EconomiX

http://economix.fr

Media Coverage and ECB Policy-Making: Evidence from a New Index

Hamza Bennani

Document de Travail
Working Paper
2016-38

UMR 7235

Université de Paris Ouest Nanterre La Défense
(bâtiment G)
200, Avenue de la République
92001 NANTERRE CEDEX

Tél et Fax : 33.(0)1.40.97.59.07
Email : nasam.zaroualete@u-paris10.fr

Media Coverage and ECB Policy-Making: Evidence from a New Index*

Hamza Bennani†

November 7, 2016

Abstract

Using a novel index measuring media's uncertainty regarding the effectiveness of European Central Bank's (ECB) policy actions, this paper estimates the interest rate policy of the ECB with respect to media coverage of its monetary policy decisions. Our results suggest that the monetary institution implements a restrictive (accommodative) monetary policy, through its repo rate, in response to an increase (decrease) of the uncertainty expressed by the media concerning the effectiveness of its past policy actions, in particular since the global financial crisis. These results are robust when considering an alternative proxy of central bank's perceived effectiveness and ECB's unconventional policy measures in the estimation procedure. Our findings thus shed some light on the decision-making procedure of the ECB when the latter has to deal with the uncertain impact of its policy decisions as expressed by media coverage, and thus, address a critical issue related to the political economy of central banking.

Keywords: Monetary Policy, ECB, Public Media, Taylor Rule

JEL classification: E43, E52, E58

*Thanks to Christophe Boucher, Vincent Bouvatier, Hans Degryse, Etienne Farvaque, Bernd Hayo, Roman Horvath, Paul Hubert, David-Jan Jansen, Alexander Jung, Michael McMahon, Matthias Neuenkirch, Gert Peersmann, Peter Tillmann and Participants of the 1st CEREC Workshop on Banking and Monetary Policy (Brussels) and the 48th Money, Macro and Finance Annual Conference (Bath) for their helpful comments on earlier versions of the paper. The usual disclaimer applies.

†Corresponding author: EconomiX-CNRS, Université de Paris Ouest Nanterre-La Défense, 200 avenue de la République, 92001 Nanterre (France). Contact: h.bennani@u-paris10.fr.

I Introduction

In the aftermath of the global financial crisis (GFC), the European Central Bank (ECB) launched a set of unconventional monetary policy tools, with the aim to boost economic growth and to prevent a potential deflationary spiral. This period was also characterized by a strong monitoring from the media and a great uncertainty expressed by financial markets regarding the beneficial effects of these measures. As an illustration, trust in the ECB decreased notably in countries where sovereign bond yields rose significantly (Wälti, 2012).

This situation has been attributed to several causes. First, the GFC has pushed the ECB to purse multiple objectives: the objective of financial stability in addition to the traditional objective of macroeconomic stability. This has raised some doubts on the possibility for a single policy tool, namely, the central bank's policy rate, to meet these multiple and different targets. Second, the exit strategies from the unconventional measures might imply a balance sheet recession, and potentially expose the ECB to credit-risk (Bordo and Siklos, 2015). Finally, ECB's government bonds purchases might undermine its independence and its objective of price stability (Goldberg and Klein, 2011; Belke et al., 2014). Consequently, ECB's policy actions is carefully monitored by the media[1], which call into question the possibility for the unconventional policy measures to reach their pre-announced objectives, and thus, the ability of the central bank to attain its pre-commitments.

Research suggests that the media can affect public economic perceptions and shape its opinion about the economy (Soroka et al., 2014). Indeed, since the general public has cognitive capacity constraints and cannot digest all available information (Sims, 2003), the media is a cost-effective source to update its information sets. This argument is found to be relevant for financial agents as well, as Hayo and Neuenkirch (2015) show that they are time constrained and that they must rely on the media to assimilate the flood of information. The media is then a relevant source of information for the expectation formation process (Carroll, 2003; Blinder and Kruger, 2004), given that it affects agents' macroeconomic and inflation expectations that can feed into the actual evolution of inflation, for instance through wage claims, savings, investments and consumption decisions (Blinder et al., 2008; Lamla and Lein, 2014).

