On the Performance of Monetary Policy Committees

ETIENNE FARVAQUE[*]

PIOTR STANEK[**]

STÉPHANE VIGEANT[***]

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Abstract :

This paper examines the influence of the biographical experience of monetary policy committee members on their performance in managing the inflation and output volatility. Our sample covers major OECD countries in the 1999 to 2010 period. Using the DEA method, we first study the efficiency, before revealing the preferences of the central banks under review. Then, we look at the determinants of the central banks' performances. The results in particular show (i) a higher number of governors is more effective, except in crisis time, (ii) that a policymakers' background influence the performance, with a positive role for committee members issued from the academia, the central bank and the financial sector. It is also shown that some committees have been able to get back to effectiveness sooner than others during the crisis.

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[*] Université du Havre & Equippe - Universités de Lille & Skema Business School, Lille (France). Etienne.Farvaque@univ-lehavre.fr

[**] Cracow University of Economics (Poland). stanekp@uek.krakow.pl

[***] Equippe - Universités de Lille & IESEG School of Management, Lille (France). Stephane.Vigeant@univ-lille1.fr

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1. Introduction

We aim at empirically assessing the impact of the characteristics of central bankers on the macroeconomic performance of their economies. To achieve this, we study the efficiency of monetary policy committees in managing a (theoretically-founded) measure of economic performance i.e., the inflation-output volatility trade off, and look how central bankers' personal background determines this performance.

More precisely, given the diversity in actual monetary institutions, the question is how to measure the potential influence of a monetary policy committee's composition and biographical characteristics of its members on monetary policy performance. The issue notably arises from the fact that the management of the inflation-output volatility trade off is dealt with differently by various committees, with different compositions, and those can be considered equivalent in term of social welfare. The identification of an efficiency frontier capturing the best performances is therefore of paramount importance. Furthermore, it is not at all clear that with the same resources all the central banks would manage to reach a point on this desirable frontier.

Thus, it is clear that a crucial question in the management of monetary policy is how effective a given structure is at reaching a policy objective and also how, in a given structure, the resources mix is able to lead to an optimal policy. Consequently, the objective of this paper is to identify the performance of different structures at managing the inflation-output volatility trade off and how a given structure is able to reach the frontier given the composition of the board.

Our prime research hypothesis is thus that leaders matter. What was a common sense intuition has been backed by rigorous empirical work. E.g., Jones and Olken (2005) show that individual leaders can play crucial roles in shaping the growth of nations, while Besley et al. (2011) show that more educated leaders generate higher growth. A potential mechanism for this could be that more educated leaders are more inclined towards reform (Dreher et al., 2009).

As our hypothesis goes, in central banking also, leaders matter. This is supported by Chappell et al. (2005), who study the voting behavior of the Federal Reserve's FOMC members and find an explaining power for their educational and professional achievements. Göhlmann and Vaubel (2007), for a panel of almost 400 central bankers covering the period 1973–2000, show that their occupational background carries a more significant weight than their educational one. Farvaque et al. (2011), comparing central bankers from the OECD countries in the more recent period, reveal that, while academics and private sector backgrounds are influential (and hawkish) in inflation-targeting committees, the (dovish) impact of a public sector background is important in non-targeting ones. These studies generally put a greater emphasis, in the case of central bankers, on professional experience than on educational background. However, they mostly looked at the inflation performance of central bankers, when it can be considered that the central bank's mandate covers more than one goal.[1] Also related is the work by Erhard et al. (2010), who study the relation between the size of the monetary policy committee and inflation volatility, and show that countries with less than five committee members tend to have larger deviations from trend inflation than those with five members, while going above five does not contribute to a further reduction in volatility. All in

[1] For a renewal of the debate on central banks' goals in the wake of the crisis, see the reflections by Blinder (2010) or Mishkin (2011).

all, then, the literature tends to show that leadership matters in central banking too.

The ability of central banks at managing a multidimensional objective function, more precisely the inflation-output growth volatility trade-off has been the focus of, e.g., Cecchetti and Krause (2002), who derive performances for 24 central banks from inflation and output volatilities, then construct efficiency frontier for each of them and finally regress the policy-implied loss of performance on independence, transparency and accountability indexes. In a subsequent work Cecchetti et al. (2006) estimate efficiency frontiers for two periods (1983-90 and 1991-98), and find monetary policy to have become more effective in most countries, while Briec et al. (2012) theoretically explore the mechanisms that could lie behind such a result. Krause (2007) finds a similar result for pre-EMU period among the prospective members. Mester (2003) reviews the available techniques for estimating central banks' efficiency, and highlights the relevance of the efficiency techniques when measuring the performance of central banks, but notes that monetary policy is probably the most complex of their activities. Finally, Hasan and Mester (2008) use inflation variability as a single performance measure, and regress it on (among others) the number of governors and their turnover. They find a positive impact for both variables but only in developed countries. The main lessons from these studies are, first, the importance of both inflation and output variability for the assessment of central banks performance and, second, that tools from production theory are adequate to assess the performance of central banks. However, a third lesson is that the impact of the precise composition of the monetary policy committees on this performance remains completely unexplored.

Our dataset covers 194 central bankers, who served during the period 1999-2010 in the central banks of nine of the world's major economies. These are: the European Central Bank, the Reserve Bank of Australia, the Bank of Canada, the Bank of Japan, the Reserve Bank of New Zealand, the Swedish Riksbank, the Swiss National Bank, the Bank of England and the Federal Reserve System of the USA. Among these central banks, some of them follow inflation targeting regimes, which will be acknowledged in the empirical study, as it may prove influential when assessing how the central bankers in our sample have dealt with the crisis period, in particular. Overall, the sample is designed both to ensure comparability with the extant literature and consistency as the period starts with the emergence of the euro.

Our contribution to the literature is threefold. First, we provide efficiency measures for the nine central banks before and during the crisis period. Second, we look at the preferences these measures reveal. Finally, we estimate the impact of the composition of the monetary policy committee members' characteristics on the estimated efficiency measures.

Our results show that there are large differences among the central bankers in terms of efficiency in spite of the broad similarity of the institutions we consider (comparable degrees of independence, transparency and credibility). It does confirm however, that large differences persist in the world of central banking.[2] Second, they show that efficiency can evolve in time, and they notably establish that some central banks have reacted quicker than others in front of the current crisis. Third, if the preferences of the central banks we review are skewed in favor of the stabilization of inflation (compared to stabilizing the output), they are somewhat heterogeneous and evolving over time. Fourth, and final, the econometric analysis exhibits that, among the determinants of the central banks' performance, the proportions of academics, central bankers and members coming from the financial sector stand out. Moreover, their respective role evolves: if the crisis does not seem to reveal any difference in the performance of academics, it appears that members from the financial sector have missed an occasion to reveal their expertise.

[2] See Blinder et al. (2008) who show that such discrepancies also exist in central banks communication.

The reminder of the article is organized as follows. Section 2 presents our approach and the underlying model and section 3 reviews the original elements of the data we explore. In section 4.1 we assess the performance of the central banks under scrutiny whereas in section 4.2 we explore the determinants of these obtained efficiency scores.

2. Theory and background literature

In this section, we present the methodology used in this paper to assess the efficiency of the central bankers at using resources in order to manage the economy, and compare it with the ones formerly used by the related literature. The basic principle of monetary policy-making can be roughly described as central bankers using resources to promote their analysis to influence monetary policy decisions and to steer the economy.

2.1. General framework

Starting from a standard framework, the central bank's loss function assumes that it aims at minimizing a weighted sum of inflation and output variability. Using standard notations, the usual quadratic form for such a loss function writes:

$$L^{CB}(\pi_t, y_t) = \lambda \pi_t^2 + y_t^2$$

Knowing that the quadratic loss functions describing the central bank's preferences imply that the expected losses can be reduced to the weighted sum of the variances of inflation and output growth, it writes:

$$E[L^{CB}(\pi_t, y_t)] = \lambda^2 var(\pi_t) + var(y_t).$$

The key element to the success here is the way in which the central bank minimizes the expected loss function.[3] This simple view implicitly supposes that the central bank will have to manage some resources to become more or less effective, something on which we will focus on below, by looking at the composition effect of the monetary policy committee (whose members can rely on their own capacity, built through professional experience, education, cultural background, and so on). Monetary policy is thus described, in a standard way, as an attempt to reduce the volatility of the economy, as perceived through inflation and (a measure of the) economic activity.

An output-oriented measure of each central bank's efficiency is obtained by measuring the distance between an output mix given an input level[4], and the frontier of the production possibility set for that same input level. That is, $\theta^* = Max_\theta\{\theta : (x, \theta z) \text{ is feasible}\}$ where θ is a

[3] We do not delve into the microeconomic foundations of the loss functions, which are now firmly established (see Woodford, 2003).
[4] Note that x is unique and set equal to 1 at each point considered in the sample.

scalar (interpreted as the largest factor by which output can be increased given the input level x such that the production θz is still feasible) and z is a vector of the precisions of inflation and GDP growth (*i.e.* the inverse of inflation and GDP growth variances, respectively). That is, minimizing inflation and GDP growth variances is considered as equivalent to maximizing the precisions of these measures.

In the language of production method analysis, the practical problem is to implement this procedure is that the true frontier is not observed and needs to be estimated. Data Envelopment Analysis (DEA) offers a method for approximating the production possibility set. The basic principle of the methodology is that each policy-maker is compared to all the others (including herself) and her performance is compared to the best practices (that might be hers). For a central bank under scrutiny, called decision making unit (DMU) "0", the local approximation of the relevant production set and her performance is obtained by solving the linear program:

$$Max_{\theta>1}\{\ \theta : \Sigma^{D}_{d=1}\ \gamma_d z_{dj} \geq \theta z^{0}\ ,\ \forall j = 1,2\ ;\ \Sigma^{D}_{d=1}\ \gamma_d = 1\ ;\ \gamma_1 \geq 0\ \}, \qquad (1)$$

where D is the number of DMUs, J, the number of outputs. The constraint on the sum of γs ensures that the frontier is the smallest convex envelope of the data.[5]

The most important consequence for us is that, in practice, the performance of a given central bank is compared to the best practices of the others, so the performance is just an estimate of the true performance, as we do not know if the best practices are really on the frontier or just "close" to it.

2.2. Relation to the extant literature

The literature mentioned above attempts, implicitly or explicitly, to evaluate how effective central banks are and / or the determinants of the estimated efficiency. So doing, the literature generally has to make some assumptions, auxiliary or fundamental, that may curb the estimation process. The use of the production view provides a different approach (Briec et al., 2012).

First, although it may appear as surprising, the DEA method considers that a central bank is not fundamentally different from a shoe factory. However, in fact, one has to acknowledge that a central bank uses inputs such as expectations, order books surveys, knowledge of the economy identified with human capital of board members, and so on, to produce outputs such as low inflation and GDP volatility. Consequently, the performance of such decision units can be analyzed and compared (Mester, 2003). Data Envelopment Analysis (DEA) methods are tools that can be used to weighted the relative performance of central banks identified as decision making units.

