (ECB) policy for the euro area. Besides, national budgetary policies constitute relevant instruments (although insufficient) to fight the asymmetric transmission of shocks in a monetary union with financial heterogeneities. Nevertheless, the analysis of different policy-mixes shows that a cooperative regime is costly at national level. Its superiority only relies on the fact that it allows a better stabilization of public spending divergences

*Keywords*: euro area, financial heterogeneity, monetary and budgetary policy rules, DSGE model, optimization

*JEL Codes?/Classification*: E44, E58, E63, C61

## 6.1. Introduction

Heterogeneity of the European Monetary Union (EMU) represents an important feature that macroeconomic policies have to deal with. National inflation and output divergences are widely recognized and one main particularity consists in their high persistence since the beginning of the euro area[3]. Moreover, the evolution of inflation and output standard deviation in the euro area (12), depicted in

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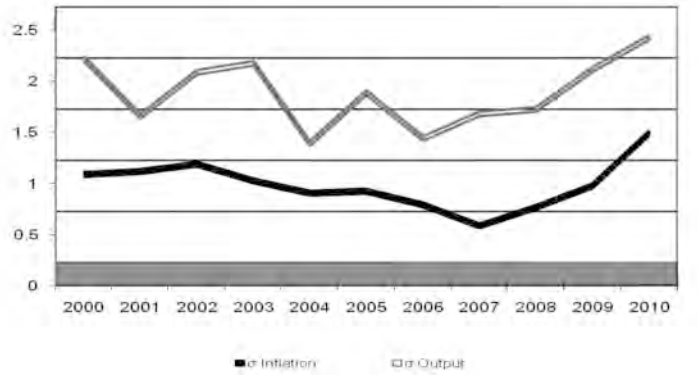
[3] It is the conclusion of Busetti & al. (2006), who analyze the persistence of the national inflation deviations from the union-wide average and distinguish two groups of European countries having positive or negative systematic inflation rate differentials from the average. Similar results about the output divergences in the euro area are provided among others by Benalal & al. (2006) or Traistaru-Siedschlag (2006).

Figure 1, clearly shows a significant amplification of divergences between the European countries during the recent financial crisis.

**Figure 1. Inflation and output divergence inside euro area (12)**




Source: Eurostat data

To explain such divergences, the presence of asymmetric shocks is certainly insufficient. The divergences persistence and their amplification since 2007 are more probably linked to the presence of structural asymmetries among European countries, explaining their asymmetric reaction to shocks. Indeed, the euro area members have not been identically affected by the subprime mortgage crisis, whose origin was however a common shock affecting the financial systems. The recent experience has also highlighted the role of banks as key actors for the transmission of shocks, while the banking markets precisely appears as the most heterogeneous financial sector in the euro area (see Baele *et al.*, 2004 or ECB, 2008, for example).

Starting from this empirical assessment, the present study focuses on the banking markets asymmetries in a monetary union and proposes an analysis of monetary and budgetary policy face to such an environment. With this aim, we first model imperfect credit markets in a double costly verification framework à la Townsend (1979) and we explicitly show that the banks' balance sheet structure may amplify the transmission of shocks to the real economy (see the bank capital channel recently discussed in the literature).

Then, we introduce heterogeneous bank capital channel in a DSGE model of a two-country monetary union. Given the structural specificities of national banking systems, some member countries can be systematically more sensitive to shocks than others, mainly in slowdown periods, facilitating the increase of asymmetries. It is a realistic hypothesis for the euro area. Indeed, considering simultaneously the main factors underlying the bank capital channel, an empirical study

by Badarau-Semenescu & Levieuge (2010a) indicates that European countries are ought to be more (Germany, Italy, Netherland) or less (Finland, France, Spain) sensitive to this mechanism.

To study the impact of financial heterogeneity in a monetary union, we simulate different monetary, budgetary and technological shocks comparatively when the two countries are part of a monetary union or not. It thus appears that structural financial asymmetries lead to striking cyclical divergences among members of the Union. It is also shown that the more financially heterogeneous the Union is, the larger the cyclical divergences. Moreover, the conduct of a single monetary policy for the Union as a whole seriously worsens these national divergences. These results are generalized in Badarau-Semenescu & Levieuge (2011), in a context that extends the present analysis by introducing financial shocks in the simulations.

Finally, we optimize simple monetary and budgetary policy rules, in order to study a suitable policy-mix able to mitigate the harmful effects of heterogeneity in a monetary union, like the euro area. We combine centralized or based on national information monetary policy conducted by a common central bank with cooperative vs. non-cooperative budgetary policies decided by national governments. To summarize, the application of the policy-mix analysis supports the idea of a centralized monetary policy conduct, rather than an inflation-divergences oriented policy. This is true whatever the budgetary regime (cooperative or non-cooperative), supporting the current orientation of the European Central Bank policy for the euro area. Besides, national budgetary policies constitute relevant instruments (although insufficient) to fight the asymmetric transmission of shocks in a monetary union with financial heterogeneities. Nevertheless, the analysis of different policy-mixes shows that a cooperative regime is costly at national level. Its superiority only relies on the fact that it allows a better stabilization of public spending divergences.

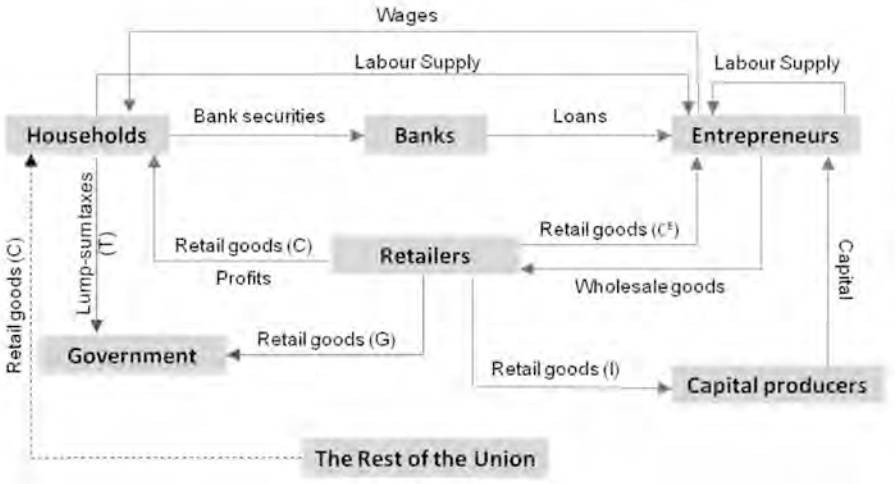
The rest of this study is organized as follows. The second section introduces an overview of the DSGE model. The third section discusses the main results using some simulations and optimization results, while the last section formulates concluding remarks.

## 6.2. An Overview of the DSGE Model

The aim of this section is to provide an intuitive overview of the model, technical details being available in Badarau-Semenescu & Levieuge (2011). The model describes a two-country closed monetary union with price rigidities and heterogeneous national banking structures. It is in fact an extension of the Bernanke & al. (1999) financial accelerator model providing evidences about the accelerating

role of the firms' balance sheet channel for the transmission of shocks. Our contribution relative to this reference financial accelerator model consists first in introducing the bank capital channel and second in extending the analysis in a two-country context, in a way similar to Gilchrist & al. (2002)[4]. The main structure for each member country is depicted in Figure 2.

**Figure 2. The main structure of the model for each member country**




For a given country, households, entrepreneurs, retailers, capital producers, banks and governments optimize their decisions in the model.

Households supply labor and own the retail firms. They receive profits from retailers and wages from entrepreneurs, using them for consumption and savings. Domestic households simultaneously consume domestic goods and foreign goods produced in the other country of the union. They maximize a CES utility function depending on consumption and leisure, subject to their budgetary constraint. They also pay lump-sum taxes to the government, used to finance public expenditures.

Entrepreneurs (firms) produce wholesale final goods in perfectly competitive markets, using labor and capital (partially financed by debt) as inputs. Retailers buy wholesale goods from the producers, slightly differentiate them (with no costs) and retail them in a monopolistic competition market. As in Bernanke & al. (1999), their role in the model is to facilitate the consideration of price rigidity,

[4] GILCHRIST *et al.*, 2002, provide a previous example in modeling a two-country monetary union with financial heterogeneity. If their work just introduces asymmetric firms' balance sheet channels within the union and analyzes the transmission of technological shocks using an ad-hoc Taylor rule for the monetary policy, we extend the study toward the consideration of the bank capital channel and we show how the model can be used to evaluate different policy-mix strategies in an asymmetric union.

important feature in the euro area. Retail products are bought by households for consumption, and also by capital producers, who transform retail goods in capital (necessary to the entrepreneurs in the production process).

The banking sector has a particular place in the model. The role of banks as financial intermediaries on the credit market is twofold. First, they participate as lenders to the national firms' investment projects. Second, they collect funds from households, so as to insure the firms financing. Moreover, as discussed before, the national banking sectors are supposed to be heterogeneous among countries. In order to model such heterogeneity, it is assumed that the debt contracts between households and banks on one hand, and between banks and firms in the other hand, occur in an asymmetric information context. Entrepreneurs have private information about the risk and the return of their projects, and banks have private information about the risk and the realized return of their activity. In these conditions, two agency problems occur and banks and firms have to bear financial premiums in their external financing[5]. More particularly, it can be shown that the external finance premium for banks negatively depends on their own financial structure, while the external finance for firms simultaneously depends on their own financial leverage and on the financial situation of their creditor (bank). In other words, banks finally transfer their financing costs to enterprises. Thus, any shock deteriorating the banks' financial position (their net worth) causes an increase in the external finance premium for banks which would be finally reflected in tighter lending conditions for firms. Such mechanism explains the role of banks for the propagation of shocks. Their balance sheet structures may act as an amplifier for the transmission of shocks to the real economy, which is the essence of the bank capital channel recently debated in the literature.

In a financially heterogeneous monetary union, like the euro area, the bank capital channel is an important source of asymmetry. Heterogeneities are introduced into the banks' financial leverage (ratio debt/inside capital) and/or in the sensitivity coefficient of the external finance premium for banks to their financial leverage. Except for these financial asymmetries, we assume that the two countries are identical (equal size, similar degree of openness to the external trade, identical preferences for consumers, same degree of price rigidities, etc.).

The model is calibrated according to the references provided in the literature for European countries[6]. It is first exposed to different symmetric monetary, budgetary or technological shocks, in order to comparatively analyze the reaction of individual countries when they are part of the monetary union with centralized monetary policy or not. Then, we are looking for a suitable policy-mix for the

[5] For further details on the determination of these external finance premiums by solving the optimal financial contracts on the credit market, see BADARAU-SEMENESCU & LEVIEUGE, 2011.

[6] For details on the numerical values used in the calibration, see BADARAU-SEMENESCU & LEVIEUGE, 2011.

union, in a context close to that of the euro area. At the union level, the common Central Bank is responsible for the conduct of the monetary policy. The main task of the Central Bank is to maintain the price stability and its behavior is described by an interest rate Taylor rule. Alternative monetary objectives are considered: union-wide inflation stabilization for a centralized monetary strategy, to which we add an inflation divergences stabilization objective for the monetary strategy based on national information. Governments decide the national budgetary policy with the objective to control the stability of national aggregates (inflation, output and public expenditures). They can do it in a cooperative or non-cooperative budgetary regime.

This is the theoretical framework that we use for simulations and optimization, in order to analyze the effects of financial asymmetries and the way to mitigate them.

## 6.3. SIMULATIONS AND OPTIMIZATION RESULTS

### 6.3.1. Financial Asymmetries, Monetary Union and National Divergences

A first result concerns the link between financial heterogeneity and cyclical divergences inside a monetary union. As expected, the reaction of the member countries to a symmetric shock is affected by the particularities of the national financial system. It is true for all monetary, budgetary or technological shocks studied in this work[7]. Moreover, a higher financial heterogeneity is associated to more asymmetric transmission of shocks inside the union, and to higher macroeconomic divergences among member countries.

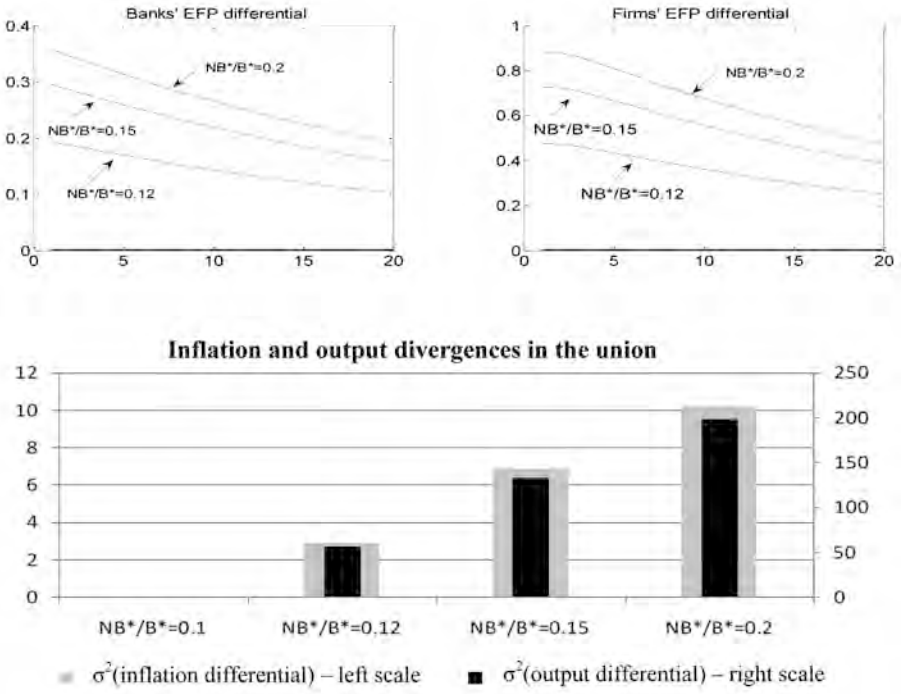
To illustrate this point, Figures 3 and 4 below represent the impact of a restrictive common monetary shock in terms of cyclical divergences[8]. The two sources of financial heterogeneity previously defined are considered separately. In Figure 3 the asymmetry affects the financial leverage of the national banking system $\left(\frac{NB}{B}\right)$, calculated as inside capital on assets ratio. It is fixed to 0.1 for country 1, and varies

[7] BADARAU-SEMENESCU & LEVIEUGE, 2011, extend the analysis to the case of financial shocks, more realistic in the context of the subprime mortgage crisis.