Therefore, since the media channel has an significant impact on interest rate expectations (Lamla and Sturm, 2013), on inflation expectations (Lamla and Lein, 2015), on public support for the ECB (Hayo and Neuenkirch, 2015) and on financial markets (Hendry, 2012); we expect the ECB to take into account the analyzes made by the media regarding its implemented policy measures, given that it might affect its objectives of price and macroeconomic stability. In other words, if the media express uncertainty regarding the impact of the policy measures implemented by the ECB, the latter might react through its policy-making procedure to re-establish its, otherwise damaged, reputation and credibility with respect to financial market participants and the general public. A natural hypothesis to test is then whether and how the ECB reacts when the media express a high/low uncertainty regarding the effectiveness of its policy decisions, as it seems to

[1] http://www.wsj.com/articles/ecb-purchases-see-corporate-bond-yields-plummet-1465387957.

be often the case since the start of the GFC.

Against this background, this paper proposes to assess the reaction function of the ECB - via an augmented Taylor rule - when the media express uncertainty on the effectiveness of its policy decisions. This approach is motivated by the evidence that the ECB tries to influence public and market perceptions through the conduct of policy, and notably by the moves of its policy rate (Goldberg and Klein, 2011). The ECB might then react to media coverage of its monetary policy decisions trough its policy-making procedure.

Our contribution in the literature is thus twofold: This paper is the first to compute an index measuring the uncertainty expressed by the media regarding the effectiveness of ECB's policy decisions: the media uncertainty index (MUI). Second, to analyze the response function of the ECB when the latter is confronted to a change in the MUI of its policy actions. Our main results show that the ECB reacts hawkishly (dovishly) when media's uncertainty regarding the effectiveness of its policy decisions increases (decreases). These findings contribute then to the literature related to the political economy of central banking, and in particular, to the ECB's decision-making process.

The remainder of this paper is structured as follows: section 2 derives the MUI, section 3 describes the data and the methodology used in the paper, section 4 presents the results, section 5 adds some additional evidences while the last section concludes.

II The Media Uncertainty Index

Following each monetary decision adopted by the ECB on Thursday at 2.30 pm, numerous newspapers articles analyze the policy decision the same day and the day after (Berger et al., 2011). Empirical evidences suggest that financial market participants and the general public rely on those media reports, rather than on self-monitoring[2], to digest information about ECB's policy decisions (Lamla and Sturm, 2013; Hayo and Neuenkirch, 2015). Furthermore, given that the main channel by which media reports affect both financial markets and public's expectations is through the tone of economic reporting (Doms and Morin, 2004), we might assess media's uncertainty regarding the effectiveness of ECB's policy decisions by extracting the tone of those articles.

In a first step, we collect *all* newspapers articles analyzing each policy decision taken by the ECB for the period 1999-2015, and appearing on Thursday and Friday following its implementation, using Factiva database. We obtain in total 21386 articles, mainly published by Dow Jones Newswire Services, Reuters, Market News International, the Financial Times, the Wall Street Journal, and many other national and regional newspapers[3]. This procedure allows then to consider the newspapers that are aimed to financial market participants as well as to the general public. However, it is important to remind that media coverage about ECB's policy decisions

[2]By attending press conferences, reading the press releases or looking at the data.