A central bank is often considered to be an optimizing agent and DEA allows us to test this claim. DEA methods allow us to exploit database on the backgrounds of the central bankers in office at decision time. In other words, we can assess the efficiency of their management

[5] In a standard DEA model, we would introduce the inputs through a constraint of the form $\Sigma^{D}_{d=1}\ \gamma_d\ x_m \leq x_{0m}$, $\forall m = 1,...,M$. But, in our case, because $x = 1$ for all m and d, and with the constraint on the γs, this constraint reduces to $\Sigma^{D}_{d=1}\ \gamma_d = 1\ ;\ \gamma_1 \geq 0$.

based on their "human capital" (perceived as an input in the production process). Hence, we can assess the productivity of a producer endowed with several inputs when she has to transform those inputs into an output vector, i.e. the volatility of inflation and GDP growth.

It is important to note that the method proposed allows us to study the ability of central bank at managing the trade-off between inflation and GDP growth volatility without relying on a parametric assumption about the trade-off. The frontier of the best practices is estimated non-parametrically from the data. This frontier is then used to compare the other central bankers to those used to define the best practices. One central innovation that DEA allows us to provide is an estimation of the arbitrage central bankers do over alternative policies.

As a consequence, an important difference with the extant literature is that we do not have to rely on the, official or (worse) supposed, objectives of the central banks under scrutiny. Cecchetti et al. (2006), for example, assume an inflation target equal to 2%, and the minimization of the variability of GDP around its potential. This induces that they have to check the robustness of their results by comparing several alternative scenarios. The DEA method we make use of afterwards avoids the need for such assumptions, by comparing each central bank to the best performance in the sample. More precisely, each one is compared to the best radial projection (on the frontier), and the latter may not belong to the performance of the same central bank. For example, this permits to compare the Reserve Bank of Australia to the European Central Bank, and not only each central bank with herself.

A second, related, difference of the method we use is that we do not have to rely on filtered measures of potential output, a notoriously tricky process. Here, we do not impose the differentiation between the trend and the seasonal component of the series, but make use of the statistical properties of the series themselves, through a GARCH estimation procedure. This also means that we do not have to estimate the dynamics of inflation and output for each of the countries we study to be able to define the policy rule followed by each central bank, but only use the predicted volatility from the GARCH.[6] This necessarily comes at the cost of further identifying assumptions, something we bypass by resorting to GARCH estimates. Importantly, so doing, we do not have to impose neither a policy rule nor a policy instrument, which is especially valuable as our sample period includes the financial and economic crisis periods, where several central banks have changed their policy course and modified their intervention methods (given the zero lower bound on interest rates, the ECB and the Fed, in particular, have implemented large quantitative easing measures, which would spoil the results, would they be based on estimated policy rules).

Moreover, the issue of real-time data, as raised since the contribution by Orphanides (2001), can be overlooked with this method. The reason is simply that, any existing bias in the real-time data would be expected by the central bankers, and be integrated in their decision process. More technically, the noise brought by the revision of data would be a process with an average equal to zero.

A third difference comes from the fact that, in the traditional approach, the quadratic loss function has to be estimated, which raises the question of the relative weight of the two

[6] To save on space, the results from the GARCH estimates are not provided, but are available upon request from the authors. The estimated model is an AR(1) in mean and a GARCH(1,1) for the variance. Exceptions are for Canada's inflation and Japan's output (we have used an AR(1)-ARCH(1)) and for inflation in the USA (we have used an AR(1)-ARCH(5)) model. All processes have been estimated over the 1971:1-2010:4 quarterly data except for New Zealand output (1983:2-2010:4) because of data availability and for the UK 1990:1-2010:4 for output and for the UK and USA over the 1991:2-2010:4 for inflation because unconstrained convergence was not achieved otherwise. We have used the predicted values of the variance of the estimated process to construct the precision measure.

objectives (λ). Two possibilities are in order here: either one has to estimate the policymakers' preference parameter (as Krause and Méndez, 2008, do for a sample of central banks[7]), or has to assume that the preferences do not shift over time (as in Cecchetti et al., 2006). As the DEA method compares each central bank with her peers, the relative weight of the two objectives can evolve over time and does not have to be over-imposed on the estimation procedure.[8]

A final difference is that the peers that are considered by the DEA method are those who pursue (implicitly or explicitly) the same kind of objectives. For example, central banks that tolerate high GDP growth volatility will be compared together, and not with central banks that accept high inflation volatility. Moreover, the upper bound of the performance is determined in this example by those that minimize the variance of inflation, given the same output growth volatility.

3. Data

The dataset covers the nine central banks (as in Eijffinger and Geraats, 2006): the European Central Bank (ECB), the Reserve Bank of Australia (RBA), the Bank of Canada (BC), the Bank of Japan (BJ), the Reserve Bank of New Zealand (RBNZ), the Swedish Riksbank (SR), the Swiss National Bank (SNB), the Bank of England (BoE) and the Federal Reserve System of the USA (Fed). This sample covers major OECD countries: all G7 countries plus other countries of the euro area, New Zealand, as well as Switzerland and Sweden.

The time span contains quarterly observations from 1999Q1 to 2010Q4. It begins with the activity of the European Central Bank and data availability - e.g. BJ and SNB publish their annual reports on their website since 1999, BoE since 2000 only. Overall, this time span also ensures consistency and comparability.

In order to assess the impact of central banks' elites on their outcomes, the analysis relies on a databank including macroeconomic data and the CVs of monetary policy committees' (MPCs') members. The former comes from the IMF's International Financial Statistics, the latter was constituted by the authors and contains 195 entries.

Most of the data have been retrieved from the websites and especially annual reports of the analyzed central banks. Nevertheless, some details of certain biographies come from other sources: *Who's who* website, *Central bankers in the news* (www.centralbanking.co.uk), *Forbes*, *Quid* and finally directly from press or personnel services of central banks.

The database allows for taking into consideration some external factors (which do not depend on the individual members' characteristics), such as: the number of members and measures of MPC dynamics (number of changes and turnover, i.e. the number of changes related to the size of the MPC). However, its focus is on the internal characteristics of MPCs: demographic characteristics (age and gender) as well as social ones (professional profile and educational background).

3.1. Monetary Policy Committees size and demography

[7] See, for estimates of preferences that focus on a single bank, e.g., Favero and Rovelli (2003) for the Fed, and Berger et al. (2005), for the Bundesbank.
[8] The variances are estimated around zero, and not around the target of the variable.

We first consider the size of the committee by itself. This feature is both empirically important (as the debates around the enlargement of the Euro area have shown), and theoretically (as there is a presumption, related to Condorcet's jury theorem, that an increase in the number of members of a committee could lead to better informed decisions[9]).

However, one of the distinctive features of the database is to take into account the real number of appointed policy makers and not the statutory number of MPC members (see Table 1). For example, while the FOMC has 12 voting seats, during 1999-2001, most of 2005 and 2007-8 two positions were vacant. Here, we consider the number of members to be 10 and not 12 during that period.[10] This choice influences the analysis (and especially the shares of different categories presented below) as the total number of members in the sample varied between 69 in 2006:Q3, and 73, when all positions were filled (during 2003-2004), and 76 in the last observed period (2010:Q4), when one seat was vacant in the board of the BC, one at the Fed, while the Governing Council of the ECB has already been enlarged by representatives of Malta, Cyprus and Slovakia (but not yet Estonia).

The second characteristic we consider is also linked to the number of members and is the turnover of MPC members. In the corporate governance literature, this feature has been shown to influence the work of any committee. In the case of MPCs, turnover might be even more important for a number of reasons. On the one hand, the turnover is linked to the tenure of MPC members, which is used as one of the factors influencing central bank independence, and this interaction has already been investigated.[11] Similarly, an excessive turnover might endanger the MPC credibility, which is probably equally important. On the other hand, from a principal-agent perspective and depending on the appointment process, an increased turnover may be an incentive to work harder, for example by acquiring additional information.

Within the whole sample, the New Zealand Reserve Bank is the only one where monetary policy is decided by a single decision-maker. The largest MPCs are the ECB's (21 members since 2008 and 22 since January 2009, when Slovakia joined the euro area) followed by the FOMC (12 members). In most of the analyzed countries the number of members is absolutely stable and equal to the statutory number of members, though, in some countries like the USA, Great Britain or Australia, some seats remained unfilled during relatively long periods.

In most of the analyzed countries the replacement of MPC members is quite smooth and, usually, the terms of office overlap and each year there are a few changes, without affecting the overall composition of the committee. However, in a country with a single decision maker, one change signifies a “total turnover” of the committee. Moreover, in the FOMC, due to the rotation scheme of Federal Reserve Banks’ Presidents, each year in January at least 4 voting members change. In order to assess the impact of these MPC dynamics two variables are computed: the number of changes and turnover (see Table 1). A replacement was counted as one change, whereas a resignation without replacement (or a nomination to an unfilled position) was counted as “half a change”, to account for the different nature of these changes[12]. However, as the sizes of MPCs differ, to take into account the relative impact of the change, the turnover variable is defined as the number of changes with regard to the effective number of members of the committee.

As the total number of MPC positions in analyzed OECD countries equals 78 and the number

[9] The presumption is now severely contested in the literature; see Gerling et al. (2005).
[10] However, as the frequency adopted for the whole analysis is quarterly, it was decided not to pay attention to members present and absent during any particular MPC meeting.
[11] See e.g. Cukierman (1992) and the more critical study by Dreher et al. (2008).
[12] Thus, e.g. the joining of the President of Bank of Greece to the Governing Council of the ECB in 2001 or Bank of Slovakia (related to the enlargement of the euro area) was counted as "half a change".

of decision-makers who served during the analyzed time span is 194, the average (unweighted) turnover in the sample approaches 1.5 for the whole period (see Table 1). This means that, on average, in all the analyzed MPCs, each member was replaced at least once. Taking into consideration the fact that not all the seats are filled in and the rotation system in the Fed, the registered turnover is even higher and exceeds 5.

