NATIONAL BANK OF THE REPUBLIC OF MACEDONIA

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Central Banking Under Prolonged Global Uncertainty: The Latest Lessons While Searching for the "New Normal"

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Foreword

On April 5-6, 2017, the National Bank of the Republic of Macedonia organized the 6-th Annual Research Conference entitled: Central Banking Under Prolonged Global Uncertainty: The Latest Lessons While Searching for the "New Normal". This conference is traditionally organized on the occasion of the anniversary of the monetary independence of the Republic of Macedonia, thus specifically in 2017 to mark the 25-year jubilee. The 6-th Annual conference started with a keynote lecture and a panel of the distinguished speakers of the international organizations, Central Banks and academic institutions on the main conference topic. In addition, high quality papers were presented, received upon Call for papers sent to the Central banks in the region. This booklet incorporates some of the papers presented at the conference, as well as the official speech of the Governor of the National Bank of the Republic of Macedonia.

Launching this booklet, we would like to express our gratitude to the esteemed Governors, representatives of the Government, representatives of the international institutions, all presenters, the discussants, the moderators of the conference sessions, as well as to all other participants, all of them adding value to the success of the conference.

National Bank of the Republic of Macedonia

Honorable Minister of Finance, Your Excellences,

Dear representatives of central banks,

Ladies and gentlemen,

It's my great pleasure to welcome you again to our regular Annual Research conference that is traditionally organized to mark the anniversary of the country's monetary independence. As you already know, on April 26 this year, we celebrate the 25-year jubilee of the monetary independence and the Conference will label this jubilee more specifically with the discussion within the introductory high-level policy panel. We are especially honored that this jubilee year, our Conference is organized as a joint event with the London School of Economics - Research on South Eastern Europe that I believe will contribute to enlarging the discussion issues valid for the region and beyond. In light of the Conference topic and our jubilee, I will just briefly mention some important issues that I believe will be discussed in more details during the high-level policy panel and the next two days.

One could find the title of this year's Conference highly descriptive for the current global macroeconomic environment. Central banks still operate under prolonged global uncertainty, trying to define and move towards the "new normal" while recognizing and implementing the latest lessons arising from the global crisis. During this crisis period, we all passed through a relatively long process of correcting the shortcomings from the past, learning new experiences and strengthening capacities to better cope with the future challenges. While global economy is gradually recovering, it still faces uncertainty, although of different nature. The world attention is now focused on the rising probability of entering into a new protectionism era, the implication of Brexit and the growing EU skepticism as well as the geopolitical risks that are still present. The general economic debate brings to the fore implications of these risks for the global economic recovery and, as far as the first issue is concerned, it is predominantly against trade barriers worldwide. The expansion of global trade significantly contributed to the global economic growth prior to the global crisis. At the same time, the principle of free movement of people, goods and services, capital and payments is one of the main pillars of the EU and so far, it has contributed to boosting EU economy. Speaking about the EU, it seems to be in a specific stage of reinventing itself. In general, without going into details, the world is obviously on a crossroad - a phase where both stronger internal consolidation and international cooperation are more than needed.

Regarding policy setup, the subdued inflation due to low commodity prices and the accompanying easing cycle of the monetary policy in the developed economies ended or have been approaching the end. While the US economy seems to be close to its "new normal", for the EU economy it will probably happen a bit later. This would mean a return to monetary policy normalization and upward shift of the yield curves. Although the situation could differ across countries, the bottom line is that the world economy used to live under low interest rates for relatively long period of time that is over or close to an end. Monetary policy supported the economic recovery under very specific circumstances, however sustainable economic growth must be grounded on profound structural reforms. Therefore, the policymakers need to be bold in implementing reforms focused on flexible labor markets, higher productivity, stronger competition and innovation. This would be a task not only for developing, but also for developed economies, although at different initial position. The "bell is ringing" also for the fiscal policy, which in many countries has become quite comfortable in low interest rates environment. It also needs to prepare for tightening of financial conditions that will make fiscal consolidation more challenging.

In the financial system, the regulatory authorities across the world are facing challenges arising of new capital requirements under Basel III, aimed at preserving the soundness and stability of the banking system not only in normal times, but also in times of stress. In Macedonia, we have just launched this new package of regulation and are looking for its smooth implementation, considering the already strong capital position of the banking system. In the age of globalization, and digital technologies entering into financial services, there are growing challenges for the regulatory authorities. One of the lessons of the last global crisis is that the development of the financial system must go hand in hand with the establishment of proper risk mitigation and crisis management mechanisms.

Such a dynamic and complex surrounding is even more challenging for the emerging economies that are undergoing structural reforms, which are key precondition for faster convergence towards higher income levels. Now, when we celebrate 25 years of monetary independence in Macedonia, we can say that we have experienced different situations, we dealt with couple of shocks – both internal and external, we learned a lot - from the others and from ourselves, we accomplished many goals and finally, realized that we need to work even harder to perform better in the future. I would also briefly mention that at the beginning of transition, we faced with hyperinflation, low foreign reserves, macroeconomic imbalances, need of restructuring of banks and companies, and additionally, unilateral embargo by one neighboring country. We are proud to say that in the last twenty years, we have managed to maintain price stability with impressive 2% average inflation and stable exchange rate as well as sound banking system that survived many "real time stress tests". While trying to protect the economy in the booming stage prior to the global crisis, we experienced the opposite situation – we provided monetary stimulus to the economic recovery after the impact of the global crisis, by using both conventional and unconventional measures. We believe the monetary policy was and will continue to be a reliable counterpart of the macroeconomic policy mix in the country, contributing to maintenance of the overall macroeconomic stability. This environment proved to be supportive to the structural reforms implementation which in the last years provided visible results through changing the economic structure into production and export of higher value added products and continuous reduction in the unemployment rate, even during the global crisis. It is extremely important to mention that all these years, the National Bank of the Republic of Macedonia has been continuously strengthening its institutional capacity in all areas of operation, as a main precondition for facing new and different tasks arising from the above described global environment.

The transition process was a process of learning about market principles and simultaneously implementing them in practice. I believe that all countries that have been going through this process have experienced successful and less successful, satisfactory, not satisfactory, and undergoing reforms. Many years after the start of transition, it is useful to look back and consider the overall progress, to separate areas where the transition is over or close to an end, and others, where transition is lagging behind. We need to face the current standpoint and to speed up reforms in the future.

Apparently, there are many and different issues related to the transition, especially in light of the changing global economy. However, I would stop here and leave the stage for discussion within the high-level policy panel.

It is my great honor that today we have a distinguished key lecturer to introduce the topic of the panel devoted to the transition process of the region – that is Mr. Poul Thomsen, Director of the European Department at the IMF and the first Mission Chief for Macedonia, back in 1993, who provided valuable support in coping with different shocks that our economy faced at the onset of the transition. Other participants of the panel are: Mr. Peter Sanfey, Deputy Director for Economics, Policy and Governance, European Bank for Reconstruction and Development, who is highly involved in the activities of the EBRD in the region, and professor Vassilis Monastiriotis from LSE, Research Unit on South Eastern Europe (I will also join them in the discussion). Moderator of the panel will be Mr. Gligor Bishev, former Deputy Governor of the NBRM and one of the main counterparties of Mr. Thomsen back in 1993.

It is also my great pleasure that our Minister of Finance, Kiril Minoski has joined us today. I will first invite the Minister of Finance to take the floor with his opening remarks on the occasion of the 25th anniversary, and then Mr. Thomsen with his keynote presentation. At the same time, allow me to express our deep gratitude for their presence today.

At the end, let me just wish you fruitful and interesting discussion during the Conference and pleasant stay in Skopje.

Thank you!

Dimitar Bogov, *Governor of the National Bank of the Republic of Macedonia*

5 April 2017, Skopje

UDK ???????

HAS THE CRISIS CHANGED THE MONETARY TRANSMISSION MECHANISM IN ALBANIA? AN APPLICATION OF KERNEL DENSITY ESTIMATION TECHNIQUE.

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(Draft)

Abstract

The post crisis period in Albanian economy has been distinguished by low inflation and slow economic growth. In response to negative inflation and output gaps Bank of Albania has persistently reduced its policy rate to support economic activity and bring inflation to its objective. Despite credit and aggregate demand growth are lagging. The transmission mechanism seems to have lost some of its efficiency. This paper investigates the hypothesis that the relationship among interest rate, money and inflation has changed in the post crisis period (the case of Albania). Density estimation techniques based on Tanku and Ceca (2013), is used as an alternative method of empiric investigation within the probability framework. Two dimensional densities of inflation, money and interest rates are estimated for two different periods. The PDF and CDF of the estimated densities are reported graphically and are used to test whether pre-crisis and post-crisis datasets arise from the same distribution. The comparison of probability spaces is based on the two-dimensional Kolmogorov-Smirnov (K-S) test. We conclude that the relationship between interest rate and inflation, and interest rate and money has changed in the post-crisis period. These findings have important implications for the conduct of monetary policy in Albania.

Key Words: Monetary policy regime switch, kernel density estimation, probability density function, probability space, two dimensional KS test.

JEL: B41, C18, C51, E52

1. INTRODUCTION

The post 2008 period has marked significant changes in the economic performance in terms of growth, inflation, and credit developments in Albanian economy. Following the demise of absorption growth model, the post crisis period in has been distinguished by low inflation and slow economic growth, leading to persistent negative inflation and output gaps. In response to these developments Bank of Albania has pursued an expansionary monetary policy to support economic activity and bring inflation to its objective. Starting from 2010 the policy rate has been reduced persistently from 6.25 to the historically low level of 1.25.

The reduction of the policy rate has been fully transmitted to interest rates of all maturities and across the range of financial instruments. Despite this reduction in interest rates the response of credit growth has been sluggish. Credit in domestic currency is growing but rather than contributing to overall credit growth, its growth is substituting for the decrease of credit in foreign currency. Investments and aggregate demand has responded positively but less vigorously than expected. Prices and economic growth remain below their average pre-crisis level. On the other hand, banks' time deposits are flocking toward the extreme ends of the maturity spectrum rather than flowing to consumption or investments. The transmission mechanism seems to have shifted all together into a new regime of efficiency relative to the pre-crisis period.

This paper takes note of these developments and asks whether the post-crisis period has altered the transmission mechanism of monetary policy in Albania. The main hypothesis is that the relationship among interest rate, money and inflation has changed in the post crisis period. Empirical investigation is based on a new method based on multidimensional density estimation proposed by Tanku and Ceca (2013). Essentially two dimensional densities of inflation, money and interest rates are estimated using multidimensional estimation techniques for two different periods. The PDF and CDF of the estimated densities are reported graphically and are used to test whether pre-crisis and post-crisis datasets arise from the same distribution. The comparison of probability spaces is based on the two-dimensional Kolmogorov-Smirnov (K-S) test. We find that with the exception of money-inflation relationship the crisis has induced a change in the rest of transmission mechanism, respectively relationships between policy rate and inflation and policy rate and money.

There is significant interest in empiric investigation to transmission mechanism from academic and policy making point of view. Therefore, the study of transmission mechanism has along and broad history and involves research for developed and developing economies. In the context of Central and South Eastern European economies research in this area has preceded the introduction of indirect instruments of monetary management or the change of monetary regime in transition economies. The topic of monetary policy transmission mechanism and its regime change is covered by very prominent authors, using the entire range of available empiric research methodologies from pure observation, to time series analysis based on VAR-s SVAR-s, BVAR-s, Cointegration, VECM and sophisticated DSGE platforms (models). As usual the analysis is based on estimated coefficients, IRF and similar shock analysis.

There are also a significant number of studies conducted in the context of transition economies, including the economies of South-East Europe (SEE). The most recent among them is Koukouritakis, Papadopulos and Yannoupoulos (2014) which revisits the transmission mechanism of SEE economies. This study benefits from the unit root and cointegration tests that can adjust for structural breaks, which are necessary to accommodate potential regime shifts introduced by the process of EU memberships or monetary regime changes. In similar fashion monetary transmission mechanism has been studied in Albania, first to discuss the shift of monetary policy from monetary targeting to inflation targeting regime, and second to perfect the modeling for monetary policy forecast and analysis purposes. They are all based on the above mentioned methodologies and try to depict exactly the potential changes in the transmission mechanism.[1]

Such empiric models are well established and broadly accepted; yet, past and recent practice (eg. Bank of England 1999) suggests that from the point of view of understanding economic developments and

[1] For a list of Albanian Studies please see: Kolasi, Shijaku and Shtylla (2009), Shijaku G. (2016), Dushku and Kota (2011)

decision making, the imposition of a framework of specific channels through which monetary policy works may be too restrictive. Therefore, regardless of the technique employed and in estimation, it is important to have full understanding of the implications of such limitation in the interpreted of econometric results. This critique remains very relevant and deserves due attention from academics and policymakers.

The study of monetary transmission mechanism regime changes in US represents a very good example that beautifully illustrates the limitations indicated by the critique above. The US monetary transmission mechanism has a long history of empiric research and represents one of the leading sources for the development of different empiric investigation strategies. A brief review of this research shows that it is not easy to reach a firm and clear conclusion on the identification of monetary policy regime changes. Studies conclude with contradicting results. On one hand, we have DeLong (1997), Taylor (1997), Sargent (1999), Clarida, Gali and Gertler (2000), and Lubik and Schoorfheide (2004), who conclude that policy changes are responsible for economic outcome. In other words, they observe a change in the estimated parameters of the econometric models. On the other hand, a larger group of authors reject the conclusion that monetary policy has changed drastically. Among them, Bernanke and Mihov (1998), Leeper and Zha (2003), Stock and Watson (2002) and Orphanides (2004) find little evidence against stable coefficients suggesting only modest changes in monetary policy and monetary policy rules used in the 25-30 years preceding the 2008 crisis. Likewise Sims (2001) and Sims and Tao Zha (2006) suggest that changes in observed data are caused by changes in the variance of exogenous shocks rather changes in relationships.

It is therefore not easy to dismiss the fact that: assumption of structural relationship, endogeneity status among variables, the choice of functional form, along with data availability and the employed empiric methodology, can affect the results and the conclusion of the study. This is also observed by Canova and Gambetti (2010, pp.184) who remark that "the division appears to be linked, in part, to the type of empirical analysis conducted".

We believe that the method of density estimation, proposed by Tanku and Ceca (2013), provides an advantage compared to traditional methods described above. The traditional framework takes a stochastic event "adopts" the data to empirical method, imposes particular functional form and model identification structure, estimates the system via empiric techniques and finally compares the estimated coefficients and IRF assuming that the results carry over to the stochastic model. Alternatively we propose to estimate the probability mass in two dimensional spaces (by using density estimation techniques) and, after that, to compare those probability masses using Kolmogorv-Smirnov techniques. In this respect, density estimation does not introduce or force any structure in the model and data. Most importantly, the comparison is based on the estimation and comparison of the probability model rather than the estimated coefficients and/or IRF.

In line with the above discussion next section introduces briefly the economy as a random event, the rest of the paper is organized as follows section three describes density estimation methodology and the KS test vs. traditional methodology; section four discusses research plan, data and methodology; section five presents and discusses results, and section six concludes.

2. THE ECONOMY AS A RANDOM EVENT – METHODOLOGICAL ISSUES

This section gives a general description of theoretical background, the main concepts and definitions that are considered in in the adaption of density estimations techniques.

2.1 The probability approach in economics

Economic behavior and economic developments fit very well the characteristics of random events. As such it must be studied or fitted by stochastic models that are able to replicate this stochastic environment. Haavelmo (1944) formalized and present the economic phenomena in the form of a probability model. In his view, the economy is represented by a multi-dimensional, set of

variables $x^1,x^2,\ldots,x^d$. A particular set of valuesthat corresponds to a particular moment in time *"t"*, where $(x_t)= (x_t^1,x_t^2,\ldots,x_t^d)$, is represented by a point (entry) in d-dimensional Cartesian space. There are altogether t such point entries in this d dimensional space, forming a set S in the same space. Haavelmo (1944) observes that if one can identify a system of rules or operators ζ which define a subset S' of all these points, than she/he can define the entire set of points by the property of belonging to S' or not belonging to S'. This rule ζ defines the function $F(x)$:

$$F(x)=f(x_t^1, x_t^2, \ldots, x_t^d), \qquad 2.1.$$

which represents the "model" that generates the particular S' in this d dimensional time series. Building upon this representation of the random economic process, the assumed presence of more than one system of rules or operators leads to the generalization below:

$$F(x) = f^{i_1}\left(x_t^{i_k}\right) \otimes f^{i_2}\left(x_t^{i_l}\right) \otimes \cdots \otimes f^{i_m}\left(x_t^{i_m}\right), \qquad 2.1.1.$$

where $i_k \neq i_l$, for $k \neq l$ *and* $m \leq d$; $k,l \in \{1,2,\ldots,m\}$ and $f^{i_k}, f^{i_l}, \ldots, f^{i_m}$ are subsets of S, that cover the entire set S.

Expression 2.1.1. represents the "model" that generates the entire space S spanned by this d dimensional random event. Therefore the economy can be defined and expressed in terms of function $F(x)$ which represents a joint set of rules or operators ζ that satisfies equation 2.1.1 for the entire space S.

Function $F(x)$ in 2.1.1 above is comprised of m $(m \leq d)$ different sets of rules or operators ζ denoted ζ_m, that span the entire space S.[2] Functions f_j^i in the 2.1.1. The identification of all m functions in the d dimensional space as defined by 2.1.1 provides the exact model of the natural process that generates a particular set of data[3]. Haavlemo (1944) points out that the deterministic solution of model 2.1.1, "would not absolutely cover every single x_t in the d dimensional Cartesian space". Therefore this probabilistic nature of the economy requires to split the information given by 2.1.1, into two parts: *one* containing "restrictions which form the theoretic model or general fundamental laws" and *two* "the disturbances or the stochastic part".

2.2 Portraying economy as a random multidimensional event.

Economist study the economic phenomenon using the observed set of economic data that is created by some unobserved data generating process (DGP). The economy as a random phenomenon, is also discussed by Hendry and Richard (1983) and Ericsson, Hendry and Mizon (1998). These authors define the data generating process (DGP) in the form of a probability space $[\Omega, \mathcal{F}, P(\cdot)]$, and express it in the form of a joint density function of the initial conditions or vector X_0 initial conditions for all observed economic variables, a vector of parameters ζ, and all the subsequent vectors x_t (realizations of economic variables at time *t*) for all $t \in (1,2,\cdots t-1)$ as follows:

$$D_X(X_T|X_0,\zeta) = \prod_{t=1}^{T} D_x(x_t|X_{t-1},\zeta_t) \qquad 2.2.$$

Here X_{t-1} represents the stochastic process $(X_0, x_1, \ldots x_{t-1})$ and ζ_t representing a subset of the parameters set $\zeta = (\zeta_1, \ldots \zeta_T)$. The subset of parameters is the mechanism that relates all random variables together. It is not known to the researcher or the policy making authoritiy and therefore it is the focus of the empiric research. The estimation of the parameters is necessary for forecasts and policy analysis and renders this probabilistic representation of the economy useful to authorities. The empirical model takes the form:

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[2] Index *m* stands to denote the number of models, restrictions or functions *f(x)* in the *d*-dimensional space *S*.

[3] Hendry and Richard (1983) call this natural process "the data generating process *(DGP)*".

$$f_x(X_T^1|X_0,\theta) = \prod_{t=1}^{T} f_x(x_t|X_{t-1},\theta) \qquad 2.3.$$

This is the framework that supports the empiric analysis of time series and dynamic stochastic models, including the works of Sims (1980) and its later developments with SVAR, BVAR, VECM and the development of the DSGE models. It relies in the decomposition of the joint probability into a conditional probability and marginal probability for each $t \in T$ repeating the process until we reach t_0 as in eq. 2.3, above. The solution comes in the form of set of estimated parameters that depict the relationships among the present and past values of the variables of interest (part one of 2.1.1), and a set of i.i.d. vectors of errors (part two of 2.1.1), which accounts for the errors of estimation and "fits" the model to the stochastic real world.

Following this setup, current econometric analysis requires that the researcher formulates a hypothesis for the supposed economic model 2.3., (and its functional form) which is accepted or rejected in the basis of statistical tests. The estimation of the parameters requires several additional assumptions; several long and short term restrictions of assumed theoretic relationships and identification are required to generate a uniquely identified solution imposing additional structure in the assumed data generating process[4]. Finally, the estimation requires the correct indentification of the endogeneity status among variables.

Given this complicated and imposing nature of assumptions and their potential negative implications in the estimation and representation of DGP, Tanku and Ceca (2013) propose an alternative methodology that goes back to the original Haavelmo's description of the random process. The objective is to use kernel density estimation techniques to estimate the joint probability density function of the d dimensional random event and its conditional density function as method of empiric observation, investigation and representation of the true DGP. The general idea is to reformulate the DGP in terms of x^d, as a conditional process of dimensions in the form of joint density function of our d-dimensional in the following general form:

$$D_X\left(X^i; \left| f(.), X^j\right.\right) = D_x\left(x^i \left| x^j, \hat{f}(.)\right.\right) \qquad 2.4$$

where:

$i \leq d$ is the variable which density function is estimated (the variable or the set of variables of interest), j= (1,2,…i-1,i+1,…d) represents the conditioning dimensions, f(.) represents the true d-dimensional joint density function and $\hat{f}$(.) represents the estimated d-dimensional joint density function.

Alternatively the DGP could be expressed as an unconditional process in terms x^d by estimating the joint density function of our d-dimensional space spanned by the variables of interest in the following general form:

$$D_{X^d}\left(X^d, f(.)\right) = D_{x^d}\left(x^d \left| \hat{f}(.)\right.\right) \qquad 2.4.1.$$

In principle expression 2.4.1., estimates the probability of location of points x_t^i along dimensions i of the multidimensional (d-dimensional) space spanned by economic variables (as given in 2.2.1). It *provides an alternative representation of the equation 2.1.1. It also* defines the economy as a sequence of expanding spaces, within any d dimensional space generated by d different random variables. Given this framework Tanku and Ceca (2013) note that: "*each m dimensional space (where m ≤ d), represents a subspace of the entire random event. Adopting Hendry (2004) definition we will call such subspaces a local data generating process (LDGP). The resulting m dimensional LDGP represents a projection of the DGP into a lower dimensional (remember m ≤ d) space defined by the LDGP itself. This projection preserves the original DGP in the lower dimensional space identifying as much of eq. 2.1.2, as is included in the LDGP. Therefore no information is lost regardless of the particular choice of the variables that are included in LDGP.*" This very important because, Hendry (2004) shows that under current empiric methods "reduction" of the true DGP into a transformed LDGP (read: a subset of variables), can radically alter the causality and endogeneity status of the variables" (Hendry 2004, pp.3).

[4] See Juselius and Franci for a detailed discussion on the implication of the imposed theoretic restrictions and their implications.

Therefore, using the representation of the DGP in 2.4.1., one can make correct inferences about stochastic behavior of economic variable i given knowledge of the joint density function of the chosen LDGP and alternative values of conditioning variable(s) j. This is rendered possible by the estimation of joint density function of the chosen LDGP using the framework of kernel density estimation.[5] This alternative methodology yields two particular benefits. First it studies the DGP without related assumptions and the imposed theoretic structure. Practically Tanku and Ceca (2013) propose to estimate the multidimensional PDF and CDF of the LDGP of the set of variables of interest and use it to obtain information about the existence and nature of relationships among variables of LDGP. Further the comparison of different events is based on comparison of the probability spaces which are approximated by the estimation of joint probability density functions. Practical estimation of joint densities and their comparison is discussed in the following section.

3. BRIEF DESCRIPTION OF DENSITY ESTIMATION TECHNIQUES AND KOLMOGOROV SMIRONV TESTS

Density estimation technique and KS tests are well known and discussed tools in the Probability Theory. A formal description can be found in Silverman (1986) and other authors mentioned below. However, because they are the tools of empiric investigation therefore we devote a brief description of both in the following paragraphs.

3.1. Kernel Density Estimation

Probability distribution of a random variable provides the fullest information regarding this random variable – so does the probability density function. The estimation of the probability distribution (or its probability density function) is therefore fundamental purpose of theoretic and applied probability and the best way to gain full understanding of the true nature of the random event. The probability density function of a random variable X is called a nonnegative function *f(.)*, that satisfies the condition:

$$\forall a, b \in R: \ P(a < X < b) = \int_a^b f(x)dx. \qquad 3.1.$$

tanku and ceca (2013) assume that the "event" is composed of random variables with unknown probability density function f. therefore the estimation of densities focuses on the estimation *of non-parametric distributions*, In principal the estimation of f is a generalization of the histogram concept and is based on different techniques called 'density estimation techniques'[6].

Assuming the existence of a sample $x_1, x_2, \ldots, x_n$, from the random variable X, with a starting point x_0 and the bin width parameter h.[7] Then in the right-closed intervals $]x0 + mh, x0 + (m+1)h]$[8] one can build verticals equal to the absolute or relative occurrence of x_i in the same interval. The functional form of the histogram is given:

$$\hat{f}(t) = \frac{1}{nh} \cdot (nr.of\ x_i\ in\ the\ same\ interval\ with\ t) \qquad 3.2.$$

If the random variable X has the density *f(.)*, it is true that:

$$f(t) = \lim_{h \to 0} \frac{1}{2h} P(t - h < X < t + h) \qquad 3.3.$$

Then, as a natural estimator of the density *f(.)*, becomes:

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[5] An extended discussion of the density estimation of the single and multidimensional random events is provided in the following section.

[6] The density estimation theory is described in several monographs and other literature mentioned in the article.

[7] The bin width parameter h acts as a *smoothing parameter*, in the meaning that increasing the value of h suppresses the statistical noise and gradually wipes the statistical significance of the curve while, the decreasing the value of h increase the statistical noise and gradually makes unreadable the statistical significance. A discussion on the smoothing parameter h is given in the 8th chapter.

[8] The choice of x_0 may have no restrictions in the classical way of building the histogram.

$$\hat{f}(t) = \frac{1}{2nh} \cdot (nr\ of\ x_i \in]t-h, t+h[\ ) \qquad 3.4.$$

In a more formal way, the above estimator can be written:

$$\hat{f}(t) = \frac{1}{nh} \cdot \sum_{i=1}^{n} w\left(\frac{t-x_i}{h}\right), \text{ where } w(x) = \begin{cases} \frac{1}{2}, & for\ |x| < 1 \\ 0, & x\ other \end{cases} \qquad 3.5.$$

This estimator given by eq. 3.5. is known as "naive estimator" and has two main features: first, it is a direct generalization of the histogram and second (and most important) its canonical form allows the further generalization into the "kernel density estimation"[9].

Kernel estimation is a natural generalization of the expression 3.5. Assume that $K(x)$ is a density probability function, here after called *the kernel function* (or simply *Kernel*) following the terminology of "density estimation". If the function *w(x)* is substituted with kernel $K(x)$ in the expression 3.5., the general form of density kernel estimation takes the form:

$$\hat{f}(t) = \frac{1}{nh} \cdot \sum_{i=1}^{n} K\left(\frac{t-x_i}{h}\right). \qquad 3.6.$$

Methods of kernel density estimation are described in Devroye and Gyorfi (1985), Silverman (1986), Devroye (1987), Wand and Jones (1995), and Devroye and Lugosi (2000) and Silverman (1986) who describes the details of the estimation process of a density distribution.

3.2. The two-sample Kolmogorov-Smirnov test

The Kolmogorov-Smirnov (KS) test is a non-parametrical that is used to test if a continued distribution, one-dimensional, fits or not with a given distribution, or to compare two one-dimensional samples if they come from the same set or not.

In that paper we use a generalized form of KS mentioned test. It is two-dimensional KS test of goodness of fit and is given by J. A. Peacock (1983). We applied it to compare two-dimensional samples if they come from the set or not. Based on the algorithm of Peacock paper, we programed a routine in Matlab. The algorithm makes the comparison of two two-dimensional CDFs, using the statistical hypothesis testing at the confidence level of 95%.

4. RESEARCH PLAN, DATA AND METHODOLOGY

This project intends to use density estimation techniques based on Tanku and Ceca (2013), as alternative methods of empiric investigation of the monetary policy transmission mechanism in Albania. We use multidimensional density estimation techniques to estimate and project two dimensional densities of inflation, money and interest rates for two different periods respectively pre-crisis 2001-2009 and post-crisis 2010 -2016. The interest rate variable is lagged by one quarter, to account for potential lags in interest rate effects on other variables. Money and interest rate data come from Bank of Albania. Money is represented by the growth rate of M3 Monetary aggregate, while interest rate represents the level of weekly repurchase agreement rate (the policy rate). Inflation represent the percentage changes in CPI as calculated by the authors based on CPI data reported from INSTAT. This information is summarized in table 1 below.

We estimate probability density function (PDF) and cumulative density functions (CDF) and report them graphically in figures 1-6 below. PDF is portrayed in both surface and contour representation. Dark blue color represent events with 0 probability of occurrence, while dark red colors represent events with the highest chance of occurrence. Lines of similar color indicate isobars with the same $F(X)$. In addition

[9] Other methods are in place and they are not on the focus of this paper.

we have also reported the mode of the estimated two dimensional densities as a proxy of the implied "relationship" (comovement) of the variables in the exercise. It is supposed to show how the dependent variable in the vertical axe responds to changing values (in fact for all values) of the independent variable in the horizontal one.

Given the policy framework of the Bank of Albania (which is inflation targeting) one would expect to observe a negatively sloped relationship (mode) between inflation and interest rate and a positive relationship between money and inflation rate on the assumption that inflation is a monetary phenomenon. Higher interest rates are also expected to result in a slower monetary expansion in economy. If that is the case we expect to see that estimated PDF "bells" are positioned at an angle with the x and y axes in the horizontal plane of the graph. Otherwise a perfect round bell (and concentric circles in the counter representation) would indicate the lack of any form of relationship or co-movement in between the variables in the graph. The same would be true even in the case the PDF is located perpendicular to either one of the axes of the horizontal plane of the graph.

Finally the information provided by the CDF is used to test whether pre-crisis and post-crisis datasets arise from the same distribution. Basically we compare two dimensional densities of the same pare of variables before and after the crisis. The comparison of probability spaces is based on the two-dimensional Kolmogorov-Smirnov (K-S) test proposed by J. A. Peacock (1983). As it is already mentioned before the null hypothesis is that both data sets were drawn from the same continuous distribution at 95%confidence level.

Table 1: Data and data sources

Variable	**Variable description**	**Source**	**Variable name**	**Time period**
MONEY	M3 annual growth rate	BoA	M3	[M1,2001-M12,2009] [M4,2010-M8,2016]
INFLATION	Annual percentage changes of Consumer Price Index	INSTAT	INF	[M1,2001-M12,2009] [M4,2010-M8,2016]
Interest Rate	Bank of Albania Policy rate *lagged one quarter*	BoA	Repo	[M1,2001-M12,2009] [M4,2010-M8,2016]

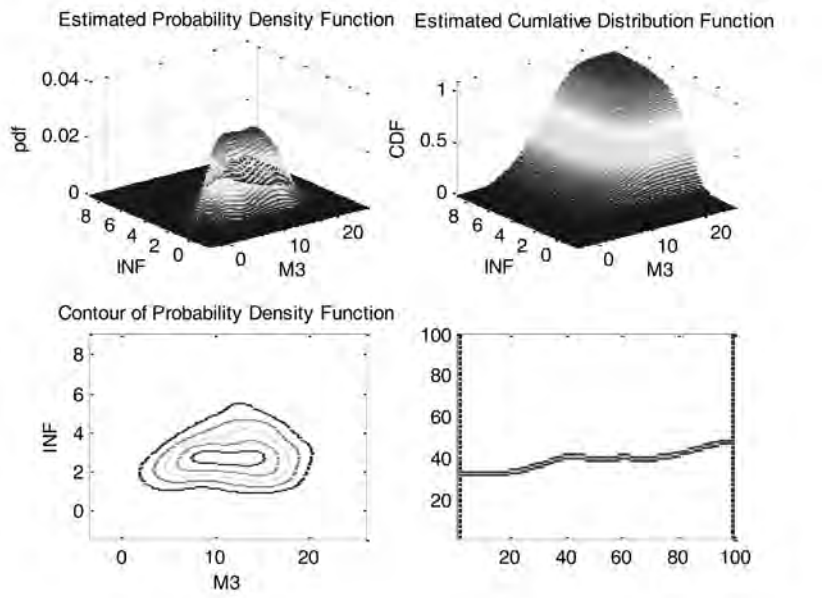
5. RESULTS AND DISCUSSION

This section presents and discusses the results of the empirical exercise. First results are portrayed in the form of the estimated PDF (surface and contour representation) and CDF (surface representation) of the joint density function. In addition the mode of the joint density is reported as a proxy for the visualization of the relationship, are reported in figures 1-6. Later results of K-S tests are presented in table 2 below.

We begin this discussion with the analysis of inflation and money relationship. Focusing on the pre-crisis period reported in fig. 1 below, we observe that the estimated PDF seems to represent a unimodal distribution which is located almost horizontally on the horizontal plane of the chart. The mode portrayed in the lower right corner of the figure shows that the mode of estimated density is slightly upward sloped, indicating a positive relationship between money and inflation. The post crisis period is portrayed in fig. 2. The PDF representations for the post crisis period show that the estimated density is located almost diagonally in the horizontal plane indicating the existence of the positive relationship between money and inflation. This is also confirmed by the upward sloping mode projected in the lower right corner of the fig. 1. The results seem to confirm the Friedman conjecture that inflation is everywhere and always a

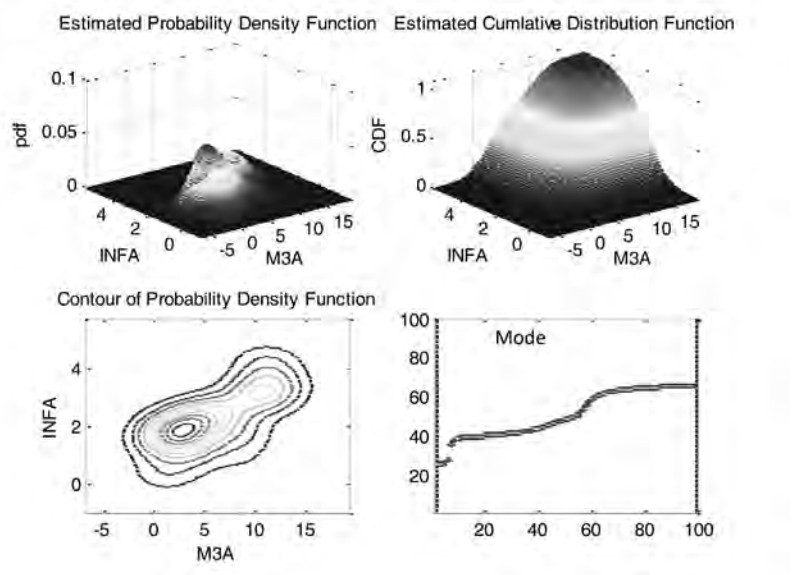
monetary phenomenon during both periods. However, the relationship is much more pronounced in the post crisis period.

Figure 1, inflation response to money before the crisis.



Moving to the discussion of the policy variable and its impact on monetary and price changes we observe as follows. The estimated PDF and CDF are expected to show how changes in the repo rate are followed by simultaneous changes in money and inflation. This discussion is important for hints to the efficiency of monetary policy. We begin by analyzing the relationship between money and repo rate portrayed in fig. 3 and 4.

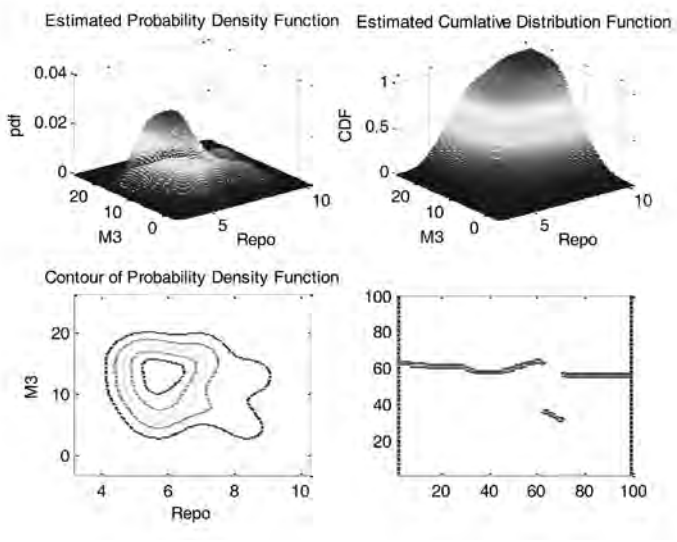
Figure 2, Inflation response to money growth after the crisis



The pre-crisis period in fig. 3, shows an irregular bell shaped PDF indicating almost no co-movement in money and interest rate, with the exception of relatively high interest rates in the right tail of the PFD. This is also confirmed from the mode in the lower right corner of fig.3, which is almost horizontal, with the exception of downward sloping section in the 7.5-8.5 interval. This interval represents the upper limit of the repo rate for the period. We interpret this as a fact that money growth rate is indifferent of changes

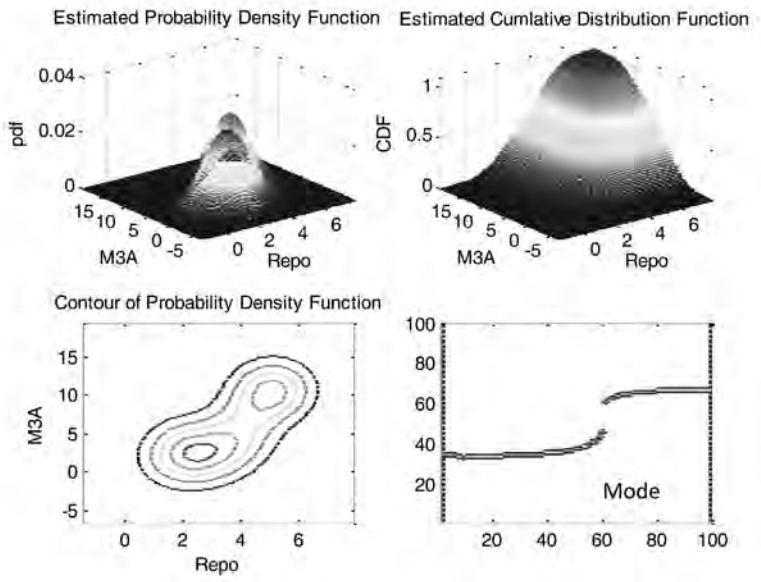
in the policy rate with the exception of the very high or very interest rated which are accompanied by a reduction of money growth rates. We also observe a positive relationship emerging in the neighborhood of 6 %. Probably, indicating that the repo rate has been following faster money growth rates.

Figure 3, money response to repo rate before the crisis



The post crisis figure 4, shows a different relationship between money and interest rate. The estimated PDF is now bimodal and is positioned along the upward diagonal in the horizontal plane. This indicates that changes in interest rate are accompanied by co-movements in same direction in money growth. This positive relationship is somehow unexpected. However, the mode shown in the lower right corner of the graph indicates that most of the positive relationship is associated the change from one mode to the other rather than in the entire distribution. At the end the estimated PDF seem to be different in both form and position, suggesting that money interest rate relationship has changed.

Figure 4, money response to repo rate after the crisis



Finally the last and the most important (given the inflation targeting framework of the BoA) relationship between inflation and the policy rate, is portrayed in the figure 5 and 6 below showing the pre and post crisis periods respectively. Both figures show that the estimated PDF are represented by single modal bell shaped densities. The estimated densities seem to portray different behavior with the

pre-crisis positioned almost horizontally and the post crisis holding an upward trend along the main diagonal. Yet looking at the mode line in the lower right corner of both figures, both relationships seem positive overall, with a more pronounced upward trend in the post crisis period. This overall conclusion is contrary to the general belief and previous empirical estimations of the Taylor rule in Albania.

A more careful observation of the post-crisis period (lower right corner of fig.6) shows a slight negative response in inflation whenever repo rate is lower than 5.5 %. This interval corresponds to the period during which Bank of Albania has implemented its expansionary monetary policy and shows that this policy has been somehow effective. The magnitude of response is small, and much lower than the findings of Dushku and Kota (2011) in their Taylor rule estimation. One might however, expect an even more pronounced downward trend for longer lags of repo rate as this provides more time for the economy to adjust. In conclusion both the shape of the PDF and the mode suggest that the relationship between interest rate and inflation has changed (for better) after the crisis.