[3]It is worth noting that all newspapers considered in this analysis are written in English.

might be biased. The literature has identified a supply-side media bias, i.e., when media coverage is influenced by journalistic preferences (Groseclose and Milyo, 2005) and a demand-side media bias, i.e., when media coverage is influenced by audience preferences (Mullainathan and Shleifer, 2005; Gentzkow and Shapiro, 2010). As an illustration, several studies have analyzed the ECB's monetary policy coverage in the press. Amtenbrink and de Haan (2003) find that while the Financial Times tends to be more focused on the inflation targeting pillar of ECB decision-making, the Frankfurter Allgemeine Zeitung follows money and credit growth more. Berger et al. (2011) find that the media has a monitoring role by evaluating the performance of the ECB: if a policy decision surprises financial market analysts, the tone of the reports is generally negative. Berger et al. (2013) show that extreme views about the ECB receive more coverage, and that negative views are reported more extensively. Finally, Neuenkirch (2014) finds that Reuters is selective in its coverage of central bank communication. Against this background, we consider *all* newspapers articles covering ECB's monetary policy decisions in order to reduce the supply-side and the demand-side media biases. Indeed, analyzing all articles allows to provide a global and, potentially, more objective picture of how the policy decision is perceived by the press.

In a second step, to compute the media uncertainty index (MUI), we extract the tone emerging from the collected newspaper articles using a computational linguistic approach. For that purpose, we use the financial dictionary developed by Loughran and Mcdonald (2011) (LM) to identify words that are related to the *uncertainty* tone in financial and economic contexts[4].

The use of a dictionary to measure tone has many advantages. First, researcher subjectivity is avoided. Second, since we use a computer program to determine the frequency of single words, the method scales to large samples. Third, as the LM dictionary is publicly available[5], it is easy to replicate this analysis. Many papers have used this approach, i.e., the use of a dictionary to count specific words, to measure the qualitative content of news stories. These quantitative measures have been called "media content" (Tetlock, 2007), "media slant" (Gentzkow and Shapiro, 2010), and "media bias" (Dyck et al., 2008).

The LM dictionary is also designed to fit financial and economic documents, and has proven to be relevant in other contexts, such as central banks' communication (Schmelling and Wagner, 2015). Thus, and as noted by Kearney and Liu (2014): "the LM lists have become predominant in more recent studies" (p. 175). As an illustration, Garcia (2013) uses the LM word lists to measure the tone of two financial columns in the New York Times during 1905-2005. He finds that newspaper sentiment plays a role in predicting future stocks returns. Solomon et al. (2014) find that fund-specific newspaper articles with more positive tone (using LM word lists) result in higher quarterly investor capital inflows for those funds.

Therefore, to measure the MUI, we determine the frequency of words related to the *uncertainty* tone appearing in the articles published at every time t[6] when a monetary decision is made by

[4]The LM dictionary lists 260 words to describe the *uncertainty* tone. Words such as "ambiguous, arbitrary, cautious, conditional, instability, confusing, turbulence, alteration, approximation..." are used to describe uncertainty in economic context.

[5]http://www3.nd.edu/ mcdonald/Word_Lists.html.

[6]Time t refers to Thursday and Friday following the monetary policy decision.

the ECB, U_t, and we compute the ratio of U_t to the total number of words used in the articles, T_t. We consider this ratio, $\frac{U_t}{T_t}$, as a proxy to measure media's uncertainty regarding the effectiveness of ECB's policy decision implemented at time t. This uncertainty might be due to several causes: (i) the effectiveness *per se* of the policy action implemented by the central bank, (ii) the economic/financial context in which the policy decision is made, (iii) the reasons underlying this decision or (iv) the future course of monetary policy induced by this policy decision. Finally, we multiply this ratio by 1000 in order to ease its numerical interpretation and obtain:

$$MUI_t = \frac{U_t}{T_t}.1000 \tag{1}$$

where MUI_t is the uncertainty emerging from media analysis of ECB's policy decision at time t, as expressed by the analyzes published in the newspapers articles, and processed by the financial market participants and the general public. The higher (lower) its value, the higher (lower) the level of uncertainty assigned by the press to the policy decision implemented by the central bank.

Figure 1 below details the level of the MUI of ECB's policy decisions, computed for the period 1999-2015.