[8] Since the dynamics of all national variables are discussed in BADARAU-SEMENESCU & LEVIEUGE, 2010b, we do not insist here on this point. We just specify that the model is perfectly coherent with the economic expectations. A nominal interest rate increase temporarily affects the real activity, because investment and consumption both reduce (asymmetrically) in the two countries of the union. As the demand decrease, inflation falls and the national real interest rates go up. Then, the real interest rate dynamics explain the arbitrage of the households between present and future consumption.

within the interval [0.1,0.2] for country 2 $\left(\frac{NB^*}{B^*}\right)$. For $\left(\frac{NB^*}{B^*}\right) = \left(\frac{NB}{B}\right) = 0.1$, the union is perfectly symmetric and there are no divergences induced by the asymmetric transmission of the common shock. An increase in the banks' financial leverage in country 2 comparatively to country 1, equivalent to higher degree of the union heterogeneity, comes with higher external finance premiums differentials for banks, and consequently for firms, between the two member countries. The real activity is thus asymmetrically affected and national divergences amplify inside the union.

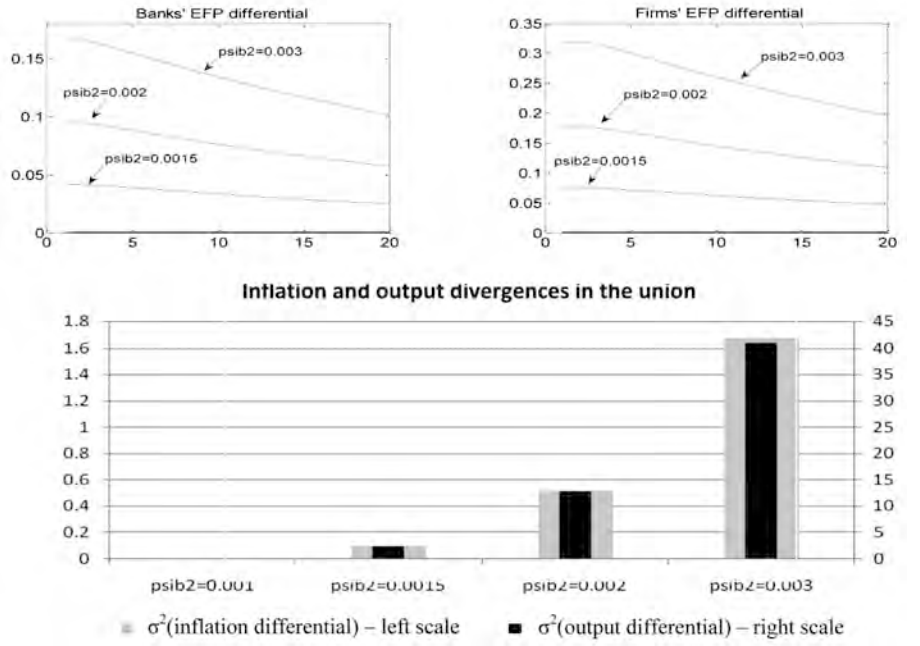
**Figure 3. Banking system leverage asymmetry and national divergences**




Similar results are obtained if we consider that the source of heterogeneity is not the banking systems' financial leverage, but rather the sensitivity coefficients of the external finance premiums for banks to their financial leverage (*psib* in Figure 4). The $\frac{NB}{B}$ ratios are identical and fixed to 0.15 in the two countries, while the sensitivity coefficient *psib* is fixed to 0.001 for country 1, and varies within the interval [0.001,0.003] for country 2. In this particular case, country 2 would be more sensitive to shocks than country 1 and again, higher heterogeneity is asso-

ciated to more asymmetric transmission of the monetary shock inside the union, and to higher inflation and output national divergences.

**Figure 4. Sensitivity coefficients asymmetry and national divergences**



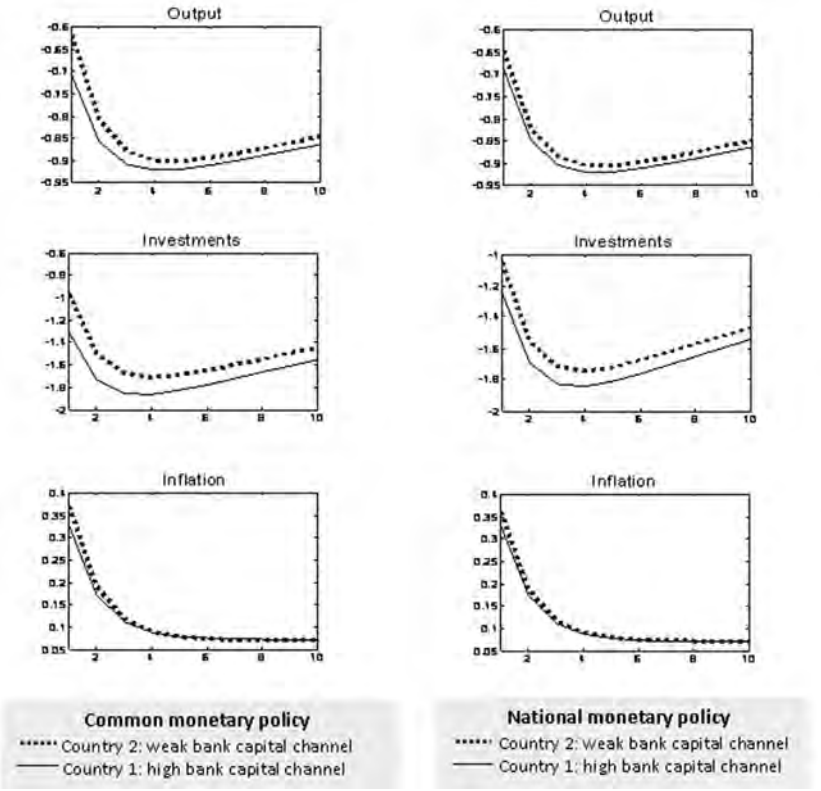

The bank capital channel heterogeneity is certainly the main cause of such increasing divergences. However, compared to other results found in the literature about the effect of the bank capital channel on real activity[9], the amplitude of the real variables reaction to shocks is higher in this study because of the single monetary policy.

As a demonstration, we propose a comparative simulation of the symmetric shocks effects at national level, when the two countries form a monetary union or not. To simplify the interpretation of results, we assume by convention that in country 1 the bank capital channel operates more than in country 2[10]. For instance, let's take a look on the comparative dynamics of the two countries to a technological symmetric shock, depicted in *Figure 5*.

[9] See SUNIRAND, 2003 or LEVIEUGE, 2009.

[10] The inside capital on assets ratio is lower and the sensitivity coefficient of the banks' EFP to the financial ratio is higher in country 1 than in country 2 $\left(\frac{NB}{B} = 0.15 < \frac{NB^*}{B^*} = 0.2\right)$ and $(psib = 0.002 > psib^* = 0.001)$.

**Figure 5. Impulse response functions to a negative technological shock with common or national monetary policies**




First, we easily observe that the technological shock acts as a negative supply shock. It affects real variables and conduces to higher inflation in the two countries. However, the national reactions are not identical, the effect of the asymmetric bank capital channel being definitely present. As expected, the country 1 is the most affected by the shock. Its lower banking sector financial leverage, as well as the more sensitive banks' external finance premium to the financial structure, explains this fact. The banks' external finance premium is more reactive to the shock in this country and its increase is transferred to the firms' external finance premium. This in turn increases the cost of external financing and has a negative impact on the demand of capital, on investment and on the GDP of country 1, comparatively to country 2. This drop in the national demand also explains the lower increase of inflation in this country.

Second, and more importantly, one can observe that the monetary regime has an impact on the amplitude of national divergences. Such divergences are higher in a monetary union than under a national monetary policy regime. If the two coun-

tries decided to form a monetary union, renouncing to their monetary autonomy, they should be aware that the response of their national variables to shocks would be amplified. As a common monetary policy seeks to stabilize the average inflation of the whole area, the interest rate increase is less important in the union than what a national monetary policy would imply for country 2 (which is by definition less sensitive to shocks). Subsequently, this economy benefits from lower real interest rates, which mitigates its decrease in investment and output, and immunizes it to shocks. Thus, national real variables are too much stabilized in the monetary union regime compared to the national monetary policy regime, for country 2 (see Table 1).

On the contrary, the interest rate increase is more important in the union than what a national monetary policy would imply for country 1. The participation of this country to the asymmetric monetary union implies more adverse reactions to shocks. National output and inflation are insufficiently stabilized in the monetary union regime compared to the national monetary policy regime (see Table 1).

So, there is actually an endogenous mechanism explaining why an asymmetric union worsens the cyclical divergences among member countries. We also must specify that this is a general result which is true whatever the shocks (monetary, budgetary, financial or technological ones)[11].

**Table 1. Common monetary policy and real variables stabilization***

| Technological shock | | | |
|---|---|---|---|
| Country 1 | | Country 2 | |
| $\frac{\sigma_{y1}^{C}}{\sigma_{y1}^{N}} > 1$ | $\frac{\sigma_{inv1}^{C}}{\sigma_{inv1}^{N}} > 1$ | $\frac{\sigma_{y2}^{C}}{\sigma_{y2}^{N}} < 1$ | $\frac{\sigma_{inv2}^{C}}{\sigma_{inv2}^{N}} < 1$ |

* $\sigma_{xi}^{C}$ denotes the standard deviation of the variable x in country i, in the common monetary policy regime

* $\sigma_{xi}^{N}$ denotes the standard deviation of the variable x in country i, in the national monetary policy regime

### 6.3.2. Policy-Mix to Mitigate the Effects of Financial Heterogeneity

The previous results clearly show that a heterogeneous monetary union where the central bank seeks to stabilize the union-wide inflation is not beneficial to all member countries. More dangerously, because of structural asymmetries, this monetary regime could be unfair, some members being systematically supported to the detriment of others. National divergences widen in this case inside the

[11] See BADARAU-SEMENESCU & LEVIEUGE, 2010b, for a discussion about the asymmetric transmission of a monetary shock, or BADARAU-SEMENESCU & LEVIEUGE, 2011, for the analysis of financial shocks.

union. The present paragraph analyses different monetary/budgetary strategies to mitigate such negative effect of heterogeneity.

On the one hand, we consider an independent common Central Bank, like the European Central Bank, whose policy is responsible for the price stability and which does not cooperate with the national governments (in accordance with the Article 130 of the Treaty of the European Union). On the other hand, decentralized budgetary policies are conducted by the national governments. Alternative strategies for the Central Bank (centralized *or* inflation divergences oriented) and for the governments (budgetary cooperation *or* autonomous conduct of national budgetary policies) are analyzed following a sequential game specific for the euro area[12]. The Central Bank chooses first its strategy. National governments define afterwards their policies.

Simple monetary and budgetary rules are optimized and evaluated in terms of welfare gains, under each configuration.

The monetary policy rule to be optimized takes the form: $i_t = \beta_0 i_{t-1} + (1-\beta_0)\beta_1 \bar{\pi}_t$ where all variables are defined in deviation from their steady state, $\bar{\pi}_t$ is the average inflation in the union $\beta_1 > 1$ is the coefficient of stabilization of the union-wide inflation and $\beta_0 \in [0;1]$ is the smoothing coefficient of the nominal interest rate. The results for the numerical optimization are the following: for $\beta_0$ equal to 0.96, reference value for the euro area[13], the optimal coefficient $\beta_1$ appears higher in the centralized strategy ($\beta_1 = 1.49279$) compared to the inflation divergences oriented strategy ($\beta_1 = 1.4635$). This means that the centralized monetary policy is more reactive to symmetric shocks than a policy taking into account the national information.

Given these optimal monetary decisions, national governments optimize their budgetary decisions. We assume the following form of budgetary rules to be optimized: $g_t = \rho_g g_{t-1} + \rho_\pi \pi_t + \rho_y y_t$, where $x_t$ is the deviation of the variable $x$ from its steady-state, $g_t, y_t, \pi_t$ define national public expenditures, output and inflation respectively. $\rho_g, \rho_y, \rho_\pi$ are the stabilization coefficients of the budgetary rule, that will be optimized under alternative (cooperative or non-cooperative) strategies. The results of the numerical optimization are summarized in *Tables 3*, for given values of the preference coefficients for the stabilization of output ($\lambda_y$), inflation ($\lambda_\pi$) and public expenditures ($\lambda_g$) in the national loss functions[14]. These values are identical for the two countries of the union, which are supposed to respect a global orientation for the budgetary policy defined at the union-wide level. Such global orientation, specified in the Treaty of Lisbon, but still unclearly defined, is

[12] Details on the modeling of these two strategies are presented in BADARAU-SEMENESCU & LEVIEUGE, 2010b.
[13] See SAUER & STURM, 2007, FOURÇANS & VRANCEANU, 2007 et LICHERON, 2009.
[14] It should be underlined that the results of this analysis are robust to the modification of the preference coefficients, the values in Table 3 are just used for exemplification. See also BADARAU-SEMENESCU & LEVIEUGE, 2010b, for a more complete analysis including financial shocks equally.

interpreted hereafter as a commitment of national governments to follow symmetric stabilization objectives for their budgetary policy. This institutional framework can be seen as an *implicit coordination mechanism* that covers not only the cooperative, but also the non-cooperative budgetary regime.