Figure 5. Inflation response to repo rate before crisis

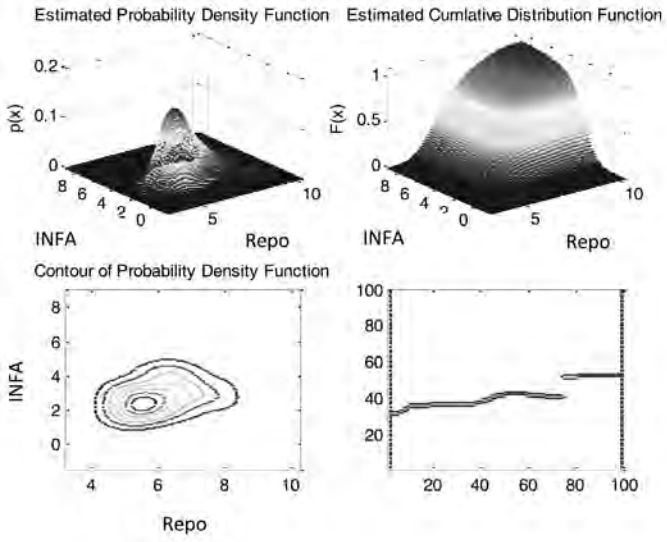
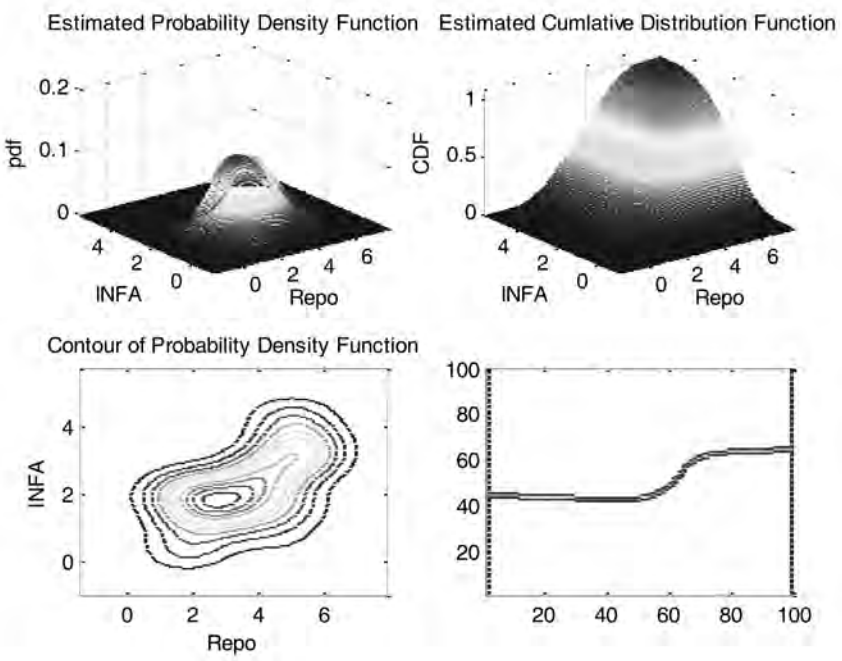


Figure 6. Inflation response to repo rate after the crisis



Despite the interesting information provided by the visual inspection of the figures 1-6 above in terms of the nature and similarity of relationships among money, inflation and policy rate, we have only guessed the answer to the fundamental question based on the visual inspection of the estimated PDF-s, their position and their shapes and modes. Therefore, for a more formal analysis we apply two-dimensional K-S test to provide statistical evidence whether both (pre and post crises) samples are drawn from the same distributions. The tests are based on the CDF which are portrayed at the upper right corners of the figures 1-6. The K-S test results are reported in table 2 below as logical values of 0 or 1, where 0 indicates that both samples are drawn from the same distribution and 1 indicates otherwise (samples come from different distributions).

Results show that with 95 % confidence level, among all three relationships considered in this study, only money-inflation relationship remains is the same for both periods indicated by the 0 reported in the corresponding entry in the diagonal matrix of results. The other two entries are represented by 1, indicating that pre and post-crisis samples are not coming from the same distributions. This leads us to conclude that there has been a change in the transmission mechanism following the crisis period.

Table 2, K-S test results

K – S Statistics	CDF – Pre-crisis data			
CDF – Post-crisis data		*INF-Repo*	*INF-M3*	*M3-Repo*
	INF-Repo	*1*		
	INF-M3		*0*	
	M3-Repo			*1*

CONCLUSIONS

This paper looks at the transmission mechanism (the relationship among interest rate, money and inflation) and tests the hypothesis that the crisis has not changed the transmission mechanism of monetary policy in the case of Albania. The novelty relies to the application of an alternative method of modeling economic relationships and the comparison based on the probability spaces. Eventually the comparison is based on kernel density estimation and the use of multi-dimensional K-S test rather than the traditional time series and DGSE methods. We believe that this alternative methodology poses several advantages vis a vis the traditional one due to the fact that it proceeds without imposing any theoretic structure, or model form on the data. Most importantly the comparison of random events is based on their probability space rather than the estimated coefficients. The study focuses at the relationship of inflation with money and interest rate as two potential instruments under different regimes of monetary policy. We also investigate the relationship between money and interest rate as well.

Based in this alternative methodology we conclude that among all three relationships considered above only the Inflation-M3 relationship seems to be drawn from the same distribution for both periods. The results of K-S test for the comparison between estimated densities of money and inflation indicate that the crisis has not induced change in the relationship between money and inflation. On the other hand the same comparison of densities between the policy rate and inflation and policy rate and money indicates that these bilateral relationships have changed after the crisis period. In addition we find that the response of money and inflation to policy rate is in the opposite direction of the expected relationship. Surprisingly money response to policy rate takes the expected sign only in the interval, while inflation response to policy rate seems to takes the expected sign only in the interval. These findings have important implications for the conduct of monetary policy in Albania and must be useful not only day to day policy making but also in the understanding of the model in which policy operates under different conditions. In the future it is important to enrich the analysis by introducing different lags and lag structures to account for the fact that monetary policy operates with longer lags between 12-16 months. Also it would be interesting to assess whether the above results are robust for different levels of confidence levels e.g. 90 % and 99 %.

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UDK ???????

COMPETITION AND CREDIT PROCYCLICALITY IN EUROPEAN BANKING

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Abstract

This paper empirically assesses the effects of competition in the financial sector on credit procyclicality by both estimating an interacted panel VAR (IPVAR) with macroeconomic data and a single-equation model with bank-level data for the European banking. The findings of the two empirical approaches highlight that an exogenous deviation of actual GDP from the potential GDP leads to more credit fluctuations in economies where (i) competition among banks and (ii) competition from non-bank financial institutions or direct finance (proxied by the financial structure) are weak. According to the financial accelerator theory, whether lower competition strengthens the cyclical behaviour of financial intermediaries, it follows that this "endogenous developments in credit markets work to amplify and propagate shocks to the macroeconomy"(Bernanke et al., 1999). Furthermore, since credit boom is closely associated with future financial crisis (Valencia and Laeven, 2012), our results can also be read as evidence that greater competition in the financial sphere reduces financial instability, which is in line with the "competition-stability" view - denying the existence of a trade-off between competition and stability.

Keywords: Credit Cycle; Business Cycle; Bank competition; Interacted Panel VAR

JEL Codes: E32, E51, G20, D40, C33

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1. INTRODUCTION

There is a long-standing debate among economists whether more intense competition among financial intermediaries promotes better economic outcomes. However, this debate has been largely intensified after the onset of the global financial crisis. First, because academics and policy-makers have wondered whether excessive competition was responsible for the crisis. Second, because the banking sector has experienced numerous structural changes (the beginning of a consolidation process, the strengthening of banking regulation, the willingness of European policy makers to deepen financial integration and develop capital markets, the low interest environment, etc.) that should change the level of competition in the financial sphere in the future.

Most empirical studies on the nexus between bank competition and economic outcomes have focused on the link between bank competition and financial instability. This has led to mixed empirical results. While a strand of this literature (the "competition-fragility" view) supports the idea that bank competition is detrimental to financial stability (Berger et al., 2009; Ariss, 2010; Jiménez et al., 2013), another strand (the "competition-stability" view) provides diametrically opposite evidence (Boyd et al., 2006; Schaeck et al., 2009; Schaeck and Cihák, 2014; Anginer et al., 2014; Akins et al., 2016). Although financial crises lead to economic dislocation, which both decreases the economic growth and increases the macroeconomic volatility, bank competition may also affect the real sphere by making the system more efficient both in normal time and in response to a crisis. As a result, some contributions have directly focused on the effects of bank competition on economic growth in the medium run (Cetorelli and Gambera, 2001; Claessens and Laeven, 2005; de Guevara and Maudos, 2011). Similarly, the effects of bank competition on stability should not only be con-sidered through the financial stability dimension, but also through the global effects on macroeconomic volatility (the occurrence and intensity of economic booms and busts), which has not attracted a lot of interest in the literature.

The purpose of this paper is to address this shortfall by examining the relation-ship between competition among financial intermediaries and the credit procyclicality, which is a factor that amplifies the business cycle fluctuations and therefore the macroeconomic volatility. The fact that financial systems are not just a passive reflection of real sector, but can be a source of real economic activity fluctuations is at the heart of financial accelerator theory (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Bernanke et al., 1999). Loosely speaking, financial accelerator theory states that shocks (real, monetary or financial) that decrease (increase) borrowers' net worth (by altering the revenue and collateral values of non-financial agents) should also have an additional effect, in more of the wealth effect, by decreasing (increasing) borrower credit worthiness due to asymmetric information problems. As a result, credit becomes more (less) expensive and has a reduced (increased) availability during a recession (expansion). This procyclicality of credit tends to amplify the real economic cycle due to the weakening (expanding) of investment, for instance. Thus, relatively small economic shocks can be amplified and propagated by endogenous procyclical changes in the credit market. Another insight into the linkages between credit and economic fluctuations is provided by Minsky's financial instability hypothesis. In this conceptual framework, the decrease of lenders' credit conditions as well as monitor-ing and the regulation of banks during periods of stability lead to finance speculative borrowers ("Ponzi borrowers") and therefore excessive lending, resulting in an increase of aggregated demand. It follows that this supports the "exuberance" and the boom of excessive credit, which suddenly stop when a negative shock leads Ponzi borrowers to no longer be able to pay-back their credit. Thus, unlike the financial accelerator theory, the works of Minsky (1982) and Kindleberger (2000) point out that the peak of credit cycle (which is driven by procyclicality of credit) is associated with a financial crisis. That being said, credit procyclicality both enhances the persistence of economic shocks and the probability of financial crisis, which in both cases reinforce the volatility of the economy.

A large empirical literature has explored several aspects of the procyclicality of the banking sector. In particular, two different directions have been taken by the existing literature. First, it analysed the consequences that procyclicality has on the real economy, but also on the banking sector itself. For example, some studies analyse the behaviour of demand and supply of loans and their role in economic fluctuations (see, e.g., Lown and Morgan (2006); Bassett et al. (2014)), and the procyclical behaviour of

bank profitability (see, e.g., Albertazzi and Gambacorta (2009)). Second, it tried to identify the factors that can contribute to strengthening or mitigating the procyclicality of the banking industry. As discussed by Athanasoglou et al. (2014), these factors include the asymmetric information, the regulatory and supervisory framework, the monetary policy, the practices of financial firms, such as leverage and remuneration policies, and some other factors such as credit rating agencies reports or the use of automated risk management systems. More generally, the cross-country differences of bank procyclicality would be related to cross-country disparities of the financial structure (Albertazzi and Gambacorta, 2009).

Our paper contributes to this second strand of the literature. Indeed, we assess whether the level of bank competition constitutes a driving force of credit procyclicality in the European banking. Economic theory has conflicted predictions on this subject. Actually, we can isolate two channels by which bank competition may impact credit procyclicality.

The first channel is related to the ability of the banking system to mitigate the asymmetries of information and reduce the associated agency costs. Theory shows that bank competition can play a key role for this purpose. On a one hand, low competition can lead bank to "a quiet life", reducing the banks' efficiency and therefore increasing the cost of gathering information necessary to mitigate lender-borrower problems. Berger and Hannan (1998) argue that this quiet life effect is due to the decrease of managers' incentives to maximize operating efficiency since the market power ensures that the prices will be above their marginal cost. On the other hand, bank competition can play on the banks' incentives to build long run relationship with borrowers, which is a mean to gather information and reduce the principal-agent problem. However there is no academic consensus whether or not lower bank competition is favourable. While some contributions point out that market power is critical to provide the incentives to collect private information (Petersen and Rajan, 1995), others suggest that high competition creates the incentives to relationship banking that help "to partially isolate the bank from pure-price competition" (Boot and Thakor, 2000).

The second channel focuses on the effects of bank competition on risk-taking and risk-management. On the one hand, the "competition-fragility" view claims that an increase in bank competition erodes the banks' franchise value (the present value of future rents) and therefore induces bank to gamble, i.e. to behave less prudently, since the opportunity costs of bankruptcy are lower (Keeley, 1990; Hellmann et al., 2000). As a results, higher competition should reduce procyclicality in this view. On the other hand, another strand of the literature argues that an increase of bank competition, by reducing the loan rates, reduces the bank risks as moral hazard incentives to shift to a riskier project decreases (Boyd and De Nicolo, 2005). Furthermore, the decrease of loan rates should also restrain adverse selection problems and improve the quality of borrowers' portfolio. Finally, competition could act on the efficiency of the risk-management practices (Allen and Santomero, 2001).

In order to clarify these theoretical discrepancies, we empirically test the relation-ship between bank competition and procyclicality for European banking. To the best of our knowledge, only Bouvatier et al. (2012) previously investigated a similar is-sue. Considering a sample of OECD countries, they assess the relationship between the banking sector structure and credit procyclicality, i.e. whether the banking sector structure affects how credit responds to the business cycle. To this end, they proceed in two steps. First, they perform a cluster analysis to evaluate the degree of similarity in the banking industry structures and, then, split their sample of countries in different clusters.[1] Second, they estimate a panel VAR (PVAR) on cyclical components for each of the clusters and compare the impulse response functions of credit to a shock in GDP. Results that they obtain suggest that credit significantly responds to shocks to GDP, but they do not find that banking sectors with various characteristics exhibit differences in terms of credit procyclicality. Therefore, the authors conclude that the banking sector structure is not an important cause of credit procyclicality.

In comparison to Bouvatier et al. (2012), our analysis goes a step further by proposing both a macroand micro-assessment of the relationship between bank competition and credit procyclicality.

[1] Bouvatier et al. (2012) consider seven variables to provide a classification of the banking system structures. These variables aim to capture the degree of concentration in the banking sector, the size of the banking sector, the financial structure (i.e. bank-based vs. market-based), the ownership structure, and restrictions in activities. According to a hierarchical clustering methodology, they obtain four different clusters for a sample of 17 OECD countries.

Our macro-analysis relies on a VAR framework and follows Bouvatier et al. (2012) by defining credit procyclicality as the orthogonalized impulse response function of credit cycle to a business cycle shock. However, contrary to Bouvatier et al. (2012), we do not only assess cross-country heterogeneity in credit procyclicality and rely it to differences in terms of bank competition, but we formally investigate whether credit procyclicality is conditional to bank competition. To this end, we estimate an Interacted Panel VAR (IPVAR) model, recently developed by Towbin and Weber (2013). The model is estimated using quarterly HP-filtered data over the period 1997Q1-2014Q4 for 16 European economies. The main feature of IPVAR is that it models the autoregressive coefficients as a function of an exogenous variable, the bank competition in our case, and then allows the relationship between credit and business cycles to vary with the level of bank competition. As a result, this framework makes that the impulse responses of credit to a shock in GDP (i.e. the propagation mechanism in the financial accelerator view) are conditioned by the level of bank competition, proxied in this paper by the commonly used Lerner index.

Concerning the micro-analysis, it aims to give a more granular view of the link between bank competition and credit procyclicality by analysing whether banking sector competition and the market power of banks play a role on the procyclical behaviour of bank credit activity. It is also motivated by addressing some important econometric issues of the VAR framework, such as identification and endogeneity issues. Moreover, one main advantage of such an approach is to control for some individual characteristics of banks that could explain their credit policy. Indeed, one can argue that the fact that banks are more willing to grant loans during the upward phase of the business cycle and more reluctant during the downward phase is not only due to bank competition, but could also be explained by bank specificities, such as their size or the diversification of their activities. Our analysis relies on balance-sheet data and consists in analysing whether the reaction of bank loan supply to the output gap depends on the level of bank competition. More precisely, we estimate a fixed effects model using panel data from 2005 to 2014 for a large sample of European banks, in which we introduce an interaction term between output gap and the Lerner index. By this way, we examine whether the link between output gap and credit dynamics is affected by the competitive environment and the market power of banks.

Results that we obtain suggest that bank competition reduces credit procyclicality. Indeed, the structural analysis of the IPVAR model shows that an exogenous onepercent deviation of GDP to its trend induces a significant more severe response of credit in economies where bank competition is low. Therefore, these results, robust to a battery of robustness checks, suggest that bank competition reduces the macroeconomic volatility by limiting the amplification mechanism of the financial sphere to the real sphere. Results of the micro-empirical analysis corroborate these findings. We find that the bank loan supply is significantly less sensitive to the output gap when the competitive environment is fierce and the individual market power of banks is weak.

Finally, one important contribution of our analysis to the existing literature is that we do not just focus on competition among banks, but we also consider competition from direct finance as a potential driver of credit procyclicality. Indeed, all financial systems combine bank-based and market-based intermediation. But financial structure, i.e. the particular blend of the intermediation channels, varies across countries. In line with previous results and the recent contributions of Langfield and Pagano (2016), Adrian et al. (2013) and Grjebine et al. (2014), one can expect that countries characterized by a relatively high degree of competition between banks and financial markets (market-based economies) exhibit a lower credit procyclicality than bank-based economies. The results of our analysis confirm this expectation.

The remainder of the paper is structured as follows. Section 2 assesses the impact of bank competition on credit procyclicality with country-level data. This section is divided into two parts. First, we discuss the data used, the identification strategy and the estimation methodology (section 2.1). Second, we present the empirical results (section 2.2). Section 3 presents the results of the analysis with granular data, i.e. bank-level data. Section 3.1 describes the data and the empirical model and section 3.2 provides the empirical results. In the section 4, we discuss the effects of the financial structure of an economy on credit procyclicality. We conclude in section 5.

2. BANK COMPETITION AND CREDIT PROCYCLICALITY AT THE AGGREGATE LEVEL

2.1. Data and Methodology

2.1.1. Data

Our macro-empirical analysis spreads over the period 1997q1-2014q4. It includes 16 European economies: the old member states of EU-15, with the exception of Luxembourg, Norway and Switzerland.[2] Therefore, the time dimension of our panel is relatively large, by including 72 quarterly observations, and the cross-section dimension relatively tightened, comprising only countries at similar stages of growth.

In order to conduct our analysis of the cyclical behaviour of credit in European banking, our baseline econometric specification, described below, is parsimonious and comprises 4 main quarterly macroeconomic variables. The variables are the real GDP, the consumer price index (CPI), the real outstanding amount of credit to the private non-financial sector and the nominal short-term interest rate.[3] Alternative specifications of our baseline model also include a residential property price index, a stock price index and the real outstanding amount of bank credit to the private non-financial sector instead of the total amount of credit. Except for the interest rate, all the series are initially seasonally-adjusted and log-transformed. Since we are interested in economic fluctuations, we do not consider these adjusted series in level or in first-difference but rather in their HP-filtered version. In this way, we statistically remove the trend and isolate the cyclical component of the series, which ensures that the series are well I(0).[4] Basically, this means that the log-transformed variables in our model are defined as a gap in percentage between the trend value and the observed value of the macroeconomic indicators.

In addition to macroeconomic variables, our empirical analysis also requires the assessment of the degree of monopolistic competition. In line with related empirical work on the relationship between banking competition and stability (see, Berger et al. (2009); Beck et al. (2013); Anginer et al. (2014)), we use a non-structural measure of bank competition: the Lerner index. This index represents the mark-up of price over marginal cost and is a country-level indicator of the degree of market power, i.e. higher value indicates lower competition. Further details on the index construction are provided in Section 3, where we compute a bank-level measure of the Lerner index on our own.

Turning to the data source, the GDP, the CPI, the short-term interest rate and the two asset price indices (residential property and share prices) are taken from the OECD database. The credit series to the private non-financial sector are from BIS database.[5] Finally, our measure of bank competition, the Lerner index, is from the Global Financial Development database of the World Bank. Unlike the other series, bank competition is computed annually. Therefore to match the variable to the quarterly frequency of our study, we use a linear interpolation procedure.[6] All the series included in the analysis are reported in Figure A2 and Figure A3.

2.1.2. Empirical Methodology

To test whether bank competition affects credit procyclicality, we use a two-step approach: (i) we check that credit procyclicality is heterogeneous in European banking sector and (ii) we test whether the differences in terms of procyclicality between the economies might be explained by differences in bank competition.

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[2] Our data set comprises the 16 following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

[3] Real credit series are constructed by deflating nominal credit by the CPI.

[4] Formally, the HP-filter decomposition consists in determining the trend component (τ_t) of a time-series (y_t) from the following minimisation problem: $\min_{\tau_t} = \sum_{t=1}^{T}((y_t - \tau_t)^2 + \lambda((\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1}))^2)$. A higher value of λ implies a higher degree of smoothing. In our study, we follow Ravn and Uhlig (2002) and initially set 1600 as a value for λ, the smoothing parameter.

[5] Comparatively with time-series from the International Financial Statistics (IFS) database of the IMF, the BIS series have the advantage to be adjusted for the existence of breaks due to change in classification or definition of the variables.

[6] Bank competition data are available from 1996 explaining why we start our study in 1997q1.

These two steps imply first and foremost to define how measuring credit procyclicality. Roughly speaking, credit procyclicality corresponds to the positive reaction of credit to a change in GDP.[7] Therefore, it is necessary to use an econometric framework which (i) allows measuring the effects of GDP on credit, (ii) takes into account the fact that the GDP cycle is a process not independent from the credit cycle, i.e. the existence of feedbacks between the banking system and the real economy (see, among others, Bernanke and Blinder (1988), Kiyotaki and Moore (1997); Kindleberger (2000), Lowe et al. (2002), Borio (2014)) and (iii) imposes few theoretical restrictions since the interactions between financial and macro variables have not been theoretically perfectly identified. Unlike a single-equation framework, a VAR modelling approach fulfills these three criteria. Thus, we opt for a multivariate framework and follow Bouvatier et al. (2012) by defining the credit procyclicality as the orthogonalized impulse response function of credit cycle to a GDP cycle shock.[8]

Our exploratory phase consists in assessing whether the credit procyclicality, defined as the credit effect of an unexpected change in output gap, differs from country to country. Therefore, we start by considering country-specific VAR. The reduced-form of the model is given by:

$$Y_{i,t} = c_i + A_i(L_i)Y_{i,t-1} + \varepsilon_{i,t} \qquad \varepsilon_{i,t} \hookrightarrow N(0,\Sigma) \qquad (1)$$

where i and t are indexes of country and time, respectively. $Y_{i,t}$ is a (4 * 1) vector of endogenous variables *(CPI, GDP, CRED, r)*, $A(L)_i$ is a matrix polynomial in the lag operator specific to each country, c_i is a country-specific intercept and $\varepsilon_{i,t}$ a vector of errors.[9]

The country-specific VAR systems are estimated by OLS and shocks are identified based on a recursive identification scheme by applying a Cholesky decomposition of the residuals with the variables ordered as follows: *CPI, GDP , CRED and r*. Hence, the GDP cycle responds to shocks in the credit cycle only with lags and the contemporaneous response remains zero. The ordering of inflation and GDP in a first block and financial variables in a second block is fairly standard in the macroeconomic literature using VAR methodology. This implies that financial variables may respond immediately to real shocks. By contrast, the relative ordering of the financial variables is subject to some discussions. In our baseline model, we follow Assenmacher-Wesche and Gerlach (2008) by ordering credit before short-term interest rate. Thus, our triangular identification structure imposes that credit cycle reacts only with lags to the short-term interest cycle. In other words, the contemporaneous impact on credit is restricted to be zero. As shown by Leroy and Lucotte (2015), among others, bank interest rate pass-through is sluggish in the short-term, justifying the fact that credit does not respond immediately to a policy rate shock.

Then to test the implication of bank competition on credit procyclicality, we have two possibilities. The first is to compare the average impulse response of countries characterized by a low and a high levels of bank competition. This involves to divide into two groups the sample of countries according to the level of competition in the financial sphere. Basically, within this approach, we have to estimate two panel VAR and compare whether the orthogonalized impulse responses of credit to a one per cent output-gap shock (to ensure comparability) are significantly different between the two groups of countries. Although this approach is tractable, it has two shortcomings: (i) it prevents to take in consideration that the degree of competition might change over time and (ii) it does not allow to control for other sources of heterogeneity, which could explain the difference between the two groups of countries. Therefore, this calls for an alternative specification of the VAR model which allows to take explicitly into account the time-varying level of bank competition as an exogenous factor acting on the response of credit to GDP shock and to control for potential correlated variables. For this purpose, we use in this study a panel-VAR framework where the autoregressive coefficients of the endogenous variables are function of cross-time-varying level of bank competition. A such type of framework has been recently developed by Loayza

[7] Credit is a component of the aggregated demand. As a result, the positive reaction of credit to a GDP shock naturally leads to increase the persistence and amplitude of the the business cycle.

[8] This is based on the common result that output causes credit (in the VAR sense) (Lown and Morgan, 2006). Recently, Peia and Roszbach (2015) confirm this idea by finding significant evidence of causality from GDP to credit, along with no systematic reverse causality going from credit to GDP.

[9] Note that the order of matrix polynomial is determined by the Akaike Information Criterion (AIC) which the maximum lag length has been fixed to 4. CPI, GDP , CRED and r refer to the consumer price index, the real GDP, the real outstanding amount of credit to the private non-financial sector and the nominal short-term interest rate, respectively.

and Raddatz (2007), Towbin and Weber (2013), Sá et al. (2014) and Georgiadis (2014) and allows to assess the impact of exogenous structural characteristics on the response of macroeconomic variables to macroeconomic shocks. Specifically, our econometric approach is based on the Interacted Panel VAR framework (IPVAR) of Towbin and Weber (2013).[10]

The structural form of the IPVAR that we estimate is given by:

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ \alpha_{0,it}^{21} & 1 & 0 & 0 \\ \alpha_{0,it}^{31} & \alpha_{0,it}^{32} & 1 & 0 \\ \alpha_{0,it}^{41} & \alpha_{0,it}^{42} & \alpha_{0,it}^{43} & 1 \end{pmatrix} \begin{pmatrix} CPI_{i,t} \\ GDP_{i,t} \\ Cred_{i,t} \\ r_{i,t} \end{pmatrix} = \sum_{l=1}^{L} \begin{pmatrix} \alpha_{l,it}^{11} & \alpha_{l,it}^{12} & \alpha_{l,it}^{13} & \alpha_{l,it}^{14} \\ \alpha_{l,it}^{21} & \alpha_{l,it}^{22} & \alpha_{l,it}^{23} & \alpha_{l,it}^{24} \\ \alpha_{l,it}^{31} & \alpha_{l,it}^{32} & \alpha_{l,it}^{33} & \alpha_{l,it}^{34} \\ \alpha_{l,it}^{41} & \alpha_{l,it}^{42} & \alpha_{l,it}^{43} & \alpha_{l,it}^{44} \end{pmatrix} \begin{pmatrix} CPI_{i,t-1} \\ GDP_{i,t-1} \\ Cred_{i,t-1} \\ r_{i,t-1} \end{pmatrix} + \begin{pmatrix} \delta^{11}\delta^{12} \\ \delta^{11}\delta^{12} \\ \delta^{11}\delta^{12} \\ \delta^{11}\delta^{12} \end{pmatrix} \begin{pmatrix} I_i \\ Z_{i,t-4} \end{pmatrix} + \varepsilon_{i,t} \quad (2)$$

where C is a constant, $Z_{i,t-4}$ a cross-time-varying measure of bank competition and $\varepsilon_{i,t}$ a vector of uncorrelated iid shocks.[11] [12] Indices t and i refer to quarters and countries, respectively. Furthermore, L refers to the number of lags.[13]

The structural parameters $\alpha_{l,it}$ distinguish the traditional panel-VAR from our framework and allow to analyse the way in which the response of bank credit cycle to a business cycle shock varies according to the degree of bank competition. For this purpose, the coefficients $\alpha_{l,it}$ have the following form:

$$\alpha_{l,it} = \beta_{l,it} + \eta_l Z_{i,t-4} \quad (3)$$

where $\beta_{l,it}$ and η_l are two vectors of coefficients and $Z_{i,t-4}$ a cross-time-varying measure of bank competition. Therefore, the structural parameters $\alpha l,it$ vary over the time and across countries with the level of bank competition. However, the coefficients are not country-specific. As pointed out by Georgiadis (2014), the coefficients remain "conditionally homogeneous". Indeed, if the structural characteristics are the same between the countries, the slope coefficients will be also the same. In our baseline specification, all the autoregressive coefficients of the VAR system are allowed to be dependent on the level of bank competition, i.e. all the variable dynamics are allowed to be conditional on the degree of bank competition. However, for robustness purpose, we also give more structure to our model by considering a parameter matrix where only the autoregressive coefficients of the credit and output equations are interacted with our measure of competition, which leads to similar results.

The fact that we impose that the impact matrix be lower triangular induces that the error terms are by construction uncorrelated across the equations. This allows to estimate the system equation by equation using OLS. It can be noted that the zerorestrictions imposed on the impact matrix correspond to a same identification scheme as in the country-specific VAR model. Thus, the variables remain ordered in the following ordering: CPI, GDP, $CRED$ and r and are considered in their HP-filtered version.

One important aspect of our baseline panel VAR is that it includes country fixed effects. This may appear needless since the endogenous variables included in the VAR are in their HP-filtered version. Indeed, this purges unobserved unit-specific fixed effects by removing the country-specific trend in

[10] We thanks Sebastian Weber and Pascal Towbin for providing us available their matlab code for the Interacted Panel VAR procedure.

[11] To account for potential endogeneity, our variable measuring the bank competition has been lagged by 4 quarters.

[12] Furthermore, we draw attention to the fact that our model assumes that there are no dynamic cross-unit interdependencies, i.e., residuals are uncorrelated across countries, which is certainly a restrictive assumption (see, Canova and Ciccarelli, 2013). To address cross-section dependence, we have checked whether we obtain similar results when we include a common factor like the oil price or an indicator of systemic risk as exogenous variable in our model.

[13] The lag length is fixed to 2 based on the average optimal lag orders of the country-specific VAR.

the series and implies zero-means.[14] Nevertheless, it remains that the structural characteristics present potential timeless specificities. Therefore, we need well to control for unobserved unit specific factors, which could be the source of heterogeneity, by demeaning the data (which is equivalent to allow intercept heterogeneity). In this case, it is well-known that estimations can be biased because the demeaning operation in a dynamic model leads error terms and regressors to be correlated. However, as shown by Nickell (1981), the size of the fixed effects bias falls as the length of the sample increases, which narrows the importance of the bias in our analysis, given that the time dimension of the panel is relatively long (72 observations by country).[15]

Another important feature of our empirical model is that it allows dynamic heterogeneity by making the slopes conditional to cross-time-varying measure of competition. However, credit dynamic heterogeneity could be related to other factors than competition, potentially correlated with competition. In this case, the issue is that allowing for heterogeneous intercepts, as in previous estimation method, solely controls for unobserved level heterogeneity and not unobserved dynamic heterogeneity, which can lead to inconsistent estimates (Pesaran and Smith, 1995) and misleading conclusions. To model this type of cross-sectional heterogeneity, Pesaran and Smith (1995) propose the Mean Group estimator, which consists in estimating country-specific VAR and then computing the average of the unit-specific slopes parameters. Nevertheless, this approach is not suited for our analysis since it veils the underlying sources of cross-country dynamic heterogeneity. To capture both unobserved country-specific variations and variations conditional to specific structural characteristics, Sá et al. (2014) implement a Mean Group type estimator. In practice, the authors augment the baseline IPVAR model by interacting all endogenous variables with country dummies. In this way, we can disentangle the coefficient heterogeneity due to country-specific effects and banking competition effects.[16]

After estimation of the IPVAR, the structural analysis is based on the comparison of the impulse responses to a GDP shock for a "high" and "low" levels of bank competition. To obtain this type of impulse responses, we first use our IPVAR estimates and replace the structural characteristic $(Z_{i,t})$ by the first quintile and the fourth quintile of its sample distribution. Thus, we obtain two different coefficient matrices, i.e. two different sets of interactions and feedback between the variables. As a result, the computed impulse responses to a common innovation vary according to the value given to the structural characteristic, for example a "high" and "low" levels of bank competition. In this way, we address our research question of how credit procyclicality would change if bank competition moves from a low to a high levels.

Finally, a bootstrap procedure is used for inference of the impulse responses.[17] In the figures below, we report the mean of the 1000 bootstrapped impulse responses with a 95% confidence band, i.e. the lower of the band is the 2.5th percentile and the higher the 97.5th percentile. In order to assess whether the impulse responses are significantly different, we use the difference between the two impulse responses computed at each draw and display in the figures the mean of these differences with a 95% confidence band.

2.2. Results

We present the cross-country asymmetries of credit procyclicality in Section 2.2.1 and the main results of our empirical analysis in Section 2.2.2. The robustness of our findings is examined in Section 2.2.3.

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[14] In fact, the endogenous variables are not perfectly zero-centering. The reason is that we use a longer sample period to apply the HP-filtering method than to estimate our model.

[15] Monte Carlo evidence in Judson and Owen (1999) suggests that the magnitude of the bias is small in a sample of the size used here (72 observations by country). We add that other studies as Goodhart and Hofmann (2008) using panel VAR methodology with similar time-series length also employ a fixed effects OLS estimator.

[16] Obviously, this procedure increases considerably the number of parameters to estimate since each endogenous variable is interacted with 15+1 exogenous variables (the number of country dummy + the indicator of bank competition), which could decrease the precision of estimates of impulses responses.

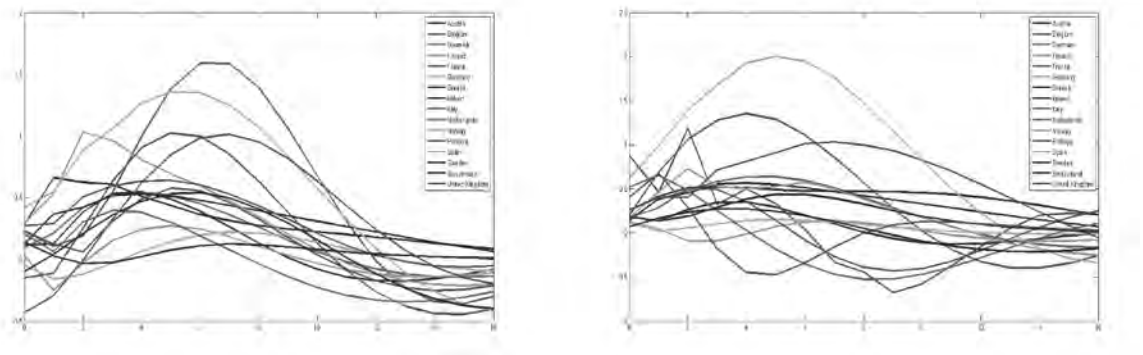
[17] See, Towbin and Weber (2013) for details about the different steps of the bootstrap procedure.

2.2.1. Preliminary Analysis

The first step of our empirical analysis is to assess the cross-country heterogeneity in credit procyclicality. Figure 1 displays the impulse responses of *Credit* or *Bank Credit* to a business cycle shock based on the country-specific VAR model in equation (1).[18] At first sight, the choice to examine both the responses of the total credit and the bank credit cycles may appear irrelevant. First, because the total credit cycle comprises the bank credit cycle that could mean that the analysis would be redundant. Then, because bank competition should primarily impact the bank credit cycle. However, in our view, focusing exclusively on bank credit cycle's responses would be damaging. Indeed, since bank credit series do not include securitised credit that leads to not take in consideration the fact that banks do not just originate and hold credit, but they also distribute credit to the non-bank financial sector. Furthermore, as a result of the widely difference in the weight of "originate-to-distribute" model and of the financial structure between European economies, bank credit cycle's responses might suffer by a lack of comparability. Hence, we expect that bank credit's responses to be more heterogeneous than total credit's responses.

The chart on the left in Figure 1 depicts the orthogonalized country-specific responses of total credit to the non-financial sector to a shock in GDP, normalized to unity (i.e., a shock of one per cent in output gap) with a simulation horizon covering 16 quarters. As can be seen, in the most of the cases, a GDP cycle shock contemporaneously affects positively the credit cycle. The four only exception are France, Germany, Sweden and the UK, where the initial responses are negative and become positive only after a few quarters. Furthermore, with the exception of Switzerland, the IRF suggest that credit gap after a shock in output gap remains above the baseline value for at least 7 quarters. Results for Germany are very singular since they highlight a very low and non-persistent impact of GDP to credit, i.e. low procyclical behaviour of credit. As a result, we should check in the next-step -when we will test the effect of bank competition on procyclicalitythat our panel-data results are not driven by the singular behaviour of Switzerland. Overall, the chart (a) clearly shows the existence of major asymmetries in terms of credit procyclicality within European economies. For instance, while Spain maximum response of credit gap is equal to 1.35% to a shock of 1% of output gap, the maximum response of credit to a shock of the same magnitude is equal to 0.21% in Germany. Finally, similar comments can be made from the chart on the right in the Figure 1, which displays the heterogeneous responses of bank credit cycle to a one unit shock of output gap.

Figure 1: Country-specific impulse response functions of Credit to GDP shock



(a) Total Credit (b) Bank Credit

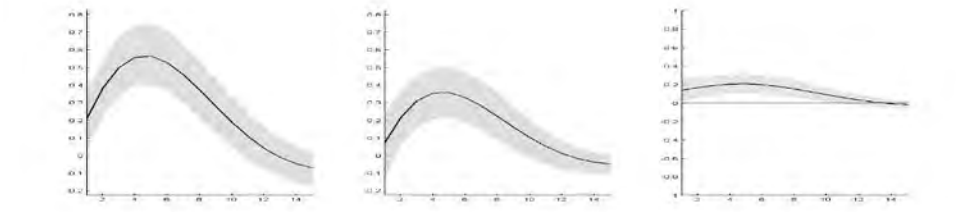
Note: The figure displays country-specific impulse response functions of Total Credit or Bank Credit cycle to a one percentage point shock to the GDP cycle.

[18] Prior to compute IRF, standard tests have been applied for checking residual autocorrelation and that the moduli of the eigenvalues of matrix A are less than one. In addition to checking that the VAR models adequately represent the DGP of the macroeconomic variables, the inter-relations between the variables have been investigated. As expected, in almost all cases, we find Granger-causality from GDP to credit as well as reverse causality quite often.

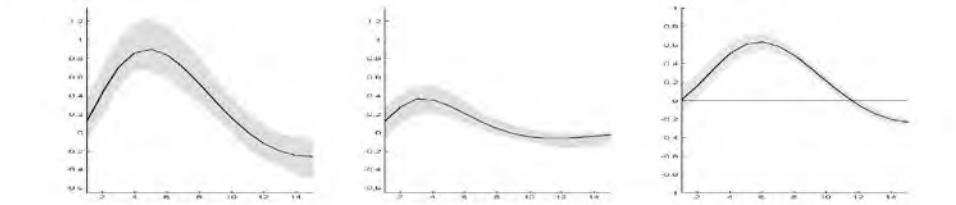
2.2.2. Main Results

Figure 2 displays the impulse responses of the credit and the bank credit cycles to a one unit GDP cycle shock. The orthogonalized responses are generated from the estimation of the panel-VAR model in Equation 2 with a fixed effects as well as a mean-group type estimators, where the exogenous variable $(Z_{i,t-4})$ corresponds to the Lerner index. The charts on the left of the figure present impulse response functions generated by setting the Lerner Index at the 80th percentile of its sample distribution. Therefore, these charts illustrate the average responses of credit in countries with low competitive banking markets. The charts on the centre show impulse response functions evaluated at the 20th percentile of the Lerner index sample distribution, i.e. in the case where bank competition is fierce. In both case, the solid line corresponds to the mean of the impulse responses in a two standard error band, computed by bootstrapping (1000 draws). Finally, the charts on the right display the difference between the means of impulse response functions for a low and a high levels of bank competition with a 95% confidence band.

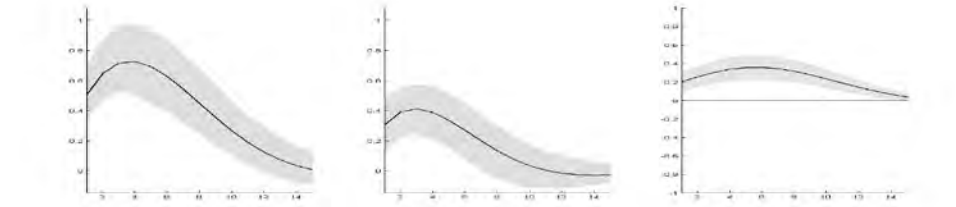
Figure 2: Impulse Response Functions of Credit to a shock of GDP: Baseline model



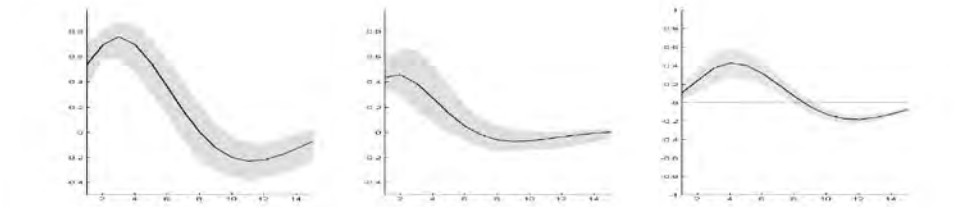
(a) Credit Fixed Effects



(b) Credit Unit Specific Slope Heterogeneities



(c) Bank Credit Fixed Effects



(d) Bank Credit Unit Specific Slope Heterogeneities

Note: The figure shows impulse responses of Credit and Bank Credit to a one percentage point shock in output cycle evaluated (from the left to the right) at the 80th("high" level) and 20th("low" level) percentiles of the Lerner Index sample distribution. The charts on the right represent the difference between the two. The coloured bands represent the 5% error band (two standard-deviations) generated by bootstrap (1000 draws).