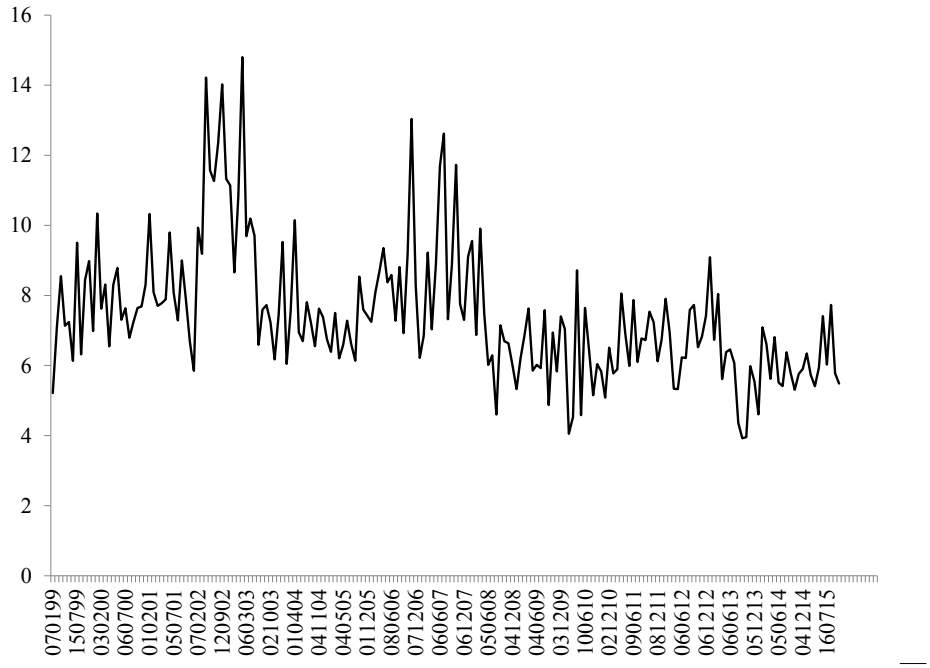

Figure 1: ECB's MUI

Source: Author's calculation

Figure 1 shows that the level of the MUI of ECB's policy actions has remained fairly stable throughout the entire period, although with a lower value from 2008 onwards.

On one hand, the maximum value of the MUI (14.8) is reached during the decision taken on February 5, 2003. Newspapers articles show effectively that there was a high uncertainty regarding the policy action implemented at that time, as illustrated by the representative example: "*ECB President Wim Duisenberg said as much after the bank's policy board left interest rates frozen at 2.75%. Economists, though, fear they might end up waiting too long[...]While waiting for a clearer picture of how war might unfold in Iraq 'makes a lot sense, the question is how long do you want to wait. If the uncertainty persists, do you want to keep waiting?'[...]HSBC economist Robert Prior agreed that there's a limit on the amount of time the ECB can afford to wait out uncertainties[...]*"[7].

On the other hand, the minimum value (3.9) is achieved during the policy decision taken on September 5, 2013. Newspapers articles show that the policy decision taken at that time benefited from a high level of perceived effectiveness by the press: "*[...]For some, that is because the ECB's guidance is too vague. But President Mario Draghi Thursday said the ECB was sticking with its current guidance formulation. It is right to do so.[...]The ECB is quite right not to tie itself to an economic indicator in setting out its guidance.[...]Indeed, the value of the ECB's guidance lies in its vagueness. By not setting a defined time horizon, it doesn't give the market a target to shoot at. And by continuing to focus exclusively on its mandate of keeping inflation below, but close to 2%, the ECB isn't sending any mixed messages[...]*"[8].