**Table 3. Optimal budgetary rules under alternative regimes (for $\lambda_\pi = 1$; $\lambda_y = 1.5$; $\lambda_g = 0.5$)**

| Monetary regime | Country 1 | Country 2 | Budgetary regime |
|---|---|---|---|
| *Centralized monetary policy* | $\rho_g = 0.2164$<br>$\rho_y = -0.2$<br>$\rho_\pi = -1.0881$ | $\rho^*_g = 0.1465$<br>$\rho^*_y = -0.1705$<br>$\rho^*_\pi = -0.7154$ | *Non-cooperative* |
| | $\rho_g = 0.1722$<br>$\rho_y = -0.1880$<br>$\rho_\pi = -1.5995$ | $\rho^*_g = 0.6213$<br>$\rho^*_y = -0.0592$<br>$\rho^*_\pi = 0.2519$ | *Cooperative* |
| *Inflation divergences oriented monetary policy* | $\rho_g = 0.2185$<br>$\rho_y = -0.2018$<br>$\rho_\pi = -1.0865$ | $\rho^*_g = 0.1475$<br>$\rho^*_y = -0.1723$<br>$\rho^*_\pi = -0.730$ | *Non-cooperative* |
| | $\rho_g = 0.1769$<br>$\rho_y = -0.1897$<br>$\rho_\pi = -0.5987$ | $\rho^*_g = 0.6280$<br>$\rho^*_y = -0.0624$<br>$\rho^*_\pi = 0.2566$ | *Cooperative* |

Whatever the monetary regime, the coefficients for inflation and output stabilization in the non-cooperative budgetary regime are (as expected) negative. Taken in absolute value, they are systematically lower in country 2 than in country 1. Precisely, in the calibration, country 1 was supposed to be more sensitive to shocks because of the bank capital channel effectiveness. It thus needs more stabilization by the budgetary policy, and it is exactly what the government does. With a simple non-cooperative budgetary regime, national governments could thus play an active role in mitigating asymmetric transmission of shocks due to the structural heterogeneity of the union.

In contrast with the non-cooperative regime, optimal cooperative budgetary rules are not consistent with the stabilization needs of member countries (Table 3). The coefficient associated to the inflation gap in the budgetary rule of country 2 is positive, corresponding to a destabilizing effect of the government optimal actions in this country. The result of Badarau-Semenescu *et al.* (2009) is useful to explain that. They show that adopting the cooperative regime amounts for national governments to optimize loss functions that incorporate simultaneously centralized stabilization objectives and national divergences stabilization objectives. Every member thus reacts to divergences in the union, making a step to

reach the average performance of the union. In the previous simulation, country 2 explicitly acts to reduce inflation divergences, even if this is detrimental to its national stabilization[15]. So, the cooperative budgetary regime is not necessarily suitable in an asymmetric monetary union. The need for responding to divergences in inflation, output and public expenditures finally makes the individual stabilizations less satisfying than in the non-cooperative regime.

This result becomes even more evident when comparing the expected social losses, calculated, in Table 4, as the average of national losses within the union. First, when the society shares the same stabilization preferences as the governments (first line in Table 4), the cooperative regime seems to be preferred to the non-cooperative one.

**Table 4. Expected social loss ratios for alternative policy-mixes (for $\lambda_\pi = 1$; $\lambda_y = 1.5$; $\lambda_g = 0.5$)**

| *Social loss function coefficients* | $EL_S^{NCoop}/EL_S^{Coop}$ *(whatever the monetary regime)* | $EL_S^{C}/EL_S^{C+Div}$ *(whatever the budgetary regime)* |
|---|---|---|
| $\lambda_\pi^S = 1;\lambda_y^S = 1.5;\lambda_g^S = 0.5$ | $EL_X^{NCoop} = 1.054EL_S^{Coop}$ | $EL_S^{C} = 0.96EL_S^{C+Div}$ |
| $\lambda_\pi^S = 1;\lambda_y^S = 1.5;\lambda_g^S = 0$ | $EL_X^{NCoop} = 0.978EL_S^{Coop}$ | $EL_S^{C} = 0.96EL_S^{C+Div}$ |

* $EL_S^C$ = expected social loss with a centralized monetary policy; $EL_S^{C+Div}$ = expected social loss with monetary policy based on national information; $EL_S^{NCoop}$ = expected social loss in a non-cooperative budgetary regime; $EL_S^{Coop}$ = expected social loss in a cooperative budgetary regime.

However, if we consider some degree of asymmetry between the social preferences and the governments' preferences for stabilization (for instance if, unlike governments, the society does not penalize public spending divergences), the results clearly favors the non-cooperative regime over the cooperative one (second line in Table 4)[16]. This means that the superiority of a cooperative regime only relies on the fact that it allows a better stabilization of public spending divergences. But, it is detrimental to the stabilization of national variables, costly at national level, and so, more probably, unacceptable.

As for the monetary policy, it appears that a centralized monetary regime is preferable to a monetary regime trying to reduce inflation divergences, for all values of the social los functions coefficients (see the last column of Table 4). The policy-mix analysis thus supports the current orientation of the European Central Bank in the conduct of the common monetary policy.

15 See BADARAU-SEMENESCU & LEVIEUGE, 2010b, for further discussions on this point.

16 The question of divergences of preferences is not a main question per se in this paper. It just allows to deeply analyzing the advantages and drawbacks of a cooperative regime.

## 6.4. CONCLUDING REMARKS

The heterogeneity of the euro area is widely recognized and commented. The persistence of inflation and output divergences since the beginning of the euro area represented an important signal about the structural asymmetries among European countries. But, the fast amplification of national divergences after the recent subprime mortgage crisis really reasserts the structural heterogeneity of the EMU. Given the key role of banks in the propagation of this crisis, a particular attention is paid nowadays to the financial sector.

This study especially focuses on the financial heterogeneity in a monetary union. It first studies the harmful effects of such heterogeneity and then wonders about the policy-mix capacity to mitigate these effects in a monetary union. The analysis relies on a DSGE model of a two-country monetary union with heterogeneous bank capital channel, hit by symmetric monetary, budgetary or technological shocks. It is found that financial asymmetries lead to striking cyclical divergences among members of the Union. It is also shown that larger heterogeneity of the Union implies larger cyclical divergences and that the conduct of a centralized monetary policy worsens these divergences.

In terms of policy-mix, a centralized monetary policy, seeking to stabilize the union-wide inflation rate would be preferable to a strategy that is simultaneously concerned by the stabilization of inflation divergences in the union. The monetary policy is thus not really an useful tool in mitigating national divergences induced by financial heterogeneity. On the contrary, national budgetary policies constitute relevant instruments to do it, fighting asymmetric transmission of shocks inside the union. They should be accompanied by relevant coordination mechanisms, such as a clear definition of a budgetary strategy for the union, specifying the main objective to be followed by national governments. Compared to a non-cooperative regime, the budgetary cooperation does not represent a better solution in the Union. Its superiority would only rely on the fact that it allows a better stabilization of public spending divergences, which would be done to the detriment of the stabilization of national variables. In euro area context, the model thus supports the current orientation of the European Central Bank and emphasizes the importance of national fiscal policies face to structural heterogeneity of the Union.

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# 7. The Impact of the Financial Crisis on the Monetary Transmission Mechanism: A case of Poland

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## Abstract

The aim of this paper is to show implications of the current financial crisis for the monetary transmission mechanism (MTM) and its effectiveness in Poland, which is an inflation targeting emerging market economy. MTM depends on the monetary policy, but also on structural features of the economy. Financial crisis could affect both. Our results based on the Polish data suggest a change in the monetary policy rule and a significant drop in the overall monetary policy effectiveness. Unlike disturbances in the interest rate pass-through, which reflect increased perception of risk and result from the financial crisis, the more pronounced role of credit market imperfections and the weakening of the exchange rate channel can be viewed rather as typical phenomena in the current phase of the business cycle. However, the magnitude of the crisis, the likely changes in the regulatory framework and adjustments in macroeconomic policies can result in a deeper evolution of the MTM.

*Keywords*: Monetary transmission, emerging economy, financial crisis

*JEL Codes?/Classification numbers*: E51, E52, G01

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## 7.1. Introduction

Monetary transmission has recently gained a new wave of interest (e.g. Boivin *et al.* (2010), Cecioni and Neri (2010)). There is also a growing number of papers

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addressing a question of an impact of the current financial crisis on the monetary transmission (e.g. Peersman (2010), showing that in the euro area the use of unconventional monetary policy, e.g. fixed rate full allotment, offset a negative impact of the turmoil and preserved monetary transmission from a substantial disruption.

The evidence for emerging market economies is scant. We would like to fill this gap – the aim of this paper is to show implications of the current financial crisis for the monetary transmission mechanism and its effectiveness in Poland, which is inflation targeting emerging market economy. After the Lehman Brothers default Poland changed its monetary policy from short-term interest rate control to liquidity management and a more pronounced role of output stabilization. However, in contrast to the euro area, US or the UK, it did not use unconventional monetary policy tools and relied on a traditional set complemented with foreign currency swaps.

Poland has both standard and non-standard features of an emerging market economy. Emerging markets are usually open economies with less developed financial sector, but on the other hand, they depend heavily on foreign capital. Thus, exchange rate usually plays a significant role in their transmission mechanism. Poland is less financially and trade open than other European emerging markets; on the other hand, it is a significant recipient of funds related to the European Union's Cohesion Policy. Therefore, financial crisis in Poland may manifest itself in a somewhat different way and can have different outcomes comparing both developed economies and emerging markets.

During financial crisis, increased global uncertainty caused massive capital outflows and these in turn led to a rapid depreciation of domestic currencies. The impact of depreciation can be twofold: on one hand, increasing competitiveness it can stimulate output, but on the other – dampen real sector activity via credit channel. Depreciations lead to a deterioration in borrowers' balance sheets, especially in dollarized economies and when central bank credibility is low (Caballero and Krishnamurthy (2004)). Tornell and Westermann (2002) stress that in the middle income countries, the balance sheet effect and depreciations mostly affect non-tradable sector, which is more bank dependant than the tradable sector. In Poland, the exchange rate depreciation rather sustained than depressed domestic demand. There are at least three underlying reasons: (i) the share of corporate sector debt denominated in foreign currencies is relatively low – it amounts to 25%. Balance sheets of the corporate sector, though affected by exchange rate impact on loans, seemed to suffer more from firms' involvement in speculations on further exchange rate appreciation (options); (ii) the aforementioned broader indicator, i.e. the level of financial openness of Poland, measured as gross stocks of foreign assets and liabilities to GDP, which in 2008 reached the level of

116.6%, remains relatively low comparing to either Czech Republic (147.4%) or Hungary (173.5%), let alone the euro area (264.5%); (iii) central bank credibility, though not very high, increases steadily (Łyziak *et al.* (2007)).

Financial crisis and exogenous negative demand shock led to an exceptionally deep contraction in the real sector in many emerging markets. Poland did not experience a formal recession – GDP growth remained low but positive. Nonetheless, various measures of output gap were negative and big in absolute terms. As suggested by Adrian *et al.* (2010), the role of the interest rate spread or output gap may vary across different phases of the business cycle. While during recessions the relationship between inflation and demand is close to linear as labour market is relatively competitive, during expansions capacities are utilized at high levels and increasing them is costly (constraint capacity models). Thus, inflation becomes more sensitive to demand pressure. There is also some evidence that exchange rate pass through and interest rate pass-through may display asymmetries over business cycle (Correa and Minella (2006), Przystupa, Wróbel (2010), Chmielewski, (2003)). We try to shed some light on the role of cyclical factors in the monetary transmission disturbances observed during financial crisis.

The paper is structured as follows. We start with a description of monetary and government policies during financial crisis. The next section provides empirical results, the last one concludes. Figures and tables are displayed in the Appendix.

## 7.2. MONETARY AND OTHER POLICIES DURING FINANCIAL CRISIS

Facing a sharp increase in uncertainty and turbulences in foreign and domestic financial markets, a fall in the unsecured transactions and a significant increase in cash holdings of households, central bank which prior to the crisis focused on controlling the overnight money market interest rate (Polonia), put into place various measures aimed at liquidity management. Financial crisis induced a transitory change in the monetary policy, but unlike the ECB or Bank of England, the National Bank of Poland used only standard monetary policy instruments.

As shown in Fig. 1, there was a clear-cut fall in the interbank overnight transactions in October 2008. They remained subdued throughout 2009 and started to rebuild only in 2010. A downward trend in the overnight transactions began in the first half of 2008, well before the Lehman Brothers collapse. Then, the central bank tightened monetary policy owing to inflation exceeding the targeted level of 2.5%. It is therefore understandable that lower free reserves led to a lower level of interbank transactions. Starting from November 2008 NBP gradually lowered its interest rate from 6% to 3.5% in June 2009.

Slightly before, in mid-October 2008, NBP introduced Confidence Package, i.e. a set of measures aimed at providing banks with liquidity in domestic and foreign currencies and at expanding possibilities for banks to obtain liquidity by broadening collateral in operations with the NBP. As in many emerging markets, Poland's banking sector exhibits structural excess liquidity. During financial crisis it alleviated but not eliminated negative effects of the confidence loss. Responding to banking sector demand, NBP added liquidity for maturities up to 6 months, whereas through swaps it provided foreign currencies. The latter operations were mostly used by domestically-owned banks which found it difficult to finance themselves in foreign markets, opposite to these which could be financed by their mother-institutions.

In addition, in January 2009, NBP pursued an earlier redemption of its 10-year bond, issued in 2002 to absorb structural surplus liquidity. Finally, in May 2009 central bank reduced the reserve requirement ratio from 3.5% to 3%.

The provision of liquidity drove short-term rates in the unsecured market to the levels below the NBP's policy rate (the reference rate). On the other hand, it helped reappearing of transactions, but mainly for maturities up to one week. This is well illustrated by spread behaviour (Fig. 2). Spreads between interest rates of various maturities and Polonia rocketed first at the end of 2007 reflecting disturbances in the world markets due to the first stage of the subprime crisis. This was a transitory phenomenon and then spreads went down. They increased sharply once again after the Lehman Brothers failure. Their increased level persisted in 2009, but while this between Wibor1W and Polonia stabilised, those between Polonia and longer rates got even larger. This is especially visible in the case of Wibor3M, even though this rate to some extent is impacted by the central bank's repo operations.