Before to present our main results, a few preliminary comments of the Figure 2 can be made. First, unlike that we expected, the estimation of the model by allowing unit specific slope heterogeneity reduces the interval confidence of the impulse response functions.[19] Despite this difference in terms of precision, the two estimators lead to broadly similar results. The only noticeable difference is that the persistence of output gap shocks are longer in the case of fixed effects estimates. Regarding the comparison of responses of total credit and bank credit, we observe that bank credit has an immediate very significant responses to an exogenous change of output gap, while the effects on total credit become significantly positive progressively. In our view, this is not puzzling since the firms that issued bonds (i.e., the difference between total and bank credit) are in average less opaque, more creditworthy, more geographically diversified and therefore less sensitive to national business cycles. However, apart from the initial impact, results do not suggest that bank credit and total credit behave differently.

Looking now at the difference of impulse responses, there is clear evidence that bank competition matters for credit procyclicality. Indeed, the reaction of credit dynamic to a GDP cycle shock varies according to the degree of bank competition. Especially, results suggest that a shock of one percent of the output gap causes a greater response of credit in a lowly competitive banking market. As can be shown on the charts on the right, the differences between high and low levels of competition are well significantly different from zero at the 5% significance level. This means that credit boom and bust are less pronounced when bank competition is fiercer. This denotes a better shock-absorbing ability of the more competitive banking markets.[20]

There are several possible explanations, not necessarily in opposition but rather complementary to each other, to explain the positive association between greater bank competition and lower credit fluctuations.

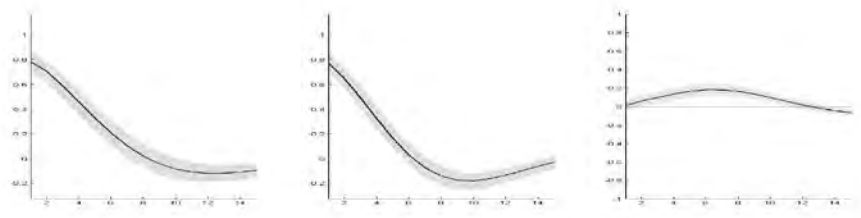
Firstly, bank competition could allow asymmetric information problems between borrowers and lenders to be solved more easily reducing market imperfections. On a one hand, as stated by the "quiet life" theory (Hicks, 1935; Berger and Hannan, 1998), bank competition may lead banks to operate in a more efficient way. Especially, bank competition could improve the screening and monitoring of borrowers. In this way, asymmetric information would be reduced, weakening the repercussion of a real shock on the financial conditions. On the other hand, a strand of the literature on relationship banking argues that an increase of bank competition can foster banks to engage in long-term relationships with borrowers (Boot and Thakor, 2000). Since long-term relationship is a way to overcome asymmetric information problems, banks would be more inclined to smooth real shock by offering credit during a slowdown, for example. Secondly, our results can be related to the literature on bank competition and stability. Indeed, theoretical (Boyd and De Nicolo, 2005; Allen et al., 2011) as well as empirical works (Uhde and Heimeshoff, 2009; Schaeck and Cihak, 2012; Anginer et al., 2014; Akins et al., 2016) show that an increase of bank competition may lead bank to hold more capital or/and to engage in less risky activities. Taking less risk implies that credit booming is less important in the upward of the cycle and therefore that banks experience less financial losses on their loans and other activities in the downward phase, which tends to save bank equity capital and the ability of banks to take new risks and supply new credits during a recession. This would be also strengthen by the positive influence of bank competition on risk-management practices.

[19] This indicates that the estimates with interacted country dummies have lower standard errors than fixed effects estimates. A first explanation is that the proposal of Sá et al. (2014) leads to use the same sample, i.e. the same number of observations, for the estimation of the model with the two types of estimator, which differs to Mean group estimator where coefficients and standard errors are calculated from each country sample. A second potential explanation is that the model presents a strong dynamic heterogeneity, which leads the estimator with interacted country dummies to increase the quality of the estimates of the model.

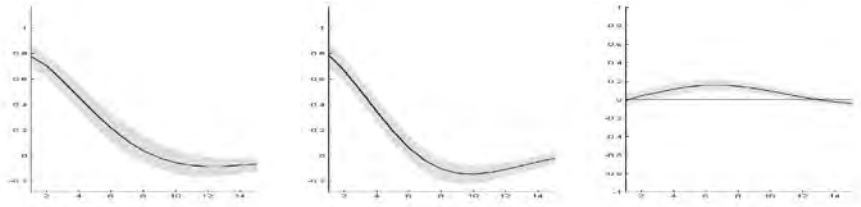
[20] To corroborate our findings, we present in Table A1 in the Appendix the responses of credit to a GDP shock based on the estimations of two panel-VAR for two groups of economies. To split our panel into two sub-panels, we group the countries according to whether they are above or below the median value of the average Lerner index. Although this framework is less efficient than the previous one, overall it confirms that bank competition reduces credit procyclicality. As a matter of fact, the average credit responses in countries where bank competition is in average lower are significantly greater than the credit responses in countries characterised by a relative higher level of bank competition.

Finally, in a broader context, our result could be simply explained by firm's profit maximisation behaviour. Indeed, a general result of the theory of the firm is that the optimal behaviour of firm with market power is to adjust the equilibrium quantity rather than equilibrium price following a change of the demand.[21]

Figure 3: Impulse Response Functions of GDP to a shock of GDP



(a) Credit Pooled



(b) Bank Credit - Pooled

Note: The figure shows impulse responses of GDP cycle to a one percentage point shock in output cycle evaluated (from the left to the right) at the 80th ("high" level) and 20th ("low" level) percentiles of the Lerner Index sample distribution. The charts on the right represent the difference between the two. The coloured bands represent the 5% error band (two standard-deviations) generated by bootstrap (1000 draws).

Our previous findings suggest that imperfect bank competition acts as a financial accelerator by intensifying the propagation of output-gap shock to the credit market. According to the financial accelerator theory that should then amplify the business cycle. Indeed, this theory states that the persistence of economic fluctuations depends on the amplitude of the effects on financial conditions and therefore on credit dynamic of an initial non-persistent exogenous real shock. As a consequence, we expect that the responses of GDP cycle to an exogenous GDP cycle shock be greater in economies where bank competition is weaker, because this leads to more credit fluctuations. Figure 3 presents the GDP cycle impulse responses for an exogenous GDP cycle shock. The charts displayed confirm our expectations: a GDP cycle shock has smaller effects on output in competitive banking markets. Indeed, it appears that GDP cycle returns to the baseline at a faster pace under these conditions.

2.2.3. Sensitivity Analysis

We perform a broad set of robustness checks, which may be grouped into three categories: (i) alternative specifications, (ii) change in data definition and (iii) disentangling the effects of bank competition from other potential determinants causing procyclicality asymmetry.

In order to assess the robustness of the results presented above, we start by estimating different specifications of the interacted panel-VAR (equation (2)). Firstly, we extend the vector of endogenous variables by including a variable reflecting the dynamic of asset prices. That provides a more complete representation of the macro-dynamic and this responses to several studies that show that there are linkages between credit, economic activity and asset prices (see, Annett, 2005; Goodhart and Hofmann, 2008; Assenmacher-Wesche and Gerlach, 2008; Muellbauer and Murphy, 2008; Beltratti and Morana, 2010). In practice, we estimate two 5-dimensional interacted panel VAR model: one incorporating a measure of the

[21] Within this framework, market power would imply simultaneously higher credit fluctuations and higher bank interest rate stickiness. The latter point is found by Leroy and Lucotte (2015).

house price cycle and the other a measure of the stock price cycle. In both cases, the asset price series are ordered last, meaning that credit is restricted from reacting immediately to asset prices.[22] Figure 4 depicts the results. As one would expect, credit responses are not fundamentally different and the difference of procyclicality between low and high competition environment remains significant.

Secondly, as it is common in VAR models, we check the robustness of our findings by ordering the variables differently. In our baseline model, our recursive identification scheme orders bank credit before the short-term rate. Our theoretical justification is that the interest rate pass-through is sluggish, justifying the fact that the supply and demand of credit react only with a lag to innovations in short-term rate. Even if our choice is in line with several previous empirical works (see, for instance, Assenmacher- Wesche and Gerlach (2008) and Bouvatier et al. (2012)), it remains arbitrary. It is theoretically not unlikely that credit reacts to the current stance of monetary policy since the changes in interest rate immediatly affect the borrowers' net worth. Therefore to take into account this possibility, we switch the ordering of credit and policy rate in our VAR system as in Goodhart and Hofmann (2008). Figure 5 displays the new IRF and confirms our previous results.[23]

Finally, we check that our conclusions remain identical when we consider a higher lag length (3 lags) for the autoregressive terms (see, Figure 5) and when we change marginally our sample. To carry out the latter robustness test, we re-estimate our canonical econometric model by dropping one country at a time. In this way, we unsure that our results are not driven by the inclusion of one particular country, which is important since the Section 2.2.1 pointed out that some country presented singular behaviours.

Our second set of robustness checks is about data processing. It is well-known that the HP-filter has some drawbacks.[24] One is related to the fact that it implies to define a priori the cycle frequency of the time series, i.e. to set arbitrary the value of the smoothing parameter. In our benchmark model, we have chosen to estimate the cycles at the business cycle frequency for all the macroeconomic series. Indeed, we have set the smoothing parameters at 1600, corresponding to cycles that last between 1 and 8 years. However, as argued by Drehmann et al. (2012) and Borio (2014) one of the features of the financial cycle is that it "has a much lower frequency than the traditional business cycle". In order to address this potential caveat, we assume that credit cycles are twice as long as an usual business cycle. In order to obtain the corresponding value of the smoothing parameter, we follow the approach of Ravn and Uhlig (2002). The authors show that it is optimal to set lambda equal to 1600 multiplied by the fourth power of the observation frequency ratio (here 2). Thus, we set lambda for the credit series to 25600 to obtain cycle lasting twice as long as business cycle.[25] As an alternative to HP-filter, we also employ the Baxter and King (BK) filter (Baxter and King, 1999) in robustness. The latter is based on the approximation of the ideal band-pass in the frequency domain to give estimate of the cyclical of the series.[26] On the whole, the graphs display in Figure 6 indicate that our results are robust to the filtering method.[27] [28]

The extent to which the credit dynamic is affected by a GDP shock could not only depend on the degree of banking competition. Credit responses are possibility also related to other financial characteristics, such as

[22] This ordering choice is questionable. For instance, it implies that policy makers do not use current asset prices when implementing monetary policy. This also implicitly involves that house prices are characterized by a low degree of stickiness since they immediately respond to credit innovations. As a result, we also test for the possibility that credit immediately responds to asset prices by ordering the latter variable before credit. Nevertheless, results are not affected by this change.

[23] This means that correlation between credit and policy rate innovations are small. The other ordering choices appear standard in the literature (see, Christiano et al., 1999).

[24] Note that the typical issue of end-point problem has been addressed by estimating cycle over the period 1997q1-2014q4 with data up to 2015q4. The starting point can also raises some statistical problems (Drehmann and Tsatsaronis, 2014). Therefore, we estimate cycles from 1997q1 with data starting in 1990q1.

[25] Lowe et al. (2002) suggest to set lambda to 400000 to isolate medium-term frequencies of credit series. In this way, it would be obtained cycle ranging from 8-30 years, which is consistent with statistical observations of the average length of the financial cycle. However, the moderate length of our panel forces us to focus more on medium-term frequencies of credit series. Furthermore, it is in line with the financial accelerator theory that focuses on the short-term frequency of the credit cycle. Another issue is related to the fact that our statistical approach supposes that credit cycle is a regular and stationary process by definition, which is criticized by Borio (2014).

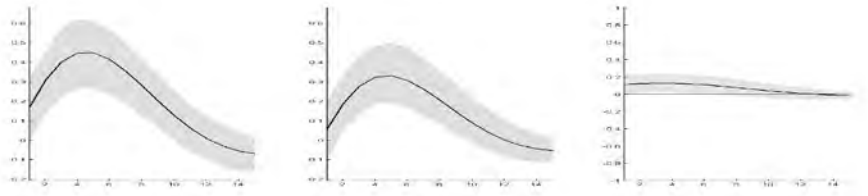
[26] Despite some statistical distinctive features, the BK filter is in line with the Christiano and Fitzgerald (2003) filter.

[27] The only slight difference is for the responses of credit in the case where the Baxter and King filter is used. Indeed, the difference of reaction according to the level of bank competition appears to have a shorter duration.

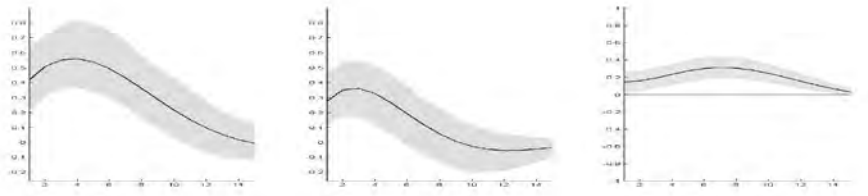
[28] We also run robustness checks regarding the transformation of the Lerner Index (results not reported in this draft). We consider two other versions of the Lerner: one without quarterly interpolation and the other with interpolation and smoothing with the HP-filter as in Georgiadis (2014). In both cases, these amendments do not affect our findings.

the capitalization of the banking system, its soundness or the financial structure. Since these characteristics are potentially correlated with bank competition, it is key to control their effects on our results. Therefore, we extend our baseline model by including three additional interaction variables at same time. Thus, $Z_{i,t}$ is now a (4 * 1) vector. To evaluate the effects of bank competition, the impulse response functions continue to be evaluated at the 20th and 80th percentiles of the distributions of the Lerner Index, while the three other variables are set at their median.[29] Analysing the results in Figure 7, we observe that controlling for the correlations of bank competition with other structural characteristics does not change our previous findings. However, this additional investigation might refine our explanations about the fact that imperfect competition acts as a propagation mechanism of output-gap shock. Two explanations has been previously given: (i) imperfect competition increases frictions, (ii) imperfect competition exacerbates risk-taking behaviours. Because we control for the disturbances in the banking system with the Z-score and the bank riskiness with the capital requirement ratio, we confirm that the first effect ("imperfect competition increases frictions") plays a very significant role. However, this does not imply that the second effect ("imperfect competition exacerbates risk-taken behaviours") is irrelevant.

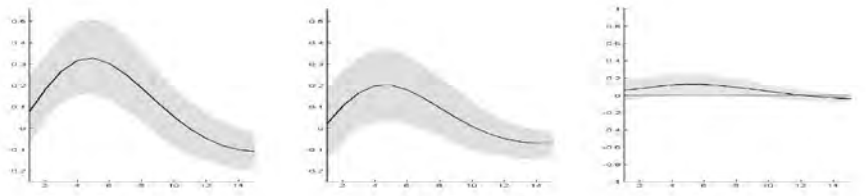
Figure 4: Impulse Response Functions of Credit to a shock of GDP: 5-dimensional VAR - Asset prices



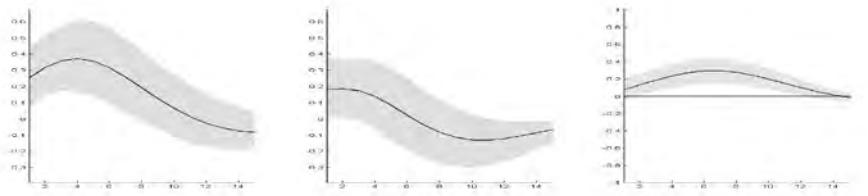
(a) Credit - House prices



(b) Bank Credit - House prices



(c) Credit - Stock prices

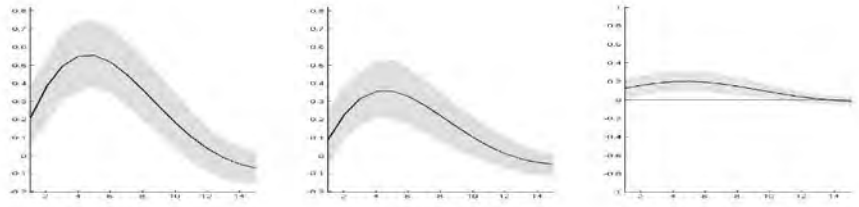


(d) Bank Credit - Stock prices

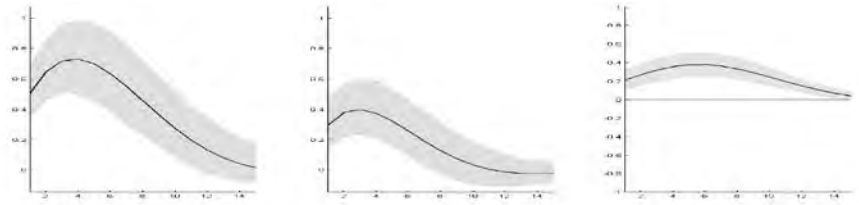
Note: The figure shows impulse responses of Credit and Bank Credit to a one percentage point shock in output cycle evaluated (from the left to the right) at the 80th ("high" level) and 20th ("low" level) percentiles of the Lerner Index sample distribution. The charts on the right represent the difference between the two. The coloured bands represent the 5% error band (two standard-deviations) generated by bootstrap (1000 draws).

[29] The three variables are extracted from the Global Financial Development database of the World Bank. Bank capitalisation, bank soundness and financial structure are proxied by the bank regulatory capital to risk-weighted assets ratio, the bank Z-score index and the stock market capitalization to GDP ratio, respectively.

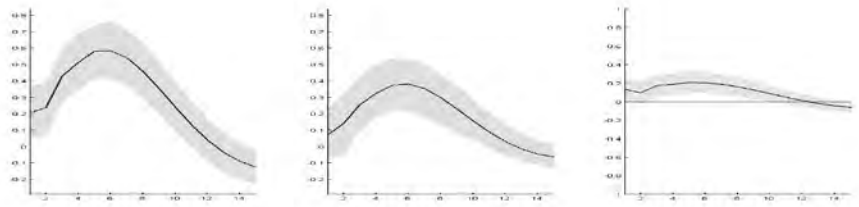
Figure 5: Impulse Response Functions of Credit to a shock of GDP: Different ordering of the variables and IPVAR(3)



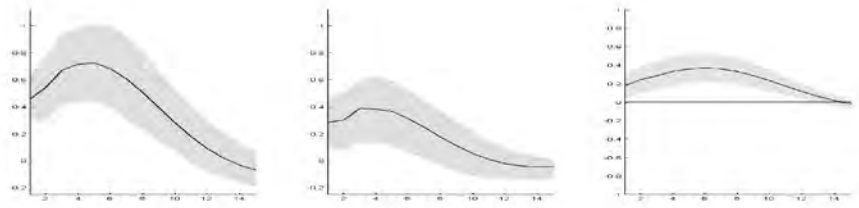
(a) Credit - Different ordering



(b) Bank Credit - Different ordering



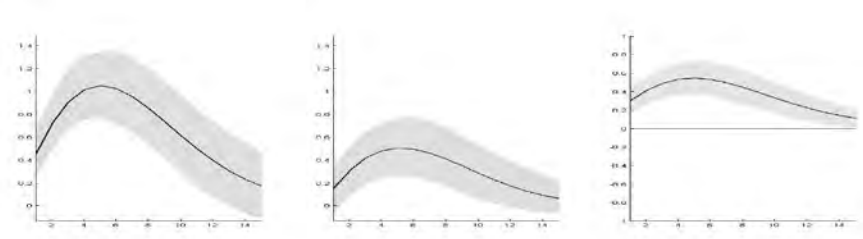
(c) Credit - IPVAR(3)



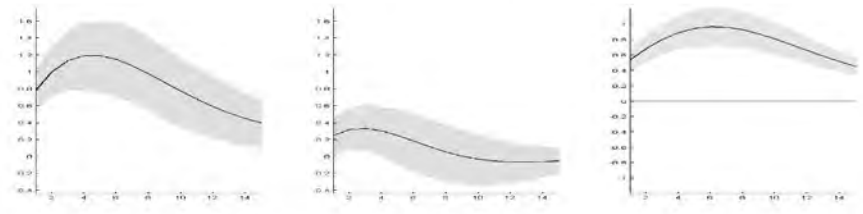
(d) Bank Credit - IPVAR(3)

Note: The figure shows impulse responses of Credit and Bank Credit to a one percentage point shock in output cycle evaluated (from the left to the right) at the 80th ("high" level) and 20th ("low" level) percentiles of the Lerner Index sample distribution. The charts on the right represent the difference between the two. The coloured bands represent the 5% error band (two standard-deviations) generated by bootstrap (1000 draws).

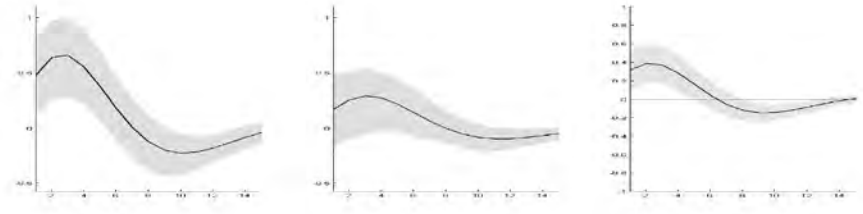
Figure 6: Impulse Response Functions of Credit to a shock of GDP: HP filter with λ equal to 25600 and Baxter-King Filter



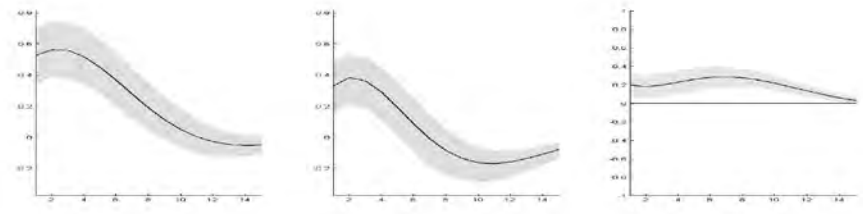
(a) Credit - HP filter



(b) Bank Credit - HP filter



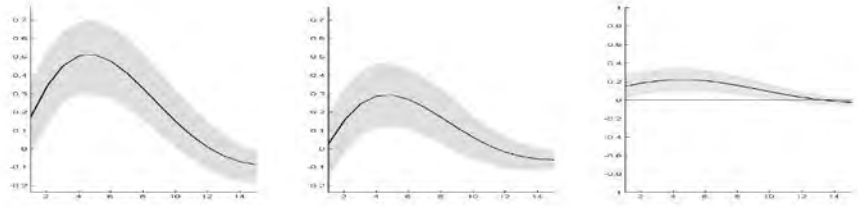
(c) Credit - BK Filter



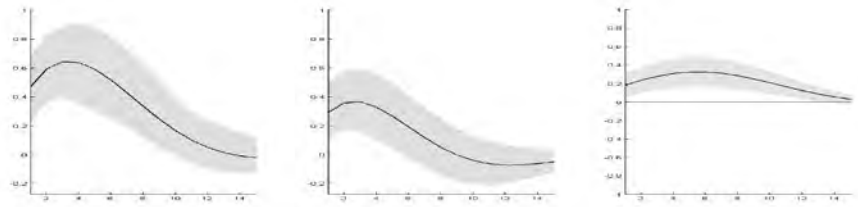
(d) Bank Credit - BK Filter

Note: The figure shows impulse responses of Credit and Bank Credit to a one percentage point shock in output cycle evaluated (from the left to the right) at the 80th ("high" level) and 20th ("low" level) percentiles of the Lerner Index sample distribution. The charts on the right represent the difference between the two. The coloured bands represent the 5% error band (two standard-deviations) generated by bootstrap (1000 draws).

Figure 7: Impulse Response Functions of Credit to a shock of GDP: Controlling for correlation with other structural characteristics



(a) Credit



(b) Bank Credit

Note: The figure shows impulse responses of Credit and Bank Credit to a one percentage point shock in output cycle evaluated (from the left to the right) at the 80th ("high" level) and 20th ("low" level) percentiles of the Lerner Index sample distribution. The charts on the right represent the difference between the two. The coloured bands represent the 5% error band (two standard-deviations) generated by bootstrap (1000 draws).

3. BANK COMPETITION AND CREDIT PROCYCLICALITY AT THE INSTITUTION LEVEL

In this section, we examine whether more granular data support our previous findings. More specifically, we aim to highlight that the bank individual's response to an output shock varies according to the degree of bank competition.

3.1. Data and Methodology

3.1.1. Data

We start by a presentation of the data used in our analysis. The required data are a mix of bank-level and country-level data. We obtain bank's balance-sheet and income statement information from Bankscope database published by the Bureau Van Dijk. This database provides comprehensive detailed information regarding European banking. Our sample comprises more than 3,600 banks operating in the 16 previous analysed economies.[30] Thus, the geographical coverage is strictly identical between the two sections. By contrast, the time-dimension differs since the bank-level data are only available over the period 2005-2014. We apply some selection criteria to build our sample. First, we select unconsolidated statement to avoid double counting from commercial, cooperative and saving banks. Then, we exclude banks of which financial statements are available for less than 5 consecutive years to really benefit from the panel dimension of our sample and we drop banks of which the loans to assets ratio are missing for one of the 5 minimal years of observation. Some basic information on the sample are provided in Table A1.

The bank-level data are employed to measure the growth rate of loans in bank's balance-sheets (which is our dependent variable) as well as to build a set of control variables and an indicator of bank

[30] Since not all variables are available for all bank-year observations, the sample size differs from one regression to another.

market power which varies across banks and time. With regard to the latter point, we measure the market power with the Lerner index, which is the only indicator that complies with the two conditions stated.

Formally, the Lerner index is defined as the difference between price and marginal cost, divided by price:

$$Lerner_{it} = \frac{p_{it} - mc_{it}}{p_{it}} \quad (4)$$

where p the price and mc the marginal cost for the bank i at the year t. In our case, p is the price of assets and is equal to the ratio of total revenue (the sum of interest and non-interest income) to total assets. To obtain the marginal cost, we employ a conventional approach in the literature that consists in estimating a translog cost function and deriving it. Consistent with most banking studies, we consider a production technology with three inputs and one output (see, e.g., Berger et al., 2009, Ariss, 2010, Anginer et al., 2014). Thus, we estimate the following translog cost function:

$$lnTC_{it} = \beta_0 + \beta_1 lnTA_{it} + \frac{\beta_2}{2} lnTA_{it}^2 + \sum_{k=1}^{3} \gamma_k lnW_{k,it} + \sum_{k=1}^{3} \phi_k lnTA_{it} lnW_{k,it} + \sum_{k=1}^{3}\sum_{j=1}^{3} \frac{\rho_{kj}}{2} lnW_{k,it} lnW_{j,it} + \delta_1 T + \frac{\delta_2}{2} T^2 + \delta_3 T lnTA_{it} + \sum_{k=4}^{6} \delta_k T lnW_{k,it} + \varepsilon_{it} \quad (5)$$

Cit corresponds to the total costs of the bank i at the year t, and is equal to the sum of interest expenses, commission and fee expenses, trading expenses, personnel expenses, administrative expenses, and other operating expenses, measured in millions of dollars. T Ait is the quantity of output and is measured as total assets in millions of dollars. $W_{1,it,}$ $W_{2,it}$ and $W_{3,it}$ are the prices of inputs. $W_{1,it}$ is the ratio of interest expenses to total assets. $W_{2,it}$ is the ratio of personnel expenses to total assets. $W_{3,it}$ is the ratio of administrative and other operating expenses to total assets. T is a trend. Furthermore, to reduce the influence of outliers, all variables are winsorized at the 1st and 99th percentile levels (see, e.g., Berger et al., 2009; Anginer et al., 2014). We further impose the following restrictions on regression coefficients to ensure homogeneity of degree one $\sum_{k=1}^{3} \gamma_{k,t} = 1$, $\sum_{k=1}^{3} \phi_k = 0$ and $\sum_{k=1}^{3}\sum_{j=1}^{3} \rho_k = 0$.

Under these conditions, we can use the coefficient estimates from the translog cost function to estimate the marginal cost for each bank i at the year t:

$$mc_{it} = \frac{TC_{it}}{TA_{it}} [\beta_1 + \beta_2 TA_{it} + \sum_{k=1}^{3} \phi_k lnW_{k,it} + \delta_3 T] \quad (6)$$

The translog cost function is estimated using pooled ordinary least squares (OLS) for each country separately to reflect differences in technology across European banking markets. We also include in the regression a trend (T) to control evolution in translog function over time.

Recently, Koetter et al. (2012) point out that the estimation approach discussed above might lead to biased Lerner indices. The rationale is that this approach is based on the implicit assumption that banks are fully efficient. In order to correct this potential bias, the authors propose an efficiency-adjusted estimate of the conventional Lerner index, as follows:

$$adjusted - Lerner_{it} = \frac{(\hat{\pi}_{it} + \hat{TC}_{it}) - \hat{mc}_{it}}{(\hat{\pi}_{it} + \hat{TC}_{it})} \quad (7)$$

where $\hat{\pi}_{it}$ is the estimated profit, $\hat{TC}_{it}$ the estimated total cost and $\hat{mc}_{it}$ the marginal cost.

To estimate this adjusted Lerner index, we follow Koetter et al. (2012) and first use a Stochastic Frontier Analysis (SFA) to estimate the translog cost function. We then obtain $\hat{TC}_{it}$ and $\hat{mc}_{it}$. Such an approach has the advantage of taking into account banks' cost inefficiency, defined as the distance of a

bank from a cost frontier accepted as the benchmark.[31] Second, we specify an alternative profit function (Berger and Mester, 1997), that we estimate using SFA to obtain $\hat{\pi}_{it}$.

In addition to bank-level variables, we also collect or build country-level variables. First, we consider three country-level measures of the Lerner index. The first is the same that the one used in the previous section and is from the Global Financial Development Database (GFDD). In this way, we effectively examine whether granular data on credit support our cross-country analysis. The two other Lerner indices are built by taking the median value by country and by year of our own individual estimates of the conventional and efficiency-adjusted Lerner indices. Finally, our analysis also requires a yearly measure of the business cycle fluctuation. For that, we use the output-gap measure from the OECD Economic Outlook database. The latter is defined as the deviation (in %) of actual GDP from the potential GDP obtained from a production function framework.[32] Summary statistics of the variables used in this section can be found in Table A2.

3.1.2. Methodology

Our empirical specification is designed to test whether the degree of bank competition impacts the reaction of banks -in terms of supply of loansto an output-gap shock. Thus, the model that we estimate has the following form:

$$\Delta ln(loans_{it}) = \beta_1 OG_{ct} + \beta_2 OG_{ct} * Lerner_{i,t-1/c,t-1} + \beta_3 Lerner_{i,t-1/c,t-1} + \sum_{j=4}^{n} \beta_j X_{j,i,t-1} + \mu_{i/c} + \lambda_t + \varepsilon_{it} \quad (8)$$

with $i = 1, ..., N$, $c = 1, ..., 16$ and $t = 1, ..., T$. N denotes the number of banks, c the country and T the total number of years. In our model, the growth rate of loans $(\Delta ln(loans_{it}))$ is regressed on the output-gap (OG_{ct}), the Lerner index $(Lerner_{i,t-1/c,t-1})$,[33] their product term $(OG_{ct}\ Lerner_{i,t-1/c,t-1})$, which constitutes our main variable of interest, and some bank-specific control variables $(X_{j,i,t-1})$. The vector of control variables includes: the log of the total of assets, the loans over total assets ratio, the equity over total assets ratio and, in some specifications, the product term between our measure of bank competition and monetary policy shock. In order to avoid an endogeneity bias, all bank-specific variables have been lagged. We further note that we include bank-fixed effects (μ_i) (or alternatively country-fixed effects (μ_c) in some specifications) and year fixed effects (λ_t) to capture bank specificities and time-varying common shocks.[34]

Unlike the cross-country analysis, here the single equation modelling is perfectly appropriated. Indeed, the possibility that the output-gap of country i responds to the loan growth of one particular bank is limited because in most cases the weight of a random bank is small compared to the overall economy. Therefore, this makes us relatively confident that the output-gap be exogenous and that our regression results well capture a causal link from output-gap to bank credit growth. However, to address all concerns about endogeneity -due to the fact that the banking markets are not atomistic and that some banks are big enough to have notable impact on the overall economywe have run some robustness checks excluding the banks with very significant market shares.

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[31] Formally, the SFA consists of decomposing the error term of the translog cost function into two components, such as $\varepsilon_{it} = v_{it} + \mu_{it}$. The random error term v_{it} is assumed iid with $v_{it} \sim N(0, \sigma 2)$ and independent of the explanatory variables. The inefficiency term μit is iid with $\mu_{it} \sim N(0, \sigma 2)$ and independent of the error term v_{it}. It is drawn from a non-negative distribution truncated at zero.

[32] The potential GDP required to compute the output-gap is obtained from a production function framework.

[33] In some specifications, we consider an aggregate measure of the Lerner index $(Lerner_{ct})$, as in previous section, while in other specifications, we take advantage of the granularity of the data and use bank-level estimates of the Lerner index $(Lerner_{ct})$.

[34] Initially, a dynamic specification of our model has been specified and estimated using both differ- ence and system GMM. However, results, in both cases, indicated that the lagged dependent variable is not significant. Note that our findings and specification choice is in line with Fungáčová et al. (2014).

3.2. Results

The estimation results for equation (8) are shown in Table 1 and Table 2. Table 1 reports estimation results obtained from three country-level measures of bank competition: the Lerner index from the GFDD (columns (1) to (4)), the own estimates of the cross-country conventional Lerner index (columns (5) to (8)) and the own estimates of the cross-country efficiency-adjusted Lerner index (columns (9) to (12)). The regressions (1), (5) and (9) include the *output gap*, the *Lerner index* and their product term as explanatory variables. To ensure that these estimates do not capture the effects of other variables, the regressions that follow include in more some conventional control variables, while the regressions (3), (7) and (11) control for the existence of a bank-lending channel effect. Finally, in regressions (4), (8) and (12), we replace bank fixed effects by country fixed effects.[35]

From these estimates, the first step consists in checking that the credit is on average procyclical, i.e. change in the business cycle positively impacts the growth of credit. Since our regressions include the interaction of the *output −gap* and the *Lerner index*, the coefficient estimates of *output −gap* cannot be read as an average effect, but as the effect of the output-gap on credit when the banking market is perfectly competitive, i.e. when the Lerner index is equal to 0. The estimates of the procyclicality for an average level of bank competition are displayed at the bottom of the table. Estimated coefficients vary between 1.442 and 1.677 and are very statistically significant. These results imply that a GDP growth of 1 percentage point under its potential is associated with approximately 1.5 percentage point decline of the loan growth.

The second step is to check whether the level of procyclicality varies according to the level of bank competition. Across all specifications, the interaction of *Lerner index* and *output gap* enters with positive coefficient which are significant at the 1% level. This suggests that a lower country level of bank competition significantly increases the reaction of loan supply to a change of output-gap. Apart from statistical significance, we also check the economic significance of the relationship. For that, as in previous section, we compute and compare the procyclicality at the first quintile and the fourth quintile of the empirical distribution of the Lerner indices. In Table 1, we show that the economic effect is sizeable. For instance in the specification (1), the estimated procyclicality is equal to 1.443 and 1.896 for a low and high levels of the Lerner index, respectively. In summary, the estimations with granular data corroborate the findings of the previous section: bank competition reduces credit procyclicality.

Our estimations also highlight other results. In brief, we find that the main effect of the Lerner index is significantly negative in all specifications.[36] More competitive the market, more important the growth of loans is, which is consistent with the traditional microeconomic view. Furthermore, size (the log of total assets) and the loan ratio are negatively associated with loan growth. Finally, in regressions (4), (8) and (12), we have some interesting results regarding the existence of a bank lending channel in Europe. First, it appears that the response of bank lending to a change in the monetary policy rate (ΔMP) has the expected negative sign. If we consider the regression (4), an increase of 1 point of the monetary policy rate leads to a decline of 1.14 percentage point of the loan growth. Second, in line with Fungáčová et al. (2014) and Leroy (2014), we find for two of the three macro-measures of bank competition that the interaction terms of ΔMP and *Lernerindex* are significantly positive. This indicates that lower bank competition increases the bank lending channel, i.e. the monetary policy transmission.

We now focus on the estimation results reported in Table 2. In these regressions, *Lerner index* is a bank-level measure of market power. It corresponds to the detailed data used to build our two own country-level measures of bank competition. Using bank-specific estimations of bank market power is of great interest because it is a convenient way to disentangle demand from supply credit movements. This relies on the hypothesis that bank-specific market power influences the loan supply, while the loan demand would be independent from change in bank market power.[37] Regressions (1)-(4) present estimates with the conventional Lerner index, while regressions (5)-(8) with the efficiency-adjusted Lerner

[35] All specifications also include year fixed effects.

[36] The output-gap average is equal to 0.506.

[37] By contrast, it is less certain that loan demand be independent from the aggregate level of bank competition, since the later could impact the cost of credit, i.e. be correlated with macroeconomic factor playing on credit demand.

index. Apart from the different level of observation of the market power, the regressions are identical to the ones presented previously. Thus, the regressions (1) and (5) only include the *output - gap*, the *Lerner index* and their product term as explanatory variables. The regressions (2) and (4) include in more some control variables, while the regressions (3) and (7) control for the existence of a bank-lending channel and regressions (4) and (8) for the existence of country fixed effects.

Overall, the results obtained from individual market power estimates are similar to those with the aggregate-level estimates: (i) credit is procyclical and (ii) the coefficients of the Lerner index and *output - gap* product term are positive and very significant for both the conventional and efficiency-adjusted *Lerner index*. Interestingly, we also observe that the economic impact of bank market power on credit procyclicality remains sizeable and comparable to the previous ones. For instance, moving from the 20^{th} percentile of the conventional Lerner Index to the 80^{th} percentiles increases the sensitivity of bank lending growth to change of business cycle by 0.453 point (for regression (1)). The effects are slightly less important when we consider the efficiency-adjusted Lerner index since the interquintile value equal 0.366 in regression (5) and 0.262 in regression (6).

Table 1: Credit procyclicality and bank competition: Aggregated measures of bank competition

	Lerner index from the GFD dat a set				Convent ional Lerner index (own estimates)				Efficiency-adjusted Lerner index (own estimates)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Output Gap	1.064***	1.082***	1.094***	1.086***	-0.801***	-0.464*	-0.832***	-0.996***	-0.455***	-0.247	-0.299*	-0.346**
	(0.095)	(0.100)	(0.098)	(0.097)	(0.261)	(0.245)	(0.233)	(0.271)	(0.156)	(0.161)	(0.160)	(0.159)
Lerner index	-19.619***	-21.031***	-18.394***	-16.331***	15.567***	-2.525	-1.060	9.931**	17.100***	13.573***	14.680***	18.468***
	(1.995)	(2.091)	(2.046)	(2.231)	(5.326)	(5.826)	(5.996)	(4.609)	(1.888)	(1.976)	(2.040)	(1.776)
Output Gap*Lerner index	3.713***	3.079***	2.908***	3.185***	10.895***	9.712***	11.082***	11.491***	8.256***	7.362***	7.433***	7.363***
	(0.487)	(0.503)	(0.501)	(0.530)	(1.113)	(1.071)	(1.007)	(1.129)	(0.674)	(0.724)	(0.725)	(0.621)
Total assets		-13.416***	-13.496***	-0.502***		-13.025***	-13.073***	-0.508***		-12.154***	-12.256***	-0.494***
		(1.493)	(1.489)	(0.070)		(1.500)	(1.493)	(0.070)		(1.391)	(1.392)	(0.070)
Loans / Total assets		-28.359***	-26.845***	-6.142***		-30.735***	-29.647***	-6.859***		-28.272***	-27.610***	-6.801***
		(2.472)	(2.489)	(0.731)		(2.555)	(2.569)	(0.739)		(2.345)	(2.363)	(0.740)
Equity / Total assets		-13.108	-13.882	-0.783		-20.004**	-21.966**	-2.771		-20.673**	-21.801**	-2.869
		(9.337)	(9.353)	(2.586)		(8.901)	(8.909)	(2.604)		(8.925)	(8.936)	(2.604)
Δ MP			-2.194***	-2.574***			-2.148***	-1.896**			-1.730***	-1.840***
			(0.233)	(0.255)			(0.805)	(0.774)			(0.523)	(0.457)
Δ MP * Lerner index			8.220***	8.902***			3.789	1.486			4.690***	4.257**
			(1.301)	(1.741)			(3.380)	(3.338)			(1.774)	(1.683)
Constant	17.930***	214.188***	213.475***	28.501***	11.868***	208.321***	207.302***	22.319***	9.464***	190.398***	190.884***	19.324***
	(0.378)	(20.894)	(20.828)	(1.260)	(1.049)	(21.232)	(21.137)	(1.503)	(0.562)	(19.607)	(19.641)	(1.233)
Average Lerner index	0.119	0.119	0.119	0.119	0.22	0.22	0.22	0.22	0.243	0.243	0.243	0.243
Low Lerner index	0.069	0.069	0.069	0.069	0.174	0.174	0.174	0.174	0.2	0.2	0.2	0.2
High Lerner index	0.181	0.181	0.181	0.181	0.239	0.239	0.239	0.239	0.268	0.268	0.268	0.268
Procyclicality: Average	1.508	1.45	1.442	1.467	1.6	1.677	1.611	1.537	1.551	1.542	1.507	1.443
Procyclicality: Low Lerner index	1.322	1.296	1.296	1.307	1.097	1.228	1.099	1.006	1.196	1.225	1.188	1.127
Procyclicality: High Lerner index	1.737	1.64	1.621	1.663	1.808	1.862	1.822	1.756	1.763	1.731	1.698	1.632
Difference between High and low	0.415	0.344	0.325	0.356	0.711	0.633	0.723	0.749	0.566	0.505	0.51	0.505
Observations	24,719	24,719	24,719	24,719	24,771	24,771	24,771	24,771	24,771	24,771	24,771	24,771
R-squared	0.529	0.558	0.560		0.528	0.556	0.558		0.539	0.563	0.565	
Number of banks	3,736	3,736	3,736	3,736	3,736	3,736	3,736	3,736	3,736	3,736	3,736	3,736
F	1816	1470	1304	.	1711	1408	1295	.	1724	1408	1282	.