Table 1: Monetary Policy Committees: Size and Demography

	Legal size	Real average size	Turnover rate	Average age	Women's share
European Central Bank[†]	22	18.8	1.34	59.0	5.3%
Reserve Bank of Australia	9	8.7	1.05	56.9	11.5%
Bank of Canada	6[*]	6.1[*]	2.01	53.8	14.3%
Bank of Japan	9	8.8	1.87	61.2	11.4%
Reserve Bank of New Zealand	1	1	1.00	56.9	0%
Sweden's Riksbank	6	5.9	1.28	56.6	38.5%
Swiss National Bank	3	3	1.00	54.3	0%
Bank of England	9	8.9	2.28	53.2	18.1%
Federal Reserve Board	12	10.6	5.57	58.4	13.0%
Average	8.6	8.0	1.93	56.7	12.5%

[†] Legal size is as of 2010 for the ECB.
[*] The Bank of Canada Act does not formally bind the number of deputy governors, however, with the exception of period January 2000 – July 2001, during almost all of the time there were 5 Deputy Governors (including Senior Deputy Governor).
Source**:** authors

We study the link between the age structure of central banks' elites and their inflationary performance, on the premise that the difference between members' ages may influence the performance of the committee. This premise can be related to Arrow's (1951) demonstration on the heterogeneity of deciders and it has been shown relevant in the corporate governance literature (Adams et al., 2010). For the age variable, the "average year of birth" of the surveyed central bankers was 1947.[13] However, the average age varied only slightly for the whole sample (between 56.2 in 1999:Q4 and 58.5 in 2010:Q1) during the analyzed time span, being equal to 57.1 in 1999:Q1 and to 57.8 in 2010:Q4.

We consider another sociologically interesting demographic feature – gender –, as it may also have an impact on MPC members' preferences. Chappell and McGregor (2000) for example remark that female members of the FOMC tended to be on the dovish side of the preference spectrum, while Farvaque et al. (2011), on a larger sample, show them on the more hawkish side. The issue is considered as important in the corporate governance literature and in policy debates. We thus include it in our context.

Among the 194 decision makers who were in charge of monetary policy in the 9 surveyed central banks, only 23 were women (11.8 %). The number of women varied more, between 7

[13] It was possible to find the years of birth for 184 out of the 195 surveyed MPC members in OECD countries. It was due, among others, to the Bank's of Canada privacy policy, whose press service did not provide years of birth for two Canadian governors. Hence, for the following empirical analysis, the year of birth of governors for whom we had no precise information was approximated by the year of their graduation minus 21, which seems a plausible assumption and turns out to be an innocuous choice.

in 1999-2001 as well as in 2009 and 13 in 2004-5 (on about 75 positions). We can see that central banking remains dominantly a men's world.[14] The most feminized MPC is Sweden's where, since 2003, the council includes 50% of women. During some periods, women represented a third (3 out of 9 committee members) of the Bank of England's MPC. On the other hand, in Switzerland as well as in New Zealand there were no women during the whole period, while in the ECB, the RBA, Bank of Canada as well as in the Bank of Japan, one of the MPC members was female (not necessarily the same during the whole period, but usually female members are replaced by other women[15]).

3.2. Central bankers' social characteristics

As in Göhlmann and Vaubel (2007), we suppose that the socialization processes the central bankers undergone throughout their professional career can influence monetary policy. In order to assess this impact, we first analyze their dominant type of professional experience. This variable is classified into six categories: public economy (meaning that the MPC member worked for the government, e.g. as the finance minister, treasurer or, very rarely, for a state-owned enterprise); private economy (if the MPC member worked mainly in the non-financial private sector); financial sector (where private bankers, insurers, or capital market specialists were classified); academia (if the member followed an academic career); central banker (if the main part of the professional life was spent within the central bank); and, finally, other (mainly professional politicians, but also a few jurists and journalists).[16] The structure of these categories for the 194 MPC members of our database is presented in Table 2.

This structure, however, is not stable, even in the relatively short (48 quarters) time span of the present analysis. The share of public economists varied between 24.6 and 28.4%. Remarkably, the share of academics increased from about 16% in the beginning of the period (11 out of 70) to slightly more than 20% (15 out of 74). This evolution was first detrimental to central banks insiders, whose share decreased from 30% in 1999 to slightly more than 21% in 2007, before coming back to more than 27% in 2008. The participation of private economists in the beginning was close to 11.5% and dropped to 10.5%. This was only implied by an increase in the number of seats - their number was the same at the beginning and the end of the sample. The financial sector representatives accounted for 13% at the beginning of the period, and slightly fell to 12% in 2010, with a peak to almost 17% in 2005. The share of members classified as "others" was very restrained (3-6%) during the whole period.

However, one has to notice that these proportions significantly differ between countries. Some central banks have the obligation to include active professionals in their MPCs (e.g. Australia), while some others interpret the general clause (present in virtually all central bank acts and statutes) that the MPC members must be recognized specialists as a quasi-obligation to appoint mainly macroeconomics and finance professors.

[14] Note that the appointed women presently tend to be younger than their male counterparts, which impacts on the average age.

[15] E.g. in the Board of the ECB Gertrude Tumpel-Gugerell replaced Sirkka Hamalainen in May 2003 and in Japan Miyako Suda replaced Eiko Shinotsuka in 2001.

[16] As in the further analysis the focus of attention will be given to heterogeneity of committees, it would have been confusing to allow for different types of career for individual members. We decided to consider the dominant (and not the last) type of occupation because the last job was in some cases very short-lasting in which case the socialization process would have been limited. In a few cases, when a member worked during similar periods in e.g. academia and government, the last experience was chosen.

Hence, for example, the Governing Council of the ECB is dominated by "public economists" (their number varied between 10 and 13 on the total 17-22 members), in Australia "private economists" systematically represent half of the Reserve Bank Board members (4 or 5 out of 9) while the Bank of Canada is governed mainly by "central bankers". Some MPCs have significantly evolved during the period: in 1999, the British MPC was constituted mainly of central bankers (4) and academics (3), while in 2006:Q3 it was composed in equal numbers (2) of academics, central bankers and public economists, all these being completed by a private economist. In 2008 once more, central bankers (3) and academics (3) dominated the rest of the council (1 public and 2 private economist). Heterogeneity is also a characteristic feature of the Swedish MPC.

Table 2: Monetary Policy Committees: Professional and Educational Backgrounds

	1999Q1	2010Q4
Career		
Public sector	18	18
Financial sector	9	9
Private sector	8	8
Academia	11	17
Central bank	21	23
Other	3	1
Education		
Prof.	17	18
Ph.D	25	30
MBA	4	3
Master (other)	12	18
Bachelor	12	7

Source**:** authors

The second social feature we consider is education, as it is an eminent factor shaping the general outlook of people and thus also their preferences[17]. Similarly to the professional background, educational attainments were dispatched into five categories: Bachelor (including LLBs), Master (of both science and arts), MBA, PhD and, finally Professors. A few comments on this categorization are in order: First, it was decided to distinguish MBA as a separate category, even if it turns to be the smallest one, because such a specifically entrepreneurial formation may matter in shaping policy preferences. Second, even if professorship is not a diploma, this professional title should prove an important capacity to analyze information and transmit knowledge to different kinds of public, which is important in modern monetary policymaking. The communication skills of academics can also be an asset to improve the accountability of the monetary policy and thus increase its effectiveness.

Among the 195 monetary policy makers we surveyed, the biggest part (33%) is represented by PhD holders, followed by professors (24%), and masters (22%), further completed by a significantly smaller participation of bachelors (15%) and by the smallest group of MBA holders (6%). Nevertheless, the important observed evolution during the period relied on the

[17] We consider education by degree and not by field (as Dreher et al., 2009, or Göhlmann and Vaubel, 2007, do). As our sample contains both the diploma and the professional background of committee members, considering the field of education would have overlapped in many cases with the committee members' experiences, and would have led to colinearity problems. Moreover, a second argument is that a dominant part of the individuals in our sample held degrees in economics (about 90%).

constantly growing part of professors – mainly at the cost of PhD holders until 2006 - a trend which was reversed thereafter. Also, the participation of bachelors markedly decreased in the second half of the period (from 12 out of 70 in 2005:Q4 to 7 out of 76 in 2010:Q4) [18]. This trend is likely to persist, as the bachelors in MPCs are significantly older than other members and are probably close to retiring (the "average year of birth" is 1940 for all the bachelors). Moreover, the general and already mentioned trend in monetary policy making is to rely more and more on academics.

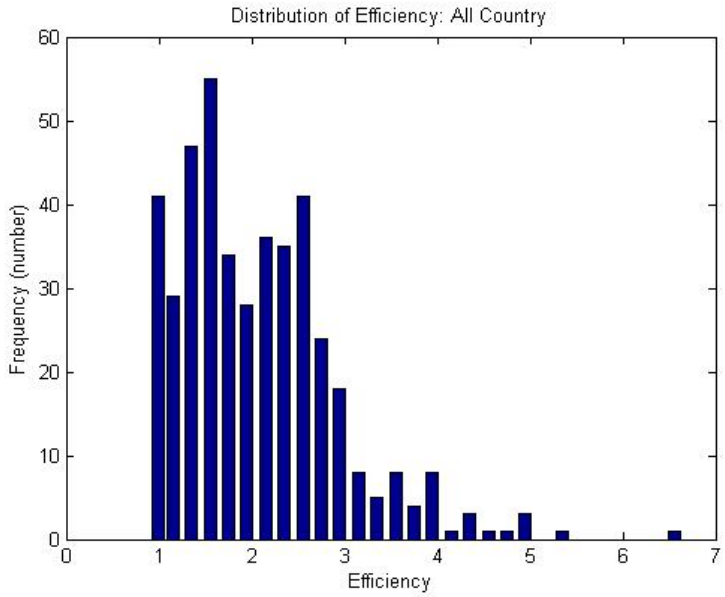
4. Results

The results are displayed in three steps: we first discuss the degrees of (in)efficiency and their evolution, in particular since the crisis period, before turning to the estimates of the preferences of the central banks. Then, we study the impact the composition of the MPCs can have on the performance.

4.1. Efficiency analysis

Efficiency scores results are displayed, for the whole sample, in figure 1 and their descriptive statistics appear in Table 3. As can be seen from the figure, the distribution is relatively dense. The frontier is built from four points, three belonging to the Bank of England's performance, one to the ECB's. There are very few extreme (i.e. very inefficient) values, although it can be noted that the last point too belongs to the BoE.

Figure 1.



[18] Moreover, five of the bachelors serving in 2006 were at the BJ, two at RBA and one in the British MPC; in 2010 there were 7 Bachelor holders, out of which 4 were at the BJ and three at the RBA. Another interesting remark is that the majority of bachelors (18 out of 29) represented the private sector. As such, they were probably expected to bring into their respective MPC the private economy's point of view.

More interesting results come from the cross-country comparison. For that purpose, we display each central bank's performance in figure 2. As can be seen, except for the Federal Reserve and the Bank of England, the distribution of the efficiency estimates does not show strong dispersion of the index. Moreover, some central banks clearly show high average efficiency results. This is in particular the case of the ECB and of the Swiss National Bank. Another striking feature is that, in the cases of the ECB, the Bank of Japan and the Bank of Canada, the observations are relatively grouped towards the frontier, even if, as for the BoJ notably, the frontier is never reached. Worth noting is of course the performance profiles of the Fed and the Bank of England, who are clearly different from the other central banks of the sample. The BoE shows at the same time a large frequency of observations at the frontier, or close to it, and several points dispersed quite far from the frontier. The Fed's behavior shows a much larger proportion of its performance indexes quite far from the frontier. This tends to indicate that the best practices, in terms of performance, for this group of central banks, are the ones of the ECB and of the BoE.