Government policies addressed to tackle disturbances the financial crisis brought about, involved four groups of measures. The first one was supposed to stabilise the banking sector through extension of household deposit guarantees and a possibility of getting a transitory state aid in mortgage debt repayment for those who got unemployed due to the financial crisis. The second group was aimed at exchange rate stabilisation, which was depreciating, driven by contagion effects. Thus, the government exchanged the inflowing EU related funds in the foreign exchange market, instead of doing it at the central bank window. Moreover, the government and the central bank arranged an access to the Flexible Credit Line (FCL) offered by the IMF. Foreign investors treated the credit line as an additional insurance of macroeconomic stability or the country collateral. Thus, the FCL reduced credit constraints, which in the case of emerging markets exist on both firm and country levels (Caballero and Krishnamurthy (2004)) and made the credit channel operation closer to the way characteristic for developed econo-

mies. The third group was to sustain domestic demand and involved a faster use of EU funds, loans from the EIB and the World Bank. Also, small and medium size enterprises were offered credit guarantees. Finally, the last group was supposed to increase flexibility of the economy, and labour market in particular. Under auspices of the government, employers and trade unions agreed to enhance flexibility of working time and, by the same token, diminish lay-offs during periods of lower demand.

## 7.3. ESTIMATION METHOD

Our sample starts in 1998 with the adoption of inflation targeting by the central bank and ends in May 2010. In the second half of 2010 the most pronounced symptoms of the financial crisis lost their momentum. In what follows, we compare results obtained from a sub-sample ending before Lehman Brothers collapse in September 2008 with these from the whole sample.

In our estimations we use a suite of structural VAR and EC models. To account for a possible regime shift and a resulting parameter instability, we introduce a dummy which is zero in the period before September 2008 and 1 thereafter. The results are presented both with and without the dummy, since it seems that it captures not only effects of the financial crisis, but also these of the business cycle.

To analyse interest rate pass-through from money market to retail rates and check whether it underwent changes resulting from the financial crisis, we use a following model:

$$\Delta_t^r = \alpha_0 + \alpha_1 \Delta mr_t + \beta_1 (r_{t-1} - \beta_2 mr_{t-1}) + \varepsilon_t$$

where $r_t$ is a respective retail deposit or loan rate, $mr_t$ stands for a money market rate (either 1- or 3-month Wibor), $\Delta$ is a first difference of a variable, whereas $\alpha_0$, $\alpha_1$, $\beta_1$, $\beta_2$ are parameters, and $\beta_1 < 0$. Coefficient $\alpha_1$ shows the instantaneous adjustment of the retail rate to the money market rate, while $\beta_2$ measures the long-term adjustment. We compare forecasts of selected retail rates obtained from models estimated on the sample ending before the Lehman Brothers collapse with the actual data. A difference between the two shows the impact of the crisis. We employ data on both outstanding amounts (stocks) and new deposits/loans (flows[5]). In this case, due to a change in the method of retail rates calculation, the sample is much shorter, starting from the year 2005.

Next stages of the monetary transmission are examined with structural VAR models in the spirit of Peersman and Smets (2003). In the benchmark model we use four macroeconomic variables – prices (CPI), industrial output, short-term

[5] In the statistics they are dubbed "new businesses".

interest rate (1-month money market interest rate, Wibor1M – serving as a proxy for the policy rate), and the nominal effective exchange rate. Foreign interest rate (Euribor) is plugged exogenously. To extract monetary policy shock we employ a recursive (Choleski) factorization. The variables are ordered in a way reflecting the assumption of a lag between monetary policy shock and the reaction of the real sector and prices. The specification reflects also monetary policy rule: central bank sets the level of its instrument (interest rate) observing current developments in inflation and the real sector. To gain more insights from the VAR analysis, we add to the benchmark specification various credit aggregates, including these denominated in foreign currencies. This brings more evidence whether – as in developed economies – credit played a significant role in the propagation of financial crisis.

The number of lags was determined taking into account information criteria, but also model stability and serial correlation of residuals. All variables except the interest rates are in natural logarithms and are seasonally adjusted. If necessary, we also use centred seasonal dummies to eliminate the remaining seasonality and autocorrelation of residuals. The VAR models are estimated in levels to allow for the long-run relationships between variables. The key variables are reproduced in Fig. 1 and Fig. 3.

Basing on our VAR models with determined optimal lags, we calculate monetary transmission effectiveness (MTE), understood as a standardized elasticity ($e_{y_2/y_1, y_A}$) between instrumental ($y_1$) and target ($y_2$) variables with intermediation of the $y_A$ variable from the transmission chain:

$$MTE_{y_1 \to y_2, y_A} = (1 - pv_{A,1})(1 - pv_{2,A}) \frac{\left| e_{y_2/y_1, y_A} \right|}{(1 + \left| e_{y_2/y_1, y_A} \right|)},$$

where:

$$e_{y_2/y_1, y_A} = e_{y_2/y_A} \cdot e_{y_A/y_1}$$

if the parameters at respective variables are significant at the *pv* level and fulfil Wald restriction tests (see e.g. Bates and Vaugirard (2009)). MTE is a product of the elasticity $e_{y_2/y_1, y_A}$ multiplied by the respective *pv*. To calculate the dynamic MTE, our VAR models were reestimated for the optimal lag + 1. This overparameterization allows for using the OLS estimator (Harvey (1991).

To account for the role of cyclical factors in disturbances of the monetary transmission, we conduct simulations on a small structural model with credit market imperfections.

The open economy IS curve is:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 r^l_{t-1} + \alpha_3 \cdot (\Delta i^l_{t-1} - \Delta i_{t-1}) + \alpha_4 e_t + \alpha_5 y^{EUR}_{t+1} + \varepsilon^y_t \quad (1)$$

where $y$ is the output gap, $r^l$ is the real and $i^l$ is the nominal rate of interest on loans, $i$ is the money market rate, $e$ is the real effective exchange rate, and $y^{EUR}$ is the GDP growth in the euro area, the main trade partner of Poland. In the model a change of spread affects aggregate demand. Moreover, the spread is endogenised to account for its cyclical fluctuations and forward-lookingness. It depends on the future output gap – banks expecting deterioration in the economic activity perceive it as a risk and increase the spread.

The exchange rate equation, expressed in terms of the nominal effective exchange rate ($s$), is a behavioural equation, although in the spirit of the UIP condition. It depends on its lag and lead, the differential between domestic and foreign ($i^f$) short-term interest rates and the future output gap:

$$s_t = \beta_0 + \beta_1 s_{t-1} + \beta_2 s_{t+1} + \beta_3 \cdot (i_t - i^f_t) + \beta_4 y_{t+1} + \varepsilon^s_t \quad (2)$$

The Phillips curve (in terms of core inflation, $\pi^n$) is explained by inflation expectations ($\pi^e$), proxied by consumer survey-based measures, the output gap and the real effective exchange rate:

$$\pi^n_t = \lambda_0 + \lambda_1 \pi^e_t + \lambda_2 y_{t-3} + \lambda_3 e_{t-1} + \varepsilon^{\pi^n}_t \quad (3)$$

In the principal version of the model the relationship between the output gap and inflation is linear. For periods of prosperity we impose non-linearities in the way suggested by Alichi *et al.* (2009), implying that the impact of the output gap on inflation is relatively stronger if the output gap is positive.

$$\hat{y}_t = \frac{y^{\max}}{y^{\max} - y_t} \qquad \text{for } y_t > 0$$

$$\hat{y}_t = y_t \qquad \text{for } y_t \leq 0$$

$$\pi^n_t = \gamma_0 + \gamma_1 \pi^e_t + \gamma_2 \hat{y}_{t-3} + \gamma_3 e_{t-1} + \upsilon^{\pi^n}_t \quad (4)$$

## 7.4. EMPIRICAL EVIDENCE

### 7.4.1. Disturbances in the Monetary Transmission

In line with the literature, we assume that banks are price takers in the money market and price setters in the case of retail rates – banks set retail rates with respect to the money market rates of corresponding maturities. Jobst and Kwapil (2008) point, however, that money market rates serve well as a proxy for the marginal cost in periods of calm, whereas in time of crisis this is not ensured. During the crisis banks had problems with fund raising in capital and money markets. And if they aim for a certain proportionality between the components when managing their liabilities, then diverging cost developments may result in marginal cost no longer being represented by money market rates alone. Moreover, retail rates can be affected by structural factors, like competition and development of the capital market. In this study we do not discuss the latter problem, since we suppose that structural factors do not differ much in the two samples we consider. Bearing in mind the scale of disturbances in the money market, we concentrate on the pure pass-through process.

Before financial crisis, loan and deposit rates moved broadly in line with the market rates. There was some sluggishness in their adjustment to the market rates – notably in the case of loans for consumption, i.e. for loans which have poorer collateral than others. In many cases, the long-run adjustment to the money market rate was lower than one. The speed of adjustment varied from less than one month to about four months in the case of loans for households' consumption.

In the aftermath of the crisis, some long-run relationships between money market and retail rates broke down. In particular this is true for households' deposits (new businesses) of maturities longer than one month and up to six months. An increase in uncertainty and the aforementioned problems with fund raising led banks to offer deposit rates exceeding Wibor3M, i.e. the rate treated as a benchmark for the retail rates. This was most pronounced in the first quarter of 2009, when negative spread between Wibor3M and deposit rates amounted to 1.4-1.5 percentage points; since then it gradually fell to 0.4-0.5 percentage points. Rates on firms' new deposits displayed similar disturbances. The long-run relationships of these of maturities exceeding three months up to six months seem to disappear. Forecasts of deposit rates suggest that banks have been awash with the short-term liquidity (up to 1 month), namely forecasted rates tend to be much higher than actually observed. In contrast, these of longer maturities are much lower than the actual (Fig. 4).

Interest rate pass-through from money market to retail loan rates for households has also displayed disturbances. The long-run relationship between Wibor and

the rate on loans for house purchases (new businesses), on loans for sole proprietors (i.e. the owners of small firms) and consumption broke down. Forecasted loan rates both for housing and on loans to the sole proprietors are much lower than these actually observed, showing the degree of risk attributed by banks to these types of loans and borrowers (Fig. 4). Interest rate pass-through to rates on loans to firms (both stocks and flows) displays less changes. As a rule, the long-term relationships still operate. The actual average rate on new loans to the corporate sector tends to exceed the forecast since the beginning of 2010, but a difference between the two is much smaller than this for household's housing purposes and sole proprietors (Fig. 4). Our results suggest that in the aftermath of the crisis banks tended to reduce loans for housing and consumption, as well as for micro-firms rather than for the corporate sector. This is consistent with imperfect information hypothesis: small firms (but also households) are particularly vulnerable to credit market disruptions.

So far we have discussed the impact of financial disintermediation on retail rates in the banking system. It is however worthwhile to compare average interest rate on loans and deposits with the real sector activity. Fig. 5 shows that the spread, which displayed an upward trend since mid-2005, rocketed in the aftermath of the Lehman Brothers collapse to fall sharply to the pre-crisis level in mid-2010. It also reveals that the strong upward movement coincided with a sharp fall of the output gap[6] and persisted as long as the output gap was highly negative. Spread behaviour reflected risk attributed by banks to the real sector. The increase in spreads resulted not only from the turmoil in the money market, but also from the expected production drop. This suggests that monetary policy actions aimed at reduction of spreads could have only limited impact.

Assuming that there was a regime change in the monetary policy, central bank's reaction function (policy rule) obtained from our VAR model is – at first sight – similar in both samples. The reaction to the domestic demand shock is slightly bigger in the long sample than in the short one, whereas the reaction to the price shock does not display any change (Fig. 5, Fig. 6 upper panel shows the response of the interest rate to the domestic demand shock). Dropping this assumption we obtain a considerably bigger response to both shocks. However, while before the crisis the reactions of the interest rate to the domestic demand shock were statistically insignificant, in the sample including data after Lehman Brothers collapse, they are significant. Our tentative explanation is that facing a risk of a severe output decline and disturbances in the interest rate pass-through and credit channel operation, central bank reacted to inflation and especially to output shocks more than in the past. Other empirical results (Fig. 5 and Fig. 6) show that the monetary transmission is somewhat slower – assuming the regime shift – the

[6] De-trended industrial production.

maximum reaction of prices to the interest rate shock appears 3 months later than in the past, but the magnitude of the reaction is very similar. As expected, reactions obtained without the dummy exhibit longer lags. The reaction of prices to the exchange rate shock under the assumption of a regime shift tends to be more prolonged than before the crisis. If, once again, we drop this assumption, the pass-through is smaller and faster. The difference between the two responses can be due to cyclical factors. Przystupa and Wróbel (2010) show that the exchange rate pass-through is asymmetric over the business cycle and tends to be the smallest during early recessions. Thus, the dummy effect may encompass not only the increased uncertainty and changes in the monetary policy, but also cyclical fluctuations.

Prices seem to be more flexible with respect to the domestic demand than before the crisis. With the dummy the effect is small, whereas much bigger without it. Bearing in mind the global character of the crisis and the scale of output drop in the EU and the US, we argue that facing adverse conditions, producers were slightly more than usually willing to adjust their prices to a fall in demand. Also, the reaction of the nominal effective exchange rate to the shock in output, which can be interpreted as a positive shock to the economic fundamentals, brings about appreciation which is less persistent than in the past. Thus, it seems that the financial crisis induced more volatility into the foreign exchange market. The reaction of output to both the interest rate shock and exchange rate shock is slightly smaller than before the financial crisis. In this case the dummy does not change the responses (Fig. 7).