Note: "Low" and "High" Lerner index refer to the 20th and the 80th percentiles of the sample distribution of the Lerner index, respectively. Robust standard errors are reported below their coefficient estimates. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2: Credit procyclicality and bank competition: Bank-level measures of bank competition

	Conventionnal Lerner Index (bank level)				Efficiency-adjusted Lerner index (bank level)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output Gap	0.933***	0.866***	0.807***	0.959***	1.054***	1.174***	1.100***	1.053***
	(0.128)	(0.141)	(0.138)	(0.112)	(0.110)	(0.114)	(0.118)	(0.107)
Lerner index	5.592***	6.400***	5.914***	3.751***	8.777***	7.951***	7.874***	5.941***
	(1.681)	(1.778)	(1.809)	(1.281)	(0.975)	(1.037)	(1.079)	(0.904)
Output Gap*Lerner index	3.493***	3.527***	3.589***	3.074***	2.440***	1.746***	1.857***	2.204***
	(0.440)	(0.483)	(0.481)	(0.385)	(0.325)	(0.308)	(0.325)	(0.307)
Total assets		-13.660***	-13.736***	-0.439***		-14.299***	-14.369***	-0.250***
		(1.527)	(1.516)	(0.059)		(1.682)	(1.671)	(0.065)
Loans / Total assets		-29.748***	-28.617***	-6.279***		-28.942***	-27.817***	-5.785***
		(2.508)	(2.521)	(0.664)		(2.649)	(2.660)	(0.679)
Equity / Total assets		-19.345**	-20.078**	-1.606		-21.327**	-22.413**	-0.085
		(9.328)	(9.336)	(2.609)		(10.257)	(10.249)	(3.019)
Δ MP			-0.618**	-0.898**			-0.931***	-1.217***
			(0.292)	(0.352)			(0.350)	(0.400)
Δ MP * Lerner index			-2.247**	-1.902*			-0.511	-0.213
			(0.923)	(1.062)			(0.909)	(0.959)
Constant	13.824***	213.870***	213.664***	22.637***	12.159***	221.074***	220.733***	18.741***
	(0.354)	(21.281)	(21.135)	(1.042)	(0.357)	(23.646)	(23.501)	(1.216)
Average Lerner index	0.209	0.209	0.209	0.209	0.241	0.241	0.241	0.241
Low Lerner index	0.146	0.146	0.146	0.146	0.163	0.163	0.163	0.163
High Lerner index	0.275	0.275	0.275	0.275	0.313	0.313	0.313	0.313
Procyclicality: Average	1.663	1.604	1.558	1.602	1.643	1.596	1.548	1.585
Procyclicality: Low Lerner index	1.443	1.381	1.331	1.408	1.453	1.459	1.403	1.413
Procyclicality: High Lerner index	1.896	1.838	1.797	1.807	1.819	1.721	1.682	1.744
Difference between High and Low	0.453	0.457	0.465	0.399	0.366	0.262	0.278	0.3308
Observations	24,194	24,194	24,194	24,194	23,765	23,765	23,765	23,765
R-squared	0.529	0.559	0.561		0.538	0.568	0.569	
Number of banks	3,661	3,661	3,661	3,661	3,622	3,622	3,622	3,622
F	1721	1404	1256	.	1722	1416	1284	.

Note: "Low" and "High" Lerner index refer to the 20th and the 80th percentiles of the sample distribution of the Lerner index, respectively. Robust standard errors are reported below their coefficient estimates. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

4. FINANCIAL STRUCTURE AND CREDIT PROCYCLICALITY

Finally, we extend our previous analysis by investigating whether the financial structure of an economy drives credit procyclicality. Following Levine (2002), financial structure refers to the importance in an economy of bank-based intermediation relative to market-based intermediation. All financial systems combine the two intermediation channels, but the financial structure varies across countries. Indeed, even if the European banking sector is heavily bank-based (see, e.g., (Langfield and Pagano, 2016)), significant cross-country differences exist. For example, Gambacorta et al. (2014) show that peripheral euro area countries (Italy, Portugal, Spain) exhibit more bank-based financial structures than core euro area countries (Belgium, France, Germany, Netherlands). Therefore, this implies that the nature of relationships between lender and borrower differs in Europe. Indeed, bank-based systems are characterized by more reliance on relationship-banking while market-based systems are associated with more arm's length relationships (Rajan and Zingales, 2001). These two kinds of relationship matter for competition: the first one, which implies opacity and implicit contracts, limits it, whereas the second one, characterized by transparency and explicit contracts, favours it. As a result, the financial structure of economies is not orthogonal to their competitive environment, which justifies the focus of this section.

The theoretical literature has long debated the relative merits of bank-based (or relationship-banking) and market-based (or arm's length) systems in terms of economic performance (Allen and Gale, 2000). However, since the pioneer paper of Levine (2002), no clear empirical evidence emerged regarding the superiority of bank-based or market-based in promoting economic growth. Most of the studies do not find that financial structure *per* se matters, suggesting that banks and financial markets are complementary, and that it is the overall provision of financial services which is important for growth. However, as argued by Langfield and Pagano (2016), the effect of financial structure on economic growth is not the only dimension along which one can assess the relative merits and disadvantages of these two financial systems. Another key dimension is the extent to which banks and markets differ in their moderating effects on business cycle fluctuations, and thus, whether financial structure is likely to explain cross-country differences in economic recovery paths. Indeed, the role of bank financing in economic recovery is a controversial issue since Calvo et al. (2006) pointed out "Phoenix miracles", i.e. the fact that output recovery occurs with virtually no recovery of private sector credit.

For the proponents of the bank-based system, the comparative advantage of banks vis-à-vis markets is their ability to collect private information through a long-term relationship with borrowers. As argued above, such information implies that banks are more likely to supply loans during an economic downturn, because they are able to identify solvent borrowers facing temporary liquidity shocks (see, e.g., Bolton et al., 2016, thus smoothing the impact of a recession. Despite the informational superiority of the banking sector, Langfield and Pagano (2016) do not find a low sensitivity of bank lending to economic activity. On the contrary, they find for a large sample of European countries that bank lending is more volatile and pro-cyclical than bond financing, especially during financial crises. More precisely, in line with Adrian et al. (2013) and Grjebine et al. (2014), findings obtained by Langfield and Pagano (2016) suggest that the two types of financing are partial substitutes. Indeed, they observe a substitution between loans and bond financing in the aftermath of the subprime crisis. This means that firms located in countries with well-developed corporate debt markets were able to respond to the contraction in bank loan supply by issuing more debt securities. Consequently, according to this result, it is expected that marketbased economies would be more resilient to macroeconomic shocks than bank-based economies.

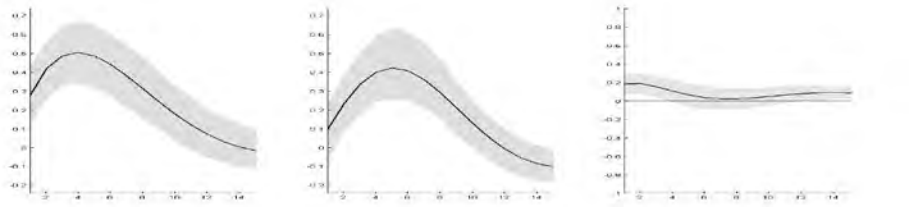
Two recent empirical studies (Allard and Blavy, 2011; Gambacorta et al., 2014) tried to clarify this issue. To this end, they cluster their sample of countries as bankoriented or market-oriented, and assess whether the speed of economic recoveries after a crisis is significantly different in bank-based and market-based economies. Results obtained by Allard and Blavy (2011) suggest that market-based economies recover faster than bank-based economies. The gap in terms of cumulative growth between and 1.4 percentage points two years into the recovery. This gap increases to 2.7 percentage points when they

compare strongly market-based economies to strongly bank-based economies. More importantly, Allard and Blavy (2011) show that the nature of the crisis matters. They find that financial crises negatively impact the ability of market-based economies to recover compared to bank-based economies. An opposite result is obtained by Gambacorta et al. (2014). Indeed, they show that when recessions coincide with a financial crisis, bank-based economies tend to be more severely hit than market-based economies, since the ability of banks to supply credit tends to be damaged. The total real GDP loss in countries with bank-oriented system is three times severe than in those with a market-oriented financial structure, while the inverse trend is observed during a "normal" recession.

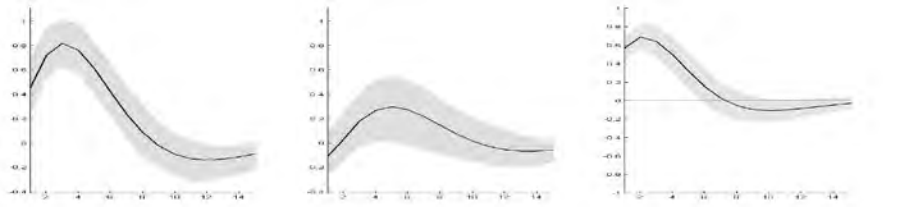
In light of these conflicting results, one of the contributions of this paper is to extend this emerging literature by estimating whether differences in financial structure in Europe could explain cross-country heterogeneity in credit procyclicality. Contrary to Allard and Blavy (2011) and Gambacorta et al. (2014), we do not split our sample of countries in two sub-samples, but we consider a time-varying aggregate indicator of financial structure. Because there is no direct measure of the intermediation services that banks and markets provide, we use a bank-market ratio as a proxy for financial structure. In line with Levine (2002) and Langfield and Pagano (2016), this ratio is defined as bank credit divided by the stock and private bond market capitalisation. Larger values of the ratio indicate a more bank-based financial system. Moreover, to control for the fact that the financial structure can vary over the business cycle (see, Grjebine et al., 2014; Langfield and Pagano, 2016), we consider the trend of the bankmarket ratio by applying a HP filter.

Due to the nature of our measure of financial structure, we rely on our macroeconometric framework to assess the conditional effect of the financial structure on credit procyclicality. We re-estimate our baseline IPVAR model by replacing the Lerner index by the bank-market ratio. Results that we obtain are reported in Figure 8. As before, we consider alternatively the bank credit and the total credit as endogenous variable, and estimate the IPVAR model by considering both the OLS fixed effects and the Mean Group estimators. We can see that more bank-based financial structures are conditionally associated with a higher credit procyclicality. Following Langfield and Pagano (2016), this result could be explained by the procyclical deleveraging process in the banking sector, which makes credit supply more sensitive to economic activity fluctuations in bank-based structures than in market-based structures. Furthermore, according to Adrian et al. (2013), this deleveraging process can be exacerbated by regulatory requirements. Indeed, they argue that credit supply decreases during a recession because banks are forced to reduce their exposure to rising default risk in order to satisfy a Value-at-Risk constraint. Moreover, competition from direct finance may also matter. Indeed, beyond the fact that higher competition from non-bank financial intermediaries puts pressure on banks to price their lending and deposit rates more competitively (see, e.g., Mojon, 2000; Gropp et al., 2014), we would also expect that easier access to direct debt financing puts pressure on banks to reduce their procyclical behaviour since it decreases the dependency of some borrowers on intermediaries for financing. Finally, our findings confirm the fact that the financial structure of an economy and the degree of banking competition are linked. Indeed, as we argue above, a more market-based financial structure is expected to foster competition within the banking industry, inducing a lower credit procyclicality as our previous results suggest.

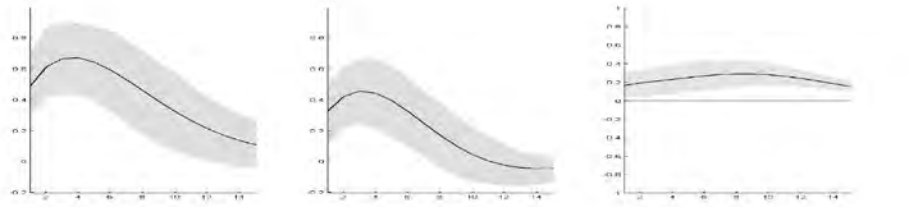
Figure 8: Impulse Response Functions of Credit to a shock of GDP: Financial structure



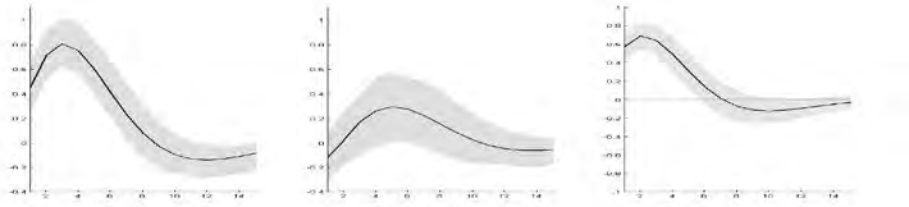
(a) Credit - Fixed effects



(b) Credit - Unit Specific Slope Heterogeneities



(c) Bank Credit - Fixed effects



(d) Bank Credit - Unit Specific Slope Heterogeneities

Note: The figure shows impulse responses of Credit and Bank Credit to a one percentage point shock in output cycle evaluated (from the left to the right) at the 80th ("high" level) and 20th ("low" level) percentiles of the indicator of financial structure. The charts on the right represent the difference between the two. The coloured bands represent the 5% error band (two standard-deviations) generated by bootstrap (1000 draws).

5. CONCLUSION

This paper is the first to empirically assess whether the degree of competition in the financial system constitutes a driving force of credit procyclicality. More precisely, the main objective of this paper is to gauge whether the sensitivity of credit to the business cycle is conditional to the level of competition. To this end, we consider a large sample of European economies and use two complementary panel data approaches. The first relies on macroeconomic data and consists of estimating an interacted panel VAR framework (IPVAR), recently developed by Towbin and Weber (2013), in which credit procyclicality is defined as the orthogonalized impulse response function of credit cycle to a GDP cycle shock. The

main advantage of such an approach is that we can explicitly assess whether the time-varying level of competition as an exogenous factor acts on the response of credit to a GDP shock. Indeed, we can compute and compare impulse response functions according to the level of competition. We then rely on bank-level data by estimating a single-equation model, in which we control for some individual characteristics of banks that could explain their credit policy. Considering more than 3,600 banks located in Europe, we analyse whether the market power of each bank affects the link between the output-gap and the annual growth rate of loans.

Moreover, contrary to most of the studies in the banking literature, we not only focus on competition within the banking sector, but we also consider the competition from financial markets. Following the existing literature, we proxy the level of competition within the banking industry using the Lerner index. This index measures the degree to which firms can markup price above marginal cost, and then is an indicator of the degree of market power. A country-level Lerner index is considered within the IPVAR framework, and we use balance-sheet data to compute an individual Lerner index within our micro-analysis. Concerning the level of competition from direct finance, it is proxied by an aggregate measure of the financial structure of an economy. This measure is defined as the ratio of bank credit divided by the stock and private bond market capitalisation. Lower values of the ratio indicates a more market-based financial system, and then a higher competition from non-bank financial institutions.

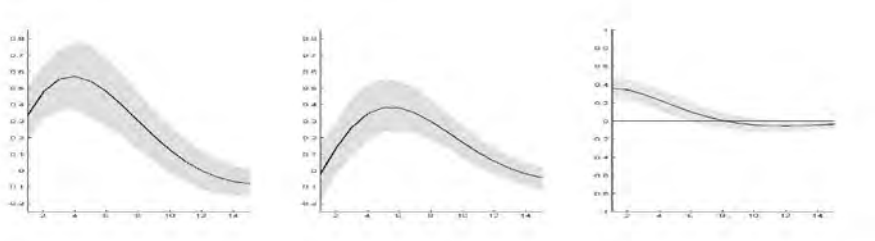
Results that we obtain at the macroand micro-level suggest that the procyclicality of credit is higher in economies where competition among banks is relatively low. This means that the lack of competition within the banking industry tends to exacerbate the sensitivity of loans to the business cycle, and then to amplify and propagate shocks to the macroeconomy. As we explain in the paper, two possible reasons could explain this result. First, competition may lead banks to operate in a more efficient way, in particular improving the screening and monitoring of borrowers. This leads to reduce asymmetric information, weakening the repercussion of a real shock on the financial conditions. The second possible explanation relates to the literature on bank competition and financial stability. Indeed, a large theoretical and empirical literature supports the fact that banks hold more capital and engage in less risky activities when competition increases. This less risk-taking behaviour of banks implies that credit boom is less important in the upward phase of the cycle, and consequently that banks experience less financial losses in the downward phase, saving the ability of bank to supply new loans during a recession.

If we now turn to the relationship between the financial structure of an economy and credit procyclicality, we find that more bank-based economies are characterized by a higher credit procyclicality. Beyond the fact that this result could be explained by the relatively pronounced deleveraging process in the European banking sector (Langfield and Pagano, 2016) and the competition from direct finance, we can also relate it to our previous findings. It confirms the link between the financial structure of an economy and the level of competition within the banking industry. Due to a more arm's length relationship and a higher transparency, market-based systems are expected to foster competition within the banking sector, and then to reduce the procyclicality of credit.

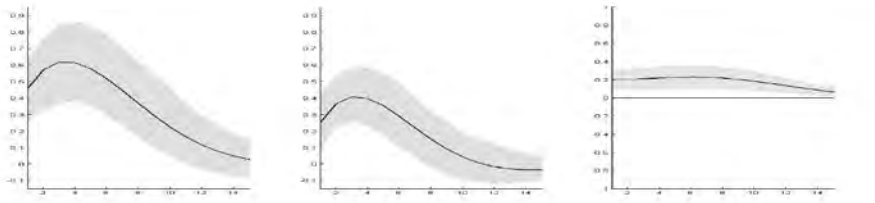
In terms of policy implications, our findings first suggest that promoting competition within the European banking sector should ensure a lower procyclicality of credit, and then a relatively less sensitivity of investment and consumption to the business cycle. Consequently, by limiting the amplification mechanism of the financial sphere to the real sphere, such a pro-competitive policy is expected to reduce macroeconomic volatility. Furthermore, a lower credit procyclicality should limit credit booms and an excessive accumulation of risks during the upward phase of the business cycle. Since credit booms usually precede financial crises (see, e.g., Schularick and Taylor, 2012), our results can also be read as an evidence that greater bank competition reduces financial instability, supporting the "competition-stability" view. The latter, advocated by Boyd and De Nicolo (2005), rejects the existence of a trade-off between competition and stability. Finally, in line with an emerging empirical literature, our results confirm the fact that the financial structure of an economy and the development of financial markets can help to mitigate the contraction in the supply of loans during a recession, and thus, to soften recession costs. These findings support the recent initiative by the European Commission aiming at implement policies to develop markets for corporate debt securities.

APPENDIX

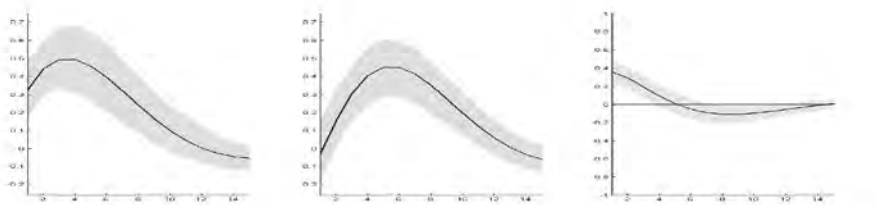
Figure A1: Impulse Response Functions of Credit to a GDP shock: Sample split



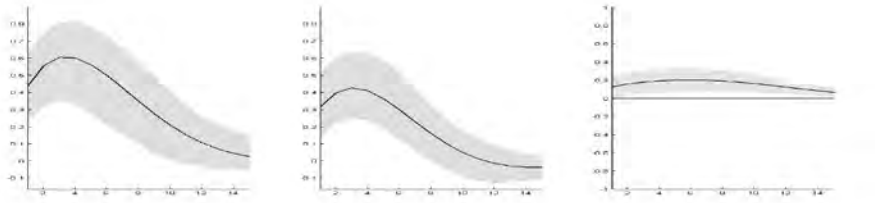
(a) Total Credit - Bank competition



(b) Bank Credit - Bank competition



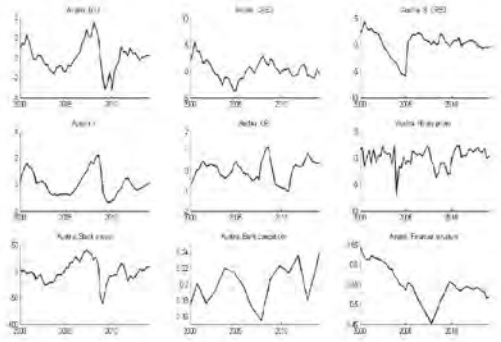
(c) Total Credit - Financial structure (Global structure)



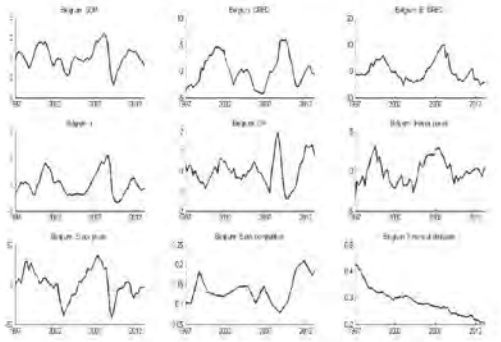
(d) Bank Credit - Financial structure (Global structure)

Note: The figure compares the impulse response functions of Credit/Bank Credit to a one unit shock in GDP for economies characterized by a low and a high level of competition in the financial sphere. Competition refers both to competition among banks and competition from financial markets. In order to split our initial sample into two groups, we rank the countries according to country averages of Lerner index and of our measure of financial structure. Credit responses depicted on the left correspond to economies where competition in the financial system is weaker, i.e. characterised by low bank competition or bank-based financial intermediation. The "low bank competition" sub-sample comprises: Austria, Denmark, Greece, Ireland, Norway, Spain, Sweden and the United Kingdom, while the "bank-based" sub-sample includes: Austria, Denmark, Germany, Greece, Ireland, Italy, Portugal and Spain. Obviously, credit responses depicted on the centre correspond to the average reaction of countries where banking markets are more competitive (Belgium, Finland, France, Germany, the Netherlands, Portugal, Sweden and Switzerland) and where the market-based intermediation is more developed (Belgium, Finland, France, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom).

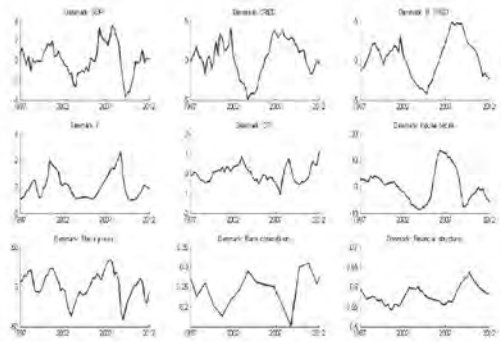
Figure A2: Time series by country



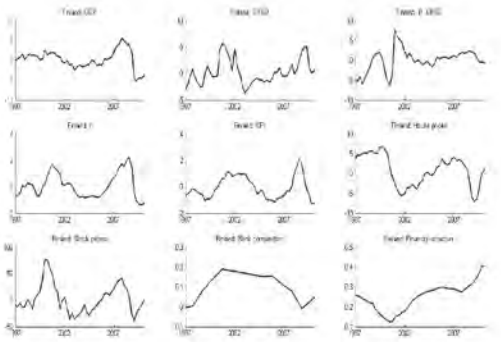
(a) Austria



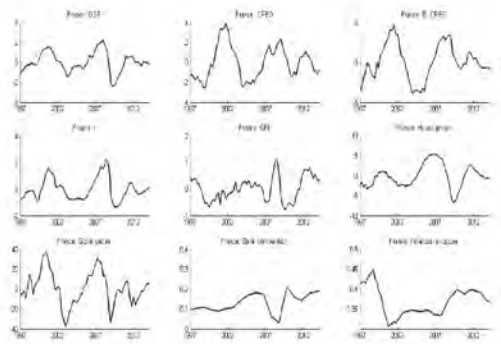
(b) Belgium



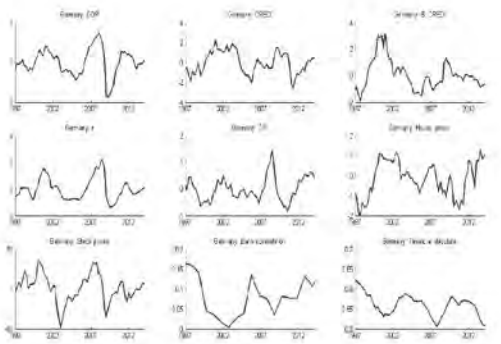
(c) Denmark



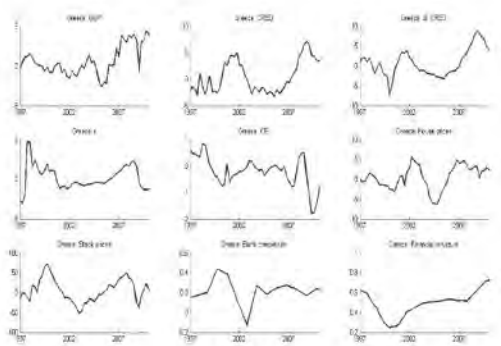
(d) Finland



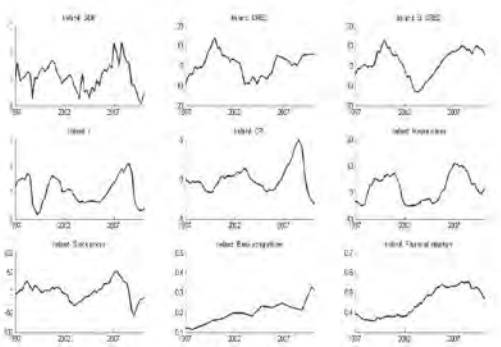
(e) France



(f) Germany

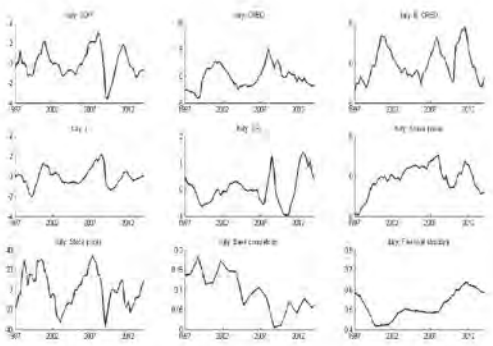


(g) Greece

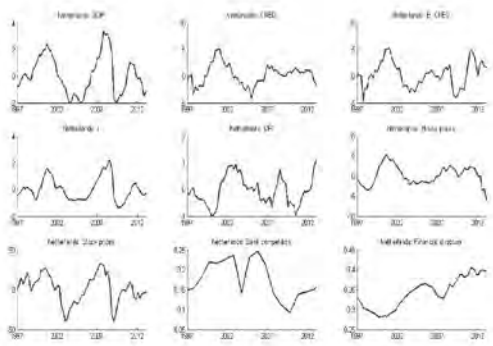


(h) Ireland

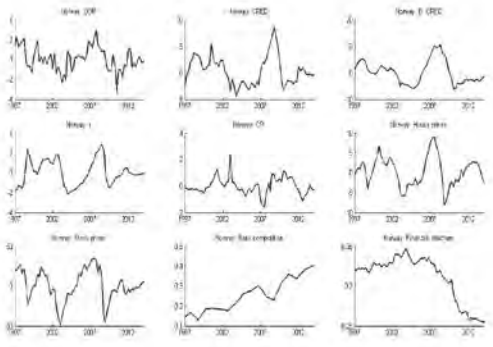
Figure A3: Time series by country



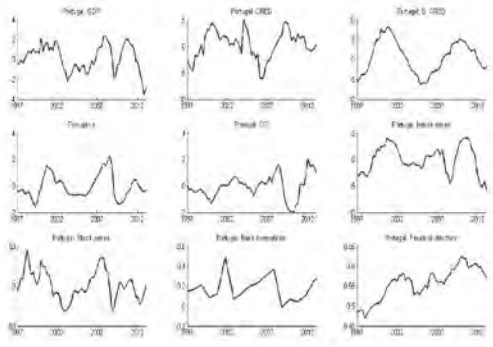
(i) Italy



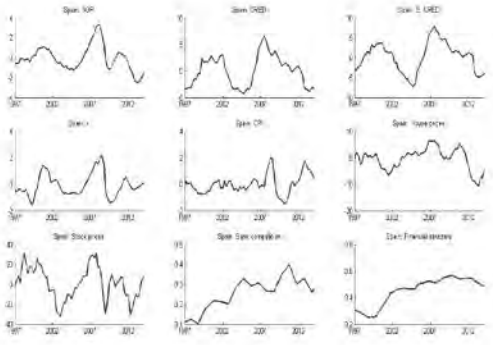
(j) the Netherlands



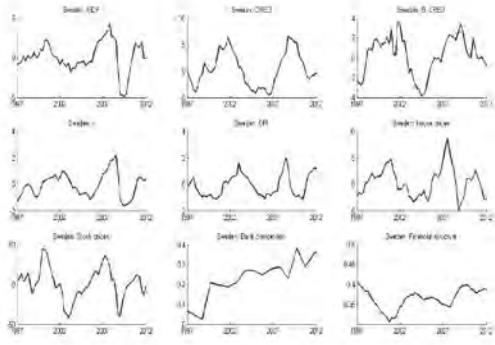
(k) Norway



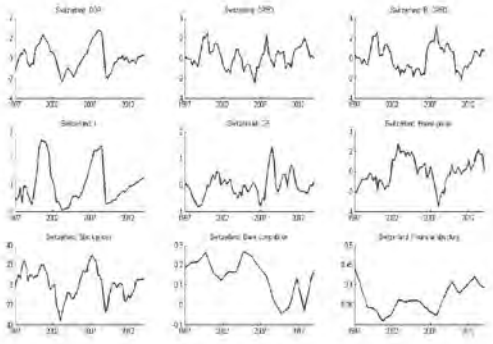
(l) Portugal



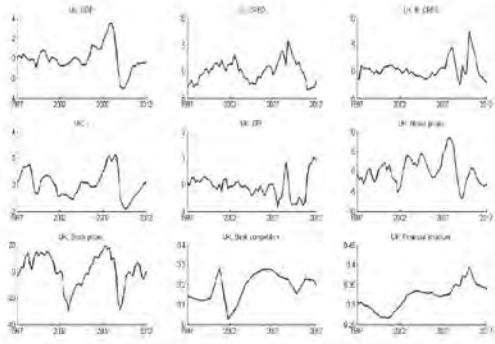
(m) Spain



(n) Sweden



(o) Switzerland



(p) UK

Table A1: Number of banks by country

Austria	233	France	211	Italy	577	Sweden	89
Belgium	34	Germany	1711	Norway	128	Switzerland	356
Denmark	98	Greece	16	Portugal	21	the Netherlands	23
Finland	13	Ireland	10	Spain	126	United Kingdom	90

Table A2: Summary statistics: Bank-level data analysis

Variable	Mean	Median	SD	Min	Max
Loan growth	5.61	4.49	13.3	-17.5	55
Output-Gap	-0.695	-0.527	2.4	-14.2	9.42
Lerner index (GFDD)	0.12	0.083	0.086	-0.045	0.428
Conventional Lerner index	0.209	0.209	0.0956	-0.253	0.504
Efficiency-adjusted Lerner index	0.242	0.222	0.121	-0.005	0.689
ln(Total assets)	13.5	13.3	1.65	7.17	21.9
Loans / Total assets	0.619	0.629	0.179	0.161	1
Equity / Total assets	0.083	0.072	0.060	-0.458	1
Δ MP	-0.181	-0.233	0.598	-1.33	6.75
W1	0.012	0.012	0.006	0.001	0.052
W2	0.022	0.020	0.011	0.002	0.076
W3	0.009	0.008	0.006	0.001	0.057
TC	233390	23314	1955348	89.5	9.40E+07
P	0.050	0.050	0.015	0.02	0.156

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THE COSTS AND BENEFITS OF SOVEREIGN INTEREST RATE EXPOSURE – EVIDENCE FROM A PANEL OF CESEE COUNTRIES*

Sebastian Beer†

Building on a newly compiled structural debt database, this paper examines sovereign interest rate exposures in Central, Eastern and South Eastern European (CESEE) countries. Since 2009, the average time to interest rate re-fixing (ATR) of sovereign debt has lengthened and converged across the region, indicating that associated risks have decreased over time. Amid a low interest rate environment, financing costs have dropped more sharply than the risks inherent to public debt portfolios, however. This suggests that aggregate risk aversion has decreased. Furthermore, in devising standardized risk measures, this paper provides evidence for portfolio rebalancing effects consistent with preferred habitat models: ten-year bond yields increase by 20 basis points (bp) in response to a one year extension of the average maturity; the response of one- year bond yields is less pronounced, with 6 bp, but also positive. The finding has important implications for monetary policy and optimal debt management.

* The findings, interpretations, and conclusions expressed in this paper are entirely those of the author and should not be attributed to the Oesterreichische Nationalbank or the Eurosystem.

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1. INTRODUCTION

The composition of public obligations affects the costs and risks of running fiscal deficits. Debt with a shorter maturity, for instance, is typically associated with lower interest rates but subject to more volatility. In principle, it is debt management's task to identify such cost-risk tradeoffs, determine the level of tolerable risk, and align the debt portfolio according to government's preferences (The World Bank and International Monetary Fund, 2017). The multitude of borrowing options and the volatility of financial markets suggest that continuous risk monitoring and a comprehensive strategy are key in guiding sovereign borrowing decisions. Yet, in practice, public debt management efforts vary notably (see e.g. Melecky, 2007; Cabral, 2015). Some debt agencies define strategic goals in terms of structural debt indicators, evaluate target achievement periodically, and update their strategy, based on in-depth assessments of financial and macroeconomic trends, continuously; some monitor the progression of structural debt indicators and economic variables rigorously, but keep a more detailed quantitative strategy undisclosed; and some follow no strategy at all.

In the light of recent history, this variability in national endeavors is surprising. Several European governments were unable to refinance their obligations on private capital markets following the financial crisis. The sovereign defaults were not a direct consequence of imprudent borrowing decisions (Baldwin et al., 2015), but the composition of public sector debt exacerbated the disastrous impact of the sudden interest rate dynamics. In many European countries, public debt still lies above its pre-crisis levels and the implied rise in financing needs seems to have pushed risk taking tendencies as well (De Broeck and Guscina, 2016). As national governments are increasingly the largest domestic borrower, sovereign defaults have the potential to induce or amplify economic crises. In this context, effective public debt management is key to sustain a country's financial stability.

Building on a newly compiled database, this paper is the first, in a series of two, to examine the outcomes of public debt management in Central, Eastern and South Eastern European (CESEE) countries. Volatility in interest- and exchange rates are the most fundamental risks to the sustainability of sovereign debt portfolios. This paper examines the costs and benefits of interest rate exposures. A second publication, coming forth in late 2017, investigates the risks and rewards of exchange rate exposures. Together, the publications provide an initial comparative assessment of the costs, risks, and risk preferences implicit in the structure of sovereign debt portfolios for several CESEE countries, thus supporting the evaluation of financial vulnerabilities in the region.

This paper finds that effective interest rate risk has, on average, decreased since 2009. The average term to interest rate refixing (ATR) has lengthened over time and converged across the region. At the same time, the volatility of bond yields has remained roughly constant. This suggest that the impact of sudden interest rate dynamics is less of a concern today than it was shortly after the financial crisis. Yet, amidst the low interest rate environment, risk-aversion seems to have decreased as well. Downward moving yield curves led to a significant reduction in sovereign's financing costs, inducing many debt agencies to extend the average maturity of their debt portfolios. On the margin, financing costs decreased more sharply than risks, however, implying that debt managers attach more weight on the minimization of costs today than they did in 2009. The estimation results suggests that the average weight on the minimization of risks decreased by around 13 percentage points.

Furthermore, in devising standardized risk measures, the paper estimates the determinants of one and ten year bond yields for several countries in the CESEE region and provides evidence for portfolio rebalancing effects. The results of a panel SUR regression approach indicate that both the quantity and the structure of public debt drive the costs of funding fiscal deficits. As expected, monetary variables are more effective in steering the short end of the yield curve, while fiscal variables tend to impact more directly on the long end. Notably, the estimation results suggest that bond yields are sensitive to the portfolio's maturity structure: ten year government bond yields increase by 20 basis points in response to an extension of the debt portfolio's average maturity by one year, holding the size of government debt constant; one year government bond yields increase by roughly 6%. This result is at odds with the assumption of perfect arbitrage across the yield curve and thus inconsistent with the New Keynesian model (Jagjit S Chadha and Zampolli, 2017). It can be rationalized, however, by optimization behavior in preferred habitat models as suggested by Vila and Vayanos (2009) and Greenwood and Vayanos (2010).

The paper proceeds as follows. The first section clarifies in a simple theoretical model the relation between interest rate exposure and the structure of the government debt portfolio; it characterizes basic properties of an optimal maturity and response to dynamics in the yield curve. Building on the theoretical insights, the second section lays out the empirical approach to the measurement of implicit risk aversion and introduces the new structural debt database. The third section presents empirical results on the determinants of bond yields, risk and risk preferences. The fourth section concludes.

2. THEORETICAL CONSIDERATIONS

The theoretical literature on debt management has emphasized a range of goals over time (see de Haan and Jakob, 2016, for a summary). Early contributions focused on the stabilizing impact structural debt decisions could exert on the business cycle (Tobin, 1963) and taxation (Barro, 1999). Debt management was thus seen in close proximity to monetary policy. With the rise of New Keynesian models, proclaiming that the path of the short term policy rate suffices in steering the business cycle, the instrumental character of debt management vanished from the theoretical literature (Zampolli, 2017). Missale (2000) introduced risk minimization as an explicit objective in the context of the newly introduced fiscal frameworks. A common theme in these contributions is that interest payments should be contingent upon the state of the economy, thus smoothing governmental outlays.

In practice, most debt management agencies do not pursue to stabilize anything beyond government debt. The classic mandate lies in minimizing the costs of sovereign funding subject to the constraint of containing risk at some prudent level. The acceptable level of risk remains typically an opaque concept, however, partly owing to the fact that risk to the governmental debt stock emanates from multiple sources, including from uncertainty in the path of interest- and exchange rates (market risk), unanticipated cash flow obligations (liquidity risk), non-performance of borrowers (credit risk), non-delivery of other contracted obligations (settlement risk), and other forms of risk that most organizations face, but are particularly severe for a debt management agency (operational risk).[1]

This section develops a simple model, describing basic features of a maturity structure that achieves the double objective of cost and risk minimization for risk that emanates from unexpected interest rate dynamics. In line with the dominance of fixed coupon bonds, the model disregards the issuance of variable rate debt and thus interchangeable uses the expressions ”average term to refixing” and ”average term to maturity”. Furthermore, to condense the analysis on interest rate risk, the model disregards the issuance of foreign currency obligations

2.1. A simple model

Consider a sovereign issuing fixed coupon bonds in maturities of one and *N* years. The overall financing needs are determined by fiscal policy, constant, and normalized to 1.

Debt managers decide on the share (1 − α) which is rolled over each year. The remaining obligations are evenly distributed between N bonds, issued in N distinct years to ensure a smooth redemption profile. These assumptions imply that the composite interest rate paid in period *t* follows the weighted average

$$R_t = (1-\alpha)i_t^s + \frac{\alpha}{N}\sum_{j=1}^{N} i_{t+1-j}^l, \qquad (1)$$

where α denotes the share of long-term debt, i_t is the interest rate paid on short-term obligations and i^l_t is the period t interest rate on long-term obligations.

For simplicity, I assume that long- and short-term bond yields are random variables with stationary means. Their average difference, the term spread, is positive and denoted $b = \bar{i}l - \bar{i}s > 0$. Arbitrage opportunities imply that deviations from the long-run values are correlated. I denote the variance of long and short run bond yields by σ_l^2 and σ_s^2, respectively, and their covariance by $\beta\sigma_s^2$. It follows from these

[1] The World Bank and International Monetary Fund (2017) summarizes and explain these risks in detail.

assumptions that the mean (costs) and the one step-ahead variance (risk) of the composite interest rate read

$$c(\alpha) = \bar{i}_s + \alpha b, \quad \text{and} \quad r(\alpha) = (1 - \alpha e)^2 \sigma_s^2 + \left(\frac{\alpha}{N}\right)^2 \sigma_l^2, \tag{2}$$

where $e_j = 1 - \beta/N$ captures the relative sensitivity of interest payments associated with long- and short-term debt. This system of equations describes the typical cost-risk tradeoff inherent to debt management decisions: by increasing the maturity of public debt, average funding costs increase, but deviations from the expected rate become increasingly unlikely.[2] As this tradeoff holds, by construction, for all values of α, the debt portfolio is efficient for all values of α. Preferences determine optimality.