The evolution of the MUI depicted in figure 1 seems intuitive as the first years of the EMU were considered as a learning period for the monetary institution, the press was then critical towards the policy actions taken by the ECB. Following this line of thought, Amtenbrink et al. (2004) show that the ECB did not rank highly in terms of credibility, and thus, of perceived effectiveness, in the first years of the EMU, and suggest that this may be caused by the quality of the information provided by the monetary institution and its lack of transparency with respect to other central banks, such as the Fed or the Bank of England. The lower value of the MUI from 2008 might be surprising given the very volatile macroeconomic environment prevailing at that time. Nevertheless, it is important to remind that it is the *perceived* effectiveness, as expressed by the uncertainty emerging from media's coverage of ECB's policy actions, that is depicted above and not the *actual* effectiveness. There might be a discrepancy between the two types of effectivenesses, especially that the early days of the crisis were a period when the transmission mechanism was apparently broken. Thus, we are not asserting from the evolution of the MUI in figure 1 that the policy actions implemented by the ECB were truly effective in achieving the central bank's objectives, but that the media was considering their impact to be less uncertain. Following this line of thought, Gerlach-Kristen and Moessner (2014) show that it is indeed the case, as ECB's policy actions remained effective despite the large increases in the balance sheet

[7] Lee, C (2003, February 6)."ECB Watch: On A Sea Of Uncertainty". Dow Jones Newswires.

[8] Barley R. (September 5, 2013)."DJ Heard On The Street: Vague Has Value for ECB Guidance". Dow Jones Newswires.

and the introduction of an explicit forward guidance at the zero lower bound. This continuous effectiveness is also evidenced by many empirical studies which find that in the euro area, long-run inflation expectations remained stable within the central bank's comfort zone throughout the GFC, and that the ECB's expansionary balance sheets had a positive impact on economic activity and provided temporary support as the crisis unfolded (Boeckx et al., 2016; Szczerbowicz, 2015; Strohsal and Winkelmann, 2015; Hördahl and Tristani, 2014; Autrup and Grothe, 2014; Gambacorta et al., 2014; Beechey et al., 2011). Finally, the change of the perception of ECB's policy actions as revealed by the evolution of the MUI is confirmed by Goldberg and Klein (2011), who find that the public perception of the anti-inflation stance of the ECB evolved positively through time. Based on these observations, the MUI computed in this paper seems to be relevant to describe the evolution of the perception of the press concerning the effectiveness of the policy measures implemented by the ECB. This allows us to pursue our investigation, and notably, to assess the response function of the ECB through its main policy tool, the repo rate, with respect to the evolution of the MUI.

III The Methodology and the Data

III.1 The Augmented Taylor Rule

Our econometric methodology follows the standard policy rule established by Taylor (1993)[9], and adapted to the ECB's policy formulation (Sauer and Sturm, 2007):

$$i_t^* = r^* + \beta\pi_t + \gamma y_t \tag{2}$$

where i_t^* is the central bank's policy rate, r^* is the neutral real interest rate, π_t the inflation rate, y_t the output growth. β and γ represent respectively the estimated weights on inflation and output growth. Given the difficulty to measure the output gap in real time, the ECB does not focus on it to take its policy decisions (Gerlach, 2007). We choose then to estimate a Taylor rule using output growth[10]. Walsh (2004) and Gerberding et al. (2005) suggest that such a rule performs well in the presence of imperfect information.

However, central banks tend to rely in practice on all information concerning the expected evolution of prices when defining the interest rate. Following this line of thought, Clarida et al. (1998) suggest the use of a forward-looking version of the Taylor rule where central banks target expected inflation and output instead of past or current values of these variables. The model is re-defined as follows:

$$i_t^* = r^* + \beta E_t[\pi_{t+12} - \pi^*|\Omega_t] + \gamma E_t[y_{t+12}|\Omega_t] \tag{3}$$

[9]The original Taylor rule was designed to describe the US Federal Reserve's choice of short-term interest rates from 1987 to 1992.

[10]Estimation results remain similar even when considering a measure of the output gap. Alternative results available upon request.

where $E_t[\pi_{t+12}]$ is the expected one-year ahead inflation rate, π^* the ECB's long run inflation objective (2%), $E_t[\pi_{t+12} - \pi^*|\Omega_t]$ represents then the inflation gap. $E_t[y_{t+12}|\Omega_t]$ is the expected one-year ahead output growth and Ω_t is a vector including all the available information for the central bank at time t.