In the wake of the financial crisis domestic currency loans for households display practically the same reaction to the interest rate shock as before (Fig. 8)[7]. In this group of loans, only these to sole proprietors seem to exhibit more downward movement in the longer sample. This could suggest that banks perceived loans for these small entities as relatively risky. The reaction of the corporate sector loans (Fig. 9) in the longer sample is unchanged over the period of first 15 months after the shock and only afterwards some differences begin to develop. Both overdraft and loans of maturity exceeding one year (serving here as a proxy for investment loans) exhibit initially slower and smaller (overdraft) reaction to the interest rate shock than before the crisis. This can reflect the fact that during financial crisis banks lengthened the interest rate adjustment period. The more rigid reaction of the overdraft to the interest rate shock can be also due to an increase in demand for such loans. On the other hand, tightening of loan conditions for small and medium size enterprises could have a negative impact. It is noteworthy that in the

[7] Dummy variable was insignificant in the case of all credit variables but loans in foreign currencies to the corporate sector. Relatively high variability of loans in Poland since 1999 seems to be the underlying reason (see Fig. 3), therefore reactions of loans denominated in the domestic currency are displayed only for the specification excluding the dummy.

longer sample total amount of household and corporate sector loans (up to 17-18 months after the shock) exhibits the reaction pattern similar to that before the collapse of Lehman Brothers. Thus, we conclude that banks simultaneously used in a more active way instruments other than interest rates to affect loan supply, setting tighter standards and conditions[8].

In the case of loans denominated in foreign currencies to households[9] and corporate sector, we discuss impulse responses to the (domestic) interest rate shock only. Exchange rate shock seems to induce mostly the accounting effect. After monetary tightening, both before and after the crisis corporate sector tends to increase its debt in foreign currencies (Fig. 10), since this in the domestic currency becomes relatively more expensive. The effect is somewhat bigger in the longer sample and is statistically significant. Loans in foreign currencies to private persons do not change in response to the monetary policy shock (thus we even do not reproduce them in the graph), whereas these to sole proprietors display a similar pattern as loans to the corporate sector. Thus, in the sample including financial crisis data, loans in foreign currencies to the corporate sector and sole proprietors seem to be more responsive to the monetary policy shocks. It should be stressed however, that in both samples they clearly weaken monetary transmission.

### 7.4.2. Effectiveness of the Monetary Transmission Mechanism. Impact of Cyclical Factors

The efficiency of the monetary policy depends on its credibility and effectiveness of the monetary transmission mechanism. The effectiveness may change over time and tends to be impacted by both structural shocks and cyclical behaviour of the economy.

Monetary policy effectiveness, defined as in Section 3, indicates that the exchange rate has been the most efficient channel among these included in our VAR model, i.e. interest rate, exchange rate, and credit channel (Fig. 11). In the wake of the

[8] Our setting of the VAR does not allow us to draw hard conclusions on credit channel operation, since we do not disentangle between loan supply and demand. Senior Loan Officer Opinion Surveys (SLOOS), conducted by the NBP on quarterly basis, involve questions on both demand and supply. SLOOS show that banks aimed at reducing loans for housing and consumption. As we discussed before, the former are mostly extended in foreign currencies. Also, loan officers report that demand for consumer loans was slightly falling in the first half of 2009 but then started to increase. In the case of loans extended to the corporate sector, banks report to tighten standards and conditions with respect to the supply of short-term (of maturity up to 1 year) and long-term loans (of maturity exceeding 1 year) in the same way. The standards and conditions were tightened more for small and medium size enterprises than for the big ones. On the other hand, loan officers reported a more pronounced fall in demand for long-term than for short-term loans, suggesting that firms abandoned investment plans, whereas they tried to find financing for the working capital, inventories and debt restructuring.
Our results are broadly consistent with the SLOOS, with exception of loans to the corporate sector of maturity exceeding one year.

[9] Over the period 2004-2010 loans denominated in foreign currencies for sole proprietors accounted only for about 2.5-10% of the total amount of such loans extended to households.

financial crisis, its effectiveness dropped by one third. However, the effect seems to be transitory – since July 2009 the effectiveness has been increasing. Similarly, between the third quarter of 2008 and the first quarter 2010, effectiveness of the interest rate decreased by almost 20% and remains subdued, presumably reflecting a temporary change in the NBP's monetary policy (a shift from the interest rate control to the liquidity management) and an effect of the economic slowdown with a fall of investment and credit use. This would also suggest a transitory fall of the effectiveness. The level of the indicator of the credit channel effectiveness is twice lower than this of the interest rate, but its reaction to the financial crisis is bigger, suggesting a significant squeeze of credit supply. Though in our setting it is impossible to disentangle credit supply and demand, we suspect that while the first drop of the effectiveness was probably due to tightening of credit conditions, the second one, in mid-2009, is rather a result of a lower demand (see e.g. Del Giovane *et al.* (2010)).

To trace the cyclical features of our indicators, we compare them with the output gap[10], leaving however apart a big drop of the exchange rate efficiency in 2001 and a parallel increase of that of the interest rate, since they were clearly due to changes in the monetary policy (exchange rate liberalization, inflation targeting adoption). In contrast to Chmielewski (2003) who found some evidence of an asymmetric interest rate pass-through across the business cycle in Poland on the bank-level data, we do not observe on the macro level any significant asymmetries in the interest rate channel efficiency.

However, we find that the exchange rate efficiency tends to fall during recessions and remains stable during expansions. It may result from a low exchange rate pass-through to consumption prices in the early and middle stage of recession, when enterprises expecting lower profits cut costs (see Przystupa and Wróbel (2010) for details). Then, the slope of the Phillips curve becomes less steep (enterprises are more reluctant to raise prices than to lower them, see e.g. Filardo (1998)). In the early expansion, the convex Phillips curve is combined with a high pass-through effect. The same phenomenon, although due to the opposite reaction, can be observed in the late expansion, when the concave Phillips curve is combined with a lower pass-through. That is, during a recovery the effectiveness of the exchange rate channel may slightly increase or remain constant. Analytically this can be described by a two-leaf clover curve drawn by a segment moving in the rectangular coordinates along the horizontal coordinate (output gap) and the vertical one (inflation gap, i.e. difference between current and target inflation) – Fig. 11. The segment may be interpreted as a long-run path of the GDP growth rate expressed in nominal terms.

[10] As before, de-trended industrial production.

To develop further the role of the business cycle phase for the effectiveness of the monetary transmission mechanism we used linear and non-linear versions of the structural model described in Section 3. In the non-linear model the estimated direct impact of the output gap on net inflation varies from 0.13 in the case of a non-negative output gap to 0.42 in the case of the output gap significantly positive (the highest value observed in the sample). In the linear version of the model the direct impact of the output gap on net inflation is 0.28. To analyse main features of the monetary transmission mechanism we analyse results of the simulations, in which the short-term interest rate increases or decreases by 1 pp. for 4 quarters and then it returns to the baseline. Due to non-linear effects of the output gap on inflation simulations are conducted for different initial values of the output gap. Table 1 summarizes the results.

Simulations based on the non-linear model support previous evidence of the impact of the business cycle on the monetary transmission mechanism. The maximum inflation response to the interest rate increase varies between -0.37 pp. in the case of non-positive output gaps to 0.59 pp. in the case of the actual output being 4.5% higher than the potential output. A reduction of interest rates leads to outcomes even more diversified: inflation increases by 0.37 pp. for a non-positive output gap and by 0.68 pp. for a highly positive output gap.

The operation of the monetary transmission mechanism is different in both versions of the model. Capturing non-linear effects in the monetary transmission mechanism makes inflation response to the interest rate impulse less persistent. For the initial levels of the output gap not sizeably higher than 0.03 the maximum inflation response in the linear model is stronger, although more delayed than in the non-linear one. In the periods of economic boom and the output gap approaching its highest observed value, the maximum response is significantly higher than in the linear version of the model and occurs with the same delay.

## 7.5. CONCLUSIONS

The paper shows implications of the current financial crisis for the monetary transmission mechanism in an emerging market economy. The transmission mechanism crucially depends on the monetary policy and structural features of the economy. Financial crisis could potentially affect both. In its sharp phase, many central banks changed their monetary policy from short-term interest rate control to liquidity management. Some of them resorted to non-conventional instruments. In the case of Poland, which used only standard tools, we find some support for the hypothesis of a change in the monetary policy rule. Facing a risk of a severe output decline central bank apparently took into account possible disturbances in the interest rate pass-through as well as in credit channel opera-

tion and increased its responsiveness to both inflation and output shocks. Reactions of inflation and industrial output to the interest rate and exchange rate shocks display minor changes.

Increase of uncertainty in the money market and the real sector brought about problems with transmission from the monetary policy instrument to money market and retail rates. A breakdown of the long-term relationships concerned mostly deposits of households, loans for housing and consumption, as well as these to sole proprietors. We show a significant gap between actually observed and forecasted retail interest rates. Apart from deposits of one month maturity, which tend to be lower than the forecast due to liquidity provision by the central bank and smaller risk in this segment of the market, interest rate on other deposits and loans are higher than forecasted. It should be stressed, that this concerns much less loans for the corporate sector than these for households' consumption and housing, and especially loans for sole proprietors. This corresponds to the results obtained from a structural VAR, showing a bigger than in the pre-crisis period reaction of loans to sole proprietors to the monetary policy shock.

What is specific for emerging market economies, it is a significant role of the exchange rate in the transmission mechanism and the fact that the increased global uncertainty caused massive capital outflows. In the case of Poland we do not find evidence that it significantly hampered output via credit channel. Though our setting does not allow us to draw hard conclusions on credit channel operation, we observe that after the crisis reactions of loans to small entities became deeper, what is consistent with credit channel and asymmetric information literature.

Our results suggest a significant drop in the overall monetary policy effectiveness since the fourth quarter 2008 and a slight improvement at the end of 2009. The increased role of credit market imperfections and the weakening of the exchange rate channel can be viewed as typical phenomena in the current phase of the business cycle. There is some evidence that the latter tends to fall during recession and remains stable during expansion.

All in all, it seems that apart from the interest rate pass-through disturbances in the monetary policy transmission rather reflect increased perception of risk and cyclical features of the transmission process activated by the financial crisis and to a much smaller extent structural changes in the economy. The magnitude of the crisis, its duration and evolution, as well as the likely adjustments of the regulatory framework and in the macroeconomic policies can lead to changes in the behaviour of economic agents and result in the evolution of the monetary transmission mechanism. The learning process of economic agents – consumers, producers and the banking sector will exert a significant impact.

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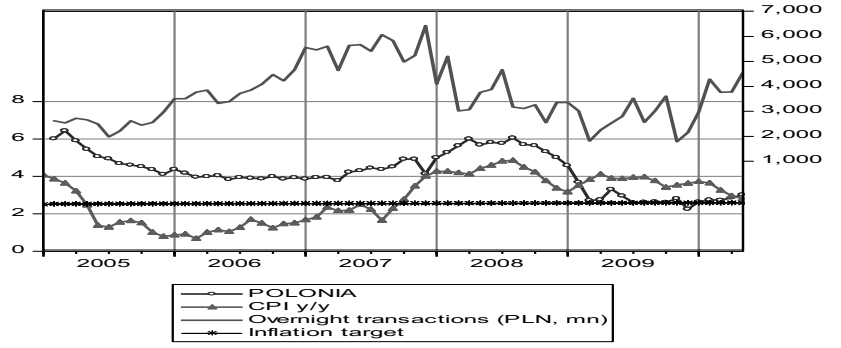
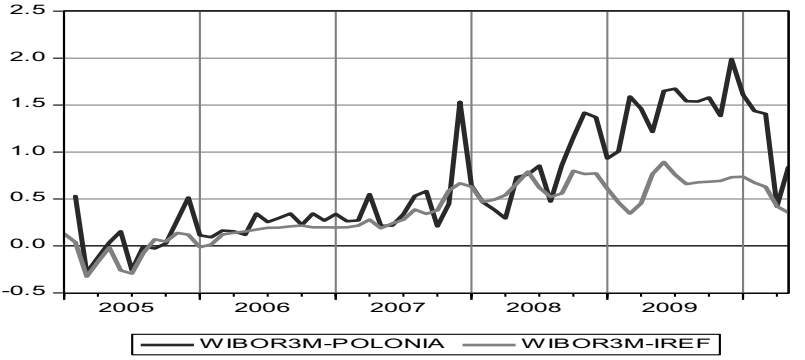
## APPENDIX

**Figure 1. Overnight transactions in the unsecured market, POLONIA, inflation CPI y/y and inflation target**



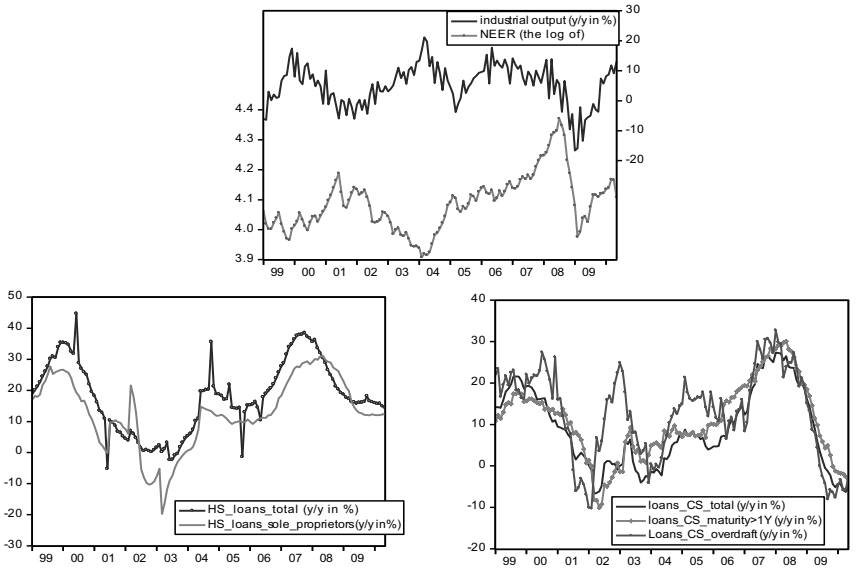

Source: NBP

**Figure 2. Spreads between 3 month money market rate (WIBOR 3M), the overnight rate (POLONIA) and the NBP reference rate**



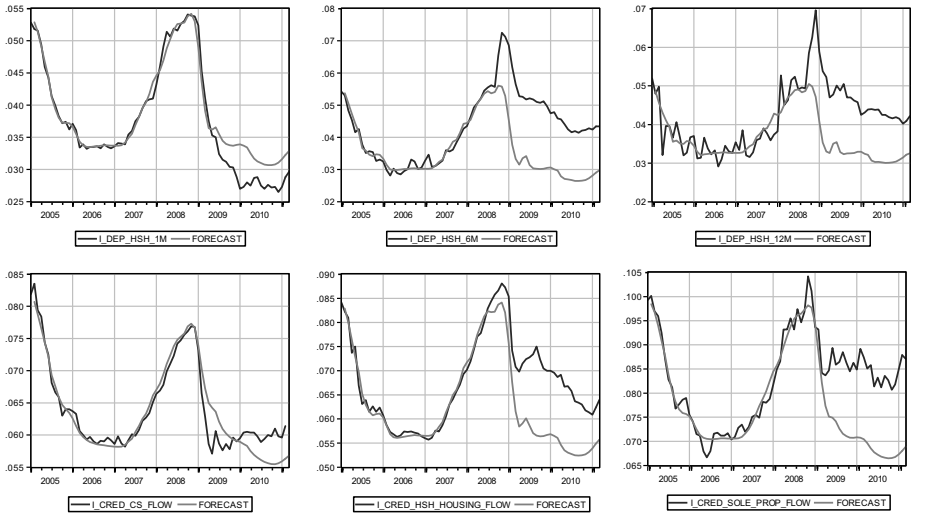

Source: Authors' calculations. Data: NBP and Reuters.