2.2. The optimal maturity structure

A necessary condition for a balanced choice of α requires that the marginal rate of transformation between costs and risk be aligned to debt managements' indifference curves. Under constant substitution elasticity, this condition can be stated as

$$\ln\left(-\frac{r_\alpha}{c_\alpha}\right) = \ln(\delta) + \gamma \ln\left(\frac{c}{r}\right), \tag{3}$$

where δ represents the relative weight debt offices place on the minimization of costs and $\gamma^{-1} > 0$ reflects the elasticity of substitution.[3] The equation implicitly defines the optimal maturity structure as a function of risk preferences and the characteristics of the yield curve. Implicit differentiation shows that α is a decreasing function of δ and γ, implying that both of these parameters reflect the propensity to accept risk in return for a reduction in costs.

It is instructive to consider the special case of linear disutility, as typically assumed in term structure models. Setting $\gamma = 0$, using the above definitions and rearranging the necessary condition gives an explicit expression for the optimal maturity:

$$\alpha^* = \frac{e\sigma_s^2 - \delta b}{(e\sigma_s)^2 + (\sigma_l/N)^2}. \tag{4}$$

The equation provides a range of intuitive and useful insights. As expected, the optimal maturity structure is a decreasing function of the relative weight placed on cost minimization, $\alpha'(\delta) < 0$. The empirical analysis builds on this insight in reverse order: average maturities signal risk aversion if other factors are held constant. The shape and volatility of the yield curve are additional drivers of the share of long term debt. The optimal maturity is a decreasing function of the yield curve's slope and an increasing function of the volatility of both short-term and long-term yields. Notably, parallel shifts in the yield curve, leave marginal incentives unchanged. The yield curve's intercept does therefore not affect the optimal maturity structure under linear preferences.

2.3. Portfolio rebalancing effects

The above formulation abstracts from general equilibrium effects in that the debt offices' structural decision does not perturb the decision context. In fact, standard economic theory predicts that arbitrage opportunities should equalize investor's risk-less returns across all maturities (Modigliani and Sutch, 1966). Accordingly, the path of the central bank's policy rate determines both short and long-term bond yields while the relative supply of these bonds is irrelevant.

This view contrasts sharply with preferred habitat models, initially proposed by Culbertson (1957), where investors exhibit preferences for specific time horizons. In its extreme version, the assumption

[2] An increase in α unambiguously lowers the variance of next period's interest rate if the sensitivity of long-term yields is sufficiently lower than the response of short-term yields. The exact condition is $\frac{\alpha}{N^2}\sigma_l^2 < (1 - \alpha e)\sigma_s^2 e$. As N tends to infinity, this condition requires a positive variance of short term bond yields.

[3] The sufficient condition is $\gamma[\frac{c'}{c} - \frac{r'}{r}] \geq r''$, requiring that $\gamma > 0$.

of market segmentation implies that a shift in the composition of public debt towards long maturities raises the yields on long-term debt and reduces the yields on short term debt due to supply effects. Vila and Vayanos (2009) and Greenwood and Vayanos (2014) extend the classic preferred habitat theory by incorporating arbitrage opportunities and thus introducing substitutability between debt maturities. Their model predicts that all yields increase in response to an increase of the debt portfolio's average maturity, reflecting the escalated aggregate risk which is associated with the larger supply of risky long term debt.

Portfolio rebalancing effects impact on the optimal maturity of government debt. If the reaction of long-term rates is more pronounced than the sensitivity of short-term rates, the term spread is an increasing function of the maturity structure. With increased marginal costs, the optimal maturity is therefore shorter than it would be without portfolio rebalancing effects.

3. DATA AND EMPIRICAL APPROACH

3.1. Empirical approach

The theoretical model clarifies that the optimal debt structure responds to both preferences and market conditions. Simple structural indicators, such as the ATR, confound these components, however, with the result that the same maturity structure potentially implies different degrees of effective interest rate risk depending on the volatility of the underlying yield curve. Structural indicators are therefore poor measures for cross-country comparisons. This section builds on the theoretical insights and presents a strategy to disentangle risk preferences from effective interest rate risk, thus enabling the evaluation of debt management outcomes on a standardized and objective basis. Specifically, standardized cost and risk measures follow from combining information on the maturity structure with information of the yield curves' basic properties, such as its slope and volatility, as outlined in equation (2). The necessary condition for a balanced maturity structure (equation 3), in turn, suggests that a simple linear regression can be used to elicit risk preferences, underlying sovereign debt portfolios.

To operationalize the approach, I first examine the determinants of short- and long-term bond yields in a SUR panel approach. More specifically, I estimate the system of equations

$$y_{it} = \mu_i + \beta x_{it} + \tau_{it} + \epsilon_{it}, \tag{5}$$

where the variables are vectors of the form $y = (y^{b1}, y^{b10})'$. The dependent variable are one and 10-year generic bond yields, the vector x collects its drivers, and the coefficient matrix is constant across countries. The intercept vector is country- and yield-specific to control for heterogeneity in time preferences and the vector controls for country- and yield-specific time trends of the third order (compare progression of yields in the descriptive section below). The error-vector is independently and identically distributed across time but not across countries. Specifically, I allow for a country-specific covariance pattern between the unobservable components in one- and ten-year bond yields and estimate the system of equations with a feasible GLS approach to increase the efficiency of short- and long-term elasticity predictions.

Term structure models suggest that the interest rate, the risk of default, and the expected loss given default are the key determinants of bond yields (Liu et al., 2009). In the long run, the interest rate is a function of economic growth, household's time preferences, risk-free investment opportunities abroad, and exchange rates. In the short run, monetary policy and inflationary shocks likely matter (Poghosyan, 2012). Accordingly, the explanatory vector *x* comprises public debt and deficit as a share of government revenue to proxy for the risk of default. It furthermore includes five macro-variables:[4] GDP growth, inflation, the three-month interbank rate, the real effective exchange rate and the share of non-performing loans in total loans, controlling for differences in contingent liabilities.

[4] In constructing the underlying series, I draw on quarterly information from IMF, Eurostat, Bloomberg, and wiiw datasets and perform seasonal adjustments using the X-13ARIMA-SEATS method of the US Census Bureau.

To examine the potential of portfolio rebalancing effects, I include the country-specific ATR as an additional explanatory variables in subsequent specifications. The inclusion of the ATR might pose an endogeneity issue if debt offices are, in fact, optimizing, thus responding to dynamics in the yield curve. I investigate the likely magnitude of bias by introducing the lags of one and ten-year bond yields as additional explanatory variables. Given the extensive time dimension (T=29), the bias in dynamic regression specifications (Nickell, 1981) should be of less concern in this context.

3.2. Sovereign structural debt database

The main information for the analysis is a newly compiled dataset, summarizing public debt structures for 15 countries across the CESEE region. The dataset covers Albania, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, and Turkey. The database builds on Bloomberg's DDIS function which records public sector obligations differentiated according to the type of debt (bonds vs. loans), the type of coupon (fixed vs. floating), and the currency of issuance on a quarterly basis since Q4 2009. Granular information on redemption profiles enables the calculation of a range of structural indicators, including the average term to maturity of total debt, of domestic- and of foreign- currency obligations, the currency composition of total debt, and the average term to refixing of bond obligations. Notably, the magnitude of debt recorded in Bloomberg is highly consistent with other data sources,[5] suggesting that the derived structural indicators provide an accurate depiction of sovereign debt structures across the CESEE region.

The upper panel in Figure 1 illustrates the progression of country-specific ATRs on domestic currency bonds.[6] The average refixing period increased on the Romanian, Russian, Slovakian, Turkish, and less so on the Hungarian debt portfolio; it decreased notably on Czech Republic's outstanding bonds. Under constant volatility in the underlying bond markets, this indicates a reduction of risk in the former group and an increase thereof in the latter. On average, the ATR extended from 3.5 years in 2009 to 4.5 years in 2016. Risk has thus likely decreased across the region. Furthermore, a simple regression indicates that the standard deviation of refixing periods across countries is decreasing over time, from 1.8 in 2009 to 1.3 in 2016. While there remain important differences in refixing periods, their dispersion thus seems to have converged.

To better understand the drivers and possible consequences of changing maturity structures, the lower panel in Figure 1 presents the progression of ten- (orange line) and one-year (green line) generic bond yields as reported by Bloomberg. With the exception of Russia, and Turkey, average financing costs have decreased sharply over the observed time span, from around 5.7% in 2009 to 2.7% in 2016. The difference in the costs of short and long-term finance determines the marginal costs debt managers confront in their maturity choice. The graphs suggest considerable heterogeneity in associated dynamics. The yield curve's slope decreased notably in the Czech Republic, Russia, and Slovakia and increased slightly in Hungary. While Bulgaria, Croatia, and Poland have experienced some dynamics in the intercept of their domestic yield curves; the slope remained largely unchanged. On average the difference between ten- and one-year bond yields decreased from 2.2 percentage points to 1.2 percentage points over the observed time horizon.

In the aggregate, the described dynamics follow theoretical predictions of an optimal maturity choice. Under constant risk aversion and volatility in the bond markets, the aggregate flattening of yield curves led to a reduction in the marginal costs of hedging against interest rate risk. The average maturity of public debt portfolios increased as a consequence.

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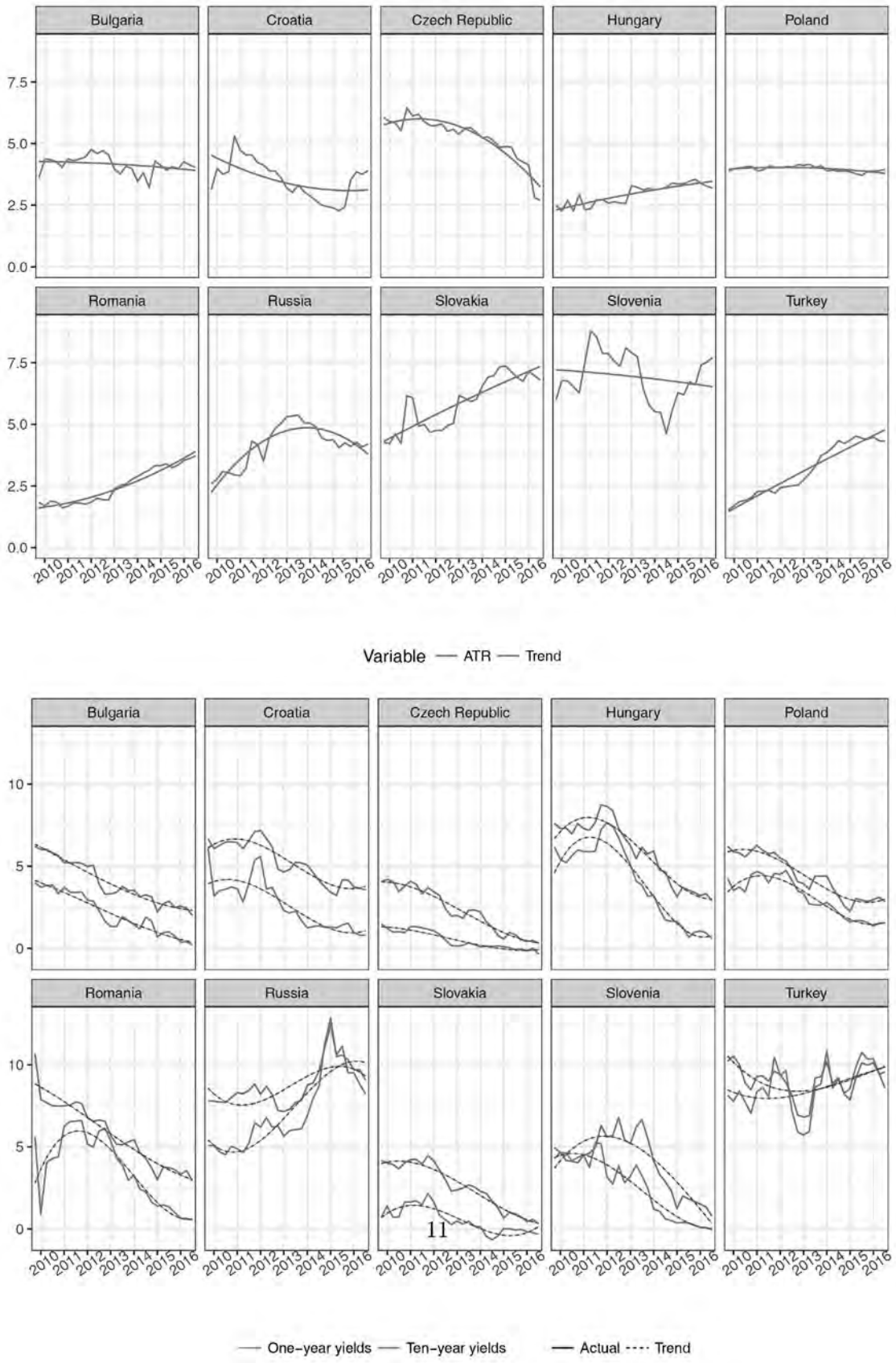
[5] On average, the country-specific deviation between the debt recorded by Bloomberg and the debt recorded by IMF's Financial Indicators lies at around 2%. With an average deviation of 8%, the database depicts the largest inconsistency for Slovenian debt.

[6] While other indicators directly follow from the provided information, the calculation of the ATR requires a few assumptions as it builds on a distinction between variable and fixed coupon payments; a differentiation which is available for total but not for domestic currency obligations. Specifically, I assume that term loans are exclusively issued in foreign currencies and the ratio of domestic- to foreign- maturities is equivalent to the ratio of domestic- to foreign- refixing periods.

Figure 1: Average time to refixing and Government bond yields



4. EMPIRICAL FINDINGS

4.1. Drivers of sovereign bond yields in the CESEE region

Table 1 below summarizes the determinants of bond yields in a set of static regression specifications. Columns (1) to (4) present the estimated sensitivity of short-term financing costs, columns (5) to (8) report estimates on the sensitivity of long-term financing costs. All specifications include country-specific time polynomials of the third-order, as well as a set of year and quarter dummies to capture global trends in risk aversion. The columns labeled OLS (1-2, and 5-6) estimate the determinants of one- and ten-year bond yields in separate equations. In columns 3-4 and 7-8, a generalized least squares procedure increases the estimation efficiency by accounting for potential correlation between the equation's residuals.

Table 1

Drivers of short- and long-term bond yields across the CESEE region								
Balanced SUR panel regression, N=10, T=25								
Dependent variable	One year generic bond yields				Ten year generic bond yields			
Estimation method	OLS		GLS		OLS		GLS	
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ATR		-0.022		0.067*		0.118***		0.197***
		(0.046)		(0.041)		(0.049)		(0.046)
Debt in government revenue	0.285***	0.311***	0.414***	0.466***	0.610***	0.571***	0.726***	0.702***
	(0.077)	(0.076)	(0.059)	(0.059)	(0.084)	(0.079)	(0.067)	(0.065)
Deficit in government revenue	0.099***	0.122***	0.024**	0.057***	0.130***	0.094***	0.059***	0.031***
	(0.020)	(0.015)	(0.012)	(0.008)	(0.026)	(0.015)	(0.014)	(0.009)
NPL	0.107***	0.103***	0.125***	0.126***	0.146***	0.152***	0.164***	0.174***
	(0.010)	(0.011)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)
Inflation	0.738***	0.740***	0.743***	0.757***	0.616***	0.619***	0.617***	0.631***
	(0.028)	(0.028)	(0.027)	(0.029)	(0.023)	(0.024)	(0.024)	(0.025)
Real interest rate	0.589***	0.593***	0.596***	0.633***	0.466***	0.465***	0.475***	0.502***
	(0.041)	(0.040)	(0.033)	(0.034)	(0.035)	(0.034)	(0.028)	(0.030)
Reer	-0.006***	-0.006**	-0.011***	-0.015***	0.004***	-0.000	-0.000	-0.009***
	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.003)
Real Gdp growth	0.021	0.022	0.015	0.020	0.016	0.019	0.010	0.017
	(0.030)	(0.030)	(0.021)	(0.021)	(0.026)	(0.026)	(0.020)	(0.020)
Residual Variation	0.241	0.241	0.280	0.280	0.223	0.224	0.183	0.182

All specifications include country-specific time polynomials of the third order, a set of year and quarter dummies. In columns 3-4 and 7-8, the estimation accounts for correlation in the residuals of one- and ten-year bond yields. Robust standard errors in parentheses.

Fiscal measures and contingent liabilities seem to be important signals for the risk of default in the CESEE region. On average, the estimated impact of these variables is larger on long-term bond yields, likely reflecting the higher risk premium inherent to costs of long term funding. An increase of one percentage point in the ratio of debt to governmental revenue inflates ten-year bond yields by roughly 0.7 basis points (bp). The response of one- year yields is not as pronounced (0.4 bp) but also statistically significant. With an average estimated effect of 0.08 bp, current deficits exert a similar but much smaller effect on the costs of short- and long-term funding. This result is in line with prior evidence, suggesting that the debt burden is a strong signal for the risk of default (Manasse et al., 2003), while the impact of fiscal deficits is less clear, potentially depending on the state of the economy (Jaramillo and Weber, 2013). Moreover, contingent liabilities impact notably on sovereign borrowing costs across all estimated specification. With an average response of 0.17 bp, ten-year bond yields are more sensitive to changes in the share of non-performing loans than one-year bonds (0.12 bp).

Furthermore, real interest rates and inflation impact significantly on the short- and long- end of sovereigns' yield curves. The Fisher equation thus seems to explain nominal funding costs to a large extent. With an average coefficient of around 0.4 on both of these variables, the response of short-term financing costs is much more pronounced, however. Ten year bond yields increase by around 0.2 percentage points in response to a one percentage point increase in either inflation or the real interest rate. As expected, conventional monetary policy measures are more effective in steering the short-end of the yield curve. The real effective exchange rate, on the other hand, seems to drive the intercepts of the estimated yield curves rather than their slope: both short- and long-term financing costs decrease in response to an appreciation of the local currency. Depending on the specification, the estimated effect is a reduction between 3 and 9 percentage points in response to a one point increase in the Reer Index. GDP growth does not exert any measurable influence on the bond yields in the CESEE region.

Columns (2), (4), (6) and (8) provide evidence for portfolio rebalancing effects. The GLS estimations suggest that ten-year government bond yields increase by some 20 basis points in response to an increase of the average term to refixing by one year; the yields on one year bonds increase by roughly 7bp. Both effects are statistically significant. Simple OLS estimations confirm the positive impact on the long-end of the yield curve but do not reject the null hypothesis for the sensitivity of short-term financing costs to changes in the portfolio structure. This finding is likely due to the reduced accuracy of the OLS approach.

Table 2

Drivers of short- and long-term bond yields across the CESEE region								
Balanced SUR panel regression, N=10, T=25								
Dependent variable	One year generic bond yields				Ten year generic bond yields			
Estimation method	OLS		GLS		OLS		GLS	
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ATR		-0.046		0.035		0.084**		0.140***
		(0.042)		(0.031)		(0.036)		(0.032)
Deficit to government revenue	0.038*	0.074***	-0.008	0.017***	0.071***	0.041***	0.029**	-0.012
	(0.020)	(0.015)	(0.010)	(0.007)	(0.019)	(0.011)	(0.013)	(0.009)
Debt to government revenue	0.006	0.053	0.003	0.077	0.171***	0.143**	0.183***	0.159***
	(0.083)	(0.080)	(0.068)	(0.061)	(0.070)	(0.065)	(0.063)	(0.062)
NPL	0.046***	0.042***	0.050***	0.063***	0.043***	0.048***	0.047***	0.059***
	(0.014)	(0.014)	(0.014)	(0.013)	(0.010)	(0.011)	(0.010)	(0.010)
Inflation	0.493***	0.494***	0.417***	0.427***	0.263***	0.265***	0.200***	0.214***
	(0.053)	(0.053)	(0.042)	(0.036)	(0.038)	(0.038)	(0.033)	(0.033)
Real interest rate	0.419***	0.425***	0.361***	0.373***	0.254***	0.253***	0.206***	0.213***
	(0.046)	(0.046)	(0.034)	(0.032)	(0.034)	(0.033)	(0.028)	(0.029)
Reer	-0.009***	-0.007***	-0.007***	-0.010***	-0.001	-0.004**	-0.000	-0.006***
	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
lag(One year yield)	0.021	0.035	0.236***	0.264***	-0.144**	-0.140**	0.036	0.038
	(0.080)	(0.081)	(0.057)	(0.049)	(0.061)	(0.061)	(0.050)	(0.050)
lag(Ten year yield)	0.408***	0.638***	0.652***	0.774***	0.776***	0.200***	0.257***	0.392***
	(0.083)	(0.084)	(0.063)	(0.049)	(0.069)	(0.068)	(0.059)	(0.059)
Residual Variation	0.241	0.241	0.280	0.280	0.223	0.224	0.183	0.182

All specifications include country-specific time polynomials of the third order, a set of year and a set of quarter dummies.

The estimated effect of the Reer, for instance, changes signs in the OLS estimations, depending on the specification used. The descriptive analysis in section 3 indicates that debt offices might react to changing funding conditions. If the prevailing portfolio structure is a function of lagged funding conditions, however, the estimated residuals are likely correlated with the average maturity. According to the theoretical prediction, suggesting a negative correlation, the estimated coefficients should be biased downwards.

To examine whether the ATR variable is endogenous in the static specifications, I reestimate all specifications and include lagged one- and ten-year bond yields as additional explanatory variables. Table 2 depicts the results of these dynamic regressions. The GLS approach seems to provides more credible results in this context, suggesting that lagged ten- and one-year bond yields are significant predictors for short-term financing costs while the long end is significantly driven by the lagged effect of ten-year bond yields only. The OLS estimations, on the other hand, find no persistence in short-term bond yields. It also suggests that the lagged value of short-term bonds are negatively correlated with current long-term bonds; a finding which is hard to rationalize economically.

The dynamic GLS results substantiate the hypothesized endogeneity of the static specification, at least when estimating portfolio rebalancing effects. Short-term and long-term bond yields increase instantaneously by 3.5 bp and by 14 bp in response to an increase of the ATR by one year when controlling for lagged values of the yield curve. The effect on ten year bond yields is significant at the 1 percent level. Combining the estimated persistence in the yield curve with this effect suggests a cumulative effect of 19bp and 40bp, respectively. This is more than double the magnitude implicated by the static regressions and confirms the relevance of portfolio rebalancing effects: an increase in the average maturity increases both the intercept and the slope of the yield curve.

The coefficient estimates on the other variables do not differ dramatically from the static specifications. Fiscal variables, including contingent liabilities, impact more forcefully on ten-year bond yields while monetary variables affect the costs of short-term funding more severely. Some differences are perceptible, however. In contrast to the static specifications, the estimated impact of the deficit and debt ratio is now less consistent. Holding last quarters bond yields constant, an increase in the debt ratio does not change the costs of short-term funding significantly. The deficit ratio, on the other hand, remains in most specifications an important predictor for default risk premiums on short and long-term bond yields. Contrasting the dynamic results with the static findings suggests that the Nickel bias is negligible.[7]

4.2. Interest rate risks and implicit risk preferences

Building on the regression results above, this section quantifies risk and risk preferences inherent to government debt portfolios. Each regression provides a unique set of estimates on the conditional slope and the volatility of the yield curve. Upon knowledge of the structural errors, country-specific cost and risk measures follow immediately from the definitions in the theoretical section and the ratio of marginal risk to marginal costs depicts a first approximation to the relative weight placed on cost minimization. However, given that several estimation steps are necessary to operationalize the approach, I employ different models to check the robustness of my findings.[8]

Figure 2 presents standardized cost and risk measures, based on six different SUR models. The first four models rely on the GLS regression results presented in the prior section. Two additional models increase the estimation flexibility of the static and dynamic portfolio rebalancing model (Table 1 and 2, Column (8)), by allowing the coefficients to vary between countries. All risk measures are normalized so that the average risk across all countries and time is equal to one in each model. The black dots depict country-specific average estimated cost-risk pairs; the horizontal and vertical line represents the sample average and the panels differentiate between 2010 and 2015.

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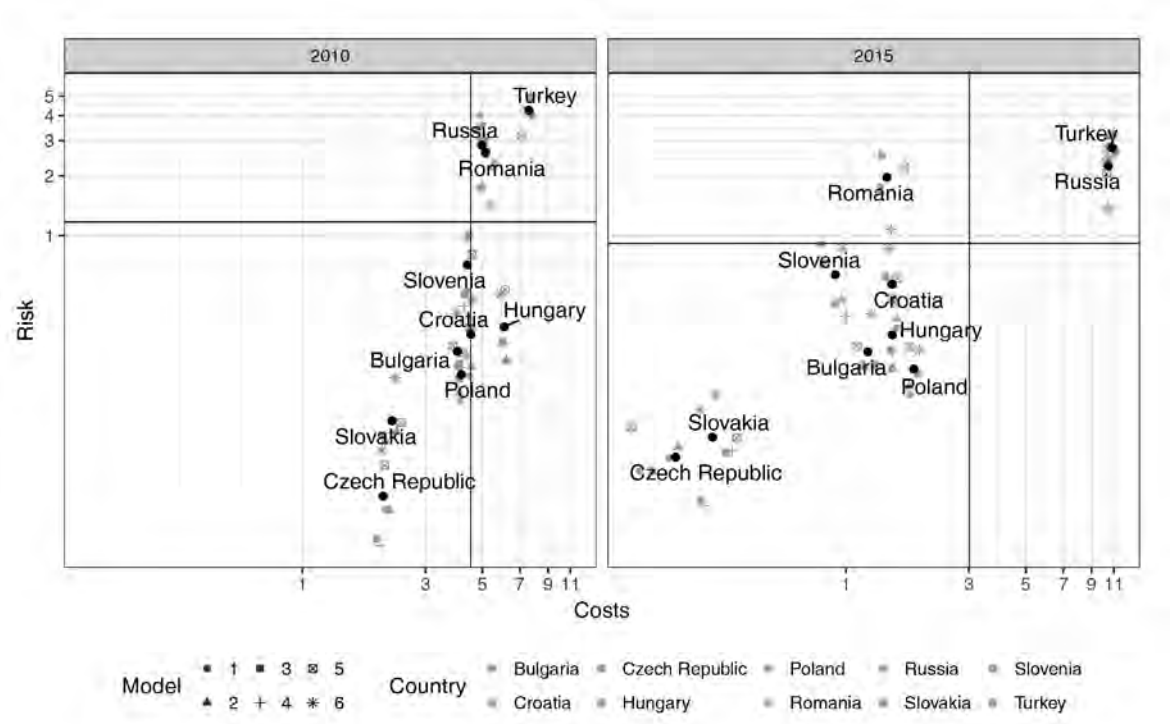
[7] The estimated magnitudes for some variables are all but equivalent: the dynamic specification suggests that an increase in the share of non-performing loans has an immediate impact on the costs of long-term funding by 0.06 bp (Table 2, Column (8)). In the long run, given the high persistence of long-term bond yields, this effect cumulates to 0.16 bp. The static estimation results suggest a long-term effect of 0.17 bp (Table 1, Column (8)).

[8] Specifically, I first construct a set of standardized cost and risk measures, based on the static and dynamic GLS results and building on the assumption that the structural volatility in the yield curve remains constant over time. In this setting, risk differentials between countries exist due to differences in the volatility of short- and long-term bond yields as well as due to difference in refixing periods. Estimations which allow the structural volatility to change over time provide similar conclusions. For simplicity, I present the time-constant specification here. Relative changes in risk over time, however, are only caused by variation in country-specific ATRs. I employ a Cholesky decomposition on the estimated covariance structures of one- and ten-year bond yields to identify the structural shocks. The ordering of the decomposition follows from the theoretical model where I assume that the structural shocks are propagated from the short- to the long-end (see Section 1). This assumption is without loss of generality, however, as the ordering of the error structure does not affect the overall magnitude of risk.

Figure 2: Interest rate risk and funding costs



The graph conveys (in its vertical dimension) that Turkey, Russia, and Romania have been, and still are, particularly exposed to interest rate dynamics. While the estimation results concur that risk is above average (the horizontal line) in this group of countries, the specific ordering remains ambiguous. Backed by the extension of average refixing periods, risk has decreased in this high-risk group over time, however. Moreover, the decline of the horizontal line indicates that risk has decreased more generally since 2010. On the other hand, shorter maturity structures in Croatia and the Czech Republic thwart a further reduction of risk in the group of countries which were already characterized by risk-below- average in 2010. As a result, the potential of unexpected interest rate dynamics seems to have converged more perceptibly than the change in average refixing periods would suggest. The horizontal dimension illustrates notable differences in the underlying funding costs. In contrast to the interest rate risk distribution, the dispersion of contemporaneous composite interest costs has widened over time. The Czech Republic and Slovakia face the lowest funding costs with a weighted average bond yield below 1 percent. Note that the cost-risk pairs presented in Figure 2 are a direct consequence of the chosen maturity structure and other pairs would have been observed had the country's debt offices chosen to issue differently. In other words, the points depicted are but one realization in the country- and time-specific set of feasible cost-risk combinations. Marginal incentives and preferences determine the observed choice. Note that the cost-risk pairs presented in Figure 2 are a direct consequence of the chosen maturity structure and other pairs would have been observed had the country's debt offices chosen to issue differently. In other words, the points depicted are but one realization of the country- and time-specific set of feasible cost-risk combinations. What is not depicted are the marginal incentives, which determine the observed choice.

Figure 3: Risk preferences

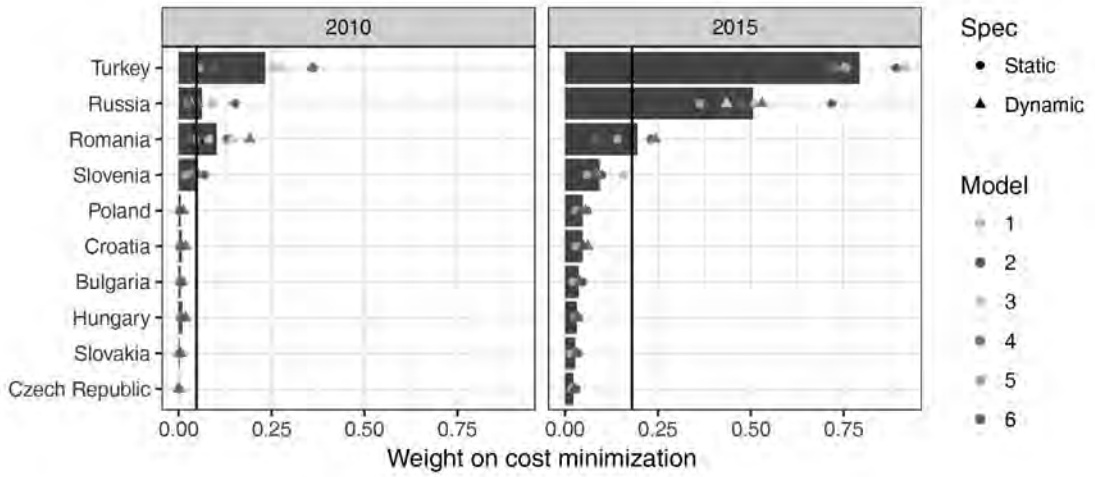


Figure 3 illustrates implicit risk preferences and their changes over time.[9] The average weight attached on cost minimization has increased notably, from 5% in 2010 to roughly 18% in 2015.[10] This implies that the weight on risk minimization has decreased by 13 percentage points within five years. Country-specific trends in risk-taking behavior differ notably, however. The estimation results indicate that risk aversion decreased most rapidly in Turkey and Russia. Given the important extensions of refixing periods in these countries, the finding reflects primarily the substantial (relative) decline in long-term financing costs: even though debt managers extended average refixing periods, the response to changing funding conditions was not forceful enough to keep the ratio of costs to risks balanced on the margin.

5. CONCLUSION

This paper draws on a new structural debt database to provide estimates on interest rate risk and risk preferences implicit in sovereign debt portfolios across the CESEE region. The results, which combine information on the volatility and slope of domestic yield curves with structural debt indicators, suggest that Turkey, Russia, Romania, and to a lesser extent Slovenia, are particularly exposed to domestic interest rate dynamics. On the margin, the costs of funding fiscal deficits have dropped more sharply than the risk inherent to sovereign debt portfolios, suggesting that aggregate risk aversion has decreased over time. By providing an initial comparative perspective on structural sovereign debt risks, this paper supports the evaluation of financial vulnerabilities across the region.

Furthermore, the results of a panel SUR approach confirm the importance of fiscal variables in driving the costs of long-term funding and underline the relevance of monetary policy variables in driving the costs of short-term funding. Notably, the results provide evidence for portfolio rebalancing effects. A lower bound estimate suggests that long term bond yields increase by 20 bp and short term bond yields by 6bp in response to an extension of the ATR by one year. Knowledge on the magnitude of portfolio rebalancing effects is crucial to better understand the likely effectiveness of unconventional monetary policy measures, as pursued by many central banks more recently. Early evidence suggests that the ECB's large scale asset purchasing program has been successful in that it reduced bond yields significantly and

[9] The results are based on a flexible estimation of the theoretical model's first order condition. See the Annex for details of the estimations.

[10] A simple transformation of the estimated intercepts provides the implicit relative weight attached on the minimization of costs. Specifically, the estimated intercept is given by $c = ln(\alpha/(1-\alpha))$, where α denotes the weight on cost minimization and c is an estimate of the intercept. Rearranging gives $a = exp(c)/(1 + exp(c))$.

led to a higher valuation of these assets on bank's balance sheets (Philippe Andrade, 2017). The effect of government debt structures on bond yields has been examined before (Greenwood and Vayanos, 2014; D'Amico and King, 2013; Gagnon et al., 2010; Zhu and Feng, 2016); but prior work is limited to US data.

The results presented in this paper indicate that optimal debt management in Europe might mitigate the effectiveness of the program. For the CESEE region, however, a more forceful extension of average maturities would lock-in the currently low rates and widen fiscal space in that it decreases the risk of unexpected interest rate dynamics for the future.

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A. DESCRIPTIVE STATISTICS

Table 3

Descriptive statistics					
Variable	Observations	Min.	Median	Mean	Max
One year bond yield	280.00	-0.65	2.96	3.49	12.86
Ten year bond yield	280.00	0.30	4.89	5.19	12.41
ATR on domestic bonds	280.00	1.53	4.07	4.24	8.80
Debt as a share of government revenue	270.00	0.21	1.23	1.20	2.52
Deficit as a share of government revenue	270.00	-0.79	-0.08	-0.08	0.12
Real effective exchange rate	270.00	75.63	103.09	106.45	132.65
Real interest rate	280.00	-5.06	0.72	0.63	12.95
Inflation	280.00	-2.32	2.12	2.90	16.20
Non-performing loans in total loans	275.00	2.71	8.97	10.01	21.87
Real GDP growth	277.00	-7.06	0.42	0.51	8.96

All shares, interest rates, inflation, and growth rate are depicted in percentage values. Real interest rate is interbank short-term interest rate minus inflation divided by one plus inflation.

B. REGRESSION RESULTS

Tables 4 and 5 summarize the estimated first order condition for an optimal maturity structure, depicted in equation 3. Each of the six columns presents estimates for the same specification but uses a different set of cost and risk measures to examine the influence of the first stage regressions. The dependent variable is the logarithm of the ratio of marginal risks to marginal costs. In Table 4, country-specific intercepts are interacted with a time trend, thus allowing the relative weight placed on cost minimization to vary over time. The ratio of country-specific costs over risk, on the other hand, is held constant for ease of interpretation. Subsequently, Table 5 drops this restriction and introduces an interaction of the ratio of costs to risk with a time trend.

In Table 4, the estimated (inverse) of the substitution elasticity between costs and risk is not different from zero in all but one column, which presents the results from the static portfolio model with country-specific coefficients, supporting the proposition that debt offices pursue a linear optimization objective. The estimated intercepts vary considerably between countries, but are surprisingly similar across columns. This suggests that the first stage estimation, used to construct standardized cost and risk measures, exerts little influence on the implicit risk estimates. The irrelevance of the first-stage estimation also seems to hold when allowing for time-varying substation elasticity in Table 5. However, in this case, I find a positive coefficient on the ratio of costs over risk which moreover decreases over time. This result is consistent with optimization behavior and indicates concave preferences in the cost-risk plane.

Table 4

Risk preferences in the CESEE region						
Dependent variable: log(marginal risk/marginal costs)						
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-3.039***	-2.879***	-2.989***	-2.932***	-3.594***	-3.141***
	(0.240)	(0.236)	(0.229)	(0.220)	(0.304)	(0.260)
Croatia	-0.111	-0.051	0.318***	0.309***	0.165	0.105
	(0.128)	(0.127)	(0.120)	(0.117)	(0.137)	(0.125)
Czech Republic	-0.629***	-0.693***	-0.990***	-1.051***	-0.484***	-0.670***
	(0.132)	(0.129)	(0.119)	(0.115)	(0.146)	(0.129)
Hungary	0.005	0.011	0.157	0.177	0.404***	0.102
	(0.133)	(0.133)	(0.119)	(0.115)	(0.135)	(0.126)
Poland	0.055	0.113	0.276**	0.284***	0.220*	0.020
	(0.134)	(0.132)	(0.120)	(0.116)	(0.138)	(0.132)
Romania	1.749***	1.622***	1.908***	1.870***	1.787***	0.819***
	(0.142)	(0.139)	(0.142)	(0.139)	(0.156)	(0.123)
Russia	2.256***	2.561***	1.803***	1.911***	2.057***	1.790***
	(0.143)	(0.136)	(0.128)	(0.120)	(0.143)	(0.131)
Slovakia	-0.304**	-0.303**	-0.276**	-0.280**	-0.374***	-0.279**
	(0.132)	(0.131)	(0.124)	(0.119)	(0.142)	(0.130)
Slovenia	1.841***	1.229***	1.285***	1.098***	1.405***	1.290***
	(0.141)	(0.127)	(0.121)	(0.117)	(0.139)	(0.127)
Turkey	3.975***	3.704***	3.321***	3.240***	3.308***	2.854***
	(0.151)	(0.144)	(0.136)	(0.132)	(0.166)	(0.150)
Timetrend	0.016	0.010	0.008	0.005	0.018	0.008
	(0.013)	(0.013)	(0.012)	(0.012)	(0.014)	(0.013)
costs/risk	0.139	0.056	0.033	-0.009	0.178*	0.037
	(0.098)	(0.097)	(0.088)	(0.084)	(0.113)	(0.097)
Croatia*Timetrend	-0.008	-0.007	-0.001	-0.001	-0.008	0.000
	(0.017)	(0.017)	(0.016)	(0.016)	(0.018)	(0.017)
Czech Republic*Timetrend	0.074***	0.066***	0.070***	0.063***	0.071***	0.067***
	(0.018)	(0.018)	(0.017)	(0.017)	(0.019)	(0.018)
Hungary*Timetrend	-0.035**	-0.034**	-0.035**	-0.034**	-0.034*	-0.034**
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)
Poland*Timetrend	0.007	0.009	0.007	0.007	0.006	0.007
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)
Romania*Timetrend	-0.006	-0.004	-0.011	-0.010	-0.006	-0.013
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)
Russia*Timetrend	0.055***	0.097***	0.089***	0.109***	0.076***	0.100***
	(0.021)	(0.020)	(0.020)	(0.018)	(0.022)	(0.021)
Slovakia*Timetrend	0.034**	0.031*	0.037**	0.033**	0.038**	0.035**
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)
Slovenia*Timetrend	-0.056***	-0.052***	-0.051***	-0.042***	-0.048***	-0.054***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.019)	(0.018)
Turkey*Timetrend	0.104***	0.094***	0.055***	0.050***	0.119***	0.091***
	(0.021)	(0.021)	(0.021)	(0.020)	(0.023)	(0.022)

All specifications include country-specific time polynomials of the third order, a set of year and a set of quarter dummies.