Table 3: Efficiency scores

	Whole sample	ECB	BoC	BoJ	RBNZ	BoSw	SNB	BoE	FRB	RBA
Mean	2.1581	1.4981	2.2859	2.0797	2.5502	2.7900	1.6620	1.6819	2.0847	2.7907
Median	2.0053	1.2247	2.0062	1.9240	2.5479	2.6184	1.5145	1.2679	1.7076	2.5322
Min.	1.00	1.00	1.6067	1.5230	1.8401	2.2367	1.3428	1.0000	1.0636	2.0586
Max.	6.7380	3.6396	4.0689	3.5313	3.6357	4.1343	2.6113	6.7380	5.1121	4.9807
Standard Error	0.8578	0.6447	0.6517	0.5103	0.4179	0.5028	0.3683	1.1980	1.0969	0.7180
Variance	0.7358	0.4156	0.4247	0.2604	0.1747	0.2528	0.1356	1.4353	1.2031	0.5155
Interquartile	1.0821	0.5122	0.8948	0.5760	0.6112	0.4872	0.1860	0.5304	0.5398	0.6370

Of course, our results could be driven by the period we consider, which includes a deep financial and economic crisis. Hence, we also display the evolution of each central bank's performance in figure 3. Figure 3 shows the evolution across the whole period under review in the top panel, while the bottom panel focuses on the last four years (i.e. the crisis period).

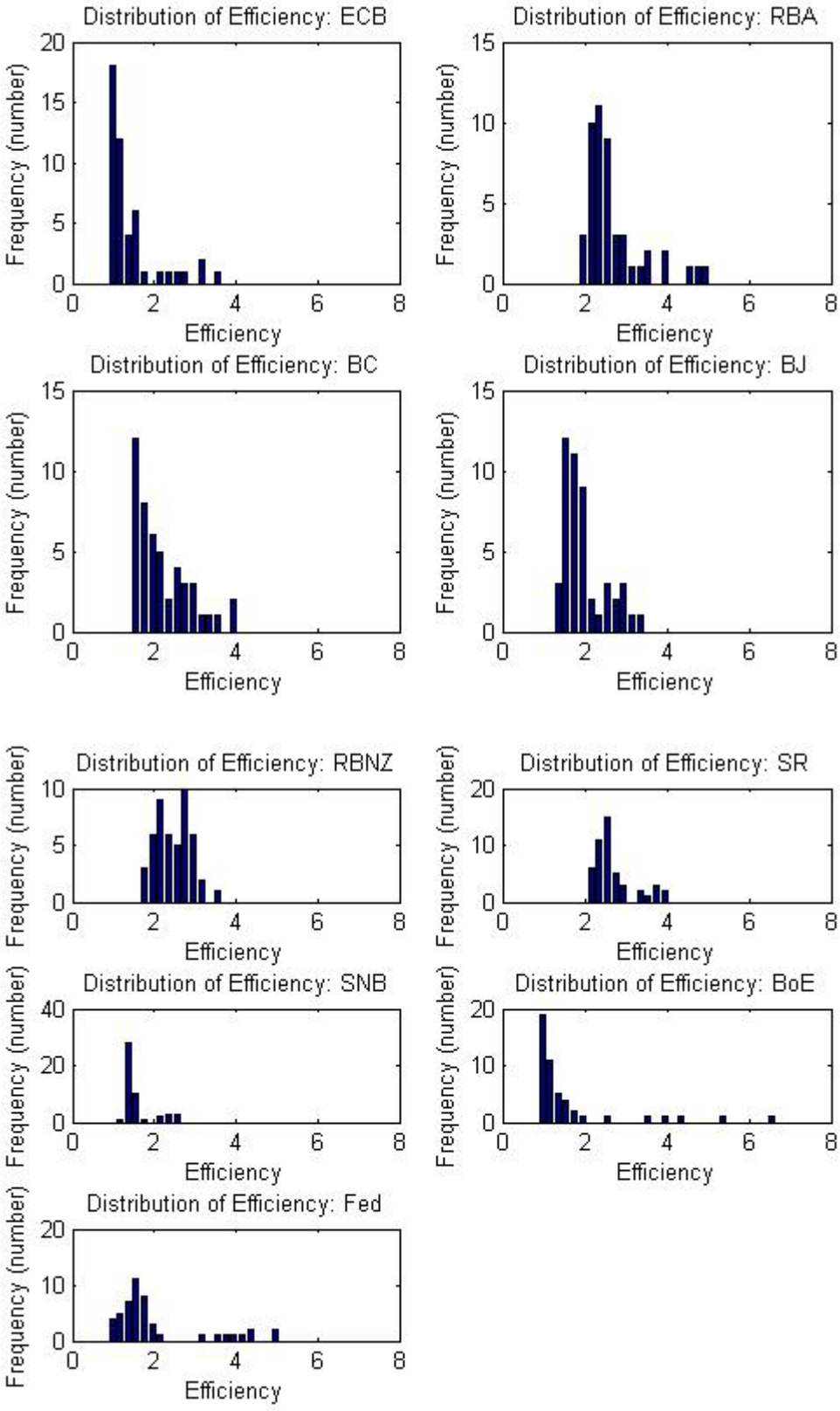
As can be seen from the top panels of figure 3, some central banks show a relatively flat (i.e. a relatively constant degree of performance). This is particularly the case of the ECB and of the Swiss National Bank. On the contrary, some institutions show a more erratic performance, the Reserve Bank of Australia being a case in point, as well as the Bank of Canada. New Zealand is outstanding, in that its profile is relatively flat, but at a higher level of inefficiency. As a consequence, the efficiency index of the Reserve Bank of New Zealand is, on average, superior to the whole sample, but with a lower variance.[19]

As revealed by the bottom panels of figure 3, the last four years show a decrease in efficiency for all the central banks under review, although the deterioration in stronger for some than for others. The BoE's profile is striking, being the central bank that reaches the highest degree of efficiency in the sample during the crisis.

The steepest rise, however, is the ECB's. As this steep rise occurs after the other main central banks have already started to change their behavior, our results may feed the "too little, too late" criticism addressed to the ECB (see Gerlach-Kristen, 2005). However, this is contradicted by the fact that the ECB is also the first to come back to pre-crisis levels, reaching even lower levels than the other central banks under review. Strikingly, the UK and US institutions have not reached their pre-crisis levels by end-2010.

[19] All the descriptive statistics are available from the authors upon request.

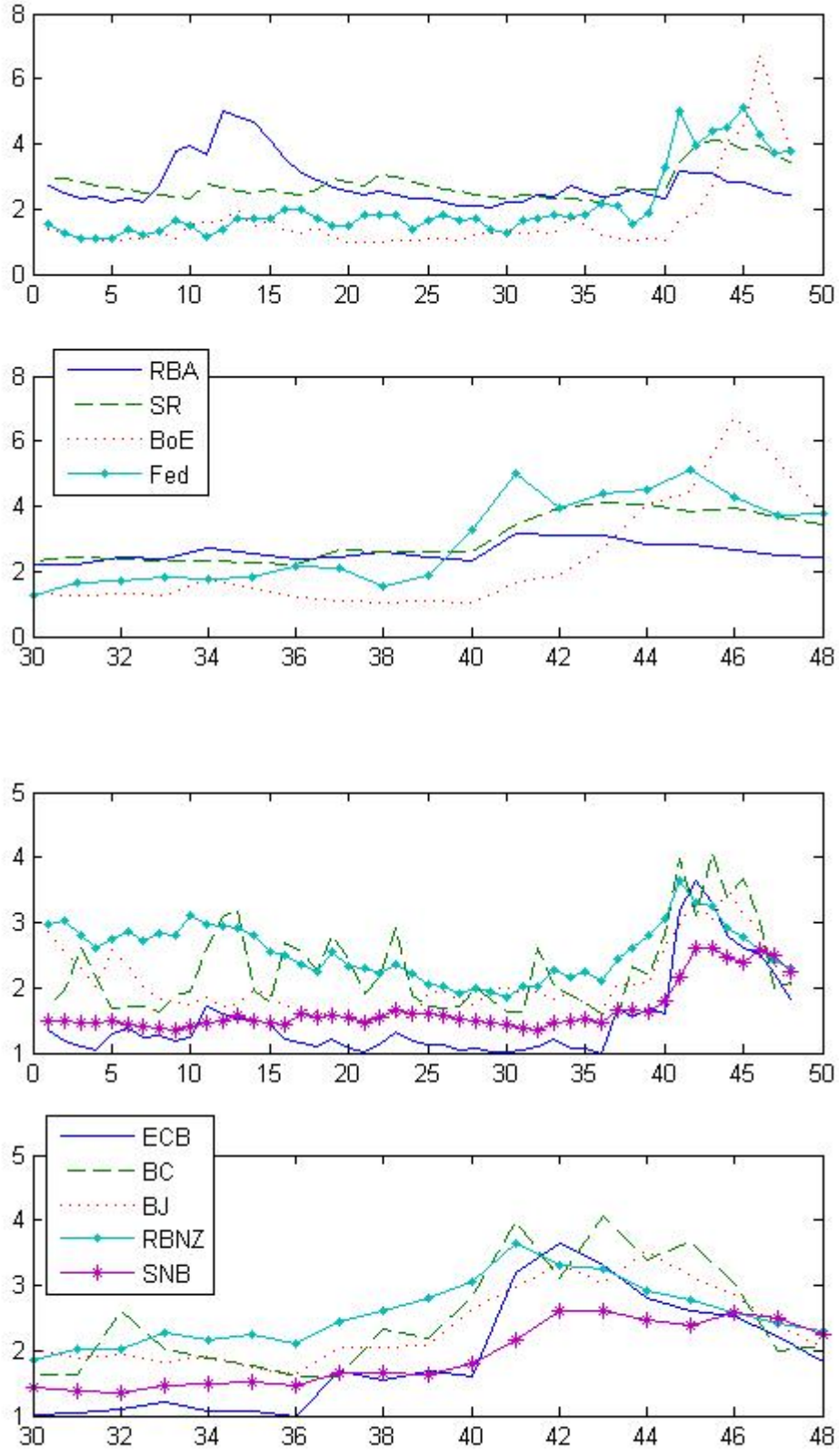
Figure 2. Central banks' performance



Source: authors.