**Figure 3. Main variables used in the estimation: industrial output (y/y), NEER, loans in the domestic currency to households – total amount(y/y), to the sole proprietors (y/y), to the corporate sector – total amount (y/y), of maturity over 1Y (y/y) and overdraft (y/y)**



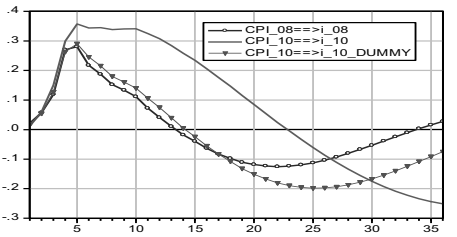

Source: Central Statistical Office and NBP

**Figure 4. Selected actual and forecasted new deposit and loan retail rates (upper panel from left to right - households' deposits – 1M, 6M, 12M; lower panel from left to right - loans to the corporate sector, loans to households for housing purposes, loans to the sole proprietors)**



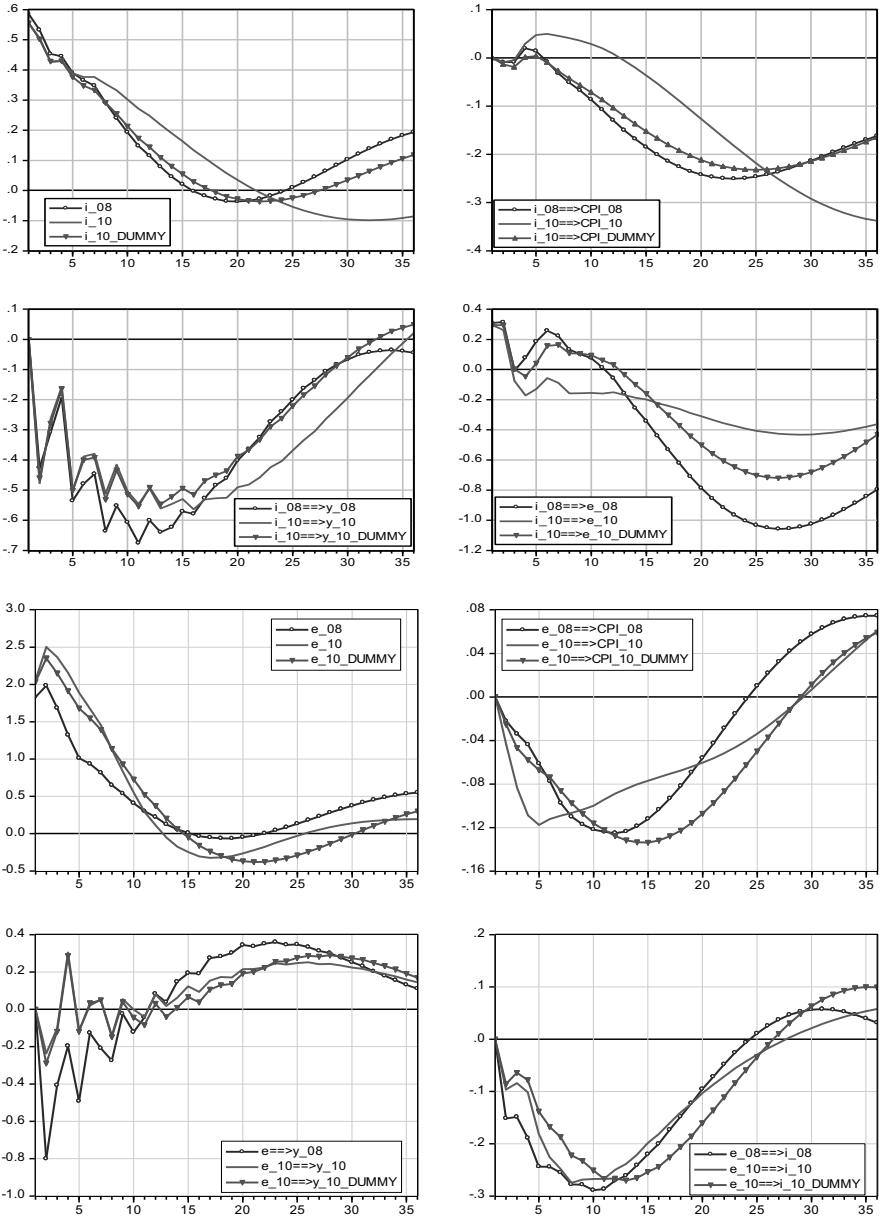

Source: Authors' calculations.

**Figure 5. Response of WIBOR1M to a shock to the consumer price index**



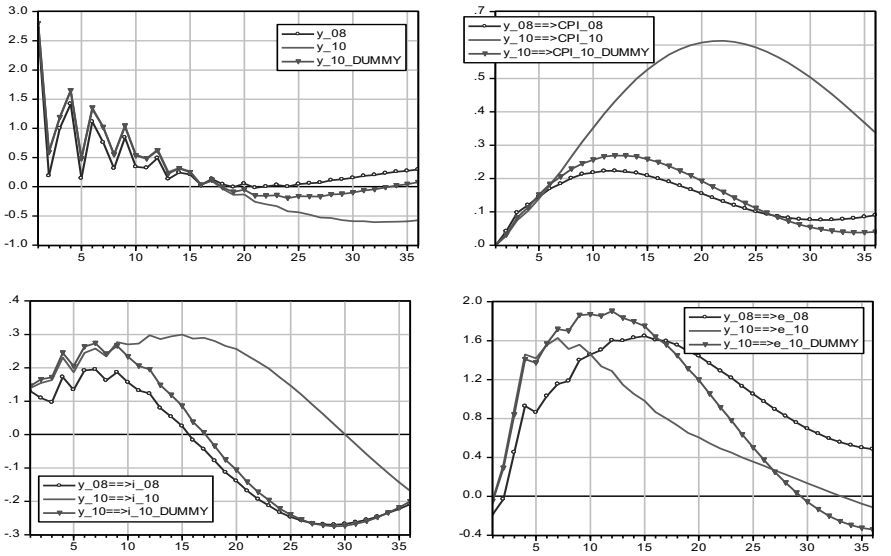

Source: Authors' calculations.

**Figure 6. Reaction functions: interest rate shock (upper panel) and exchange rate shock (lower panel)**



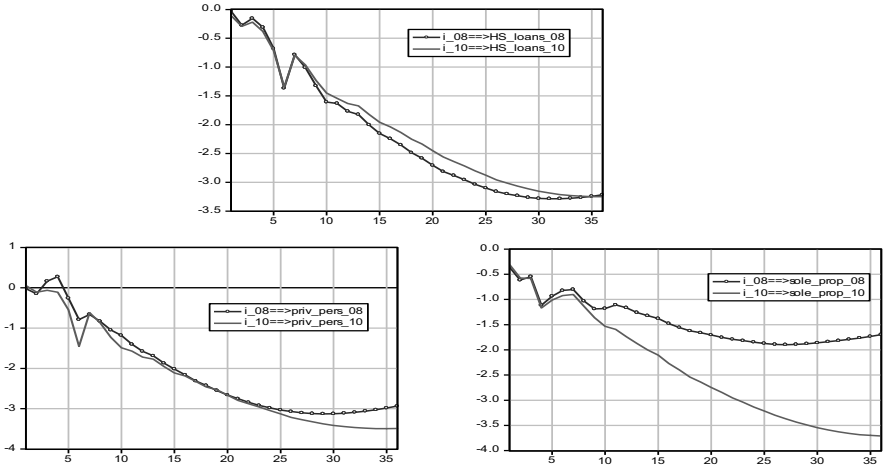

Source: Authors' calculations.

**Figure 7: Response functions: domestic demand shock**



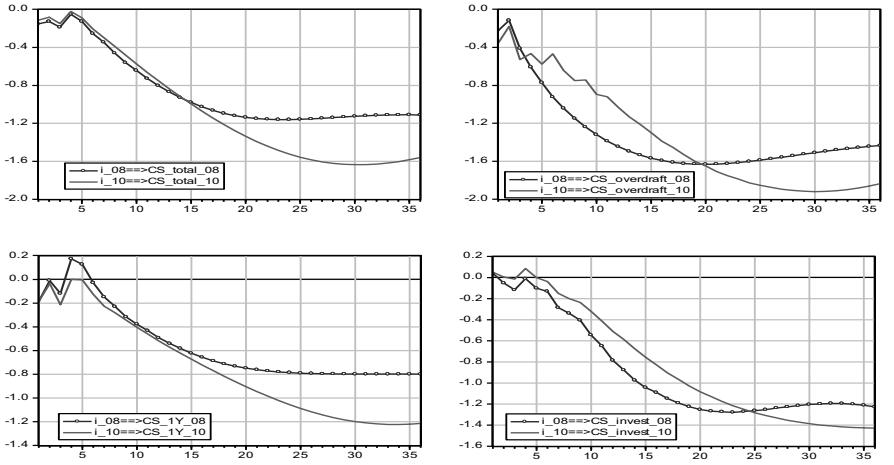

Source: Authors' calculations.

**Figure 8. Response functions of loans in the domestic currency to households (interest rate shock)**



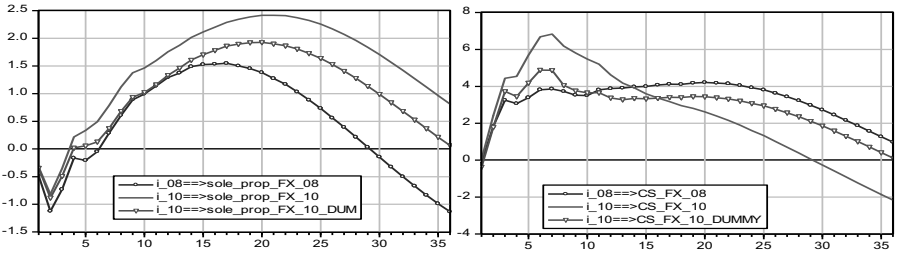

Source: Authors' calculations.

**Figure 9. Response functions of loans (domestic currency) to the corporate sector (interest rate shock): total, overdraft, loans of maturity up to 1 year and exceeding one year ("investment")**



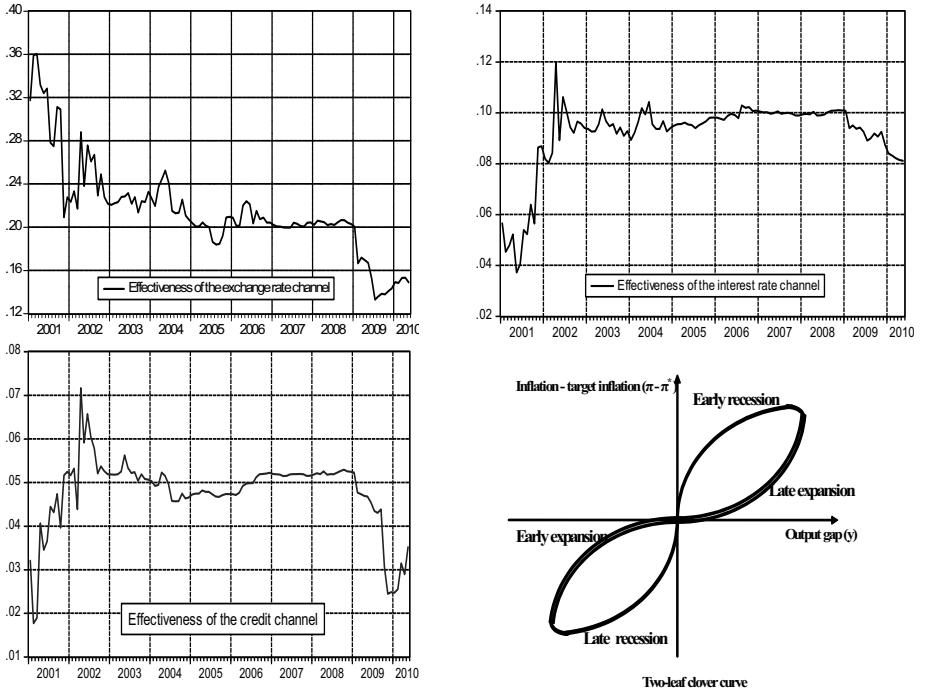

Source: Authors' calculations.

**Figure 10. Loans in foreign currencies to the sole proprietors and corporate sector (interest rate shock)**




Source: Authors' calculations.

**Figure 11. Monetary transmission effectiveness (transmission to CPI)**




Source: Authors' calculations.