Moreover, central banks tend to move policy rates in small steps since the 90's. Castro (2011) suggests several explanations to justify the inclusion of interest rate smoothing in the Taylor rule, such as the fear of disruptions in the financial markets, the existence of transaction frictions and the existence of a zero nominal interest rate lower bound. The interest rate smoothing behavior can be captured as follows: $i_t = (1-\rho)i_t^* + \rho i_{t-1}$, where ρ is the smoothing parameter, i_t^* the target interest rate and i_t the actual interest rate. This transformation gives the following equation:

$$i_t = \rho i_{t-1} + (1-\rho)[r^* + \beta E_t[\pi_{t+12} - \pi^*|\Omega_t] + \gamma E_t[y_{t+12}|\Omega_t]] + \varepsilon_t \tag{4}$$

where ε_t is is an i.i.d. error term.

Eq. (4) is the baseline Taylor rule framework for the ECB. However, and as suggested in the introduction, the ECB tries to influence market perceptions through its interest rate setting procedure (Goldberg and Klein, 2011). It might then adjust the path of its repo rate following media comments of its past policy decision, MUI_{t-1}. Furthermore, this adjustment may also be motivated by the fact that that news stories of central bank's policy actions have an impact on financial markets (Hendry, 2012). Therefore, we also introduce a control variable corresponding to asset prices developments, z_{t-1}, and rewrite eq. (4) as follows:

$$i_t = \rho i_{t-1} + (1-\rho)[r^* + \beta E_t[\pi_{t+12} - \pi^*|\Omega_t] + \gamma E_t[y_{t+12}|\Omega_t] + \theta MUI_{t-1} + \delta z_{t-1}] + \varepsilon_t \tag{5}$$

where MUI_{t-1} is the variable measuring media's uncertainty regarding the effectiveness of ECB's policy action at time $t-1$ and z_{t-1} the lagged value of stock price developments. The augmented Taylor rule suggests then that the ECB considers news stories when adjusting the direction of its policy rate, i_t, if only to prevent troubles in financial markets.

Eq. (5) is estimated using real-time data available for central bankers at the moment the decision is made. The sampling period is 1999M1-2014M08. We choose to limit the sample until August 2014 given that the ECB reaches its Zero Lower Bound on the interest rate the month after. Following Orphanides (2001) who defends the use of OLS estimates for real-time data, we use an Heteroskedasticity Consistent Estimator (HCE) to control for potential heteroskedasticity in the estimation procedure.

III.2 The Data

The data used in this paper are at a monthly frequency, since this corresponds to the frequency with which the ECB's Governing Council met to set interest rates until January 2015[11]. Forecasts

[11] Before 2015, the GC voted once a month on the future course of monetary policy. From that date, the GC votes on the future course of monetary policy in the euro area every six to eight weeks.

for the inflation rate and the output growth are obtained from Consensus Economics (CE). Real-time expected inflation and output forecasts are used as a proxy for the ECB's expectations of inflation and output growth. The Consensus data are unique, not revised and then, not subject to the critique of Orphanides (2001). For month m of a given year t, the expectation is defined as $\frac{13-m}{12}$ times the forecast for year t plus $\frac{m-1}{12}$ times the forecast for year $t+1$. Using the ECB's definition of price stability :"HICP inflation below, but close to, 2% over the medium to long term", we subtract 2% from the inflation expectation to obtain the expected inflation gap. We include the Eurostoxx 50 index as a benchmark for asset prices developments as in Hoffmann (2013). The source of this variable is Macrobond. The central bank's policy rate is the ECB's repo rate.