Figure 3. Evolution of performance

(top : 1999 – 2010 ; bottom: 2007 - 2010)

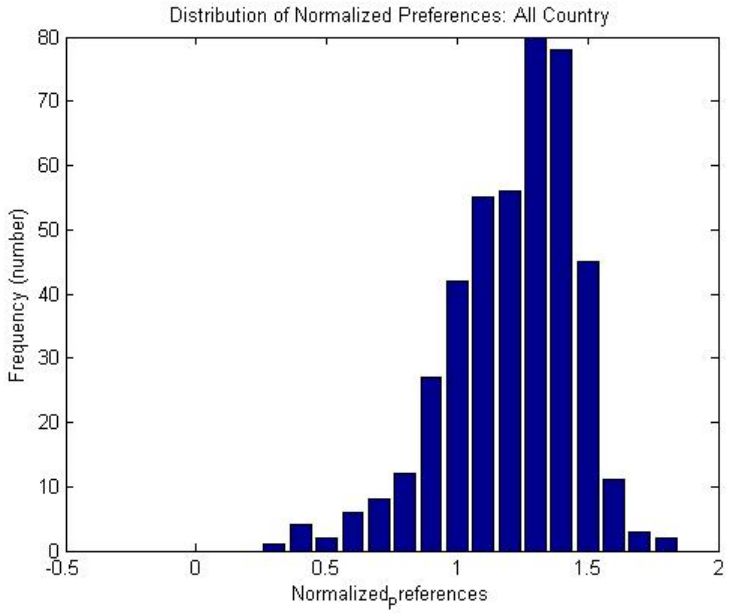


4.2. Central banks' preferences

Another advantage of the DEA method is that, from the obtained inefficiency indexes, one can derive an original measure of the central banks' preferences: considering the angle formed by the ray from the origin going through the actual performance of the bank (in the whole dataset enveloped by the efficiency frontier) delivers the degree with which each central bank trades-off the volatility of inflation with regard to the volatility of output.

Hence, taking the ratio of both (inverse) volatilities and normalizing so that a preference measure (λ, in the above theoretical framework) equal to 1 corresponds to a 45°-angle (i.e., the central bank does not weight one of the two goals more than the other, or objective neutrality), we get measures of the given central banks' preferences.[20] Their distribution is shown in figure 4 for the whole sample, while figure 5 details the evolution of these preferences over time for each central bank separately.

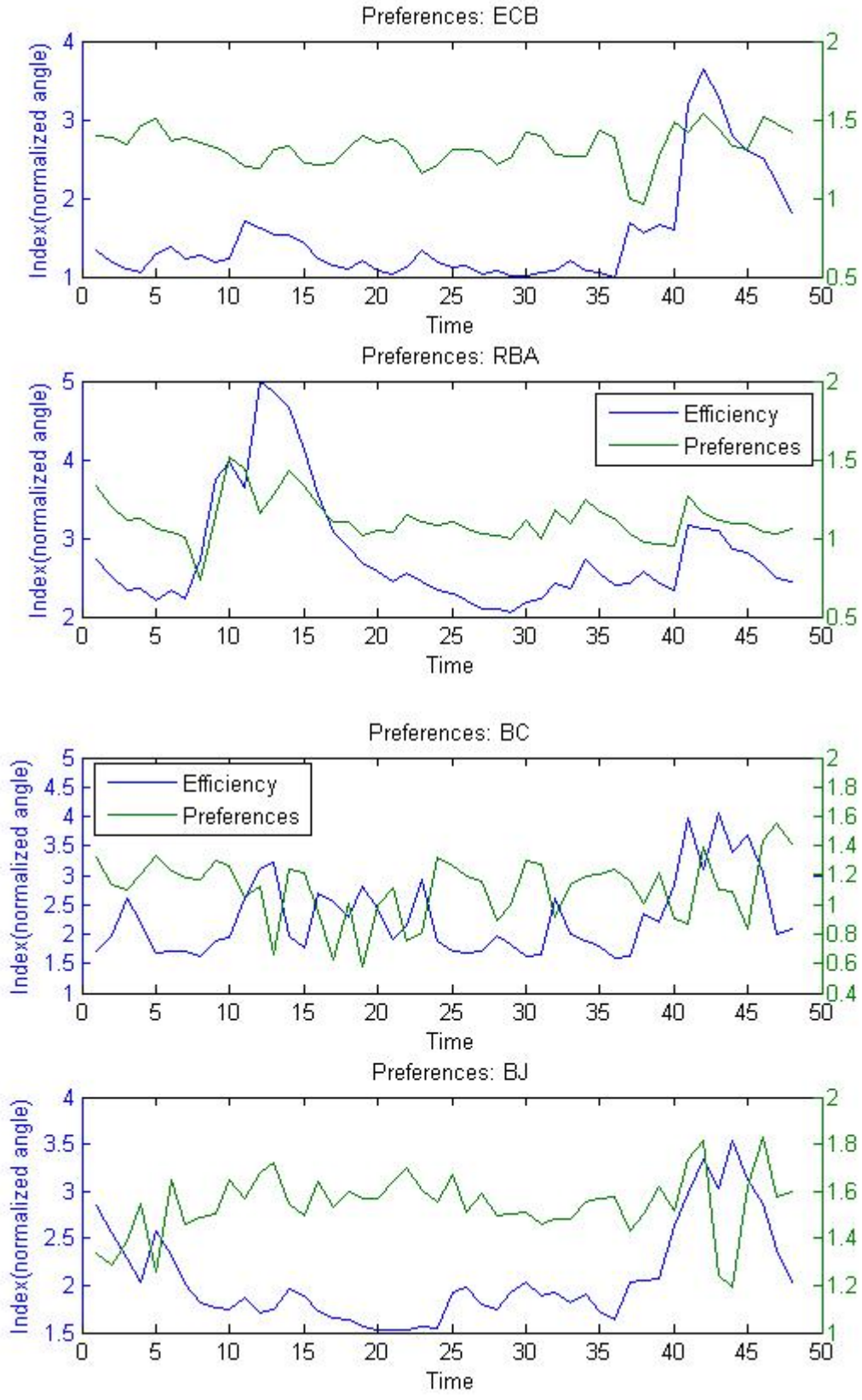
Figure 4. Distribution of Normalized Preferences: Whole Sample

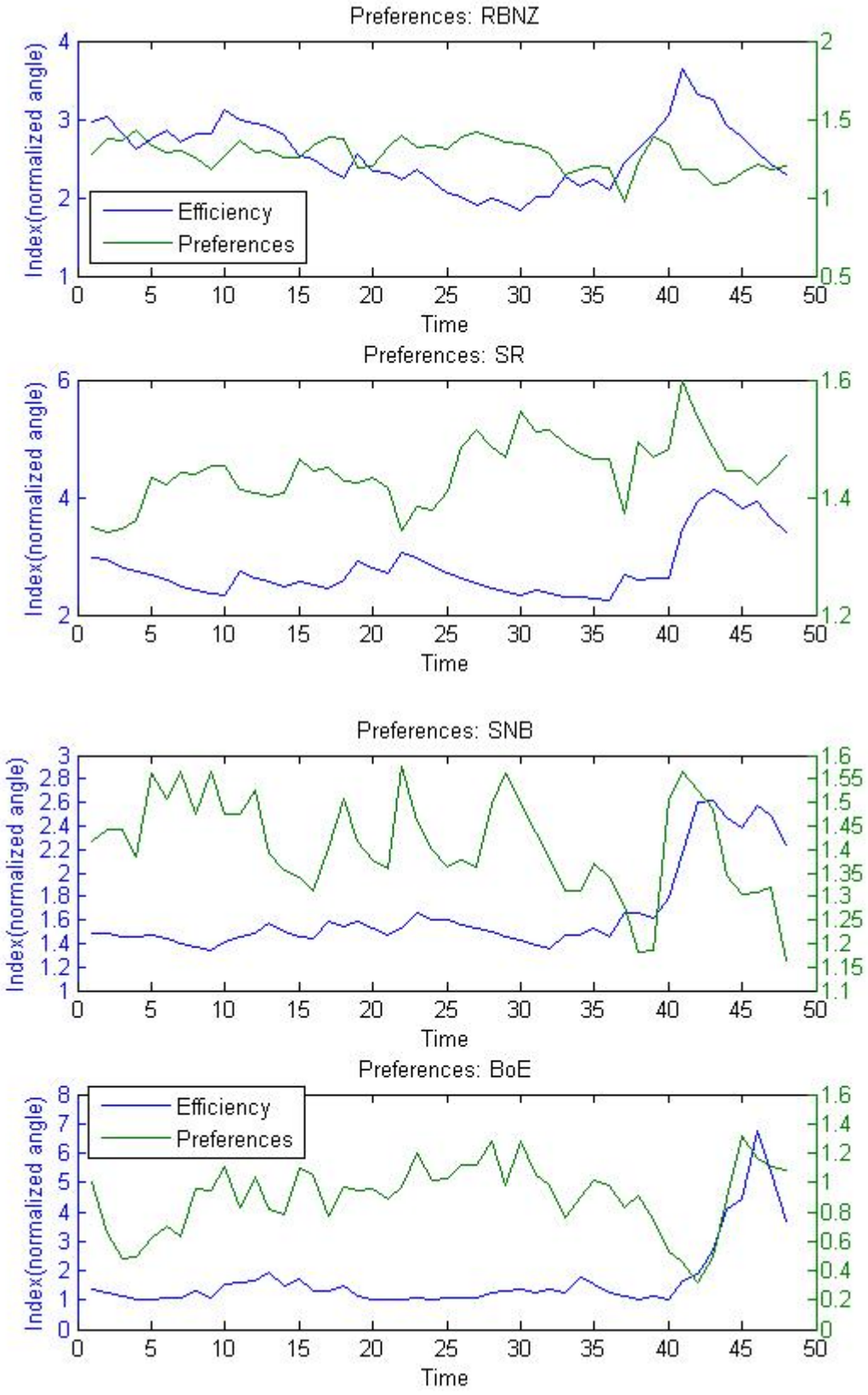


Interestingly, as figure 4 reveals, the distribution of preferences is clearly skewed to the right, and concentrates beyond 1, which means that the central banks in our sample clearly favor the stabilization of inflation over the stabilizing output. However, none of the central banks under review appears as a pure "inflation nutter" (i.e., a central bank solely focused on inflation, as Mervyn King, then Governor of the Bank of England coined it). This would be revealed by a normalized preference measure equal to 2, a value never taken in our sample (although the maximum value is 1.8, which could be considered as relatively close to 2).

[20] More precisely, we have computed the measure as the tangent of the ratio, which means that when the normalized measure of preference tends towards 2, the tangent goes to infinity.