**Table 1. Maximum inflation response [delay (in quarters)] after the interest rate impulse for different initial values of the output gap, non-linear (NL) and linear (L) model**

| | NL: GAP=0 or GAP<0 | NL: GAP=0.01 | NL: GAP=0.02 | NL: GAP=0.03 | NL: GAP=0.04 | NL: GAP=0.045 | L |
|---|---|---|---|---|---|---|---|
| Interest rate increase | -0.35 | -0.36 | -0.36 | -0.37 | -0.45 | -0.59 | -0.38 |
| | 5 | 5 | 5 | 5 | 7 | 7 | 7 |
| Interest rate decrease | 0.36 | 0.36 | 0.37 | 0.38 | 0.50 | 0.68 | 0.38 |
| | 5 | 5 | 5 | 5 | 7 | 7 | 7 |

Source: Authors' calculations.

# 8. Effectiveness of Unconventional Monetary Policies and their Impact on Long-Term Inflation Expectations

*Urszula Szczerbowicz*[1]

## Abstract

Unconventional monetary policies seemed to be the isolated experiment run by the Bank of Japan during the deflation period. However, recent financial crisis made it clear that the conventional monetary policy – the interest rates setting – is no longer enough to bring back the financial stability and economic recovery. In fact, when the interest rate is close to zero and the transmission from the central bank rates to other short-term rates is impaired, the central banks need to implement new policy tools. In this paper I review the evidence on the effectiveness of the unconventional monetary policies implemented in the United States during the 2007-2010 crisis and on their impact on long-term inflation expectations. I compare the previous findings with my results (Szczerbowicz, 2011).

*Keywords*: unconventional monetary policy, inflation expectations, long-term interest rates, Libor-OIS spread

## 8.1. Introduction

Setting the central bank interest rate according to the current economic situation has been proved effective as the standard monetary policy transmission channel. The models in which the interest rate rule characterizes the monetary policy are commonly used by researchers and central bankers. However, the recent financial crisis and subsequent economic recession showed the limits of conventional monetary policy. Indeed, interest rate setting has been confronted so far with two major difficulties: zero interest rate environment and impaired transmission from the central bank rates to other short-term rates.

There exist several alternatives to conventional monetary policy. Bernanke, Reinhart and Sack (2004) classify unconventional monetary policies into three groups:

1) expectation management strategy. Central bank commitments can affect the expectations of the future interest rates;
2) expansion of monetary base. When the financial frictions are present the quantitative easing is non-neutral. Money and other financial assets are no longer perfect substitutes. Agents want to trade money for non-money assets,

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and therefore the prices of non-monetary assets raise and the yields go down which stimulates the economy;

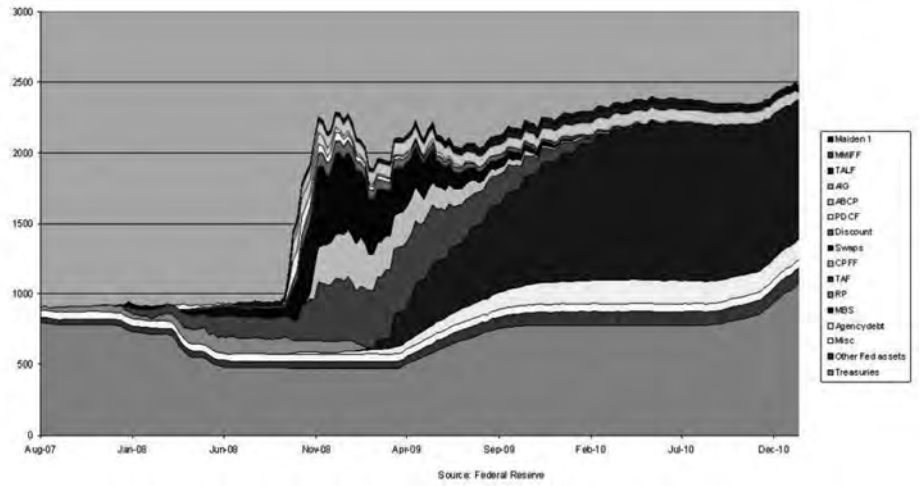
3) changes in the composition of the central bank balance sheet. Credit easing changes the composition of the portfolio of securities left in the hands of the private sector and can substantially affect their yields.

The Bank of Japan was the first to implement unconventional monetary policies during the prolonged stagnation following the burst of the asset price bubble in the early 1990s. During that period, it also faced some serious deflationary pressure for about a decade. The negative inflation rates measured by the consumer price index (CPI) change first appeared in 1998 and lasted until the autumn 2005. To counteract the deflationary pressure, the Bank of Japan (BOJ) adopted various unconventional policies. First, in 1995, the BOJ lowered the target of the uncollateralized overnight call rate from around 1.75 percent to 0.5 percent. Second, the BOJ decided to encourage the uncollateralized call rate to be at about zero percent in February 1999. This was the introduction of the so-called "zero interest rate policy (ZIRP)." Afterwards, at the BOJ governor's press conference in April 1999, it was declared that the ZIRP would be continued until deflationary concerns were dispelled. Third, in March 2001 the BOJ adopted "quantitative easing monetary policy (QMEP)" with a large expansion of the monetary base. In doing so, the BOJ had also made a commitment to maintain this policy package until the core CPI inflation rate registered zero percent or higher on a sustainable basis. The QMEP framework included employing by the BOJ the outstanding balance of its current account as an operating target for monetary market operations. In addition, it was also declared that the BOJ was ready to increase the purchase of long-term government bonds if necessary to provide ample liquidity. The QMEP was exited in March 2006 when the conditions for the exit had been satisfied, i.e. both the development of actual inflation rate and outlook of inflation rate were above zero percent.

Since the beginning of the 2007-2010 crisis other central banks have also switched to alternative monetary tools. The generalized uncertainty regarding the healthiness of bank balance sheets generated frictions in the financial and monetary markets. In that context, lowering the central bank interest rates did not affect the interbank rates to the extent it used to do. As a consequence, the monetary policy remained unable to lower the cost of credit. The Federal Reserve responded to this problem in a number of ways. First of all, it introduced new liquidity facilities. It also expanded the maturities and range of eligible collateral, the frequency of operations and the number of counter-parties. As the crisis got worse, especially after the failure of Lehman Brothers, the unconventional monetary policies were implemented even more intensively. The Fed started its interventions in specific market segments and initiated the asset purchase programs including commercial papers, agency debt and MBS as well as longer-term gov-

ernment debt. The Fed also conceded swap lines to other central banks to enable them to provide further dollar liquidity. Figure 1 illustrates the way the unconventional policies affected the Fed's balance sheet. Since the beginning of the crisis the composition of the Fed's assets was significantly altered and the size of the balance sheet more than doubled.

**Figure 1: Fed's Assets**

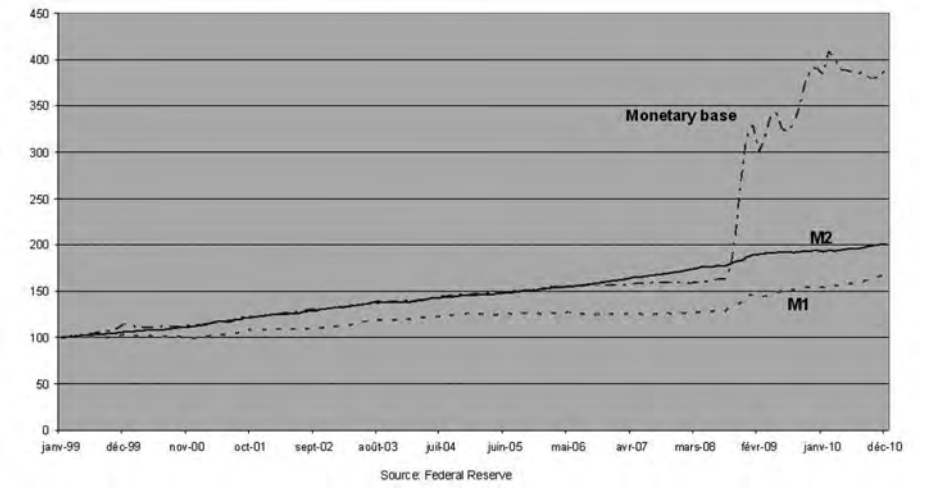



In this paper I review the evidence on the effectiveness of the unconventional monetary policies implemented in the United States during the 2007-2010 crisis and on their impact on long-term inflation expectations. I compare the previous findings with the results of my paper (Szczerbowicz, 2011). I focus on the effectiveness of unconventional policies in lowering the long-term interest rates and relieving the strains on the US money markets as these aspects were essential in stimulating economy in the context of the crisis. Indeed, when short-term interest rates are close to zero, the Fed can still stimulate the aggregate demand by reducing the long-term rates. On the other hand, reducing tension on interbank market allows financial institutions to extend credit and therefore counters the recession.

Apart from efficacy, unconventional monetary policies brought another important question: their impact on long-term inflation expectations. In principle, raising inflation expectations was not an objective of the Federal Reserve and throughout the crisis the importance of price stability was emphasized. Also, as Figure 2 shows, the monetary base expansion did not have impact on broader money aggregates (M1, M2). However, there are several reasons to think that the unconventional monetary policies might affect the anchorage of the long-run inflations expectations. First, expansion of monetary base can encourage doubts

about the central bank's capacity to absorb the excessive liquidity once the crisis is overcome. Second, without explicit announcement of future tax increase or expenditure reduction, agents might expect the growing public debt to be monetized. Also, the central banks' purchases of risky assets moved some risk onto them. Possible credit losses would diminish the Treasury budget and could encourage some political pressure. The independence of the Federal Reserve might be threatened. These concerns have become even stronger since the Fed started Quantitative Easing 2 (QE2).

**Figure 2: M2, M1 and monetary base in the US**




The reminder of the paper is organized as follows. In the following section I describe the unconventional monetary policies implemented in the United States during the 2007-2010 crisis. In section 3 I discuss their effectiveness. The impact of unconventional monetary polices on long-term inflation expectations is presented in section 4. Section 5 concludes.

## 8.2. UNCONVENTIONAL MONETARY POLICIES IN THE US DURING THE 2007-2010 CRISIS

Unconventional policies implemented by the Federal Reserve during the 2007-2010 crisis can be classified into five categories: interest rates commitment, long-term Treasury bonds purchases, agency debt and MBS purchases, liquidity facilities and rescue operations.

### 8.2.1. Interest Rates Commitment

Under this class we consider statements through which the Federal Reserve impact the expectation of the future federal funds rates. The economic situation after the Lehman Brothers collapse was constantly worsening. Therefore, on December 16, 2008 the FOMC cut the fed funds rate by three quarters of percentage point to 0.25%. This news surprised the markets as most participants expected the half percentage cut. However, the FOMC statement released after that meeting contained other surprising information. The release stated that "the Committee anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time". On March 18, 2009 the FOMC made a stronger pledge announcing that the exceptionally low levels of fed funds rate would be maintained "for an extended period" rather then "for some time". In this way, the Fed communicated to markets its commitment to lower the path for future interest rates and therefore reduced long-term interest rates. Expectations management has been proven effective in lowering long-term interest rates during the deflation period in Japan (Ugai 2007). In fact, according to New Keynesian models this kind of policy should stimulate the aggregate demand even in the zero-bound environment as the current demand depends not only on the current interest rate but also on the future expected short-term rates and expected inflation.

### 8.2.2. Long-term Treasury Bonds Purchases

Another tool at the disposal of the central bank when the interest rates are close to zero is the outright purchase of long-term government securities. The effectiveness of this policy is based on the "portfolio rebalancing effect". By purchasing long-term securities, the central bank changes the composition of the portfolio of securities left in hands of private sector and therefore affects their yields.

On December 16, 2008 the Federal Reserve announced that they were "evaluating the potential benefits of purchasing longer-term Treasury securities". On January 28, 2009 they indicated that they were "prepared to purchase longer-term Treasury securities if evolving circumstances indicate that such transactions would be particularly effective in improving conditions in private credit markets". On March 16, 2009 the FOMC decided to purchase up to 300 billion dollars of longer-term Treasury securities over the following six months. This was the first time the Fed tried to change the relative supply of the long-term Treasury bonds since the "Operation Twist" in 1961.

Purchases of long-term bonds ended in October 2009 but were resumed the next year. On August 10, 2010 the Fed announced that they would reinvest principal payments from agency debt and agency mortgage-backed securities into longer-

term Treasury securities. In addition to this reinvestment which represented from $250 to $300 billion, the Fed announced on November 3, 2010 that they would buy $600 billion of longer-term Treasury securities. This second round of Treasury bonds purchases was called Quantitative Easing 2.

### 8.2.3. Agency Debt and MBS Purchases

In addition to longer-term Treasury bonds, the Fed purchased also Fannie Mae and Freddie Mac debt and mortgage-backed securities. Fannie Mae and Freddie Mac operated since 1968 as government sponsored enterprises (GSE). Their principal activity consisted in expanding the secondary market in mortgages. They were both privately owned but benefited from the "implicit" government guarantees which insured them favorable interest rates. In July 2008 Freddie Mac and Fannie Mae faced serious problems in meeting their obligations as the US housing crisis worsened. In response to that, on Sunday July 13, 2008 the Secretary of the Treasury announced that the US government would provide the backstop to GSE. On September 7, 2008 the Federal Housing Finance Agency (FHFA) had put Fannie Mae and Freddie Mac under its conservatorship. Since the GSE were effectively nationalized, their debt and MBS became close to Treasuries in terms of risk profile[2].

### 8.2.4. Liquidity Facilities

Since the beginning of the crisis, the Fed established several liquidity facilities in order to restore the normal functioning of money markets. In December 2007, they introduced the Term Auction Facility (TAF) designed to auction term discount window loans to depository institutions. After the collapse of Bear Stearns, in March 2008 two facilities for primary dealers were launched: the Term Securities Lending Facility (TSLF) providing term loans of Treasury securities, and the Primary Dealer Credit Facility (PDCF) providing discount window loans. The failure of Lehman Brothers was followed by creation in September 2008 of the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) designed to support money market funds and the market for ABCP. In October 2010, the Fed established the Money Market Investor Funding Facility (MMIFF) designed to provide liquidity to US money market investors, and the Commercial Paper Funding Facility (CPFF) providing a liquidity backstop to US issuers of commercial paper. Finally, in March 2009 in cooperation with the Treasury the Fed launched the Term Asset-Backed Securities Loan Facility (TALF) intended to revive the market for ABS.