Table 5

Risk preferences in the CESEE region						
Dependent variable: log(marginal risk/marginal costs)						
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-4.089***	-3.591***	-3.837***	-3.589***	-4.500***	-3.736***
	(0.302)	(0.301)	(0.296)	(0.291)	(0.380)	(0.296)
Croatia	-0.100	-0.037	0.406***	0.379***	0.222*	0.140
	(0.121)	(0.124)	(0.117)	(0.116)	(0.134)	(0.121)
Czech Republic	-0.657***	-0.730***	-1.049***	-1.107***	-0.468***	-0.699***
	(0.125)	(0.126)	(0.115)	(0.113)	(0.142)	(0.126)
Hungary	-0.166	-0.113	0.055	0.097	0.355***	0.027
	(0.130)	(0.133)	(0.117)	(0.115)	(0.131)	(0.123)
Poland	-0.082	0.025	0.206*	0.232**	0.162	-0.051
	(0.129)	(0.131)	(0.116)	(0.114)	(0.135)	(0.129)
Romania	2.057***	1.822***	2.222***	2.117***	2.036***	0.895***
	(0.147)	(0.146)	(0.155)	(0.154)	(0.165)	(0.121)
Russia	2.555***	2.776***	1.912***	2.007***	2.230***	1.905***
	(0.146)	(0.145)	(0.126)	(0.121)	(0.146)	(0.131)
Slovakia	-0.167	-0.207*	-0.169	-0.194*	-0.278**	-0.214*
	(0.128)	(0.130)	(0.122)	(0.119)	(0.140)	(0.128)
Slovenia	2.037***	1.249***	1.306***	1.089***	1.438***	1.286***
	(0.138)	(0.124)	(0.117)	(0.114)	(0.135)	(0.123)
Turkey	4.243***	3.883***	3.540***	3.413***	3.432***	2.953***
	(0.151)	(0.149)	(0.140)	(0.139)	(0.164)	(0.148)
Timetrend	0.145***	0.100***	0.110***	0.084***	0.133***	0.096***
	(0.027)	(0.028)	(0.027)	(0.026)	(0.033)	(0.026)
costs/risk	0.521***	0.316***	0.327***	0.219**	0.475***	0.229**
	(0.118)	(0.118)	(0.109)	(0.106)	(0.135)	(0.107)
Croatia*Timetrend	-0.002	-0.005	-0.006	-0.005	-0.009	-0.001
	(0.016)	(0.016)	(0.016)	(0.016)	(0.018)	(0.017)
Czech Republic*Timetrend	0.077***	0.068***	0.077***	0.069***	0.068***	0.062***
	(0.017)	(0.017)	(0.017)	(0.016)	(0.018)	(0.017)
Hungary*Timetrend	-0.023	-0.025*	-0.028*	-0.029**	-0.034**	-0.027*
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)
Poland*Timetrend	0.020	0.016	0.013	0.011	0.010	0.018
	(0.015)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)
Romania*Timetrend	-0.056***	-0.037**	-0.056***	-0.044***	-0.047**	-0.032*
	(0.018)	(0.018)	(0.018)	(0.018)	(0.020)	(0.017)
Russia*Timetrend	0.001	0.059***	0.064***	0.090***	0.042*	0.085***
	(0.022)	(0.022)	(0.020)	(0.019)	(0.024)	(0.021)
Slovakia*Timetrend	0.008	0.012	0.019	0.019	0.017	0.017
	(0.016)	(0.017)	(0.015)	(0.015)	(0.017)	(0.016)
Slovenia*Timetrend	-0.082***	-0.060***	-0.057***	-0.044***	-0.060***	-0.062***
	(0.017)	(0.017)	(0.017)	(0.016)	(0.018)	(0.018)
Turkey*Timetrend	0.072***	0.071***	0.026	0.026	0.100***	0.081***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.023)	(0.022)
costs/risk*Timetrend	-0.046***	-0.032***	-0.035***	-0.026***	-0.037***	-0.030***
	(0.009)	(0.009)	(0.008)	(0.008)	(0.010)	(0.008)

All specifications include country-specific time polynomials of the third order, a set of year and a set of quarter dummies.

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FIRMS' RESPONSES TO SHOCKS BY PRICE, WAGE AND EMPLOYMENT IN MACEDONIA

Gani Ramadani*

Abstract

This paper analyses the role of the intensity of output market competition, firm's technology and of the incidence of collective wage-bargaining on firm's adjustment strategies to adverse shocks using firm-level data for Macedonia. We find that international character of product market competition reduces the relevance of firms' price reactions to cost shocks, whereas firms' exposure to domestic competition seems to have an opposite effect. The presence of collective wage agreements at national level makes a price increase less likely. The results suggest that labour intensity in production process makes firms more likely to increase prices after wage shock. The second part of the paper focuses on cost-cutting strategies and the factors that explain the choice of the strategy. The data indicate that market competition and wage agreements signed outside the firm increase the likelihood of cost-cutting strategies via labour costs, particularly through employment reduction, after cost shock. On the contrary, empirical results indicate that fluctuations in permanent employment to cost and wage shock are safeguarded by presence of temporary and part time employment.

Key words: survey data, product market competition, labour market institutions, firm's technology, Macedonia

JEL classification: C42, D21, E30, J38

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1. INTRODUCTION

A crucial element of microeconomic and macroeconomic adjustment is the behavior of firms to adverse shocks and their decisions for prices, wages and employment. Firm-level reactions to shocks form the distribution and dynamics of wages and employment with important policy implications. Namely, the higher the labour market rigidities are the more difficult labour (re)allocation becomes. This, in turn, reduces productivity and profits and may increase the degree to which cost-push shocks and demand shocks are passed on to prices. On the policy side, higher labour market rigidities decrease the functionality of the monetary policy transmission and make it more difficult to achieve the price stability goal. This is especially important for a small and open economy, like Macedonia, with a fixed exchange rate regime and imperfect capital mobility, where autonomy of monetary policy is relatively high.

We focus on price, employment and wage adjustment strategies in firms' reactions to shocks and assess the influence of structural and institutional characteristics of the firms in their chosen response strategy. For this we use survey data collected at the firm level in Macedonia. The survey uses the harmonized survey questionnaire and design applied within the Wage Dynamics Network (WDN)[1] of Eurosystem. Moreover, we compare some of the factors that influence firms' decisions in Macedonia to supply shocks with firms from EU investigated by Bertola et al. (2010).

Using the very rich survey database, we analyse the role of the intensity and international character of output market competition, of firm's technology and of the incidence of collective wage-bargaining constraints on firm's adjustment strategies to shocks. Our findings indicate that these factors are relevant for price, wage and employment adjustment and in most cases are in line with theoretical considerations. Also, these determinants are found to be relevant for surveyed EU firms investigated by Bertola et al. (2010). The second part of the paper focuses on cost-cutting strategies and the factors that explain firms' choices.

The remaining structure of the paper is as follow: in Section 2 we describe the dataset of Macedonian survey, and outline theoretical considerations to be used in empirical specifications. Next, in Section 3 we investigate the influence of firms' characteristics on price and cost adjustment strategies to cost shocks, and in Section 4 we consider different cost-adjustment strategies applied by firms. In each case we report descriptive statistics as well as controlled probit regressions. Finally, in Section 5 we conclude the paper.

2. DATA, RELEVANT THEORY AND LITERATURE

2.1. The dataset

In this paper, we use survey data for Macedonia. The survey contains questions on wage and price-setting behaviour at the firm level. It was conducted by the National Bank of the Republic of Macedonia for the first time during the first half of 2014, using an outsourcing global market research company. The survey design uses the common harmonized questionnaire and sample design, drawn up by the European Central Bank for EU countries within the Wage Dynamics Network (WDN)[2].

Table 1 presents the sample composition by sector and firm size. The representative sample covers 514 firms with different size in regard to employees that operate in manufacturing, construction, trade and market services. A detailed description of the Macedonian survey sample and the results can be found in Ramadani and Naumovski (2015). In order to make our results representative for the workforce in the sectors covered, we use employment adjusted sampling weights. As we noted above, the survey

[1] The WDN is an ESCB/Eurosystem research network studying the features and sources of wage and labour cost dynamics in EU countries.

[2] The WDN is an ESCB/Eurosystem research network studying the features and sources of wage and labour cost dynamics in EU countries.

was conducted in 2014, which represents the period of sluggish economic recovery from the global economic and financial crisis and low consumer price inflation.

Table 1

Sample composition by sector and size

	Number of firms					
	1-4 employees	5-19 employees	20-49 employees	50-199 employees	>200 employees	Total
Manufacturing	12	32	30	64	23	161
Construction	7	14	10	15	3	49
Trade	51	72	19	18	4	164
Market services	25	67	17	20	11	140
Total	**95**	**185**	**76**	**117**	**41**	**514**
	Percentages					
	1-4 employees	5-19 employees	20-49 employees	50-199 employees	>200 employees	Total
Manufacturing	2.3	6.2	5.8	12.5	4.5	31.3
Construction	1.4	2.7	1.9	2.9	0.6	9.5
Trade	9.9	14.0	3.7	3.5	0.8	31.9
Market services	4.9	13.0	3.3	3.9	2.1	27.2
Total	**18.5**	**36.0**	**14.8**	**22.8**	**8.0**	**100.0**

Source: Survey on wage and price setting in Macedonia (2014).

This paper studies firm-level adjustment strategies in reaction to hypothetical shocks. The common questionnaire contains information on how firms respond to three different adverse shocks (oil, wage and demand shocks). Similar to Bertola et al. (2010), this paper concentrates on two cost shocks.[3] One shock is an unanticipated increase in the cost of an intermediate input (e.g. an oil price increase), and the other shock represents an unanticipated increase in wages (for example, due to contracts bargained at higher levels or legislation that changes the required minimum wage). Both shocks affect all firms in the market in a similar way, and the wage shock is of permanent nature. Minimum wage in Macedonia for all sectors was introduced in the beginning of 2012 and after that it was increased almost each year[4]. In this regard, the question about wage shock represents an event that firms in Macedonia, mainly in manufacturing sector, have faced it recently.

The respondents had to tick the relevance (choosing between "not relevant", "of little relevance", "relevant" and "very relevant") of four different adjustment strategies in response to cost-push shocks: (1) increase prices, (2) reduce margins, (3) reduce production and (4) reduce other costs. Firms that rated "cost reduction" at any relevance were also asked what strategy they pursued (how they reduced costs). They had to choose between six options: reduce base wages (this option is not relevant for the wage shock), reduce flexible wages, reduce the number of permanent employees, reduce the number of temporary employees, and reduce the number of hours worked or reduce non-labour costs. Appendix 1 reports the exact wording of the questionnaire. The construction of variables is given in sections 3.2 and 4.2, that deal with explanation of empirical results about firms' adjustment strategies and cost-cutting strategies.

[3] As stated at their paper, while firms were also asked to consider reactions to a demand shocks, it is conceptually easier to study whether and how labour-cost adjustment is shaped by the firm's environment in response to the two hypothetical cost-push shocks.

[4] Law on minimum wage ("Official Gazette of the Republic of Macedonia" 11/12; 30/14; 180/14; 81/15; 129/15).

2.2. Relevant theory and literature

The rich database allows us to investigate the key question of this paper, what factors make Macedonian firms to use price and cost adjustment strategies in response to adverse shocks. Put differently, we focus on how reaction strategies correlate with structural and institutional features of the firms' business environment in which choices are made. To our knowledge, no empirical study exists of the reaction of Macedonian firms to adverse shocks. One empirical study that uses the same Macedonian survey data is that by Huber and Petrovska (2015), but they focus on nominal price and wage rigidities. They find that higher price flexibility is associated with a higher degree of product market competition, and firms facing high levels of domestic and international competition tend to adjust prices faster.

The main reference paper for our research is Bertola et al. (2010). Bertola et al. (2010) analyse the overall results of wage and price setting surveys for EU countries with respect to price versus cost and wage versus employment adjustments in response to cost-push shocks. Their finding is that the intensity and character of the adjustment depends on the intensity of competition, the importance of collective bargaining and on other structural and institutional features of firms and their environment. Our analysis pay special attention to Macedonian survey data. More specifically, the paper focuses on the reaction of Macedonian firms to adverse shocks, compares the results of firm-level adjustment strategies with selected EU countries, and we extend the set of explanatory variables.

Dhyne and Druant (2010) also investigates firms' responses to adverse shocks. They concentrate their analysis on the reaction of Belgian firms versus other European firms. Their main findings are that the importance of wage bargaining above the firm level, the automatic system of index-linking wages to past inflation, the limited use of flexible pay, the high share of low-skilled blue-collar workers[5], the labour intensive production process as well as the less stringent legislation with respect to the protection against dismissal are associated with a stronger employment reaction of Belgian firms to adverse shocks.

The theory about firms' decisions is elaborated at Bertola et al. (2010). Amongst others, they elaborate that the relevance of price and cost reactions depends on the shape of the firm's marginal revenues and marginal productivity (hence marginal costs). In turn, these depend on the firm's market power, and on institutional constraints on wage and employment adjustment. Under flexible prices, margins may be adjusted if the elasticity of demand varies (as in e.g. Gali, 1994). If prices are sticky, however, margins need to be adjusted when costs change. Thus, the relative relevance of the 'increase prices' and 'reduce output' should depend on the extent of price stickiness.

As discussed in theoretical section by Bertola et al. (2010), in response to supply shocks that (like those mentioned in the survey questions[6]) are common to all firms, it is more likely that prices rather than costs are the preferred adjustment strategy, when the output market is more competitive and firms have less control over the prices they charge.[7] Moreover, according to Bertola et al. (2010), the relevance of employment and wage reactions in a firm's cost-minimisation strategy in response to shocks depends essentially on the elasticity of its demand function, and on institutional constraints. Wage and employment responses are expected to be larger when labour demand is more elastic[8]. Moreover, employment adjustment should be larger when wages are rigid, and smaller when turnover is more costly (Bertola and Rogerson, 1997).

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5 Classification of employees is made according to the International Standard Classification of Occupations (ISCO-08)

6 An increase in intermediate input prices (such as the rise of crude oil prices) and a permanent increase in wages (for example, legislation that changes the required minimum wage).

7 When prices are sticky, however, a high elasticity of product demand and small margins make it easier for wage and cost shocks to overcome the cost of price changes.

8 International economic integration is generally expected to increase the elasticity of labour demand as well as labour productivity (see Andersen et al., 2000 and Andersen and Skaksen, 2007). Also, the elasticity of labour demand is expected to be larger, when a firm's production and investment choice spans international borders (Scheve and Slaughter (2004).

3. ADJUSTMENT TO COST AND WAGE SHOCKS

3.1. Descriptive analysis

The survey evidence allows us to understand the issues of interest by considering the information available on firm reactions to two different adverse shocks, particularly an increase in the cost of intermediate inputs (e.g. an oil price increase) and a general permanent rise in wages. Firms in Macedonia were asked to assume that these kinds of shocks hit them. Then, they had to assess how relevant the different adjustment strategies[9] in response to the shocks would be. They could choose among the options "very relevant" (4), "relevant" (3), "of little relevance" (2) and "not relevant" (1)[10].

Table 2 lists the four different adjustment strategies and their relevance for firms in Macedonia. The table contains the average score across all respondents and the proportion of respondents indicating that a particular shock-absorbing strategy is "very relevant" or "relevant" for them. The majority of Macedonian firms prefer to adjust to shocks by reducing their costs, where more than 70 percent of firms indicate that the reduction of other costs is "very relevant" and "relevant" option in response to a cost shock. Approximately 63 percent of the firms increase prices when facing a (hypothetical) cost shock. Around 54 percent of the firms indicate that a reduction in profit margins is a relevant answer, whereas only approximately 45 percent say that they reduce output after a cost shock.

Table 2

Reaction after cost shocks and wage shocks (firms assigning "very relevant" or "relevant" to any adjustment strategy)

Adjustment strategy	after a cost shock		after a wage shock	
	Av. Score	Proportion	Av. Score	Proportion
Increase prices	2.69	62.54%	2.38	50.15%
Reduce margins	2.39	54.31%	2.08	40.69%
Reduce output	2.22	44.61%	1.91	34.13%
Reduce costs	2.85	71.46%	2.69	65.69%

Source: Survey on wage and price setting in Macedonia (2014).

Consequently, almost two thirds of all firms increase prices in response to an input-cost shock, while more than one third will keep them constant. Furthermore, our results suggest that the fraction of firms increasing prices after a wage shock is somewhat lower compared with that after a cost shock. Moreover, reducing costs, reducing output and reducing profit margins seem on average slightly less important after wage shock than after other input-cost shock, probably suggesting that firms experienced on average smaller wage shocks than cost-push shocks in general. In addition, over the last few years, firms experienced two strong oil price spikes in 2007-08 and 2011-12 mainly owing to high demand coming from emerging markets economies.

In order to evaluate the pattern of covariation or substitutability across different survey answers, Table 3 reports the empirical correlations between the various adjustment channels, i.e. answers to the question on cost shocks and the one on wage shocks. All the cross-correlations presented in the table are positive and statistically highly significant. The diagonal elements of the sub-matrix reporting between-shocks correlations (the bottom-left quarter of Table 2) are all above 40 percent and significantly exceed the corresponding off-diagonal elements. This indicates that there is a tendency for firms to use the same adjustment strategies in response to both cost and wage shocks. The highest correlations in the "within-shock" sections of the table (figures in italic) correspond to the price-margin pair (approximately 50 percent in the case of wage shock) and margin-costs pair (approximately 53 percent in the case of

[9] The questionnaire includes four shock-absorbing strategies: 1. increase of prices, 2. reduction of profit margins, 3. reduction of output, and 4. reduction of other costs.

[10] The numbers in brackets give the scores attached to the degree of relevance.

wage shock). However, as correlations treat deviations from the mean in a symmetric way, these numbers indicate that the combination of increasing prices and reducing profit margins, and the combination of reducing profit margins and costs tend to go hand in hand in not being used. Put differently, both categories are often chosen to be "of little relevance" or "not relevant". Moreover, by looking at the lowest correlations in the "within-shock" sections of the table (figures in bold), the combination of increasing prices and reducing costs seems one of the most popular among the firms in Macedonia.

Table 3

Correlations across the relevance of different adjustment strategies

		Cost shock				Wage shock			
	Adjustment strategy	Price	Margin	Output	Costs	Price	Margin	Output	Costs
Cost shock	Price	1.0							
	Margin	0.52	1.0						
	Output	0.50	0.51	1.0					
	Costs	0.50	0.53	0.50	1.0				
Wage shock	Price	0.40	0.29	0.16	0.14	1.0			
	Margin	0.20	0.49	0.27	0.27	0.50	1.0		
	Output	0.26	0.36	0.49	0.20	0.39	0.43	1.0	
	Costs	0.31	0.32	0.27	0.56	0.33	0.45	0.37	1.0

Notes: Responses weighted by employment. All correlations are statistically significant at the 1% level. The sample size contains only non-missings for survey questions 23 (on cost-shocks) and 25 (on wage shocks). Survey questions are given in Appendix 1.

Summing up the descriptive evidence, survey data suggest that about two thirds of the firms in Macedonia increase prices after an input-cost shock, while one third tries to deal with higher costs in a different way and will keep prices constant. The most popular combination seems to be increasing prices and reducing costs. This gives evidence that cost-push shocks are not passed through proportionately (1:1) in the production chain but smoothed by Macedonian firms. Finally, these results seem to challenge the theoretical assumption that firms always operate at minimal costs. About 65 to 71 percent of the firms (depending on the kind of shock) indicate that they try to reduce other costs after a cost-push shock, which opens up some room for manoeuvre by the occurrence of a shock itself. These results are very similar compared to those of surveyed EU firms. According to Bertola et al. (2010), this way of dealing with cost-push shocks by EU firms would then constitute - at least to some extent - a shock-absorbing mechanism in the economy, as prices have to be raised and output reduced by less than without these cost reductions.

3.2. Firms adjustment strategies and some relevant covariates

In this paper, we focus on the two most popular adjustment strategies, namely reducing costs and increasing prices (see Table 1). In theory, the choice of adjustment strategy is dictated by firms' marginal revenue and cost considerations. Though these are not directly observed in the survey, some of the variables available in the survey dataset can be used indirectly to capture certain characteristics of firms' marginal revenue and cost schedules.

We are interested to analyse whether cost reduction is a more relevant adjustment strategy than price adjustment for firms that behave as price takers rather than price setters. For this purpose we create the variable competition, which is a dummy variable coded as unity if the firm replies that

it would be "very likely" and "likely" to decrease the price of its product if the firm's main competitor reduced its price (and as zero if "not likely", "not at all", and "do not know/does not apply" was indicated by the firm). The variable share of foreign sales in firm's revenues can also proxy for the intensity of price competition, since (controlling for sector and size) market power should be smaller for firms that are more exposed to large international markets. Moreover, to account for differences in production technologies and labour intensities across firms, our specifications also include: labour share - the share of labour costs in total costs; the sector in which the firm operates - four NACE-based sector dummies (manufacturing, construction, trade and market services); and firm size - a set of five dummy variables indicating firm size category in terms of employment (1-4, 5-19, 20-49, 50-199 and 200 and more employees).

While the choice of price adjustment as a shock-reaction strategy is shaped importantly by product market characteristics, the relevance of cost adjustment depends in theory on how easy it would be to do so. This depends on rigidities and adjustment costs in the labour market. In this respect, the survey dataset offers a number of variables that can be regarded as indirect measures of rigidities and adjustment costs associated with the labour input. To account for wage rigidities, our set of explanatory variables includes collective agreement, higher level - a dummy variable showing whether a given firm adopts a collective agreement concluded at national, regional, sectoral or occupational level, and collective agreement, firm level - a dummy variable indicating the presence of collective bargaining at the level of the firm. Table 2A reports some basic summary statistics for the covariates used in the analysis and is provided in Appendix 2.

3.3. The model and explanation of responses to shocks: what affects the adjustment channel at the firm level?

The main aim of the paper is to explain the firms' responses to different shocks. Following the approach of Bertola et al. (2010), the study explores the determinants of firms' choice to increase prices and/or lower costs in response to intermediate input and wage shocks by focusing on one of these adjustment strategies at a time. As described above, firms could indicate the importance of each strategy in their sets of measures by telling whether a given margin of adjustment is "very relevant", "relevant", "of little relevance" or "not relevant". On the basis of this information, we will define the endogenous variables as dummies, which are equal to unity if the adjustment strategy is "very relevant" or "relevant", and zero otherwise. Thus, we model the determinants of price increase and cost-cutting decisions using econometric technique by estimating probit models of the following form,

$$Prob\ (Y = 1) = \Phi(\beta' x),$$

where $Prob$ denotes probability, Y is response variable (endogenous variables described above, for example the adjustment strategies such as increase prices or reduce costs), β is a vector of coefficients, x is a vector of explanatory variables, and Φ (.) denotes the cumulative normal distribution function.

Table 4 presents the estimation results characterising firms' adjustment to cost and wage shocks. This table shows average probit marginal effects for price increase and cost reduction decisions. It gives the average over the marginal effects computed for all firms in the sample. The size of the average marginal effect and its significance, however, do not differ substantially from those computed for a (hypothetical) firm for which all model covariates are set at their average values. As explained by Bertola et al. (2010), these average marginal effects give an indication by how much the probability that a price increase or a cost reduction is a "very relevant" or "relevant" strategy changes, if one of the covariates changes by one unit (or change from zero to one if the covariate is a dummy variable). The bottom row of the table reports the predicted probability for a hypothetical benchmark firm to report that the response to a shock is "relevant" or "very relevant".

Table 4

Adjustment of prices and (other) costs in response to cost shocks and wage shocks, probit, average marginal effects

	Cost shock		Wage shock	
	Increase price	Reduce costs	Increase price	Reduce costs
competition_market2	0.2048**	0.1586*	0.1532*	0.1237
	(0.0842)	(0.0807)	(0.0833)	(0.0882)
share_of_foreign_sales	-0.2371**	-0.2561**	0.0605	-0.1114
	(0.105)	(0.111)	(0.1175)	(0.1227)
labour_share	-0.0014	0.0561	0.6043***	0.3858***
	(0.1476)	(0.1243)	(0.1327)	(0.1374)
coll_agr_higher	-0.1792**	-0.1488	0.0016	-0.0742
	(0.0857)	(0.0929)	(0.0829)	(0.0927)
coll_agr_firml	0.0481	0.0170	0.1483*	0.0440
	(0.0744)	(0.0705)	(0.0766)	(0.0769)
Observations	514	514	514	514
Pseudo-R2	0.1006	0.1099	0.1515	0.0695
Log-likelihood	-305.7	-273.6	-302.3	-307.6
Observed frequency	0.625	0.715	0.501	0.657
Predicted frequency	0.633	0.733	0.500	0.668

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. Not reported: sector and firms' size effects (see table 2B in Appendix 2 for these effects).

Let's start by analysing the estimation results with the effect of product market competition in firms' adjustment strategies. Our empirical results show that stronger competition is associated with more intensive adjustment in costs in the aftermath of (hypothetical) supply shocks. A firm in a very competitive environment is 15.9 p.p. more likely to reduce costs after a cost shock and 12.4 p.p. after a wage shock. However, this effect is statistically significant only for the cost shock. On the same direction, but contrary to our theoretical considerations in Section 2.2, price increases are more likely when competition in the product market is strong, and this effect is statistically significant for both shocks. In this regard, qualitatively, domestic market competition makes firms in Macedonia more likely to use a combination of both price and cost adjustment.

The complementary indicator of competitive pressure, the share of foreign sales in total sales, appears to matter or is statistically significant for the way firms in Macedonia react to cost shock only. Specifically, we find that firms with a higher exposure to foreign product markets are less likely to respond to cost shock by increasing their prices. In this regard, exposure to foreign markets implies a qualitatively different effect to that of our more direct measure of price competition, and confirms the theory that firms facing strong competition have very few margins to adapt prices. On the other hand, we find that firms with a higher share of foreign sales in total sales seem to be less likely to reduce costs, which theoretically are expected to reduce them when acting in a competitive environment. This possibly can be explained by looking at which type of costs firms in Macedonia apply reduction (labour or non-labour cost). Below, in section 4.1, it is given evidence that majority of firms in Macedonia reduce non-labour cost after cost-push shock. Having this in mind, in a competitive environment, especially in international environment, these costs (for instance, advertising, marketing and other costs) should be minimised even without a presence of negative shock.

Summarizing the intensity of product market competition, firms increase their prices in cost-push shocks when they operate in competitive domestic environment, but when competition is from international character they are less likely to do so. Generally, firms that operate only in domestic environment are possibly less productive and less profitable compared with firms exposed in foreign markets, and, as a consequence, are more inclined to pass on to prices the cost-push shocks. Another explanation can be the nature of shock itself which imposes firms to automatically include this shock in their cost structure, especially oil shock, and general believe that this kind of shock may be implemented by firm's main competitor as well. So, the character of output market competition, whether international or local, matters for firms in Macedonia how they pass-through to prices when cost-push shocks happen.

Looking at wage rigidities, firms covered by collective bargaining at the firm level are more likely to respond to shocks by increasing prices, whereas collective agreements at the national, regional or sectoral level do not seem to have strong effects on price and cost adjustment. Non influence of higher level collective bargaining corresponds with the World Bank difficulty of redundancy index for Macedonia, which indicates the relatively loose employment protection in Macedonia (WB, 2011). Thus, rigidities in marginal cost stemming from the presence of lower level collective agreements increase the likelihood that cost shocks and wage shocks will be passed-through to product prices by 4.8 p.p. and 14.8 p.p., respectively (statistically significant only for wage shock). Overall, the existence of collective agreements makes it more likely that adjustments are taking place by raising prices. In other words, rigidities in wages increase the likelihood that cost-push shock (increase in price of intermediate inputs or wages) will be passed on to prices and, hence, be a sign of the presence of second round effects.

A firm's production technology also affects the way it reacts to shocks. When the labour cost share is high, prices are more likely to be adapted. Since a higher labour share implies that marginal costs are more sensitive to labour costs, prices are more likely to be raised in response to a general wage increase. According to results presented in Table 4, a higher labour cost share increases the likelihood of price adjustment after a wage shock (a 10 p.p. rise in the labour share increases the incidence of price adjustment by about 6 p.p.). Also, a tight link between wage and price changes when labour costs are an important part of total costs has also been found in Druant et al. (2009) about surveyed firms in EU. At the same time, besides increasing prices, firms with high labour intensity are more likely to reduce other costs when there is occurrence of wage shock. In response to the input-cost shock, firms with higher labour intensity process seem to be neutral in their decisions on price and cost adjustment and coefficients are not statistically significant.

Our estimations suggest two additional results, and they are about sector and firm dummies. The continuations of results from Table 4 are reported in Appendix 2, table 2B. First, there is a clear sectoral effect indicating that compared to the manufacturing sector, firms operating in the market services sector and trade sector are less likely to respond to the input-cost shock. Similar reactions of these firms from these sectors can be seen also to the wage shock, but results are not statistically significant. Second, we find that larger firms are less likely to respond by increasing prices or reducing costs after a cost or wage shock.

Considering the goodness of fit of our model, the pseudo R^2 associated to the estimations of our probit specifications are relatively small. Moreover, it seems that most of the explanatory power of the model is associated to the dummy variables coding for the firm size and the sector.[11]

In an alternative specification (not reported in the study), the set of explanatory variables has been extended. We considered the firms covered by a collective agreement at any level and the share of the wage bill related to individual or company performance related bonuses or benefits as additional explanatory variables. Results with respect to firms covered by a collective agreement at any level are not significant. Firms with large share of flexible wage bill are more inclined to reduce costs in response to cost shock. This confirms that flexible pay structures (bonuses and other kinds of flexible pay) can be more easily adapted to the firms' situation.

[11] The size and sector indicator variables account for around 85% of the pseudo R^2 of our model.

4. COST-CUTTING STRATEGIES

The survey and its rich information allows us for a deeper analysis with regard to the most popular adjustment strategy after cost-push shocks (see Table 1), namely reducing other costs. Thus, we proceed to analyse the determinants of different cost-cutting strategies reported by firms in Macedonia. The respondents were asked to report their most important strategy of cutting costs. They could choose among six different options: (a) reduce base wages, (b) reduce flexible wage components, (c) reduce the number of permanent employees, (d) reduce the number of temporary employees, (e) reduce hours worked per employee and (f) reduce non-labour costs. Our aim is to measure the extent to which wage rigidity implies larger employment responses to shocks when labour demand is more elastic[12].

4.1. Descriptive analysis

Before we proceed to analyse the empirical results first we observe the results from descriptive evidence. The answers are summarised in Table 5, which shows that about three quarters of firms prefer to reduce non-labour costs, while the other quarter prefers to reduce labour costs. These non-labour costs include for instance negotiating with suppliers about prices, reducing administrative costs and reducing advertising costs. The first three categories in Table 5 imply an employment response to a shock. In reaction to a shock, and without conditioning on any other variable, some 17-20 percent of the responding firms plan to implement their cost reductions by reducing employment. Only around 6 percent of the firms indicate that they are likely to reduce costs by cutting flexible wage components, and only about 1 percent would cut base wages. Finding that firms are more likely to cut employment than wages is of course common in the literature (e.g. Bewley, 1999). We will analyse below how these differences are related to features of the firms' environment.

Table 5
Acceptance of different ways of cost adjustment (share of firms)

Cost-cutting strategy	after a cost shock	after a wage shock
Reduce number of temporary/other employees	10.00%	10.00%
Reduce number of permanent employees	3.70%	4.80%
Reduce hours worked per employee	3.30%	4.90%
Reduce flexible wage components	6.50%	6.10%
Reduce base wages	0.80%	-
Reduce non-labour costs	75.70%	74.20%

Notes: Responses weighted by employment and rescaled excluding non-responses; figures are based on survey questions 24 and 26. Source: Survey on wage and price setting in Macedonia (2014).

On the basis of the simple theoretical considerations outlined above, wage and employment responses are expected to be bigger when firms are subject to strong product market competition. Moreover, they should be smaller when collective agreements reduce wage flexibility, and employment protection legislation (or non-availability of temporary contracts, or technological features) reduces employment flexibility. The following empirical analysis brings this reasoning to bear on the data, using information from the firm-level.

[12] When labour expenses are a high proportion of total costs, then labour demand is more elastic, and when there is presence of strong product market competition.

4.2. Adjustment channels and some relevant covariates

To determine factors explaining the choice of the most important cost-cutting strategy, we run a set of probit regressions relating each adjustment choice to theoretically relevant covariates. In particular, we focus on indicators of product market structure and labour market institutions. The dependent variable in the probit regression equals one if the firm indicates that the respective cost-cutting strategy is the most important one, and zero otherwise. Additional to the covariates already described in Section 3 *(competition, share of foreign sales, labour share, collective agreement (higher level and firm-level)* as well as *industry* and *size*), we include more variables on characteristics of the labour market, as we are especially interested in their influence on labour-cost cutting strategies.

For this reason, we include the *share of temporary employment*, as a continuous variable giving the percentage share of employees with a temporary contract. Also, we introduce the *share of part-time employment*, which gives the percentage share of employees with a permanent contract, but working part-time. Finally, we use the *share of variable wages*, which is also a continuous variable and gives the percentage share of the total wage bill that is related to individual or company performance related bonuses and benefits.

Results on cost reductions due to employment (permanent and temporary) and wage adjustments are presented in Table 6, whereas results on hours and non-labour cost adjustment are reported in Appendix 2 (see Table 2C). We analyse the impact of output market competition (competition and share of foreign sales), the firm's technology (labour share), the structure of the workforce and its remuneration (share of temporary and part-time employment as well as share of variable wages) and labour market institutions (collective agreement at firm level and higher level) on each type of cost-adjustment strategy separately. Moreover, as previously mentioned, we consider industry dummies and size dummies in order to control for all kinds of differences in technology.

Let's start by analysing the results for the impact of competition on the choice of the preferred cost adjustment channel. Product market competition appears to be positively associated with the relevance of employment and wage adjustment after both types of shocks (statistically significant in the case of intermediate input shock for employment). For a given degree of wage rigidity, this is consistent with standard labour demand theory, in that, for a given labour share, a more elastic product demand function implies a more elastic labour demand and a more pressing need for firms to reduce employment. As we mentioned above, wage adjustment is more likely in a highly competitive environment after both types of shocks, but appears to be not statistically significant. The main impact of competition is on the choice between labour and non-labour costs, where reduction of non-labour costs[13] is less likely for firms with higher competitive pressures (shown in Table 2C). Overall, firms operating in a highly competitive environment are less likely to reduce non-labour costs and more likely to reduce labour costs, regardless which type of labour costs.

[13] These costs could include, for instance, advertising, marketing and other costs that in a competitive environment should be minimised even without a negative shock.

Table 6

Cost adjustment strategies (employment and wages) and some relevant covariates, probit, average marginal effects

	Cost shock			Wage shock		
	Permanent employment	Temporary employment	Wages	Permanent employment	Temporary employment	Wages
competition_market2	0.0547***	0.067***	0.0488	-0.0339	0.0149	0.0388
	(0.021)	(0.0185)	(0.0328)	(0.0611)	(0.0406)	(0.0259)
share_of_foreign_sales	0.0496	0.0879	-0.0781*	-0.0690	-0.0117	-0.0164
	(0.0479)	(0.0655)	(0.0455)	(0.06)	(0.0503)	(0.0301)
labour_share	-0.0533	-0.0053	0.0398	0.1553	-0.0090	0.0530
	(0.057)	(0.054)	(0.0676)	(0.0967)	(0.0874)	(0.064)
coll_agr_higher	0.0438*	0.0080	-0.0326	-0.0580	-0.0067	-0.0132
	(0.0257)	(0.0367)	(0.0295)	(0.0386)	(0.0383)	(0.0267)
coll_agr_firml	-0.0075	-0.0153	0.0299	0.0030	0.0562	-0.0106
	(0.0194)	(0.0282)	(0.0286)	(0.052)	(0.0401)	(0.0255)
share_temp_empl	-0.463***	0.0239	0.0920	-0.2791	0.1078	0.1012
	(0.1702)	(0.0642)	(0.0992)	(0.2346)	(0.0831)	(0.0628)
share_part_time_empl	-0.2694	-0.1359**	-0.5339*	-0.4026*	-0.6873	-0.1908
	(0.2709)	(0.0692)	(0.2828)	(0.2132)	(0.5987)	(0.2523)
share_variable_wages	0.0623	-0.0353	-0.0714	-0.2941**	-0.0666	-0.1026
	(0.06)	(0.0455)	(0.0772)	(0.1494)	(0.0735)	(0.0735)
Observations	433	433	433	412	412	412
Pseudo-R2	0.2085	0.4552	0.1022	0.1788	0.1135	0.2103
Log-likelihood	-56.0	-79.3	-104.3	-61.4	-111.2	-70.2
Observed frequency	0.0371	0.1004	0.0726	0.0483	0.0999	0.0612
Predicted frequency	0.0084	0.0247	0.0464	0.0184	0.0692	0.0272

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. Not reported: sector and firms' size effects (see table 2D in Appendix 2 for these effects).

With regard to labour market institutions, we find that collective agreements outside the firm (that is collective agreements signed at the national, regional, sectoral or occupational level) make an adjustment of permanent employment more likely. Imposing a wage agreement negotiated at a higher than the firm level to a firm increases the probability of laying-off permanent workers by 4.4 p.p. Again, this confirms the weak collective bargaining institutions in Macedonia and may reflect the less heavily regulated Macedonian labour-market, the more flexible lay-off arrangements, as well as weak enforcement of law. Additionally to wage-setting institutions, in case of cost-push shocks, firms with collective wage agreements at higher level are more likely to adjust the number of hours worked per employee. Overall, firms covered by collective wage agreements at higher level appear to reduce the number of permanent employees and to adjust the number of hours worked per employee.

Regarding the structure of workforce, the share of temporary workers shows a solid association with the character of cost-cutting strategies of Macedonian firms. Firms with a high share of temporary employment are less likely to reduce the number of permanent employees as the preferred adjustment strategy, and more likely to indicate layoffs of temporary employees. An increase in the share of temporary workers by 10 percentage points decreases the probability of cutting permanent employment by 4.6 p.p. and increases the probability of reducing temporary employment by 0.24 p.p. (not statistically significant for the second one). Thus, temporary employment in Macedonian firms, acts as a buffer against employment fluctuations for permanent workers.

Now we turn to additional variables included in our regressions that deal with firm's technology and the structure of remuneration. Looking at their sign, the results suggest that firms in Macedonia with high labour share are more likely to cut wages, although regressions cannot confirm its statistical significance. Furthermore, the results presented in Table 2C in the Appendix 2 suggest that firms using a labour intensive technology are associated with a higher likelihood of working hours reduction in reaction to shocks. On the other hand, a larger share of variable wages makes firms less likely to reduce permanent employees in reaction to wage shock. Moreover, a high share of variable pay increases the probability of non-labour cost adjustment after adverse wage shock. Thus, a larger share of variable wages safeguards permanent employment and increases the reaction through non-labour costs after wage shock.

Looking at size and sector of Macedonian firms (Appendix 2, Table 2D), we find a smaller employment reaction and hours worked for larger firms, while firms operating in construction compared to the manufacturing sector tend to cut temporary instead of permanent employment. Firms operating in construction and trade sector are less likely to cut wages, while reduction of hours worked is less likely to occur in market services sector.

To summarize our main results regarding the cost-cutting strategies, we find that product market competition is a substantial determinant in the firm's decision to adjust labour costs instead of non-labour costs. Thus, firms operating in a highly competitive environment are less likely to reduce non-labour costs and more likely to reduce labour costs. The framework of the labour market has impact on firms' decisions choosing between different kinds of labour costs. In this respect, wage setting institutions, in particular, wage agreements signed outside the firm appear to reduce the number of permanent employees and to adjust the number of hours worked per employee. The structure of the workforce, such as temporary employment acts as a buffer against employment fluctuations for permanent workers. Firms using a labour intensive technology are associated with a higher likelihood of working hours reduction, whereas structure of remuneration safeguards permanent employment and increases the reaction through non-labour costs after wage shock.

5. CONCLUSIONS

This paper provides empirical evidence from the firm-level survey data by focusing on determinants of price, wage and employment reactions to unexpected changes in the economic environment for Macedonian firms.

Using the very rich survey database for firms in Macedonia, our findings indicate that factors such as: intensity and international character of output market competition, of firm's technology and of the incidence of collective wage-bargaining shape the relevance of firms' price, wage and employment adjustment strategies to shocks. Also, according to other studies, these determinants are found to be relevant for surveyed EU firms. In most cases, empirical results are in line with theoretical considerations. Firms in Macedonia that face strong market competition and are exposed to large international markets are more likely to reduce the relevance of price reactions to cost shocks, whereas the influence of domestic competition seems to have opposite role reflecting their possible lower productivity and profits compared with firms engaged in foreign markets. Consequently, less productive and less profitable firms are more inclined to pass-through the cost-push shocks to product prices. The presence of collective wage agreements at national level makes a price increase less likely. Findings about EU firms are opposite, which reflects their stronger unions. Moreover, the data suggest that firm's technology or labour intensity

in production process makes firms more likely to increase prices after wage shock and is in line with the findings for surveyed EU firms.

Regarding the cost-cutting strategies and the factors that explain the choice of the strategy, results indicate that competition increases the likelihood of cost-cutting strategies via labour costs, particularly through employment reduction, after cost shock. Also, wage agreements signed outside the firm appear to reduce the number of permanent employees and to adjust the numbers of hours worked per employee. Moreover, higher labour share increases the odds of reduction of hours worked after cost and wage shock. In addition, empirical results indicate that fluctuations in permanent employment to cost and wage shock are safeguarded by the presence of temporary and part time employment. Employment is also safeguarded by a large share of flexible pay in total wages, only in the case of wage shock.

Evaluating the extent to which such features influence the behaviour of firms in Macedonia could help determining the degree to which the recent positive oil shock and increases in minimum wage can be transmitted to consumer prices. However, in a situation when the oil shock has different direction (from negative to positive), the intensity of adjustment can be dissimilar. Moreover, this has important implications for transmission mechanism of monetary policy. Accordingly, identifying determinants and factors of firms' price and cost reaction to adverse shocks may help policymakers of Macedonia (and other countries with similar economic characteristics) assess their current policies and design a system that will lead to more optimal policymaking.

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APPENDIX 1: SURVEY QUESTIONS

23 — How relevant are each one of the following strategies when your firm faces an unanticipated increase in the cost of an intermediate input (e.g. an oil price increase) affecting all firms in the market? Please tick an option for each line.

	not relevant	*of little relevance*	*relevant*	*very relevant*	*don't know*
Increase prices	□	□	□	□	□
Reduce margins	□	□	□	□	□
Reduce output	□	□	□	□	□
Reduce other costs	□	□	□	□	□

24 — If the reduction of other costs is of any relevance in your answer to question 23, please indicate the main channel through which this goal is achieved:
Please choose a single option, the most important factor.

Reduce base wages	□
Reduce flexible wage components (for example bonuses, benefits, etc)	□
Reduce the number of permanent employees	□
Reduce the number of temporary employees / other type of workers	□
Adjust the number of hours worked per employee	□
Reduce other non-labour costs	□

25 — How relevant are each one of the following strategies when your firm faces an unanticipated permanent increase in wages (e.g. due to the renewal of the national contract) affecting all firms in the market? Please tick an option for each line.

	not relevant	*of little relevance*	*relevant*	*very relevant*	*don't know*
Increase prices	□	□	□	□	□
Reduce margins	□	□	□	□	□
Reduce output	□	□	□	□	□
Reduce other costs	□	□	□	□	□

26 — If the reduction of other costs is of any relevance in your answer to question 25, please indicate the main channel through which this goal is achieved:
Please choose a single option, the most important factor.