Figure 5. Evolution of Normalized Preferences




Preferences: RBNZ
Index(normalized angle)
Efficiency
Preferences
Time
Preferences: SR
Index(normalized angle)
Time
Preferences: SNB
Index(normalized angle)
Time
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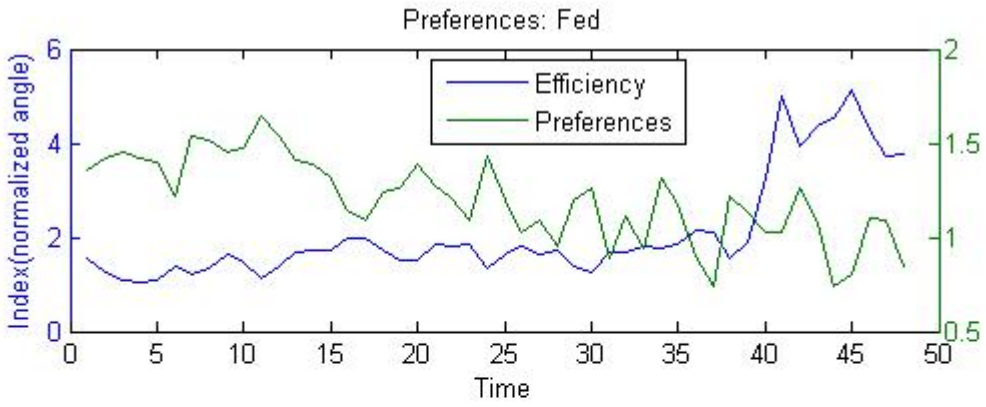
Index(normalized angle)
Efficiency
Preferences
Time



The central bank that has the highest preference in terms of inflation is the Bank of Japan, whose measure never goes under 1 (i.e., always favoring inflation stabilization over output during the period under review, a result that confirms the many criticisms the BoJ has endured since the beginning of the deflation period in Japan). Two other central banks are in this case, namely Sweden's Riksbank and the Swiss National Bank, but they do not go as far as the Bank of Japan. Conversely, two central banks (Canada's and the Bank of England) appear to have strongly evolving preferences, as the normalized measure goes from 0.3 to 1.6, hence passing through almost the whole spectrum of values the measure can take. The other central banks have a more moderate profile, as their preferences are not stuck to one objective only, and as they show some flexibility in the weight attached to each objective across time.

Of course, the crisis has impacted the preferences of the central banks under review (at least of those whose preferences have not been stuck to high levels – the Bank of Japan and the Swedish Riksbank). As figure 5 shows, some of them have rapidly and strongly changed the weight attached to each objective. It is the case of the ECB, for example, which appears to have switched around 2008 to a much more equilibrated preference profile, before switching back to its average level (ca. 1.4). It is also at this period that the Swiss National Bank has shown the highest concern with regard to output stabilization, although its weight never goes below 1.15.

The Fed's case is remarkable as it shows a regular trend towards preferences that are more and more biased towards the stabilization of output as we move towards the end of the period under review. This contrast with the particularly flat profiles of Australia's and New Zealand's central banks preferences.

Simultaneously considering the results on efficiency and the preference measures, the Bank of England appears as a very pragmatic institution, whose preferences can evolve quickly, allowing her to be effective in front of adverse shocks. Compared to such a benchmark, this is much less true of institutions that appear much more rigid, like the Bank of Australia or the

Bank of Japan. It may be worth noting that the oft-criticized European Central Bank does not appear in the latter camp, contrary to a recurrent argument.

4.3. The determinants of efficiency

As explained above it is very likely that the composition and characteristics of the central bank committees has its influence on the conduct of the policy. The features that one would like to capture are multiple and we focus on some of them. Firstly, age is a key factor, with age difference inside the committee potentially bringing difficulties to converge on a common decision, due to a generational cohort impact. For example, Malmendier and Nagel (2011) show that being born in a depression period affects risk-taking, which would induce a central banker, in our context, to have different preferences. Another justification comes from the difference between Göhlmann and Vaubel (2007) and Farvaque et al. (2011) on the degree of inflation aversion of academics, which may be attributed to the fact that the sample of the former study includes central bankers educated in a period strongly influenced by the most traditional Keynesian thinking, or simply to an evolution of central banks priorities. The justification for including the number of members of each committee lies back to Condorcet's Jury Theorem and the value of information each extra member of a committee brings with her, although some costs may arise from increased transaction costs if the committee reaches a certain threshold (Berger et al., 2008).

The following regressors, that detail the professional and educational background of the members of each committee we consider, are the most related to the above-cited work of Jones and Olken (2005), Besley et al. (2011) or Dreher et al. (2009), that all show the importance of leaders' qualifications on their economy's performance.

Finally, we include two dummy variables, one for inflation targeting countries and the second for the crisis period. Although the latter does probably not need to be strongly justified, as the crisis period (2008 to 2010 in our sample) may have induced central bankers to change their assessment of their decisions on the balance of risks for the economy, the inflation targeting dummy is included to reflect the constraint the adoption of an inflation targeting regime imposes on the actions of a central bank, and thus on central bankers' assessments of the policy decisions to be taken in each situation (Walsh, 2011).

Understanding the sources of the differences in efficiency is another contribution of this paper. Standard regression analysis is not the correct procedure to infer the impact of environment variables on the efficiency scores. It must be noted first that the efficiency scores are bounded below by one and so a DEA estimator of the frontier is biased upward by construction as it envelops the observations. Secondly, the dependent variable is constructed using all the information on all central banks creating a correlation between the error terms when this variable is used in a regression. These two characteristics cannot be accounted for by a standard regression and inference procedure.

The bound at one is accounted for by a truncated regression procedure. The second problem is more troublesome as it creates a correlation in the error term and the estimator is biased upward. It is possible to show (Kneip et al.,1998) that the estimator is asymptotically consistent. However, standard small sample inference is no longer available because the distribution of the regression parameters is not known. Simar and Wilson (2007) advocate for bootstrap simulation to obtain small sample distribution, arguing that it is possibly the only way to achieve meaningful inference.

Knowing that the first step estimator is consistent, the focus is on the second stage regression,

when we try to infer the effect of environment variables on the effectiveness estimates. The procedure to obtain consistent inference is as follows. First, let

$$\hat{\hat{\theta}}_i \approx \varphi(z_i, \beta) + \varepsilon_i \qquad (2)$$

where $\hat{\hat{\theta}}_i$ is the biased corrected estimate of the effectiveness parameter. Correcting for the bias should improve the performance of the inference procedure in small sample.

The algorithm we have used to account for these problems and solve them is the one recommended by Simar and Wilson (2007). It is as follows:

1. Use the original data to estimate by DEA the effectiveness parameter θ_i for all DMU (the central banks at any decision time) using equation (1).
2. Use the method of maximum likelihood on the truncated model (2) to obtain estimates of β and σ^2 denoted $\widehat{\beta}$ and $\widehat{\sigma^2}$ using only the observations for which $\hat{\theta}_i$ is strictly greater than one. That is, for E sample points with $E<D$ where D is the total number of observations in the sample.
3. We use the following sub-procedure to obtain B_1=300 sets of bootstrapped efficiencies for all D DMU, $BS1_i = \left\{\hat{\theta}^*_{ib}\right\}_{b=1}^{B_1}$ for i=1,…,D.
    a. For each $i=1,...,D$ draw ε_i from the left truncated at $(1 - z_i\hat{\beta})$ normal distribution N(0, $\widehat{\sigma^2}$)
    b. For each $i=1,...,D$ compute $\theta_i^* = z_i^T\hat{\beta} + \varepsilon_i$
    c. Set $x_i^* = x_i$ and $y_i^* = y_i\left(\frac{\theta_i}{\theta_i^*}\right)$ for all $i=1,...,D$
    d. Compute $\hat{\theta}_i^*$ using the program defined in equation (1) by replacing the x and y by their bootstrapped version obtained in c.
4. For each DMU compute the biased corrected estimates of the effectiveness parameter using the original estimates and the bootstrapped version obtained in 3 above using $\hat{\hat{\theta}}_i = \theta_i - bias(\hat{\theta}_i)$ where $bias(\hat{\theta}_i) = E(\theta_i) - \theta_i$ where we approximate the expectation by the mean of the bootstrapped efficiencies.
5. Use the method of maximum likelihood to estimate the truncated regression of $\hat{\theta}_i$ on z_i to obtain the original set of estimator for inference purpose, $\widehat{\hat{\beta}}$ and $\widehat{\hat{\sigma^2}}$.
6. We use the following sub-procedure to obtain B_2=3000 sets of bootstrapped efficiencies for all D DMU, $BS2_i = \left\{\left(\widehat{\hat{\beta}}, \widehat{\hat{\sigma^2}}\right)_b\right\}_{b=1}^{B_2}$ for $i=1,...,D$.
    a. For each $i=1,...,D$ draw ε_i from the left truncated at $\left(1 - z_i\hat{\hat{\beta}}\right)$ normal distribution N(0, $\widehat{\hat{\sigma^2}}$).
    b. For each $i=1,...,D$ compute $\theta_i^{**} = z_i^T\hat{\hat{\beta}} + \varepsilon_i$

c. Use the method of maximum likelihood to estimate the truncated regression of θ_i^{**} on z_i to obtain the original set of estimator for inference purpose, $\hat{\beta}^*$ and $\hat{\sigma}^{2*}$.

7. We use the bootstrap value $BS2_i$ for $i=1,...,D$ and the original estimates $\hat{\beta}$ and $\hat{\sigma}^2$ to construct estimated confidence intervals for each element of β and σ^2.

Building upon the above description of each central bank's monetary policy committee, in order to decipher the intricacies hiding behind the efficiency parameter, we have used this procedure with the following vector of regressors: a constant, the difference in age of each central bank's monetary policy committee, the number of governors, the share of central bankers, the share of members coming from the public sector, the share of members coming from the financial sector, the share of members from the academia, the share of Bachelors, of MBA holders, the share of women, the turnover ratio, and a dummy indicating if the central bank has officially adopted an inflation targeting regime. Given the period under review, we also add a dummy variable to control for the crisis period.

Table 4 contains the obtained parameters from the regression. To analyze the results, it has to be remembered that a negative sign means a reduction in ineffectiveness, and thus a positive impact on efficiency.