[2] There exists an additional prepayment risk linked to MBS.

The additional funding sources were meant to encourage banks and non-banking institutions to lend more funds to each other and to bring down the borrowing costs. With the central bank liquidity at their disposal, the financial institutions have smaller incentive to hoard liquidity for precautionary reasons as they know they would be able to meet the unanticipated liquidity needs. On the other hand, the facilities should also bring down the default risk as the institutions' counterparties would also benefit from the access to Fed's liquidity backstop.

### 8.2.5. Federal Reserve's Rescue Operations

During the crisis, the Fed rescued several financial institutions. Section 13(3) of the Federal Reserve Act allows the Fed to extend credit through discounts in "unusual and exigent circumstances" when a borrower is "unable to secure adequate credit accommodations from other banking institutions." The main beneficiaries were Bear Stearns and AIG but can be included in this category also the loans granted to Fannie Mae and Freddie Mac and the conversion of Morgan Stanley and Goldman Sachs into traditional bank holding companies.

## 8.3. EFFECTIVENESS OF UNCONVENTIONAL MONETARY POLICIES

There exists an extensive literature which evaluates the effects of unconventional monetary policies but the empirical evidence on this subject is yet not conclusive. Before the 2007-2010 crisis, Bernanke, Reinhart and Sack (2004) analyzed the effectiveness of different unconventional monetary tools in lowering the long-term interest rates in the United States and in Japan. In the United States they consider the announcement of "debt buybacks" that followed the emergence of budget surpluses in the late 1990s, the massive foreign official purchases of Treasury securities during the period of Japan's exchange-rate interventions and the "deflation scare" episode of 2003. They also evaluate the zero interest rate policy and the quantitative easing policy in Japan. Their empirical evidence confirms to the large extent the effectiveness of non-standard policies in lowering long-term interest rates in the United States. However, the impact of unconventional policies implemented by the Bank of Japan is more ambiguous. Ugai (2007) surveyed the empirical analyses which examine the effects of the unconventional monetary policies implemented in Japan during the deflation period. According to the studies surveyed, the commitment effect lowers considerably the long-term interest rates but the expansion in monetary base and the change in the composition of the central bank balance sheet were found to have little impact or none at all.

During the recent economic crisis unconventional monetary policies were extensively implemented by many central banks. Since then, several descriptive (Borio and Disyatat (2009), Meier (2009)) and theoretical (Adrian and Shin (2010), Cùrdia and Woodford (2010), Gertler and Karadi (2011)) studies contributed to the better comprehension of non-standard monetary policies. The empirical research focused on their impact on the reduction of interbank risk premia and the reduction of long-term interest rates.

### 8.3.1. Libor-OIS Spread

Some of the unconventional monetary policies were designed to ease the tensions on interbank market that appeared in August 2007 and intensified after the collapse of Lehman Brothers. Indeed, the generalized uncertainty concerning the health of banks' balance sheet made the banks unwilling to lend to each other. As a consequence, the Libor-OIS spread which is considered as a barometer of interbank market distress widened significantly[3]. This dramatic increase in the spread (Figure 3) demonstrated that monetary policy lost its influence on interbank credit conditions. To address this issue, the Fed implemented new liquidity facilities.

**Figure 3: 3-month Libor-OIS spread (%)**


[3] The London interbank offered rate (Libor), is an average interbank borrowing rate published daily by the British Bankers' Association (BBA). The overnight-indexed swap (OIS) rate represents market expectations of the funds rate over the future months. There is no exchange of principal and only the net difference in interest rates is paid at maturity, so there is very little default risk in the OIS market.

There is a discussion in the recent literature concerning the effects of new liquidity facilities on the Libor-OIS spread. Taylor and Williams (2009) claim the liquidity facilities like TAF (Term Auction Facility) cannot have an impact on the Libor-OIS spread because it is mostly due to credit risk and not the liquidity risk. On the other hand, Wu (2008) maintains that the spread was caused by the misallocation of liquidity and that the financial strains in the interbank money market were alleviated after TAF was implemented. Aït-Sahalia *et al.* (2009) consider all macroeconomic and financial sector policy announcements in the United States, the United Kingdom, the euro area and Japan and find that both macroeconomic and financial sector policy announcements were associated with reductions in the Libor-OIS spreads.

In Szczerbowicz (2011) I also consider the impact of all policy announcements but take a different approach: regression-based event study, which allows to estimate the effect of all policies simultaneously. First, I identify and classify unconventional monetary announcements made in the United States during the crisis into five categories: interest rates commitment, long-term Treasury bonds purchases, Agency debt and MBS purchases, liquidity facilities and the Federal Reserve's rescue operations (as described in section 2). Then, I use the regression-based event study methodology to assess the impact of each type of policy on the Libor-OIS spread. Under market rationality assumption, the effect of the policy announcements should be reflected in asset prices over a short time period (two days[4]). I rely on dummy variables to discriminate between days with or without announcement. In line with the previous literature (Kuttner 2001) the financial markets are assumed to react only to the announcements that were not fully anticipated. The surprise component of dummy variables is defined based on information included in specialized articles in Wall Street Journal and Reuters before and after the event.

I find that announcements related to TAF do not affect the Libor-OIS spread but those related to other liquidity facilities (TSLF, PDCF, AMLF, CPFF, MMIFF, AMLF) reduce the spread by 9 basis points. The facilities associated with a reduction in counter-party risk seem to have bigger impact on the OIS-Libor spread than measures aimed just at providing liquidity.

### 8.3.2. Long-Term Interest Rates

When the official rate is close to zero, the central bank can still stimulate the economy by reducing long-term interest rates. Long-term rates are the fundamen-

[4] There is a timing issue related to using this measure in the event study. The Libor rate is published at 06:00 Eastern Time while the OIS rate is taken from Datastream and the last update is from 14:15 Eastern Time. In order to ensure that the markets had the possibility to incorporate the announcements I considered 2-day event window.

tal variable from the economic and financial point of view. They have an important effect on durable goods expenditures, especially business investment. From the finance perspective they are crucial determinants of mortgage prices, derivatives and other long-term financial assets. Therefore, the goal of some of unconventional policies was not to lower short-term rates but to influence long-term interest rates. In particular, purchases of longer-term Treasury bonds and agency securities directly aimed at diminishing long-term yields[5].

The impact of the Fed's long-term debt purchases within Quantitative Easing 1 (QE1) on long-term interest rates was analyzed by Hamilton and Wu (2010) and Gagnon *et al.* (2010). They found that QE1 indeed lowered nominal long-term interest rates. In Szczerbowicz (2011) I contribute to the discussion on the effectiveness of this unconventional policy via regression-based event study. In addition to studying the effects of QE1, I also measure the impact of Quantitative Easing 2 (QE2) and other unconventional monetary policies discussed in section 2. As previously described, the effect of each policy is captured around relevant monetary policy announcements over short period of time (1 day). As Hamilton and Wu (2010) and Gagnon *et al.* (2010) I find that QE1 reduced long-term interest rates. Indeed, the purchases of longer-term Treasuries lowered the ten-year interest rates by 22 basis points and the purchases of long-term Agency debt and MBS reduced it by 17 basis points. Nevertheless, I find evidence that unlike QE1, QE2 did not significantly lowered nominal long-term rates.

Interest rates commitment is another unconventional monetary policy that was intended to lower long-term interest rates. In December 2008, the FOMC's stated that it would maintain the federal funds rate at "exceptionally low levels" for "extended period of time". The expectation theory says that long-term interest rates equal an average of current and expected future short-term interest rates. Therefore, the Fed's commitment to lower the path for future interest rates was supposed to reduce long-term interest rates. Empirical analyses on the Japanese experience during the deflation period show that this kind of "expectation management" strategy was effective[6]. However, Gagnon *et al.* (2010) and Szczerbowicz (2011) find that signaling a commitment to keep policy rates low for an "extended period of time" did not contribute to reducing long-term interest rates in the United States during the 2007-2010 crisis.

[5] Chairman Ben Bernanke stated in his speech on December 1, 2008 that the Fed's purchases of longer-term Treasury or agency securities on the open market "might influence the yields on these securities, thus helping to spur aggregate demand." BERNANKE, 2008.

[6] UGAI, 2007 and BERNANKE, REINHART and SACK, 2004.

## 8.4. UNCONVENTIONAL MONETARY POLICIES AND LONG-TERM INFLATION EXPECTATIONS

While the impact of alternative monetary policies on money market distress and long-term interest rates was largely discussed in the previous literature, their effect on long-run inflation expectations is still poorly known. As we mentioned earlier, some of the Fed's unconventional measures were perceived as inflationary by the markets. The liquidity facilities were intended to be short-term but there was still inflationary risk related to them. The markets feared that the huge amounts of liquidity put on the markets could not be easily absorbed once the crisis would be over. The risk linked to longer-term Treasuries purchases was twofold. They were followed by an important expansion of the overall size of the Fed's balance sheet and they changed the maturity structure of the Treasury debt held by the Fed. By preferring the longer-term debt, the Fed took some risk on its balance sheet as the price of long-term bonds fluctuates with time. The outright purchases of agency debt and MBS and lending directly to specific financial institutions (Bear Stearns or AIG) were also perceived as risky. These assets were meant to stay on the Fed's balance sheet for long time[7]. Market participants were worried that the Fed would not be able to sell them at the desired price. The eventual Fed's losses would be covered either with the help of the Treasury (donation of Treasuries for example) or by printing money if the cooperation of Treasury would not be possible. The Fed's losses would also have consequences on the Treasury's budget and might incite the government and the Congress to make pressures on the Fed, which in turn could compromise the Fed's independence and credibility.

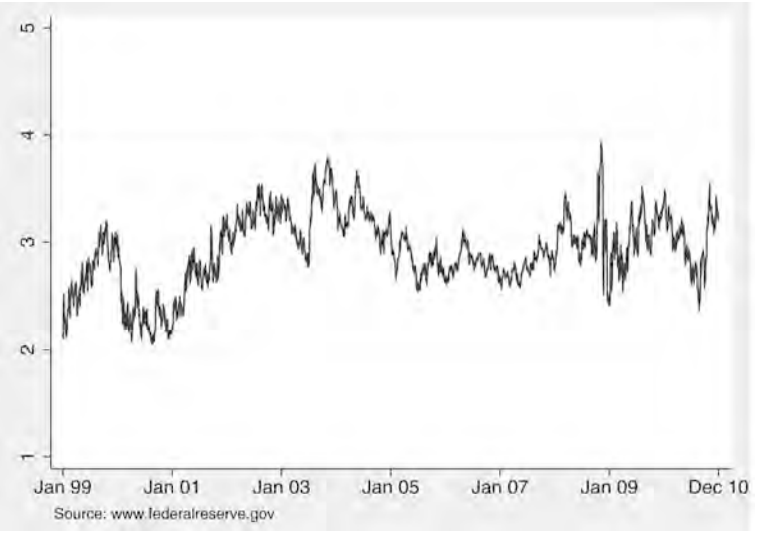
In order to measure the inflationary impact of the unconventional monetary policies described in section 2 I test the response of long-term inflation expectations over short periods surrounding unconventional monetary announcements (Szczerbowicz (2011)). Following Gürkaynak, Levin and Swanson (2010) I use the measure of inflation expectations extracted from financial markets, and in particular the daily data on forward inflation compensation from 9 to 10 years ahead. Inflation compensation rates are obtained by comparing nominal bonds yields to inflation-linked bonds (break-even inflation rates). The one-year far-ahead forward rates provide cleaner indication of long-horizon inflation expectations as they filter out the effects of short-term expectations[8]. Figure 4 shows 1-year forward inflation compensation from 9 to 10 years ahead. The series has been changing over time and became particularly volatile in autumn 2008. In the beginning of 2009 it returns to its usual volatility. In January 2010 it starts declin-

[7] BERNANKE, 2010.

[8] Break-even inflation rates also incorporate liquidity and inflation premia. See SZCZERBOWICZ, 2011, for detailed explanation on why this measure is still informative about long-term inflation expectations during the crisis.

ing but the trend reverses in August 2010 which coincides with the beginning of Quantitative Easing 2.

**Figure 4: 1-year inflation compensation ending in 10 years (%)**




As in the case of Libor-OIS spread and long-term nominal rates I employ the regression-based event study to measure the effects of unconventional monetary measures on long-term inflation expectations. It results that news related to Fed's rescue operations increases far-ahead forward inflation compensation by 5 basis points. Purchases of longer-term Treasury bonds within QE2 raise long-term inflation expectations by 6 basis points. However, announcements related to QE1 and other unconventional monetary policies do not have significant impact on long-term inflation compensation.

## 8.5. CONCLUSIONS

The implementation of unconventional monetary policies required the huge expansion of the Federal Reserve's balance sheet and the change of its composition. These policies proved effective in many ways. The liquidity facilities, especially those associated with the reduction of counter-party risk, helped reduce strains on the interbank markets. Purchasing long-term Treasury debt and Agency debt and MBS within Quantitative Easing 1 lowered long-term nominal interest rates. However, the second round of quantitative easing (QE2) did not have the same effect. Also, the interest rates commitment was not found to have lowering impact on long-term interest rates.

Furthermore, the Fed's rescue operations and Quantitative Easing 2 raised long-term inflation expectations. This result provides evidence that QE1 and QE2 had different effects: QE1 lowered nominal long-term interest rates without affecting long-term inflation expectations while QE2 raised long-term inflation expectations and did not reduce nominal long-term interest rates. However, QE2 was also effective in stimulating the economy. By raising long-term inflation expectations without raising long-term nominal rates it put downward pressure on long-term real interest rates which are more relevant for spurring the aggregate demand.

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