Reduce flexible wage components (for example bonuses, benefits, etc)	□
Reduce the number of permanent employees	□
Reduce the number of temporary employees / other type of workers	□
Adjust the number of hours worked per employee	□
Reduce non-labour costs	□

APPENDIX 2: STATISTICS OF VARIABLES USED IN ANALYSIS AND DETAILS ON EMPIRICAL RESULTS

Table 2A
Variables used in the analysis

Variable	Type	Mean	Std. Dev.	Min	Max	Number of obs.
manufacturing_sector	Dummy	0.487	0.500	0	1	514
construction_sector	Dummy	0.128	0.334	0	1	514
trade_sector	Dummy	0.140	0.347	0	1	514
market_services_sector	Dummy	0.246	0.431	0	1	514
size_employees_5to19	Dummy	0.053	0.225	0	1	514
size_employees_20to49	Dummy	0.070	0.255	0	1	514
size_employees_50to199	Dummy	0.359	0.480	0	1	514
size_employees_200andmore	Dummy	0.510	0.500	0	1	514
size_employees_lessthan5	Dummy	0.008	0.090	0	1	514
competition_market2	Dummy	0.724	0.447	0	1	514
share_of_foreign_sales	Fraction	0.411	0.425	0	1	514
labour_share	Fraction	0.394	0.278	0	1	514
coll_agr_higher	Dummy	0.363	0.481	0	1	514
coll_agr_firml	Dummy	0.382	0.486	0	1	514
share_part_time_empl	Fraction	0.020	0.111	0	1	514
share_temp_empl	Fraction	0.068	0.176	0	1	514
share_variable_wages	Fraction	0.193	0.281	0	1	514

Table 2B

Adjustment of prices and (other) costs in response to cost shocks and wage shocks, probit, average marginal effects

	Cost shock		Wage shock	
	Increase price	Reduce costs	Increase price	Reduce costs
construction_sector	-0.1580	-0.2619	-0.0655	0.0401
	(0.1581)	(0.1666)	(0.1422)	(0.1737)
trade_sector	-0.3633***	-0.4238***	-0.0846	-0.1461
	(0.1206)	(0.1193)	(0.1157)	(0.1408)
market_services_sector	-0.2398***	-0.163*	0.0724	-0.0367
	(0.0919)	(0.0982)	(0.102)	(0.1114)
size_employees_5to19	-0.0928	-0.0572	-0.0573	-0.0785
	(0.0721)	(0.0681)	(0.0708)	(0.07)
size_employees_20to49	-0.0245	-0.0296	-0.0076	-0.0302
	(0.0935)	(0.0874)	(0.0885)	(0.0898)
size_employees_50to199	-0.0878	0.0144	-0.1100	-0.0275
	(0.0926)	(0.0903)	(0.0865)	(0.0926)
size_employees_200andmore	-0.0562	-0.0551	-0.1600	-0.0874
	(0.1166)	(0.1107)	(0.099)	(0.1157)
Observations	514	514	514	514
Pseudo-R2	0.1006	0.1099	0.1515	0.0695
Log-likelihood	-305.7	-273.6	-302.3	-307.6
Observed frequency	0.625	0.715	0.501	0.657
Predicted frequency	0.633	0.733	0.500	0.668

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. Reported sector and firms' size effects only.

Table 2C

Cost adjustment strategies (hours and non-labour cost reduction) and some relevant covariates, probit, average marginal effects

	Cost shock		Wage shock	
	Hours	Non-labour cost	Hours	Non-labour cost
competition_market2	0.0343	-0.1701***	-0.0120	-0.0652
	(0.0236)	(0.05)	(0.0335)	(0.0761)
share_of_foreign_sales	-0.0246	-0.0495	-0.0562	0.1205
	(0.0364)	(0.0875)	(0.0391)	(0.0995)
labour_share	0.1264**	-0.0418	0.0899*	-0.1740
	(0.0589)	(0.1176)	(0.0507)	(0.1375)
coll_agr_higher	0.1045**	-0.0246	0.1256***	-0.0253
	(0.052)	(0.0674)	(0.0436)	(0.0784)
coll_agr_firml	-0.0612**	0.0066	-0.0227	-0.0583
	(0.0307)	(0.0591)	(0.0297)	(0.0726)
share_temp_empl	0.0428	-0.0616	0.0442	-0.3001
	(0.0702)	(0.1735)	(0.0675)	(0.1881)
share_part_time_empl	-0.0428	0.4544**	0.1943**	0.3687
	(0.0692)	(0.1826)	(0.0981)	(0.4365)
share_variable_wages	-0.0362	0.0795	-0.0153	0.3286**
	(0.0365)	(0.1299)	(0.0466)	(0.1503)
Observations	433	433	412	412
Pseudo-R2	0.1921	0.1876	0.2332	0.1028
Log-likelihood	-52.6	-201.3	-57.7	-197.9
Observed frequency	0.0332	0.7567	0.0488	0.7419
Predicted frequency	0.0134	0.7960	0.0135	0.7714

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. Not reported: sector and firms' size effects (see table 2D in Appendix 2 for these effects).

Table 2D

Cost adjustment strategies and some relevant covariates (sector and firms' size effects only), probit, average marginal effects

	Cost shock					Wage shock				
	Permanent employment	Temporary employment	Wages	Hours	Non-labour cost	Permanent employment	Temporary employment	Wages	Hours	Non-labour cost
construction_sector	-0.0432***	0.3903**	-0.0479	-0.0146	-0.2957*	0.0271	-0.0401	-0.0402***	-0.0263	0.1683**
	(0.0144)	(0.1897)	(0.0314)	(0.0293)	(0.1777)	(0.0802)	(0.0434)	(0.0151)	(0.0304)	(0.0848)
trade_sector	0.0026	-0.0111	-0.0868***	-0.0010	0.1306	0.0007	-0.0939***	-0.0409**	-0.1142***	0.2658***
	(0.0518)	(0.0563)	(0.0279)	(0.0406)	(0.0851)	(0.0827)	(0.036)	(0.0177)	(0.0303)	(0.0759)
market_services_sector	0.0190	-0.0117	-0.0105	-0.0547**	0.0777	0.0752	-0.0493	0.0213	-0.0905***	0.0710
	(0.0405)	(0.0481)	(0.0386)	(0.0248)	(0.0725)	(0.0642)	(0.0347)	(0.0325)	(0.0291)	(0.0827)
size_employees_5to19	-0.0084	0.0163	0.0674	0.0258	-0.0523	0.0588	0.0598	0.0040	-0.0482	-0.0719
	(0.0293)	(0.0423)	(0.0618)	(0.0396)	(0.0628)	(0.0522)	(0.0633)	(0.0426)	(0.0343)	(0.078)
size_employees_20to49	-0.0214	-0.0197	0.0932	0.0468	-0.0065	-0.0005	0.0349	-0.0101	-0.0412	0.0147
	(0.0319)	(0.0404)	(0.0896)	(0.056)	(0.0767)	(0.0593)	(0.0763)	(0.0381)	(0.0308)	(0.0885)
size_employees_50to199	-0.0537*	-0.0616*	0.0732	-0.0149	0.1000	-0.0090	0.0139	0.0051	-0.0564*	0.0527
	(0.0289)	(0.0365)	(0.0776)	(0.0362)	(0.0673)	(0.0581)	(0.0651)	(0.0438)	(0.0348)	(0.0878)
size_ employees_200andmore	-0.0299	0.0289	0.0818	-0.0318	-0.0567	-0.0335	0.0846	0.0465	-0.0664***	-0.0307
	(0.0242)	(0.0527)	(0.1008)	(0.0282)	(0.0935)	(0.0552)	(0.0988)	(0.078)	(0.0193)	(0.1109)
Observations	433	433	433	433	433	412	412	412	412	412
Pseudo-R2	0.2085	0.4552	0.1022	0.1921	0.1876	0.1788	0.1135	0.2103	0.2332	0.1028
Log-likelihood	-56.0	-79.3	-104.3	-52.6	-201.3	-61.4	-111.2	-70.2	-57.7	-197.9
Observed frequency	0.0371	0.1004	0.0726	0.0332	0.7567	0.0483	0.0999	0.0612	0.0488	0.7419
Predicted frequency	0.0084	0.0247	0.0464	0.0134	0.7960	0.0184	0.0692	0.0272	0.0135	0.7714

Notes: Robust standard errors in parentheses; ***, **, * denote significance at the 1%, 5% and 10% significance level, respectively. Reported sector and firms' size effects only.

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MONETARY POLICY COMMUNICATION: EVIDENCE FROM SURVEY DATA

Neda Popovska-Kamnar[1]

Abstract

This paper summarizes the results of a Survey on Monetary policy Communication conducted among central banks in Central Eastern and South-Eastern Europe and the euro area. The main objective of this Survey was to draw evidence on the level of transparency and communication strategies of the central banks. The results of the Survey reveal that today the central banks pay much attention to the proper transparency and provide significant information about their decisions and policy making process. The overall conclusion of the Monetary policy communication Survey is that the communication and the transparency of the 15 central banks included in the Survey is on satisfactory level. Still, there is always a room for improvement, especially in the area of introducing forward guidance by the central banks and more "proactive ways" of communication with the public.

Key words: survey data, central banks, monetary policy, communication, transparency

JEL classification: E52, E58, E66, GO1

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1. INTRODUCTION

In the past decade, there has been a dramatic change in the central banks views on the role of transparency and communication in conducting their monetary policy. The switch to flexible exchange rate in the 90s, the introduction of inflation targeting in the early 2000s and the global financial crisis 2007-2009 were the main drivers of the change in the way how the central banks communicate. Especially the last global financial crisis, highlighted the use of central bank communication as a distinct policy tool under unconventional monetary policies (Vayid, 2013).

Central bank communication can be defined as providing information by the central bank to the public regarding matters such as the objectives of monetary policy, the monetary policy strategy, the economic outlook, and the outlook for future policy decisions (Blinder et al, 2008). Very often, central banks communicate at least four different aspects of monetary policy: objectives and strategies, the reasons behind their decisions, economic outlook and future decisions. This information provided to the market participants helps them to anticipate the future economic developments, which is one of the crucial points of good central bank communication. Still, the degree of central bank openness depends on the monetary policy strategy, institutional setup and the economic developments of the country.

The importance of the central bank communication was also highlighted by the heads of the central banks. In one of his speeches, the ex-chairman of the Federal Reserve, Ben Bernanke pointed the meaning of good central bank communications: "in the short run cellar communication helps to increase the near-term predictability of the central bank decision, which reduce risk and volatility in financial markets and allows for smoother adjustment of the economy to rate changes. In the long run, communicating the central bank's objectives and policy strategies can help to anchor the publics". He pointed that clear communication is an instrument to make monetary policy itself more powerful. "Communication about the strategy helps explain the way monetary policy behaves outside the steady state, how it responds to shocks and frictions to facilitate the economic convergence back to steady state. Communicating about the principles that govern the strategy makes the process of adjustment more rapid and less painful." – was pointed by Bernanke, in his speech (2004).

This paper summarizes the results of a representative survey on Monetary Policy Communication conducted among the central banks in Central, Eastern and South-Eastern Europe. The main objective of this Survey was to draw evidence on the level of transparency and communication strategies of the central banks. The Survey was divided in four sections: Objectives and strategies, Policy decisions, Economic outlook and Forward guidance and General communication questions. The analysis of the survey results is based on the answers from the 14 central banks on one side, and the survey answers from the European Central Bank (ECB) on the other.

The Survey shows that central banks pay much attention on their transparency, and publicly disclose information about their decisions and policymaking process. They are fully transparent about their primary goal-price stability, which is published as numerical or non-numerical target. From the aspect of monetary policy, according to the Survey, all central banks published their monetary policy decisions, however in different timespan. The changes in policy settings are first announced on the central bank website or in the form of a press release, while the statements are usually half page to two pages long. Consequently, almost all the central banks disclose the numerical value for a change in the monetary policy instrument, the direction of the change in the monetary policy instrument and the reasons behind the decision

One of the main activities of the Central bank is the economic forecast, which offers information for the future path of the economy, sending signals to the market participants and public. The Survey results show that central banks are also highly transparent from the aspect of their forecasts activities, publishing them on quarterly or semi-annual base. Inflation rate and the economic growth, are the main economic indicators for which the central banks publish their forecasts. The way how the forecast information is disclosed vary among the central banks, from numerical to non-numerical.

In order for the central bank to achieve high transparency through clear and open communication with the public, good organization structure is essential. Almost all central banks have an office for

public relations or a press spokesmen. Mainly, the work of the central banks is published in the working papers, regular reports and presented on special economic conferences. Also, some central banks offer "alternative" ways of communication with the public, through presentation of their work, distribution of brochures and visits to the institutions.

The financial crisis 2007-2009 also had an impact on the way the central banks communicate. It highlighted the need for better communication among the banks, markets and central banks. According to the Survey, some central banks introduced certain changes in the communication of monetary policy with a purpose to become more active. One of the tools was forward guidance, which is a term used for likely future course of the monetary policy.

The remaining part of the paper is structured in the following way. The literature review in Section 2 gives an overview of the consulted research papers that have dealt with the communication and transparency of the central banks. Section 3 describes the survey design, providing information on the questionnaire, the sample of the survey and the way the survey was conducted, as well as the main characteristics of the surveyed central banks. Section 4 provides an overview of the survey results on the different aspects of communication strategy of the central banks. The closing section provide concluding remarks of the paper.

2. LITERATURE REVIEW

For much of 20th century, central banks maintained strict secrecy, basing their actions on a mystique derived from a somewhat metaphysical approach to monetary policy (Cordemans, 2015). One of the best proofs of the view on the transparency of the central banks in that period is the comment that the chairman of the Federal Reserve, Alan Greenspan in 1988 gave on his speech, which was quoted in The New York Times (October 28, 2005): "I guess I should warn you, if I turn out to be particularly clear, you've probably misunderstood what I said" (Norrs, 2005).

From the middle of 90s, there was a move toward transparency, and one of the main reasons was the switch to floating exchange rate, which gave countries more flexibility to conduct independent monetary policy. Still the main driver toward transparency, happened in the early 2000 when inflation targeting was introduced by most central banks. The inflation targeting requires transparency, in order to make a successful link between the inflation expectations of the central bank and the market developments.

Many central banks have become more transparent over the past 15 years and have paid more attention on their communication. A few decades ago, a conventional wisdom in central banking circles held that monetary policymakers should say as little as possible, and say it cryptically (Blinder et al, 2008). Over the recent past, it became increasingly clear that managing expectations is of crucial importance for the monetary policy, thus communication policy has risen in stature from a nuisance to a key instrument in the central banker's toolkit. The improvement in the central bank communication is also highlighted by Jeanneau (2009) in the survey conducted in 2007 on the communication practices of 32 members of the Central Bank Governance Network (CBGN). The main reasons cited by central banks for improving communication were: to ensure better accountability; to enhance the public's understanding of the objectives of policy and the decision-making process; and to guide market expectations. The direction and magnitude of policy decisions are seen by central banks as largely anticipated by market participants; this should help reduce the overall economic costs of adjusting to changes in policy settings.

The central banks provide a considerable amount of policy-relevant information, though there is diversity in what central banks disclose. According to the Survey of communication practices in the Asian-Pacific region in the mid-2007 (Filardo and Guinigundo, 2008) it was concluded that those that have adopted inflation targeting frameworks tend to be more open in terms of the provision of information. Also, the central banks rely on a mix of ways to communicate with financial markets and the general public. The results of the Survey showed that there is a difference in the degree of transparency of the central banks, depending on the region they belong. Regarding managing expectation, it was concluded

that the central banks have been putting considerable emphasis on not surprising markets but rather on guiding the markets in a more predictable way.

One crucial breaking point in the way the Central banks communicate is also the last Global financial crisis, which highlighted the need for more transparent monetary policy. From one side, the crisis made the decision process of the Central banks more complicated and on the other side, many unconventional measures were adopted by the central banks, which highlighted the need for more explicit communication. Before the crisis, major central banks, said little publicly to explain what they were up to and why (Vayid, 2013). The view among central banks was that it was best not to talk about policy actions—let alone future policy intentions—and let these actions speak for themselves. Since the global financial crisis, the central bank communication was introduced as a distinct policy tool under unconventional monetary policies. Also, according to this research many central banks are now playing a role in promoting financial stability. This paper, once again, highlighted the importance of Inflation targeting regime (IT) in the communication efforts of the central bank. The fundamental changes in the implementation of monetary policy under an IT regime in the past decade introduced the broad trend among central banks toward greater openness, transparency and accountability, all of which require proactive, well-planned communications. Although the move to transparency was more pronounced among IT central banks, other central banks, including in emerging-market economies, increasingly came to recognize the value of openness and communication in the conduct of monetary policy.

The information deduced from Dincer and Eichengreen (2013) dataset (Geraats, 2013) can be used to analyze information disclosure practices and trends. The Table 1 shows to what extent various types of information relevant to monetary policymaking were disclosed in 1998, 2004 and 2010, listed by transparency aspect. Most of the central banks around the world in 2010 were adopting explicit monetary policy strategy, while half of the central banks publish the projections. The largest improvements in the transparency can be seen in the macroeconomic forecast and policy adjustments and explanations (Table 1):

Table 1

Developments in central bank transparency

In % of the surveyed central banks	1998	2004	2010	1998-2010 change (p.p)
Political transparency				
Monetary policy objectives	90.8	95	96.6	5.8
with prioritization	36.7	45.8	46.6	9.9
Quantified objective	44.2	60.8	66.4	22.2
Explicit instrument independence	34.2	49.2	53.4	19.2
Economic transparency				
Numerical macroeconomic forecasts	14.2	46.7	54.3	40.1
quarterly medium term for inflation and output	3.3	11.7	19.8	16.5
Macroeconomic policy model	5	15	24.1	19.1
Procedural transparency				
Monetary policy strategy	50	65	73.3	23.3
Minutes	5	9.2	16.4	11.4
Voting records	4.2	6.7	10.3	6.1
Policy transparency				
Policy adjustment	15	40	46.6	31.6
Policy explanation	12.5	32.5	43.1	30.6
Policy inclination	0	2.5	4.3	4.3
Operational transparency				
Openess about control errors in the operating target	9.2	20.8	22.4	13.2
Transmission disturbances	15.8	42.5	47.4	31.6
Evaluation monetary policy outcomes	33.3	61.7	61.2	27.9
Sample size	120	120	116	-4

Source: Geraats, 2013

Along with tendency for improving the communication between the central bank and the public, ECB introduced Guiding principles for external communications by members of the Executive Board. The Guiding principles for external communication attach great importance to clear, effective and timely communication of the ECB's strategy and policy decisions as well as issues related to their implementation.

According to Guiding principles, regular contacts and interaction with members of the public, representative associations and civil society provide relevant input and information that help Executive Board members understand the dynamics of the economy and financial markets and its broader societal context. This two-way communication is based on open, transparent and regular dialogues and debates between the Executive Board members and the public as well as specialized audiences (ECB, 2015).

3. SURVEY DESIGN

3.1 Survey questionnaire

The Survey on Monetary Policy Communication was conducted with the goal to draw evidence on the level of transparency and communication strategies of the central banks in Central, Eastern and South-Eastern Europe. One of the goals of the Survey was to include countries with similar economic history but different transition pattern as well as different EU integration status. The Survey was conducted in July-September 2015 and answers on the survey questions were received from 15 central banks[2] from the region and EU. The analysis of survey results is based on the answers from all the central banks on one side, and the survey answers from the European Central Bank (ECB) on the other.

The Survey on Monetary Policy Communication was based on the Asian Central banks Survey for Transparency and Communication in Monetary Policy from 2007 (Filardo and Guinigundo, 2008). The Survey questions can be found in the Appendix 1. The questions included in the Survey are divided in following sections:

- Objectives and strategies (1-9 question)
- Policy decisions (10-25 question)
- Economic outlook and forward guidance (26-38 question)
- General communication questions (39-44 question)

The first section of the Survey (objectives and strategies) is focused on information about the monetary policy regime of the surveyed central banks and the objectives of their monetary policy, both primary and intermediate objectives. Also, it highlights the financial stability as one of the objectives of the monetary policy. The second section (policy decisions) will address the procedures behind the public disclosure of the central bank decisions, the type of statements and information which are communicated with the public and also the organization of the press conferences. One of the main tasks of the central bank is the forecast of the country's economic conditions. In this way, the central banks send signals to the market participants and investors for the future path of the main economic indicators of the country. Regarding the importance of the central banks forecast, the third section of the survey (economic outlook and forward guidance) focuses on the disclosure of information from the forecast of the economic conditions and the procedure behind the forecasting process. Also, it highlights which information from the forecast need to be communicated with the public. The last section of the Survey addresses the general information on the communication policy of the central banks.

3.2 Economic and geographical breakdown of the surveyed central banks

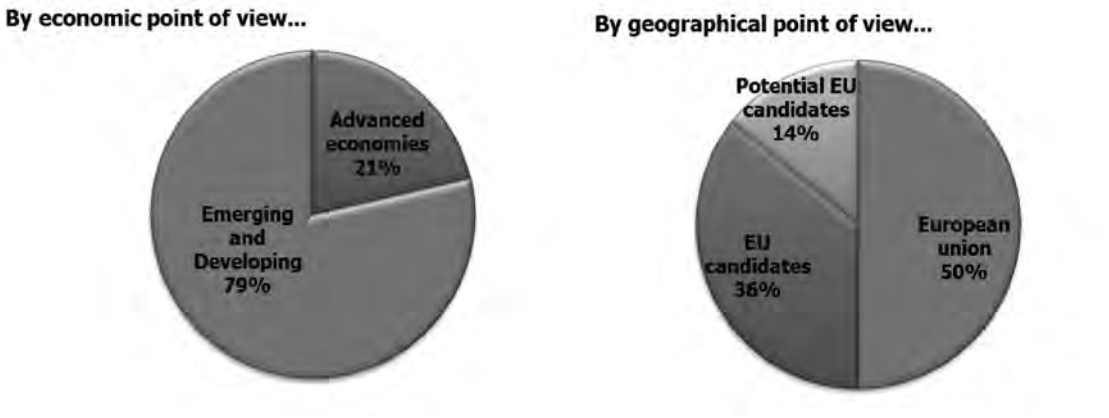
Economic development and geographical location of the central banks can influence their monetary policy framework and the way the central banks communicate their monetary decisions. According to Dincer and Eichengreen (2014) central banks in the advanced countries are more transparent than central banks in emerging and developing markets. They conducted an empirical study on economic determinants of transparency for over 100 central banks over the 1998-2010 period. Their research showed that countries with higher per capita incomes, deeper financial markets, more open economies,

[2] Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, European Central Bank, Kosovo, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Turkey.

and stronger political institutions have more transparent central banks. Also, countries with more flexible exchange rate regimes tend to have more transparent central banks.

In the Survey on Monetary Policy Communication 79% of the central banks are emerging and developing economies, and the others are advanced economies.[3] From the aspect of geographical point of view, around half of the surveyed central banks are members of European Union[4], one-third are EU candidates, and the others are potential EU candidates. European Central Bank is also included in the Survey of communication.

Graph 1:



Source: WEO, Statistical appendix, October 2016; European Union

Recent research also highlights the importance of the exchange rate regimes in determining central bank transparency. According to Crowe and Meade (2008) greater transparency is associated with more independent central banks, better governance and more flexible de facto exchange rate regime. The central banks that participated in the Survey analyzed in continuation are almost equally divided between those with Pegged (hard and soft) and Floating exchange regime (IMF, 2016).

Table 2

Exchange rate arrangement of the surveyed central banks

Hard pegs No separate legal tender (euro)	Hard pegs Currency board	Soft pegs Stabilized arrangement	Soft pegs Crawl-like arrangement	Floating regimes Floating	Floating regimes Free floating
•Montenegro • Kosovo	•Bosnia and Herzegovina •Bulgaria	• Macedonia • Czech Republic	• Croatia	•Albania •Serbia •Romania •Turkey	•Poland •Latvia •Lithuania

Source: Annual Report on Exchange Arrangements and Exchange Restrictions, IMF, 2016

[3] The IMF country classification that is used in this paper divide the world into two major groups: advanced economies and emerging market and developing economies (WEO, 2016). The IMF classification is not based on strict criteria and it has evolved over time. The advanced economies are classified according to some key indicators of their relative size (GDP valued by purchasing power parity, total exports of goods and services, and population). Emerging market and developing economies are also classified according to analytical criteria like the composition of export earnings and a distinction between net creditor and net debtor economies.

[4] Latvia entered the euro area from January 2014 and Lithuania from January 2015

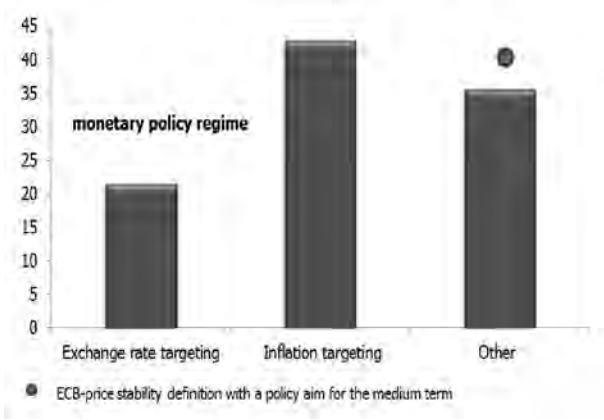
4. THE SURVEY RESULTS

In the following part, we present the results of the Survey on monetary policy communication. The analysis is based on the answers from the central banks on the questions from the Survey, divided in four main sections of the Survey. The data are presented as % of the total number of responded central banks (14 central banks). The answers from the European Central Bank are analyzed separately as a kind of benchmark. The answer option "Other" in the certain questions, includes the answers of the central banks on this option, and also the number of central banks that didn't answer this question.

4.1. Monetary objectives and strategies

Each central bank implements its own monetary regime/strategy and proper monetary policy. According to the results most of the central banks from the Survey are conducting inflation targeting regime (around 43%) and exchange rate targeting (21.4% of the banks). Inflation targeting is a monetary policy regime in which a central bank has an explicit target-inflation rate for the medium term and announces this inflation target to the public. One of the benefits of inflation targeting is the larger transparency of the central banks. The central banks publish the "Inflation Report" which gives the banks view about the future and past performance of inflation and monetary policy. From the surveyed central banks, the central banks from Czech Republic, Albania, Serbia, Romania, Turkey and Poland are conducting inflation targeting. On the other hand, under the exchange rate targeting regime, the central bank provides nominal exchange rate stability vis-à-vis the currency of a so-called anchor country via interest rate changes and direct foreign exchange interventions, thereby "importing" price stability from the anchor country[5]. From the surveyed central banks, the central banks from Macedonia, Croatia, Latvia and Lithuania are conducting exchange rate targeting. One third of the surveyed central banks, have different types of exchange rate regimes. The Central bank of Bosnia and Herzegovina and Bulgaria have monetary policy regimes based on Currency Board arrangement, Central bank of Montenegro and Kosovo implemented unilateral euroization[6] and Central bank of Croatia is using exchange rate targeting/managed floating ER regime. The monetary policy regime of the European Central Bank is based on price stability definition with a policy aim for the medium term.

Graph 2



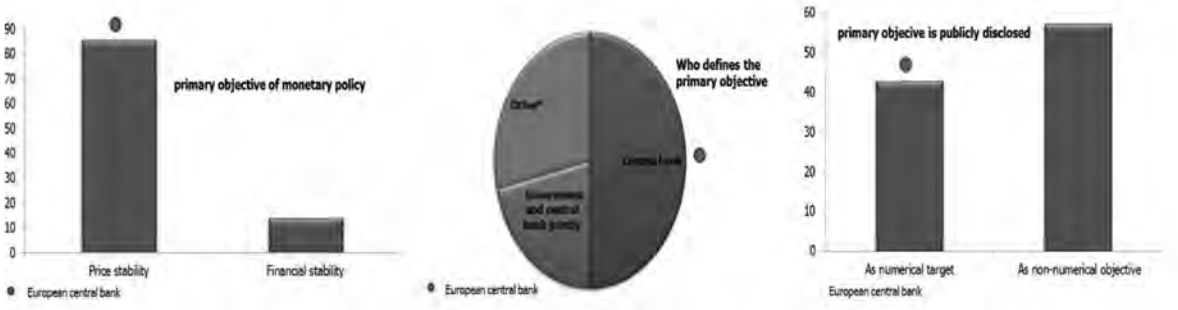
Price stability is the primary objective of the monetary policy by almost all central banks included in the survey. This is also the case with European Central Bank. The objective of price stability refers to the general level of prices in the economy. It implies avoiding both prolonged inflation and deflation. Also, price stability contributes to achieving high levels of economic activity and employment by improving the transparency of the price mechanism. Under price stability people can recognize changes in relative prices (i.e. prices between different goods), without being confused by changes in the overall price level. This allows them to make well-informed consumption and investment decisions and allocate resources more efficiently[7]. Except the price stability, there are also other types of primary objectives of the monetary policy selected by the central banks. According to the survey results, financial stability is the primary objective by the Central banks of Montenegro and Kosovo.

5 https://www.cnb.cz/en/faq/what_are_the_regimes_of_monetary_policy.html

6 Exchange rate regime under which the euro acts as a legal tender

7 https://www.ecb.europa.eu/mopo/intro/benefits/html/index.en.html

Graph 3

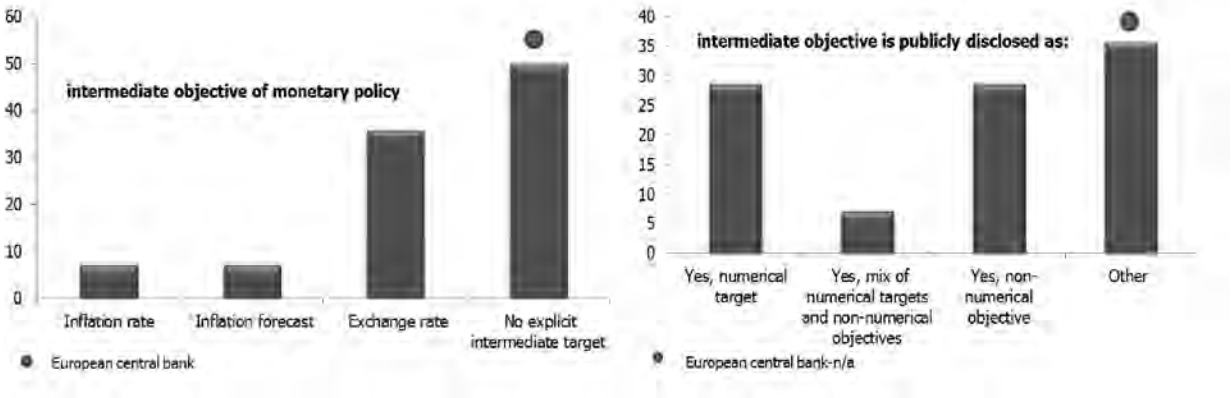


*According to Central Bank of Montenegro there are no quantitative objectives in monetary policy of CBM. The primary objective is also not specified by the Bank of Lithuania. According to this central bank intermediate objective (fixed exchange rate) had been defined by the joint resolutions of Government and central bank.

From the aspect which defines the primary objective of the monetary policy, half of the central banks answered that they define the primary quantitative objective, and around 21% of the central banks are doing that jointly with the government. The primary objective of the monetary policy can be communicated by central banks as numerical or non-numerical. Around 57% of the central banks are publishing primary objective as non-numerical, while the other central banks as numerical target. From the aspect of ECB, the central bank is responsible in defining the primary objective which is published as a numerical target to the public.

In order to achieve its primary objective, the central bank establishes intermediate objective of monetary policy. An intermediate target is an economic variable that the central bank can control with a reasonable time lag and with a relative degree of precision, and which is in a relatively stable or at least predictable relationship with the final target of monetary policy, which makes the intermediate target a kind of a leading indicator (Bindseil, 2004). Half of the surveyed central banks reported that they do not have explicit intermediate target (also the case with ECB) while around 36% of the central banks point the exchange rate as an intermediate target. Bank of Albania points the inflation forecast, while National Bank of Poland point the inflation rate as intermediate targets. The central banks that are using intermediate targets are equally divided in the way how they communicate these targets: numerical and non-numerical. Only Bank of Albania uses a mix of numerical targets and non-numerical objectives.

Graph 4



Except the monetary objectives, the central banks have other objectives which are subordinated to the primary one. The central banks support well-functioning of the banking system, and help to improve the monetary and financial conditions in support of the economic growth. They encourage stable and efficient operation of payment and securities settlement systems. Also, one of the objectives of the central banks is to maintain financial stability. According to the European Central Bank publication[8],

[8] ECB (2015) "Financial Stability Review", page 4

financial stability can be defined as a condition in which the financial system – intermediaries, markets and market infrastructures – can withstand shocks without major disruption in financial intermediation and in the effective allocation of savings to productive investment.

Graph 5

The central banks* define financial stability as one of their objectives from:

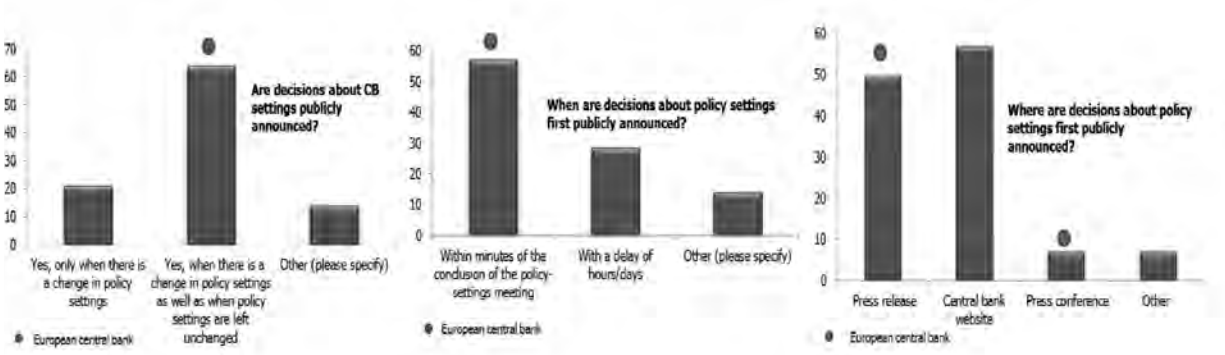
*three central banks didn't answer to this question

Successfully maintaining the financial stability contributes to efficient allocation of capital and financial resources from savers to investors and successful management of risks and vulnerabilities. Around 71% of the surveyed central banks define financial stability as one of the objectives of the central bank's monetary policy. The Croatian National Bank responded that financial stability is from always defined as one of the objectives, while Bulgaria started from 1997, Macedonia from 2010, and Lithuania is latest from 2015. The need for more extensive communications on financial stability was especially highlighted after the last global financial crisis. An important role in that regard has been assigned to central banks, many of which have explicit financial stability mandates. A large number of central banks have communicated extensively on financial stability-related matters, e.g. publication of Financial Stability Reports and financial stability-related speeches and interviews (Born et al. 2011).

4.2. Monetary policy decisions

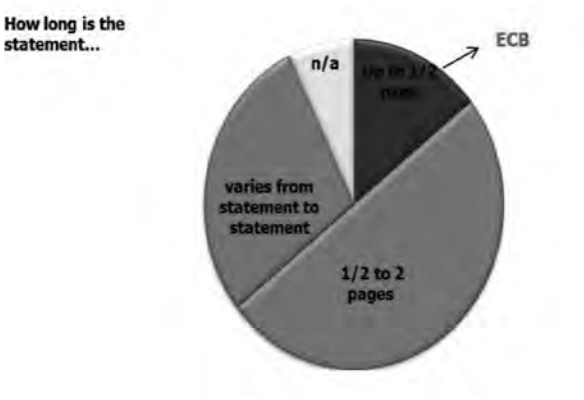
One of the biggest challenges of the central banks is to decide which information to share with the public. A more effective communication policy would reduce information asymmetries between central banks and the public (Jeanneau, 2009). In the recent years, central banks pay greater attention to their transparency, and provide significantly more information about their decisions and policymaking process. The results of the Survey confirm this conclusion. Almost all the central banks answered that they publicly announce their monetary policy decisions. Around 64% of the central banks said that they publicly announce their decisions in both cases - when there is a change in policy settings as well as when policy settings are left unchanged. This is also the case with ECB. On the other hand, 21.4% of the central banks publicly announce their monetary policy decisions only when there is a change in policy settings.

Graph 6



In both ways, the changes in the policy settings are being announced fairly quickly. More than half of the central banks announce their decision within minutes of the conclusion of the policy-settings meeting, while around 29% of the central banks with a delay of hours or days. Certain central banks have specific time for publishing their decisions. Bank of Albania, has fixed time for publishing the decisions and it's usually within a short time after the meeting. The National Bank of Poland announces the decision just after it is taken. After 2-3 hours of the conclusion of the policy-setting meeting (at 4 p.m.) the press release is published on the central bank website with justification of the decision and the press conference of the Governor takes place. National Bank of Serbia is announcing their decisions at 12 noon on the day when the policy-settings meeting is held. This central bank held its policy-settings meeting on the first Thursday after 5th of the every month. However, if necessary, the meetings can be held more frequently. European Central Bank is publishing their decisions within minutes of the conclusions of the policy-settings meeting. The Governing Council takes its monetary policy decision every six weeks. Immediately after the meeting, the President and the Vice President of the ECB explain the decision at the press conference and answer questions from journalists[9].

Graph 7



Changes in policy settings tend to be announced first on central bank websites and press release. Half of the central banks announce the policy settings on statements which are half page to two pages long. On the other hand, around 29% of the central banks said that the length of the statements varies. ECB shares press release which is half page long. Except the policy settings, the statements of the central banks also include other different issues which are important for the current period. More than half of the central banks said that except the policy settings changes, the remaining content of the statement usually varies in each statement. One fifth of the central banks said that they change most of the remaining content of the statement, while around 14% of the central banks change only little.

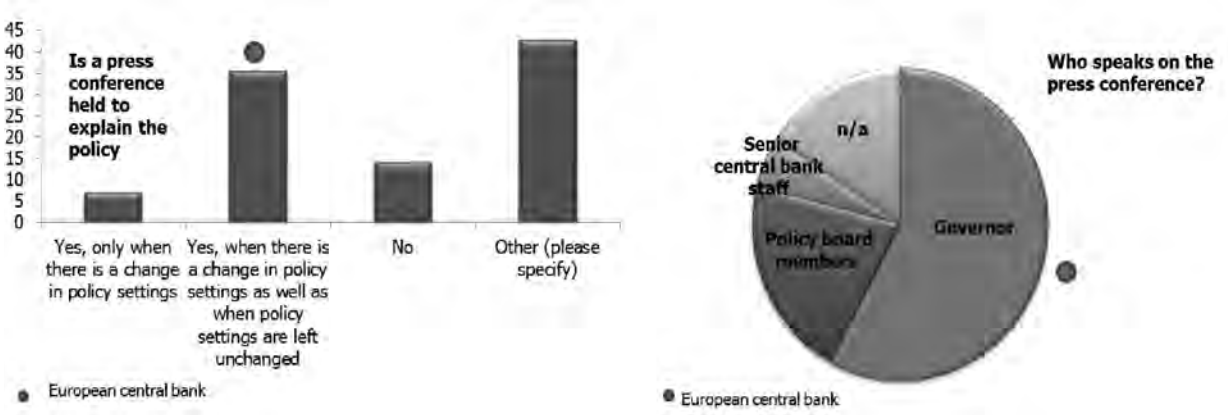
One of the objectives of the central banks in the implementation of proper communication process and transparency is to include all necessary information in their statement in order to explain their decision and policy measures. The main purpose of the statement is to make the public more familiar with the policy of the central bank, in order to understand the bank decisions. Almost all the central banks in their policy statement always disclose the precise value for a change in the monetary policy instrument (for example, 25 basis point increase in the policy rate), the direction of the change in the monetary policy instrument and the reasons behind the decision. Also, most central banks, in their statement add the assessment of current economic conditions and short term outlook for the economy and the possible risks to the outlook for the economy. Usually, central banks in their statements put information about the numerical forecast of the key economic variables. For example, Bank of Albania publishes the range of inflation forecast one year ahead. Almost all the central banks said that they never disclose the number of policy board members who voted in favor of the decision in their statement. The European Central Bank in their statement always disclose the numerical value and direction of change in the monetary policy instrument, the reason behind this change, assessment of current economic conditions; short-term outlook for the economy and the possible risks to the outlook for the economy.