From the estimates, it appears that the difference in age of central bankers reduces efficiency. This was expected, as we interpret it as signaling a higher degree of heterogeneity among members, and thus harder-to-build consensual decisions. Interestingly, however, the number of members increases efficiency, which confirms the Condorcet's jury intuition, except in crisis period: when the number of members is interacted with the dummy related to the crisis, the coefficient turns positive, which can be interpreted as signaling that the transaction costs related to decision-taking in committees are dramatically increasing in hard times. All in all, then, our results tend to show that the literature's insight that a good committee is a relatively small one (e.g., Berger et al., 2008) is truer in crisis periods.[21]

Results from the series of estimates also reveal that the share of "insiders" from the central bank, the share of academics and the share of committee members coming from the financial sector do improve efficiency. This is not so firmly established for the share of committee members from the public sector, as the coefficient is not systematically significant. If the role of academics in central banks is more and more acknowledged, to the point that being an academic is even sometimes considered as a pre-condition to an appointment to a monetary policy committee[22], our results give even more credentials to this fact. However, and interestingly, when we interact the share of committee members coming from the financial sector with the dummy for the crisis period, it turns out that the coefficient is positive (hence, a lower performance). We interpret this as indicating that central bankers coming from the financial sector may have lost their comparative advantage during the crisis, where macroeconomic management came to the fore.[23] This conclusion is reinforced by the fact that

[21] Regressions introducing the squared number of members did not reveal significant non-linear effects.
[22] For example, article 11.2 of the statutes of the ESCB request that members of the Executive Board of the ECB are "persons of recognised standing and professional experience in monetary or banking matters", which led to about half of the members on average being academics (according to our classification).
[23] Besides, this may also explain why the consensus on the need for macroprudential supervision may have been so easy to reach. See Galati and Moessner (2012) on this issue.

the same interaction with members from the academia is insignificant.[24]

Concerning education backgrounds, the results are not as clear-cut as for the professional backgrounds, as the coefficients are not systematically significant. However, they seem to indicate that MBA holders help managing a central bank towards efficiency. That MBA holders seem to have a clout on performance, which would probably not surprise business schools' alumni. [25]

The coefficient attached to the share of women is generally significant and positive, which means that women tend to weigh negatively on efficiency. This result is consistent, given the theoretical framework, with previous results from Farvaque et al. (2011), who showed that female monetary policymakers tend to be more inflation averse than their male counterparts. If true, this implies that they will push more in one direction than trade-off the two objectives we consider here.

Finally, it appears that a higher turnover is associated with a lower performance, which can be interpreted as leaving more room to less experienced policymakers or simply destabilizing the routines a group may have acquired. All in all, then, these results tend to confirm that leadership matters, in central banks too.

Interestingly - and quite logically given our approach - central banks that have adopted an inflation targeting regime are less efficient than their counterparts. This is probably due to the fact that they focus their attention more on inflation stabilization than on output stabilization, a feature that reduces their global capacity to stabilize the economy. True, no central bank ever claimed to be an "inflation nutter" and, the evidence on the subject is not clear-cut. However, our results give more weight to existing evidence claiming that inflation targeting central banks put a larger weight on inflation than on output stabilization (see, e.g., Kuttner and Posen, 2012, for the US and the UK, Otto and Voss, 2011, for Australia, or Creel and Hubert, 2011, for Sweden[26]). Hence, our results tend to add caution on the consensus that seems to build gradually towards the adoption of inflation targets.[27]

5. Conclusion

This paper builds on the literature focusing on the role of leaders to show that, in central

[24] By the way, this contradicts Jean-Claude Trichet's assertion that: "When the crisis came, the serious limitations of existing economic and financial models immediately became apparent. Arbitrage broke down in many market segments, as markets froze and market participants were gripped by panic. Macro models failed to predict the crisis and seemed incapable of explaining what was happening to the economy in a convincing manner. As a policy-maker during the crisis, I found the available models of limited help. In fact, I would go further: in the face of the crisis, we felt abandoned by conventional tools. In the absence of clear guidance from existing analytical frameworks, policy-makers had to place particular reliance on our experience. Judgment and experience inevitably played a key role." (cited in Kirman, 2012)

[25] Remember that we consider the share of members coming from academia, which strongly overlaps with Ph.D. holders.

[26] Although Creel and Hubert (2011) claim that the Swedish central bank put a lower focus on inflation after the adoption of the inflation targeting regime, their results show that the *relative* weight of inflation with regard to the output gap has been strongly reinforced. In the same way, Kuttner and Posen (2012) reveal a speed of adjustment of inflation forecast much quicker in the UK than in the US, which can be interpreted as revealing that the forecasters expect the Bank of England to be more concerned with inflation (or more quickly concerned, should she react to an output shock).

[27] Although strong voices have, since at least Friedman (2004), cautioned against the adoption of inflation targets.

banks, too, leaders matter. Using tools form production theory, our criterion is the efficiency of central bankers in managing the inflation-output volatility trade-off, relying on the DEA method to define the efficiency frontier. We show that these performance measures also allow one to derive a measure of central banks' preferences, and that even the relatively homogeneous sample of central banks under review reveal preference profiles that are different, with evolving priorities over time.

Looking at the determinants of efficiency, we also show that the educational and occupational background of leaders do influence their performance, with academics and central bankers influential in explaining their institutions' effectiveness scores. That the adoption of an inflation targeting regime may come at a cost, in terms of higher output volatility, compared to inflation volatility, is a further result of our analysis. Finally, it clearly appears that the crisis struck central bankers and derailed their performance, although some central banks have been able to recover sooner than the others, as the Bank of England exemplifies.

An avenue for further research could be to enlarge the scope of the outputs to be delivered by central banks and looking, for example, to the volatility of financial markets and asset prices. It is also possible to focus on the determinants of not only efficiency, but also preferences of monetary policy committees (i.e. the relative weight given to output vs. inflation stabilization), as revealed by the implied volatilities used to compute the scores.

Table 4. The determinants of central banks' efficiency

	Regressions							
Variables	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
CONST	-1.8340 *	-1.2594 NS	0.9522 NS	-0.7649 NS	-1.5659 *	1.0220 NS	0.9746 NS	0.6525 NS
D_AG	0.1539 **	0.2061 ***	0.2046 ***	0.1715 ***	0.2046 ***	0.2284 ***	0.1492 ***	0.2176 ***
N_GOV	-0.3128 ***	-0.4610 ***	-0.6139 ***	-0.4511 ***	-0.3710 ***	-0.5965 ***	-0.5373 ***	-0.6150 ***
S_CB	-7.6494 ***	-6.4284 ***	-3.9833 ***	-5.1314 ***	-9.9493 ***	-5.5080 ***	-5.8819 ***	-4.4843 ***
S_PUB	-5.9953 ***	-3.3852 ***	-1.2530 NS	-3.7126 ***	-5.4004 ***	-1.5832 NS	-2.6818 **	-0.9110 NS
S_FS	-7.0218 **	-13.7810 ***	-7.8272 ***	-9.2062 ***	-13.076 ***	-14.777 ***	-8.2546 **	-10.694 ***
S_ACAD	-9.8207 ***	-9.9022 ***	-11.093 ***	-11.112 ***	-9.4372 ***	-10.607 ***	-11.601 ***	-10.438 ***
S_B	-4.9317 ***	0.1508 NS	0.7156 NS	-0.1525 NS	-4.4483 **	0.2521 NS	-0.2152 NS	1.2061 NS
S_MBA	-13.8594 ***	-8.4204 **	-9.6772 ***	-9.3496 **	-1.5459 NS	-5.7493 *	-6.1635 *	-9.4693 ***
S_WOM	6.9392 ***	10.9748 ***	10.8651 ***	10.8103 ***	9.0503 ***	11.8796 ***	9.9917 ***	10.8071 ***
TURN	4.0516 **	2.8734 *	1.7894 NS	3.0581 *	3.6330 **	0.8723 NS	2.6291 NS	1.5969 NS
IT	2.2154 ***	1.1896 NS	0.0958 NS	0.6738 NS	2.1271 ***	0.7345 NS	0.6444 NS	0.4777 NS
crisis	5.7435 ***	4.7147 ***	1.4485 NS	5.5513 ***	4.6063 ***	0.1171 NS	1.0695 NS	0.2489 NS
GOcrisis			0.4654 ***			0.4813 ***	0.4957 ***	0.4840 ***
FScrisis		9.7439 **			0.8164 **	-3.0925 ***		7.6032 *
ACAcrisis				2.5705 NS	10.1694 NS	11.0986 NS	3.0775 NS	
Likelihood	-454.34	-475.36	-467.12	-474.76	-477.06	-444.57	-471.73	-465.57
R sqr	0.9267	0.9432	0.9666	0.9475	0.9340	0.9640	0.9558	0.9646

Method: Truncated ML with bootstrapped intervals, Likelihood -469.2877, Sigma regression 10.3539. Bootstrap specification: Bias correction: 300 replications, truncated regression: 3000 replications.

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APPENDIX 1

This appendix contains the confidence intervals for all eight regressions. A parameter is significantly different than zero if the confidence interval does not contain zero. In all tables, lb and ub stands for lower and upper bounds respectively.

Regression No. 1

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	*	-6.9027	-6.2178	-5.8343	-1.8340	-0.3876	0.1767	1.6917
D_AG	***	0.0548	0.0897	0.1068	0.1539	0.2985	0.3196	0.3609
N_GOV	***	-0.6598	-0.6031	-0.5737	-0.3128	-0.2466	-0.2179	-0.1503
S_CB	***	-15.070	-13.747	-13.092	-7.6494	-6.4749	-5.8597	-4.5738
S_PUB	***	-11.609	-10.553	-10.089	-5.9953	-5.1241	-4.5722	-3.5234
S_FS	**	-18.612	-16.554	-15.301	-7.0218	-2.7838	-1.5722	1.1047
S_ACAD	***	-19.677	-18.252	-17.444	-9.8207	-9.0751	-8.4211	-7.2715
S_B	***	-11.725	-10.518	-9.9146	-4.9317	-2.5076	-1.7747	-0.3825
S_MBA	***	-29.904	-27.019	-25.535	-13.8594	-9.0587	-7.4694	-4.3338
S_WOM	***	0.2019	2.2146	3.1650	6.9392	15.3554	16.5043	18.4290
TURN	**	-0.8580	0.5558	1.3296	4.0516	10.0973	11.0966	12.8223
IT	***	0.1458	0.7881	1.0835	2.2154	4.2930	4.5467	5.0483
crisis	***	5.2500	5.6839	5.9440	5.7435	8.5971	8.7995	9.2324

Regression No. 2

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	NS	-6.0300	-5.2332	-4.7453	-1.2594	0.5886	1.2861	2.5525
D_AG	***	0.1157	0.1513	0.1686	0.2061	0.3511	0.3682	0.4071
N_GOV	***	-0.8241	-0.7782	-0.7510	-0.4610	-0.4350	-0.4052	-0.3482
S_CB	***	-12.6634	-11.6572	-11.1563	-6.4284	-4.5889	-3.8957	-2.5297
S_PUB	***	-8.1269	-7.1859	-6.6030	-3.3852	-1.9018	-1.4045	-0.4569
S_FS	***	-27.7715	-25.2972	-23.8758	-13.7810	-10.5427	-9.4374	-7.0637
S_ACAD	***	-19.8440	-17.9481	-17.0424	-9.9022	-9.1514	-8.4758	-7.2239
S_B	NS	-5.0045	-3.5981	-2.9978	0.1508	3.5910	4.3212	5.9690
S_MBA	**	-21.0417	-18.5791	-17.1624	-8.4204	-1.8648	-0.4488	2.2505
S_WOM	***	5.3077	7.2197	8.3868	10.9748	19.6392	20.9450	22.7022
TURN	*	-2.1086	-0.7065	0.0311	2.8734	7.9828	8.9996	10.6782
IT	NS	-1.1356	-0.3741	-0.0997	1.1896	2.8712	3.1091	3.6255
crisis	***	3.2294	3.9380	4.2698	4.7147	7.4566	7.8035	8.3047
FScrisis	**	-1.3409	1.9269	3.3090	9.7439	19.5735	21.1251	24.9499

Regression No. 3

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	NS	-2.3776	-1.7301	-1.3385	0.9522	2.8605	3.4121	4.3389
D_AG	***	0.1436	0.1671	0.1816	0.2046	0.3291	0.3427	0.3717
N_GOV	***	-1.0334	-0.9664	-0.9360	-0.6139	-0.6320	-0.6083	-0.5653
S_CB	***	-8.6897	-7.7061	-7.2519	-3.9833	-2.1020	-1.5474	-0.3619
S_PUB	NS	-4.6256	-3.7738	-3.2895	-1.2530	0.5181	0.8854	1.8257
S_FS	***	-16.7984	-14.9512	-14.1542	-7.8272	-4.7022	-3.6972	-1.7760
S_ACAD	***	-19.6178	-18.0013	-17.1890	-11.0927	-10.7586	-10.2503	-9.2414
S_B	NS	-3.1625	-2.1488	-1.6061	0.7156	3.6756	4.2917	5.6537
S_MBA	***	-20.6478	-18.6270	-17.4894	-9.6772	-4.9044	-3.7705	-1.5018

S_WOM	***	6.2202	7.7622	8.7190	10.8651	17.9789	18.9654	20.7983
TURN	NS	-2.5894	-1.4336	-0.8356	1.7894	5.4942	6.4560	7.9729
IT	NS	-1.8362	-1.3259	-1.1262	0.0958	1.1816	1.4237	1.7778
crisis	NS	-1.0850	-0.4477	-0.1397	1.4485	2.8771	3.1502	3.5817
GOcrisis	***	0.3673	0.4213	0.4462	0.4654	0.7628	0.7967	0.8613

Regression No. 4

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	NS	-5.2790	-4.5319	-4.0535	-0.7649	1.1805	1.9892	3.1337
D_AG	***	0.0698	0.1010	0.1204	0.1715	0.3103	0.3279	0.3646
N_GOV	***	-0.8025	-0.7597	-0.7332	-0.4511	-0.4251	-0.3958	-0.3423
S_CB	***	-11.4881	-10.2465	-9.6506	-5.1314	-2.7066	-1.7979	-0.1559
S_PUB	***	-8.5762	-7.3715	-6.9788	-3.7126	-2.1434	-1.5979	-0.7642
S_FS	***	-20.7383	-18.5987	-17.7059	-9.2062	-5.0510	-3.6405	-1.5465
S_ACAD	***	-21.7755	-19.8271	-18.9557	-11.1124	-10.5904	-9.9194	-8.7119
S_B	NS	-5.1865	-3.9274	-3.2887	-0.1525	3.4090	4.2779	5.7567
S_MBA	**	-22.5530	-19.8134	-18.2684	-9.3496	-3.1463	-1.6594	0.6565
S_WOM	***	4.5036	6.5972	7.5537	10.8103	19.2752	20.5524	22.9531
TURN	*	-2.0192	-0.6257	0.1810	3.0581	8.1728	9.2666	11.0118
IT	NS	-1.5486	-0.9155	-0.6278	0.6738	2.1621	2.4354	2.9315
crisis	***	3.2590	4.2022	4.6185	5.5513	8.6009	8.9450	9.5688
ACAcrisis	NS	-8.2615	-5.5333	-3.9605	2.5705	11.6814	13.1121	18.0145

Regression No. 5

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	*	-6.7382	-6.0012	-5.5513	1.5659	-0.1158	0.4828	1.9697
D_AG	***	0.0973	0.1352	0.1543	0.2046	0.3635	0.3804	0.4227
N_GOV	***	-0.7259	-0.6735	-0.6440	-0.3710	-0.2993	-0.2686	-0.1990
S_CB	***	-18.0684	-16.9642	-16.2212	-9.9493	-8.4572	-7.8127	-6.3100
S_PUB	***	-10.7651	-9.7553	-9.3143	-5.4004	-4.0490	-3.4330	-2.3168
S_FS	***	-27.9901	-24.8887	-23.8690	-13.0761	-8.4205	-7.0082	-4.7041
S_ACAD	***	-20.2415	-18.5308	-17.5967	-9.4372	-8.3779	-7.5725	-6.2833
S_B	**	-11.2264	-9.8587	-9.1313	-4.4483	-1.3765	-0.6246	0.8955
S_MBA	NS	-13.3035	-10.6124	-8.9262	-1.5459	7.3362	8.9091	12.7351
S_WOM	***	0.9544	3.4354	4.7559	9.0503	17.7326	18.8917	21.5317
TURN	**	-1.4968	0.0383	0.5902	3.6330	9.3356	10.2641	11.9396
IT	***	0.1035	0.7099	1.0604	2.1271	4.3462	4.6408	5.2396
crisis	***	1.9784	2.8895	3.3279	4.6063	8.1365	8.5957	9.6409
ACAcrisis	NS	-12.1304	-9.0353	-7.3948	0.8164	10.3020	11.8470	15.6231
FScrisis	**	-1.1922	1.7162	3.2865	10.1694	21.2772	22.9055	26.9937

Regression No. 6

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	NS	-2.3027	-1.6181	-1.2647	1.0220	2.7056	3.2204	4.2361
D_AG	***	0.1540	0.1869	0.2027	0.2284	0.3617	0.3754	0.4150
N_GOV	***	-1.0109	-0.9543	-0.9183	-0.5965	-0.6148	-0.5931	-0.5497
S_CB	***	-10.6277	-9.5518	-9.0988	-5.5080	-3.6340	-3.0494	-1.7589
S_PUB	NS	-4.8462	-3.9739	-3.5842	-1.5832	0.1049	0.4620	1.3629
S_FS	***	-26.7084	-24.9314	-23.7563	-14.7773	-11.5820	-10.3206	-7.7412

S_ACAD	***	-19.4874	-18.1340	-17.4168	-10.6074	-10.2233	-9.6308	-8.6067
S_B	NS	-3.6695	-2.6699	-2.1746	0.2521	3.3584	4.0101	4.9952
S_MBA	*	-15.9382	-13.7930	-12.5623	-5.7493	-0.4867	0.6665	2.6836
S_WOM	***	7.3598	8.8101	9.6730	11.8796	19.6305	20.5641	22.4270
TURN	NS	-3.1944	-2.2774	-1.8765	0.8723	4.6083	5.3132	7.0178
IT	NS	-1.2104	-0.7585	-0.4907	0.7345	1.9741	2.2047	2.6163
crisis	NS	-3.0509	-2.3853	-1.9448	0.1171	1.9676	2.3451	3.2294
GOcrisis	***	0.3563	0.4184	0.4469	0.4813	0.7888	0.8299	0.8924
ACAcrisis	NS	-14.0914	-11.3818	-10.0014	-3.0925	3.8521	5.5539	8.3899
FScrisis	***	1.6771	4.2294	5.5818	11.0986	19.2075	20.3065	22.7033

Regression No. 7

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	NS	-2.6949	-1.9791	-1.6416	0.9746	2.8223	3.5875	4.6306
D_AG	***	0.0530	0.0837	0.1012	0.1492	0.2827	0.2983	0.3441
N_GOV	***	-0.9880	-0.9107	-0.8750	-0.5373	-0.5348	-0.5061	-0.4586
S_CB	***	-12.1435	-10.8859	-10.2564	-5.8819	-3.6159	-2.9409	-1.7597
S_PUB	**	-6.3458	-5.6261	-5.2104	-2.6818	-0.9231	-0.4374	0.4864
S_FS	**	-19.0373	-16.8824	-15.6755	-8.2546	-3.9039	-2.7363	0.0395
S_ACAD	***	-21.2103	-19.8828	-18.8589	-11.6007	-10.9215	-10.2934	-9.0676
S_B	NS	-4.7285	-3.5512	-3.1254	-0.2152	3.3033	3.9313	5.1479
S_MBA	*	-18.2764	-15.7443	-14.2574	-6.1635	-0.2221	1.0294	3.8969
S_WOM	***	3.4758	5.5688	6.6904	9.9917	17.9938	19.0201	21.0634
TURN	NS	-1.8072	-0.6417	-0.1324	2.6291	7.1081	7.9581	9.9206
IT	NS	-1.7719	-1.0165	-0.7104	0.6444	2.1365	2.3604	2.8247
crisis	NS	-2.3233	-1.4892	-1.1229	1.0695	3.0226	3.4138	4.1069
GOcrisis	***	0.3762	0.4384	0.4680	0.4957	0.8374	0.8867	0.9778
ACAcrisis	NS	-8.7297	-5.4301	-3.7717	3.0775	11.6530	13.0618	16.6883

Regression No. 8

	Significant	1% lb	5% lb	10% lb	Estimates	10% ub	5% ub	1% ub
CONST	NS	-2.7386	-2.0915	-1.7253	0.6525	2.5419	3.0573	3.9997
D_AG	***	0.1504	0.1804	0.1935	0.2176	0.3442	0.3565	0.3897
N_GOV	***	-1.0385	-0.9708	-0.9402	-0.6150	-0.6322	-0.6094	-0.5682
S_CB	***	-9.2012	-8.2678	-7.8531	-4.4843	-2.5369	-2.0079	-0.9211
S_PUB	NS	-4.3204	-3.3830	-2.8977	-0.9110	0.8726	1.2790	2.1134
S_FS	***	-21.1329	-19.0628	-18.1046	-10.6943	-7.0338	-5.9111	-3.4672
S_ACAD	***	-18.9127	-17.4416	-16.6580	-10.4380	-10.0612	-9.4724	-8.4315
S_B	NS	-2.6707	-1.6254	-1.0972	1.2061	4.1890	4.8434	6.0452
S_MBA	***	-20.3873	-18.3869	-17.3078	-9.4693	-4.8526	-3.6230	-1.3262
S_WOM	***	6.1603	7.8679	8.6711	10.8071	18.0478	19.0435	20.8065
TURN	NS	-2.8234	-1.6190	-1.0434	1.5969	5.3129	6.1929	7.6896
IT	NS	-1.5029	-1.0020	-0.7679	0.4777	1.6618	1.8672	2.2801
crisis	NS	-2.6852	-2.0199	-1.6139	0.2489	2.0449	2.3249	2.9272
GOcrisis	***	0.3829	0.4297	0.4610	0.4840	0.7892	0.8227	0.8893
FScrisis	*	-2.6242	-0.1537	1.4665	7.6032	14.7254	15.9036	18.7188