How the statement is presented is with the same importance as the choice of the information which is disclosed in the statement. Almost all the central banks use the press conference as a primary communication tool for direct contact with the public. The empirical research carried on ECB communications network (Ehrmann and Fratzscher, 2007) has shown that the press conferences have a stronger impact on the level of financial variables than policy announcements, indicating that they are an efficient means of transmitting

[9] http://www.ecb.europa.eu/press/pressconf/2015/html/index.en.html

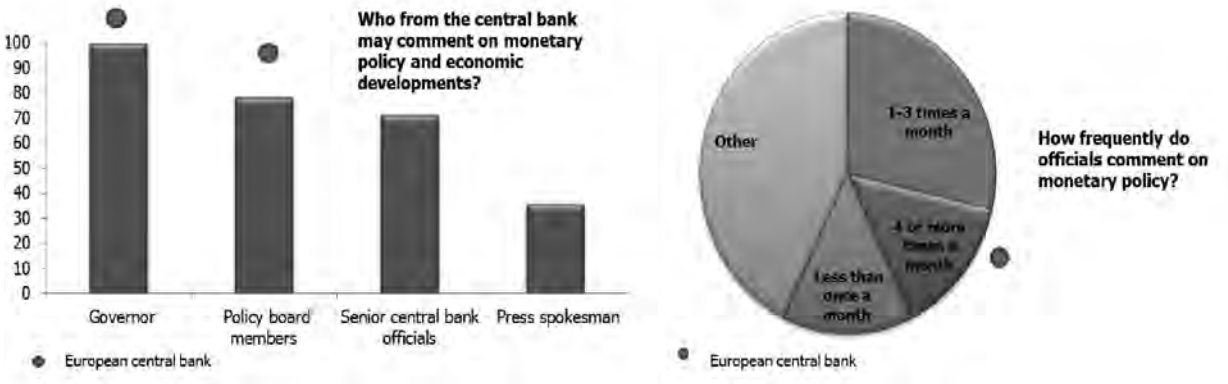
new information. According to the Survey, the reasons for press conference vary. Around one third of the central banks said that the press conference is held when there is change in policy settings as well when the policy setting are left unchanged. Around 14% of the central banks said that they do not hold the press conference to explain the policy decision. On the other hand, 43% of the central banks give different reasons for organizing press conference. The Central Bank of Montenegro is organizing press conference only if there is important policy change, while Croatian National Bank holds the press occasionally. Bank of Lithuania holds a press conferences in cases of extra-ordinary policy decisions, e.g. the change of anchor currency. The National Bank of Serbia is having regular quarterly press conferences: first Wednesday after the Executive Board adopts the Inflation Report at its policy meeting. Also, the Governor holds press conferences if needed to clarify the reasons behind the policy decisions, as well as reply to any question of the public. National Bank of Romania holds press conferences after the board meeting in which the Inflation Report is approved. Almost in all cases, the governor speaks on the press conferences, but also in some central banks, policy board members can also make a statement (one third of the central banks). European Central Bank holds a press conference when there is a change in policy settings as well as when policy settings are left unchanged, while the main speaker is the governor.

Graph 8



As we conclude from the Survey, the governor and the policy board member usually speak on the press conferences. Except on this official event the central bank officials, in certain circumstances, also give additional public comments or opinions. Usually governors, policy board members or senor central bank officials are allowed to give comments on monetary policy and economic developments.

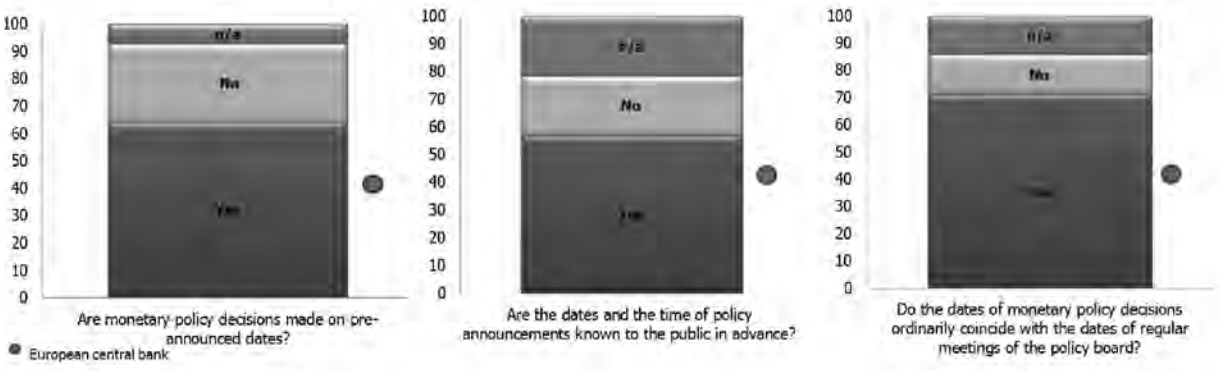
Graph 9



Still, the way the central banks comment on certain developments vary and depends on the arrangements that central banks have. In the case of the currency board in Bulgaria, commenting on monetary policy by the BNB is not as frequent as with the central banks that have an independent monetary policy. On the other hand, in the case of National Bank of Poland it depends on individual member of Monetary Policy Council (MPC). In the Central Bank of the Republic of Turkey, selected members of MPC and senior central bank officials meet economists in prescheduled meetings once a month.

Regarding the schedule of adoption of the monetary policy decisions, most of the central banks (around 64%) said that the decisions are made on pre-announced dates. In most cases, the dates of monetary policy decisions coincide with the dates of regular meetings of the policy board (around 71%). More than half of the central banks, report the dates and time of policy announcements to the public in advance. The ECB decisions are made on pre-announced date, which is known to the public in advance. The minutes of the policy boards discussions are published by four central banks: Czech Republic, Poland, Montenegro and European Central Bank. Almost all central banks do not identify the views and votes of the individual policy members, and more than half of the central banks don't reveal their names to the public. The Czech National Bank is the only central bank from the survey which identifies the views and votes of individual policy members and reveals their names to the public. Still, the identification of individual votes in the policy board depends on the institutional setup of the central bank.

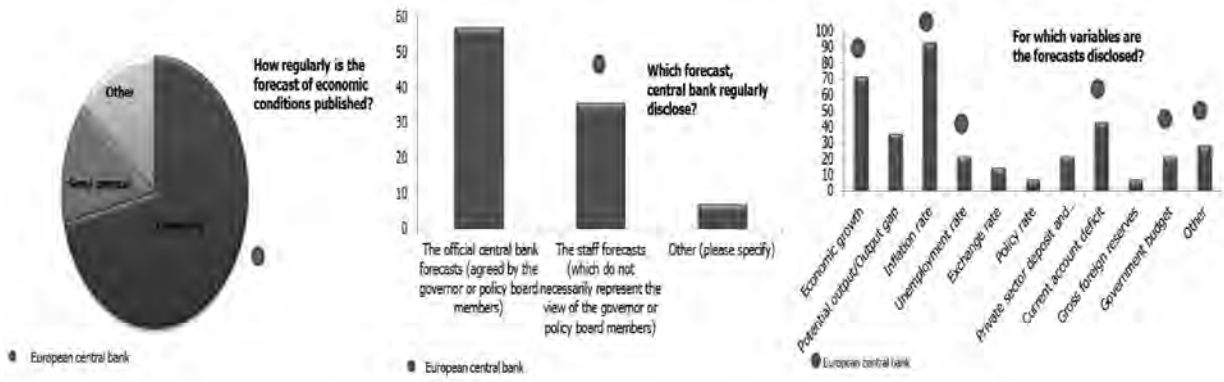
Graph 10



4.3. Economic outlook and forward guidance

The economic forecast is one of the main activities of the central banks which offers information for the future path of the economy, send signals to the market and their participants. According to ECB, macroeconomic projections play an important role as a tool for aggregating and organizing existing information on current and future economic developments[10]. The methods and assumptions behind those forecasts vary considerably across central banks. Around 71% of central banks publish their forecast on quarterly base, while the Croatian National Bank and the National Bank of the Republic of Macedonia on semi-annual base. On the other hand, the National Bank of Poland, published its forecast three times a year in their Inflation Report. The forecast of the European Central Bank is published quarterly. More than half of the central banks regularly disclose the official central bank forecast, agreed by the governor or policy board members. Around 36% of the central banks[11] are disclosing the staff forecast, which does not necessarily represent the view of the governor or policy board members. This is also the case with the European Central Bank.

Graph 11



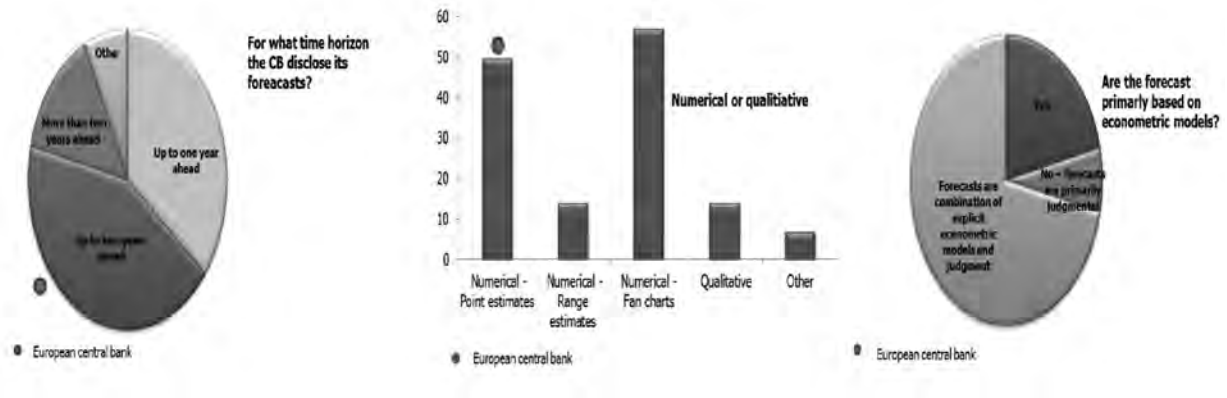
[10] European Central Bank (2001), " A guide to euro system staff macroeconomic projection exercises"

[11] In this group are the central banks of Bulgaria, Czech Republic, Kosovo, Latvia and Lithuania.

Most central banks disclose the forecast for inflation rate and economic growth. Also, around 43% of the central banks publish the forecast for current account deficit and one third of the central banks publish the potential output. Other variables for which the central banks disclose their forecast are: unemployment rate, exchange rate, private sector deposit and credit growth rate and government budget. The Croatian National Bank is also disclosing gross external debt, change in employment and banks total liquid assets. Central Bank of the Republic of Kosovo adds to the list the remittances, while National Bank of Serbia is also disclosing the trend of the real exchange rate, real interest rate trend and administrative prices. European Central Bank is also disclosing the forecast of the GDP components, employment, productivity growth, unit labor cost, compensation per employee, inflation components, structural government balance and government debt for the euro area.

The forecasts of the key economic variables are usually disclosed up to two years ahead (around 43%) and up to one year ahead (around 36%). Only small number of central banks (Poland and Turkey) disclosed its forecast more than two years ahead. Most of the central banks disclosed their forecast numerical as point estimate and also as fun charts. ECB discloses its forecasts up to two years ahead, numerically as point estimates. The forecasts are primarily a combination of explicit econometric models and judgment, (around 71% of the central banks), which is also the case with ECB, while one fifth of the central banks said that is primarily on econometric models. Around 36% of the central banks model the monetary policy in their forecast as exogenous (for example constant interest rate path) while around one third of the central banks model as endogenous variable (for example monetary policy reaction function). The ECB uses the market expectation of 3 month interest rate.

Graph 12

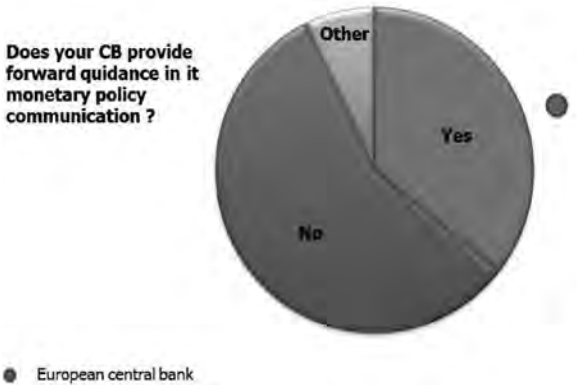


The forecast models are one crucial part in the process of conducting the central bank policy and determining the future path of the monetary policy. The information about the forecasting model in most cases is publicly available, in extensive details like equations and parameters or as broad framework (also in the case of ECB). In order to see the validity of the forecast, around 71% of the central banks perform internal evaluations of their forecast performance, which usually is for internal use only. Around one third of the central banks publish these evaluations. ECB occasionally perform internal evaluations of their forecast. Bank of Albania publishes the inflation and some short run model forecast performance as evaluations every two years. Czech National Bank and the National Bank of Serbia are publishing the evaluations in their Inflation Report. The National Bank of Serbia is publishing the comparison of last year's projections and their outcomes in their Inflation Report. The accounting for forecast revisions made during the year and the end-year forecast error is published in a box in the first Inflation Report of the following year by the Central Bank of the Republic of Turkey.

The recent financial crisis highlights the need for better communications among banks, markets and central banks. Some of the central banks introduced changes in the monetary policy communication in order to improve this channel of transmission of information. According to the Survey, around one third of the central banks introduced certain changes in the communication of monetary policy with a purpose to become more proactive. ECB took more explicit communication in terms of the crisis and the unprecedented measures, to ensure a continued understanding of their monetary policy reaction function.

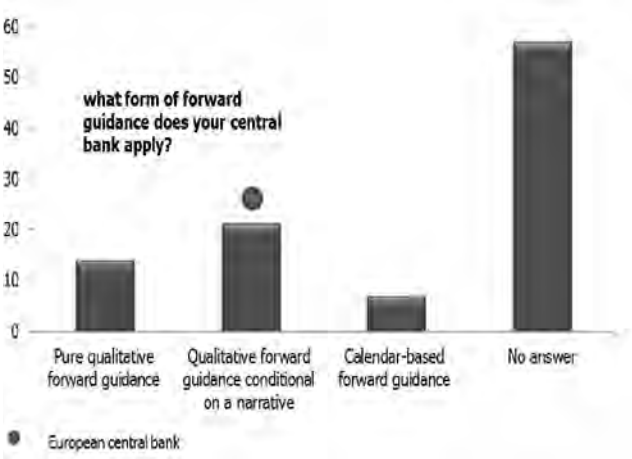
One of the tools that most central banks adopted to deal with macroeconomic consequences of the global financial crisis was forward guidance. It is a term used by central banks to communicate about the likely future course of monetary policy[12]. According to the Survey, around 36% of central banks use forward guidance in their monetary policy communication. The forward guidance helps to clarify the central banks' assessment of macroeconomic situations and their reaction function. In July 2013, ECB for the first time gave an explicit indication regarding its monetary policy stance by the ECB Governing Council announcement. Since then, the Council continually addresses its forward guidance on the ECB key interest rates[13].

Graph 13



There are different types of forward guidance like pure qualitative forward guidance, qualitative forward guidance conditional on a narrative, calendar-based forward guidance or outcome-based forward guidance. From those central banks that use forward guidance, two of them use pure qualitative forward guidance which means that it has no explicit end-date or numerical thresholds that provide information about the likely evolution of policy interest rates in the future and no explicit reference to a configuration of underlying conditions, regarding the objectives of policy, which would justify this evolution. On the other hand, three central banks use qualitative forward guidance conditional on a narrative, which provides qualitative statements about the likely evolution of policy interest rates complemented by a description of a combination of macroeconomic conditions under which the monetary policy orientation is expected to prevail. This type of forward guidance is also used by the ECB. The central bank of Poland was the only bank from the Survey that had experience with the calendar based forward guidance, which entails making a conditional commitment based on the explicit date after which the stance of monetary policy is expected to change. The central bank used forward guidance as monetary policy instrument from September 2013 to June 2014.

Graph 14



4.4. General communication questions

In order to have successful communication with the public, Central banks have a special department which is responsible for communicating with the public, media, and market participants. This department is responsible to transfer the information and decisions of the central bank to the public in a more friendly and understandable manner, in order to understand the reasons behind these decisions. According to the Survey, around 64% of the Central banks have an office for public relations, while around 29% of the Central banks have an office for public relations and a press spokesman. The

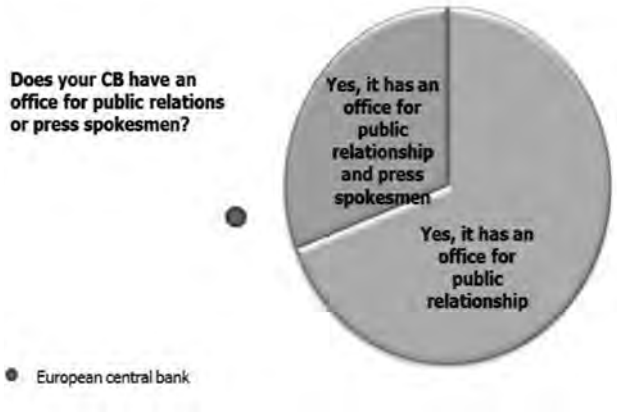
[12] http://www.federalreserve.gov/faqs/what-is-forward-guidance-how-is-it-used-in-the-federal-reserve-monetary-policy.htm

[13] Also, ECB introduced forward guidance in their asset purchase program.

National Bank of the Republic of Macedonia has persons[14] within the governor's office responsible for public relations[15].

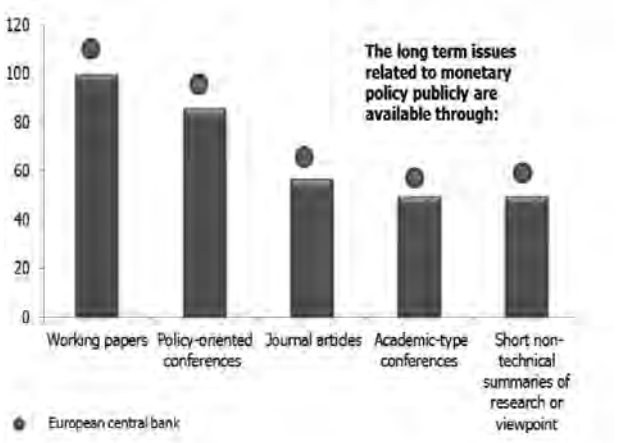
Although this is the era of technology and internet, certain people still have limited access to the internet or TV. For that purpose, central banks offer alternative ways of introducing their work and process. Bank of Albania, is publishing educational brochures which are distributed in all branches of commercial banks as well as to private and public high schools. Also, Bank of Albania is opened for public visits and organizes seminars and trainings for journalists, high-school teachers and social workers. The Central Bank of the Republic of Turkey distributes booklets and bulletins to universities, civil society organizations and public institutions. Central Bank of Bosnia and Herzegovina offers lectures for pupils and students. National Bank of Serbia uses educational programs, lectures, discussions and creative workshops in order to communicate with the public. The National Bank of the Republic of Macedonia organizes lectures for students, workshops for journalists and publishes educative brochures.

Graph 15



Central banks regularly publish their research, information or reports. All central banks publish working papers on issues related to monetary policy and most of them are also discussed on policy oriented conferences. Half of the surveyed central banks published their research in journal articles, academic-type conference or as short summaries of research. Most of these publications can be found on the web pages of the central banks.

Graph 16



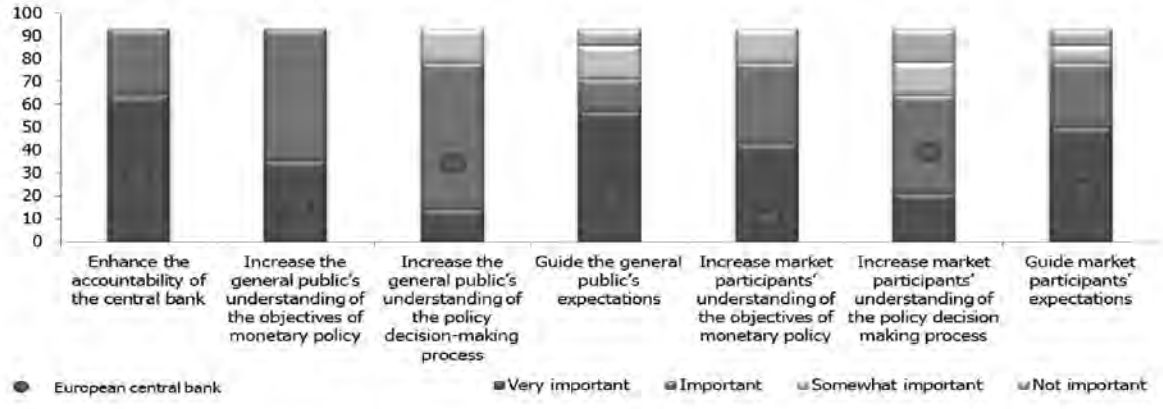
One crucial thing in communication is to define the "reasons behind the words". That means, to define the purpose and the effect of the information that is decided to be communicated with the public. Most often, the main purpose of the central bank public information is to send a clear signal for its actions and decisions to the market. The increase of accountability of the central bank and the guidance of the general public's and market expectations are the most important factors (more than half of the surveyed banks) in determining what kind and how much information about monetary policy is to be publicly announced. The increase of market and general public understanding of the monetary policy objectives are also factors that are taken into consideration.

[14] In 2017, a change was made in the organizational setup, where a special segment for public relations was established within the Cabinet of the Governor of the NBRM.

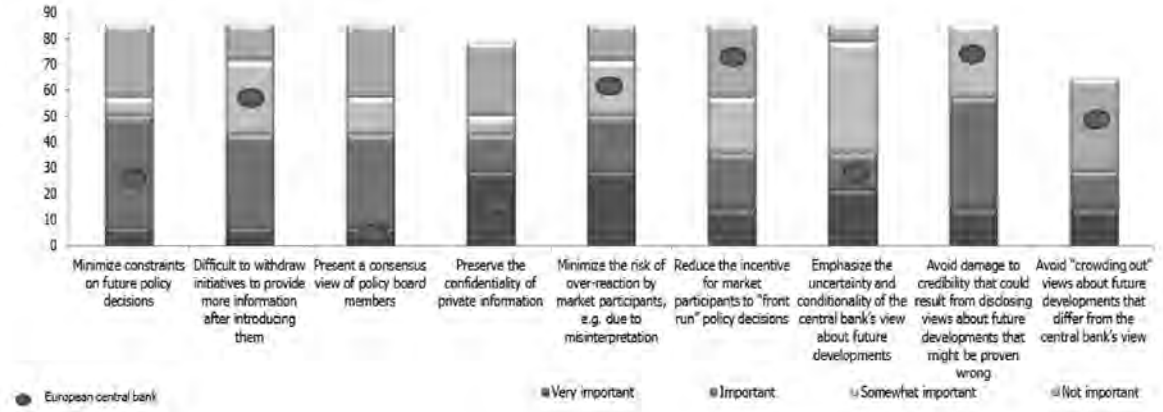
[15] The answer of National Bank of the Republic of Macedonia is not included in Graph 14

Graph 17

Reasons for increasing disclosure



Reasons for limiting disclosure



On the other hand, central banks need to be very careful about what type of information they are disclosing and how it can influence the market. Higher transparency can also be a risk for the central bank credibility, in a way that central bank promises something that is not later delivered. Also, there is the danger that market participants might take excessive risks based on some central bank information. That is why, the central banks sometimes decides to limit their disclosure of information aiming to minimize negative circumstances from announcing certain information. Around one third of the central banks said that the need for preserving the confidentiality of private information, minimize the risk of over-reaction by market participants or emphasize the uncertainty and conditionality of the central banks views about future developments are the most important reasons for limiting their disclosure. Also, as important factors that influence the restrictions from the central banks are the difficulties to withdraw initiatives to provide more information after introducing them, to present a consensus view of policy board members and to avoid damage to credibility that could result from disclosing views about future developments that might be proven wrong.

5. CONCLUDING REMARKS

Just two decades ago, central banks maintained strict secrecy. Central banks were seen as institutions which were distinguished from the public and media. Slowly, driven by the switch to floating exchange rate, introduction of inflation targeting regime and the global financial crisis 2007-2009, central banks started to admit the importance of transparency and communication of the monetary policy. They opened their doors to the public, giving information about their work, their decisions and the reasons for undertaking certain activities. The policy actions would become more effective if the market understood them. The greater transparency of the central bank contributes to reduce the surprise factor and makes the market participant more ready for the outcomes from the central bank decisions. With the proper central bank communication the market can anticipate, rather than just to react on the central bank decisions.

The results of the Survey on Monetary policy communication presented in this paper revels that today, central banks pay special attention on their transparency and provide important information about their decisions and policy making process. The Survey showed that all central banks publicly announce their primary goals and their monetary policy decisions. They try to be more open to the public, through announcing their meetings in advance and at the same time quickly announcing their decisions to the public. Central banks pay great attention for their statements to be clear and include the necessary information which will help the public better understand the reasons behind their decisions. Through regular communication of the economic forecast, central banks send signals to the market for expectations of the future economic developments. The results showed that the most common communicated forecast is for inflation rates and economic growth, which are crucial indicators for the markets. The Survey shows that central banks are putting a lot of effort in establishing a proper link with the media and public, by organizing regular press conferences and meetings. Also, all central banks are publishing their work in the working papers and participate on different conferences. One of the positive developments towards greater transparency, is the fact that the central banks started to give more attention on proactive communication with the public, which is very important for people who have limited access to TV or internet. The central banks publish brochures which are distributed to the schools, banks, organizes visits of central banks and lectures on the universities.

The Global financial crisis showed the weakness of the communication of central banks, and necessity of establishing a strong link between the central banks and market participants. Some central banks said that they introduced the forward guidance, which is used in order to communicate the future course of monetary policy. Still, this number is small, one-third of central banks. Namely, it would be useful for the central banks to adopt the forward guidance, having in mind that this way they are more transparent for the future path of the monetary policy. Except there also is a weakness in adopting the forward guidance approach, the survey also showed that there is a need for improvement in terms of identifying individual votes in the policy board. The Survey showed that most central banks are not sharing information about the names or the views of the individual policy members, which is not in line with the tendency of more opened and transparent central bank.

The overall conclusion of the Monetary policy communication Survey is that the communication and the transparency of the 15 central banks is on satisfactory level. We must take in account that in the last two decades, central banks made a great transition from completely closed to open and transparent institutions, passing a long way of changes and adjustments. Still, there is always a room for improvements, especially in turbulent times like these, when the job of the central bank in preserving the price and financial stability in the economy is becoming more complicated and demanding.

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ANNEX:

Survey on Monetary Policy Communication

Name of the central bank:

Note: If your central bank is a member of the euro area, please answer the survey providing your practice prior euro area entrance.

PART 1: OBJECTIVES AND STRATEGIES

1. Within which monetary policy regime does your central bank conduct its monetary policy?
   - o Exchange rate targeting
   - o Monetary targeting
   - o Inflation targeting
   - o Monetary policy with an implicit but not an explicit nominal anchor
   - o Other (please specify)

2. What is the primary objective of monetary policy?
   - o Price stability
   - o Exchange rate
   - o Full employment and economic growth
   - o Other (please specify)

3. How is the primary objective of monetary policy publicly disclosed?
   - o As numerical target
   - o As mix of numerical targets and non-numerical objectives
   - o As non-numerical objective
   - o Other (please specify)

4. What is the intermediate objective or target of monetary policy? Please tick all that apply.
   - o Inflation rate
   - o Inflation forecast
   - o Exchange rate
   - o Growth of a monetary aggregate
   - o No explicit intermediate target
   - o Other (please specify)

5. Is the intermediate objective or target of monetary policy publicly disclosed?
   - o Yes, numerical target
   - o Yes, mix of numerical targets and non-numerical objectives
   - o Yes, non-numerical objective
   - o Other (please specify)

6. Who defines the primary quantitative objectives?
   - o Central bank
   - o Government
   - o Government and central bank jointly
   - o Other (please specify)

7. Are there any other CB objectives besides the primary one?
   - o No
   - o Yes, there are other objectives but subordinated to the primary one (please specify)
   - o Yes there are other objectives which are equally important as the primary one (please specify)

8. Is the financial stability explicitly defined as one of the objectives of your CB policy? (If the answer to Q8 is no, please go to Q10).
   - o No
   - o Yes

9. When did your central bank decide to define the financial stability as one of its objectives?

   Year:

PART 2: POLICY DECISIONS

10. Are decisions about CB settings publicly announced?
    (If the answer to Q10 is no, please go to Q18).
    - o Yes, only when there is a change in policy settings
    - o Yes, when there is a change in policy settings as well as when policy settings are left unchanged
    - o No
    - o Other (please specify)

11. When are decisions about policy settings first publicly announced?
    - o Within minutes of the conclusion of the policy-settings meeting
    - o With a delay of hours/days
    - o Within minutes of the implementation of the decision
    - o Other (please specify)

12. Where are decisions about policy settings first publicly announced?
    - o Press release
    - o Central bank website
    - o Press conference
    - o Other (please specify)

13. How long is the statement announcing the policy setting?
    - o Up to 1/2 page
    - o 1/2 to 2 pages
    - o More than two pages
    - o Length varies from statement to statement

14. Apart from the change to the policy setting, how much of the remaining content of the policy statement ordinarily changes from statement to statement?
    - o Very little, e.g. 1 to 2 sentences
    - o Most of the statement
    - o Parts of the statement, e.g. 1 to 2 paragraphs
    - o Extent of the changes varies from statement to statement

15. Information disclosed in the policy statement

    Please indicate what information does the central bank discloses at or around the same time that decisions about policy settings are announced and whether this information accompanies every policy decision or only some decisions

	Always disclosed	Sometimes disclosed	Never disclosed	Not applicable
Numerical, e.g. precise value for a change in the monetary policy instrument (for example, 25 basis point increase in the policy rate)	○	○	○	○
Qualitative, e.g. direction of change in the monetary policy instrument	○	○	○	○
Reason for the decision	○	○	○	○
Number of policy board members who voted in favor of the decision	○	○	○	○
Likely direction of future changes in policy settings	○	○	○	○
Assessment of current economic conditions	○	○	○	○
Short-term outlook for the economy	○	○	○	○
Possible risks to the outlook for the economy	○	○	○	○
Numerical forecasts of the key economic variables	○	○	○	○
Other				

16. Is a press conference held to explain the policy decision?
    - o Yes, only when there is a change in policy settings
    - o Yes, when there is a change in policy settings as well as when policy settings are left unchanged
    - o No
    - o Other (please specify)

17. Who speaks on behalf of the central bank on the press conference?
    - o Governor
    - o Policy board members
    - o Press officer (spokesperson)
    - o Senior central bank staff
    - o Other (please specify)

18. Are monetary policy decisions made on pre-announced dates?
    - o Yes
    - o No

19. Are the dates and the time of policy announcements known to the public in advance?
    - o Yes
    - o No
    - o Other (please specify)

20. Do the dates of monetary policy decisions ordinarily coincide with the dates of regular meetings of the policy board?
    - o Yes
    - o No

21. Are the minutes of the policy board's discussions published?
    - o Yes
    - o No

22. Are the views and votes of individual policy board members identified?
    - o Neither views nor votes are identified
    - o Both views and votes are identified
    - o Only views are identified
    - o Only votes are identified

23. Are the views and votes of the individual policy board members anonymous or public?
    - o The names of the individual policy board members are not revealed
    - o The names of the individual policy board members are revealed
    - o Other

24. Who from the central bank may comment on monetary policy and economic developments? Please tick all that apply.
    - o Governor
    - o Policy board members
    - o Senior central bank officials
    - o Press spokesman
    - o Other (please specify)

25. How frequently do officials comment (press-statements and interviews) on monetary policy?
    - o 1-3 times a month
    - o 4 or more times a month
    - o Less than once a month
    - o Other (please specify)

PART 3: ECONOMIC OUTLOOK AND FORWARD GUIDANCE

26. How regularly is the forecast of economic conditions published? Please tick all that apply and also indicate the name of the report(s).
    - o Quarterly
    - o Semi-annual
    - o Monthly
    - o Annual
    - o Other (please specify)

27. Which forecasts of economic conditions does the central bank regularly disclose?
    - o The official central bank forecasts (agreed by the governor or policy board members)
    - o The staff forecasts (which do not necessarily represent the view of the governor or policy board members)
    - o No, forecasts are not disclosed
    - o Other (please specify)

28. For which variables are the forecasts disclosed? Please tick all that apply.
    - o Economic growth
    - o Potential output/Output gap
    - o Inflation rate
    - o Unemployment rate
    - o Exchange rate
    - o Policy rate
    - o Private sector deposit and credit growth rate
    - o Current account deficit
    - o Gross foreign reserves
    - o Government budget
    - o Other (please specify)

29. For what time horizon does the central bank disclose its forecasts of key economic variables?
    - o Up to one year ahead
    - o Up to two years ahead
    - o More than two years ahead

30. Are the central bank forecasts of key economic variables disclosed in a numerical or qualitative manner?
    - o Numerical - Point estimates
    - o Numerical - Range estimates
    - o Numerical - Fan charts
    - o Qualitative

31. Are the disclosed forecasts primarily based on econometric models?
    - o Yes
    - o No – forecasts are primarily judgmental
    - o Forecasts are combination of explicit econometric models and judgment

32. How is monetary policy modeled in the central bank's forecasts?
    - o Monetary policy is exogenous (e.g., constant interest rate path)
    - o Monetary policy is endogenous (e.g., monetary policy reaction function)
    - o Other (please explain)

33. Are judgmental or ad hoc adjustments to the forecasting model's estimates disclosed?
    - o Yes – policy board members' judgments are usually disclosed
    - o No – judgment is applied but the nature of the adjustment is usually not disclosed
    - o Yes – staff's judgments are usually disclosed
    - o No – judgment is not applied

34. Is information about the forecasting model made publicly available?
    - o Yes – extensive details, e.g. equations and parameters
    - o No
    - o Yes – broad framework
    - o Other (please explain)

35. Does your central bank perform internal evaluations of its forecasting performance? (If the answer to Q35 is yes, please specify whether the evaluations are regular with predetermined dynamics (quarterly, semi-annual, annual, etc. or occasional)
    - o No
    - o Yes it does, but the analysis is for internal use only
    - o Yes it does, and the analysis is published

36. Has the central bank published, within the past five years, an external review of its forecasting model?
    - o Yes
    - o No – commissioned an external review but did not publish it
    - o No – but planning to publish an external review in the near future
    - o No – never commissioned an external review

37. Does your central bank provide forward guidance in its monetary policy communication? (If the answer to Q37 is yes, please specify when this practice was firstly introduced. If the answer to Q37 is no, please go to Q39).
    - o Yes

      [ ]
    - o No

38. What form of forward guidance does your central bank apply? Please tick all that apply.
    - o Pure qualitative forward guidance

      Has no explicit end-date or numerical thresholds that provide information about the likely evolution of policy interest rates in the future and no explicit reference to a configuration of underlying conditions, including the policy objectives, which would justify this evolution (e.g., "policy accommodation can be maintained for a considerable period")
    - o Qualitative forward guidance conditional on a narrative

      Provides qualitative statements about the likely evolution of policy interest rates complemented by a description of a combination of macroeconomic conditions under which the monetary policy orientation is expected to prevail (e.g., "central bank is ready to stay committed to a near-zero interest rate policy until deflationary concerns would be dispelled")
    - o Calendar-based forward guidance

      Entails making a conditional commitment based on the explicit date after which the monetary policy stance is expected to change (e.g., "conditional on the outlook for inflation, the target overnight rate can be expected to remain at its current level until the end of the second quarter of 2014")
    - o Outcome-based forward guidance

      Explicit numerical conditions or thresholds that link central bank actions to a selected set of observed or projected economic variables (e.g., "no increase in the policy rate should be anticipated so long as unemployment remained above 6-1/2 percent and inflation and inflation expectations remained stable and near target")
    - o Other (please explain)

      [ ]

PART 4: GENERAL COMMUNICATION QUESTIONS

39. Does your central bank have an office for public relations or press spokesman?
    - o Yes, it has an office for public relations
    - o Yes, it has a press spokesman
    - o Yes, it has an office for public relations and a press spokesman
    - o No, it doesn't have an office for public relations or a press spokesman

40. Does the central bank have any special initiatives for communicating about monetary policy with people who have limited access to the internet, TV and other media?
    - o Yes (please explain)

      [ ]
    - o No

41. Have there been any revisions to the central bank law within the past three years, which have resulted in changes in the central bank communication about monetary policy?
    - o Yes (please explain)
    - o No

42. Have you introduced any changes in your communication policy due to the global economic crisis 2007-2009?
    - o No
    - o Yes (please explain)

43. Which channels does the central bank use to make its research on longer term issues related to monetary policy publicly available?
    - o Working papers
    - o Policy-oriented conferences
    - o Journal articles
    - o Academic-type conferences
    - o Short non-technical summaries of research or viewpoint

44. Please indicate how important each listed considerations is in deciding what and how much information about monetary policy to publicly announce

    44.1. Reasons for increasing disclosure:

	Very important	Important	Somewhat important	Not important
Enhance central Bank accountability	○	○	○	○
Increase general public's understanding of the monetary policy objectives	○	○	○	○
Increase general public's understanding of the policy decision-making process	○	○	○	○
Guide general public's expectations	○	○	○	○
Increase market participants' understanding of the monetary policy objectives	○	○	○	○
Increase market participants' understanding of the policy decision-making process	○	○	○	○
Guide market participants' expectations	○	○	○	○

44.2. Reasons for limiting disclosure:

	Very important	Important	Somewhat important	Not important
Minimize constraints on future policy decisions	○	○	○	○
Difficult to withdraw initiatives to provide more information after introducing them	○	○	○	○
Present a consensus view of policy board members	○	○	○	○
Preserve the confidentiality of private information	○	○	○	○
Minimize the risk of over-reaction by market participants, e.g. due to misinterpretation	○	○	○	○
Reduce the incentive for market participants to "front run" policy decisions	○	○	○	○
Emphasize the uncertainty and conditionality of the central bank's view about future developments	○	○	○	○
Avoid damage to credibility that could result from disclosing views about future developments that might be proven wrong	○	○	○	○
Avoid "crowding out" views about future developments that differ from the central bank's view	○	○	○	○

NATIONAL BANK OF THE REPUBLIC OF MACEDONIA

P R O G R A M

6th Research Conference
Central Banking Under Prolonged Global Uncertainty:
The Latest Lessons While Searching for the "New Normal"

5-6 April 2017, Skopje, Holiday Inn

5 April 2017 (Wednesday)

16.00-16.30 Registration

16.30-16.45 Dimitar Bogov, Governor of the National Bank of the Republic of Macedonia, Welcome speech

16.45-17.00 Kiril Minoski, Minister of Finance of the Republic of Macedonia, Opening remarks

17.00-17.20 Poul Thomsen, Director, European Department, International Monetary Fund, Keynote lecture

17.20-18.30 **High Level Policy Panel**

Chair: Gligor Bishev, former Deputy Governor of the NBRM

Poul Thomsen, Director, European Department, International Monetary Fund

Peter Sanfey, Deputy Director for Economics, Policy and Governance, European Bank for Reconstruction and Development

Vassilis Monastiriotis, Associate Professor, London School of Economics, LSEE - Research on South Eastern Europe

Dimitar Bogov, Governor, National Bank of the Republic of Macedonia

18.30-18.45 Questions from the audience

18.45 Open buffet reception

6 April 2017 (Thursday)

8.30-9.00 Registration

9.00-9.30 Opening of the Conference

Turalay Kenc, former Deputy Governor of the Central Bank of the Republic of Turkey, *Keynote lecture*

9.30-10.45 **Session I: Monetary policy under prolonged global uncertainty: what has changed during the last global crisis?**

Chair: Anita Angelovska Bezhoska, Vice Governor, National Bank of the Republic of Macedonia

9.30-9.50 Altin Tanku, Bank of Albania, *Has the crisis changed the monetary transmission mechanism in Albania? An application of kernel density estimation technique*

9.50-10.10 Leo de Haan, De Nederlandsche Bank*: The signalling content of asset prices for inflation: Implications for Quantitative Easing*

10.10-10.30 Goran Petreski, Faculty of Economics, Skopje, *Discussant*

10.30-10.45 Discussion

10.45-11.15 **Coffee break**

11.15 - 12.30 **Session II: Financial stability and financial system reforms**

Chair: Maja Kadievska Vojnovic, Vice Governor, National Bank of the Republic of Macedonia

11.15-11.35 Yannick Lucotte, Paris School of Business, *Competition and credit procyclicality in European banking*

11.35-11.55 Bernard H. Casey, London School of Economics, *Pension funds and their contribution to long-term investment: the case of the (Western) Balkans and CEE*

11.55-12.15 Viktorija Atanasovska Noveski, Financial Stability and Banking Regulation Department, National Bank of the Republic of Macedonia, *Discussant*

12.15-12.30 Discussion

12.30-13.30 **Lunch**

13.30-14.45 **Session III: Dealing with external and internal shocks**

Chair: Ana Mitreska, Head of the Monetary Policy and Research Department, National Bank of the Republic of Macedonia

13.30-13.50 Sebastian Beer, Austrian Central Bank, *The costs and benefits of interest rate exposure – evidence from a panel of CESEE countries*

13.50-14.10 Gani Ramadani, National Bank of the Republic of Macedonia, *Firms' responses to shocks by price, wage and employment in Macedonia*

14.10-14.30 Biljana Jovanovic, Monetary Policy and Research Department, National Bank of the Republic of Macedonia, *Discussant*

14.30-14.45 Discussion

14.45-15.15 **Coffee break**

15.15 - 16.30 **Session IV: Some old and new central banking challenges**

Chair: Aneta Krstevska, Chief Economist, National Bank of the Republic of Macedonia

15.15-15.35 Ana Martinis, Croatian National Bank, *De-euroisation in Croatia: Mission (Im)Possible?*

15.35-15.55 Neda Popovska Kamnar, National Bank of the Republic of Macedonia, *Monetary policy communication: Evidence from Survey Data*

15.55-16.15 Piotr Zuk, European Central Bank, *Discussant*

16.15-16.30 Discussion

16.30 Closing of the Conference