Augmented Dickey and Fuller (1979) test rejects the null hypothesis of a unit root in all cases but do not reject the presence of a unit root for the interest rate. As suggested by Gorter et al. (2008), this could be explained by the low power of ADF tests in short samples. Therefore, we also employ KPSS tests. According to KPSS tests, the null hypothesis of stationarity is not rejected for all variables including the interest rate[12]. We also check for multicollinearity using the Variance Inflation Factor (VIF), and find no correlation between the independent variables considered in the estimation. Figures 2-3 show the evolution of the CE forecasts considered in the estimation with respect to the ex-post data:

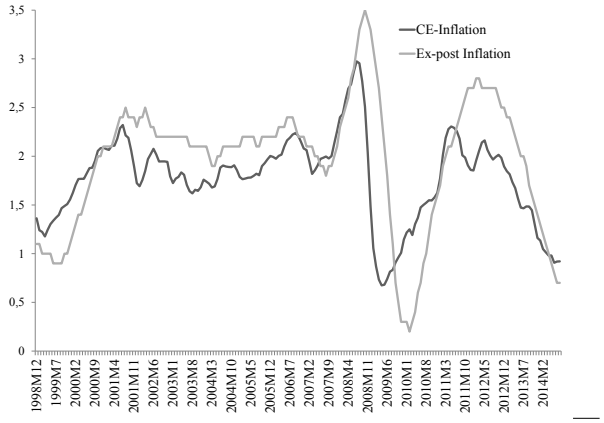

Figure 2: Ex-post inflation and CE inflation expectations

[12]To conserve space, tests results available upon requests.

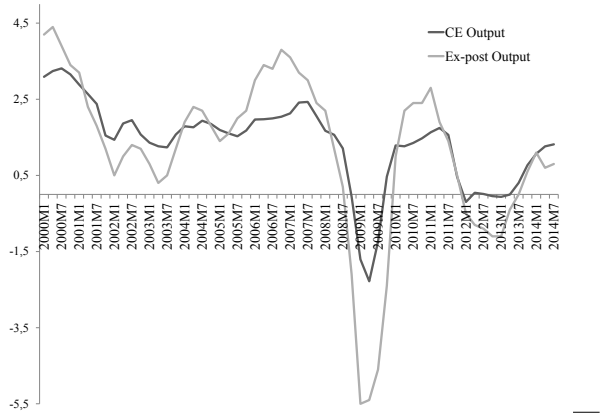

Figure 3: Ex-post output and CE output expectations

Figure 2 and 3 show that the evolution of the inflation and output expectations is very similar to the one of the ex-post data throughout the period, thus showing the reliability of the expectations made by CE, and the relevance of using these data to reveal the ECB's decision-making process.

IV Empirical Results

We consider three samples in the estimation procedure, as the GFC may have induced a shift in the ECB's monetary policy rule. A sample for the entire period 1999-2014, a sample for the first subperiod 1999-2007 and a sample for the second subperiod 2008-2014. This procedure allows to capture any change in the ECB's interest rate setting procedure after the GFC, in particular, its reaction regarding the effectiveness of its policy actions as perceived by the general public and the financial markets. Table 2 shows the results of the estimations:

Table 1: Estimation results

	Full period (1999-2014)		First subperiod (1999-2007)		Second subperiod (2008-2014)	
	Standard Taylor rule	Augmented Taylor rule	Standard Taylor rule	Augmented Taylor rule	Standard Taylor rule	Augmented Taylor rule
α	0.07	-3.27***	-0.69	-2.37***	0.81**	-3.9**
	(0.34)	(0.71)	(0.42)	(0.52)	(0.39)	(1.17)
ρ	0.91***	0.89***	0.86***	0.88***	0.89***	0.93***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.04)	(0.01)
β	1.57***	1.20***	1.28**	0.49	1.16***	1.55***
	(0.39)	(0.24)	(0.51)	(0.54)	(0.38)	(0.52)
γ	1.47***	0.65***	1.78***	1.09***	0.38**	0.51**
	(0.2)	(0.11)	(0.32)	(0.3)	(0.15)	(0.25)
θ	-	**0.20*** **	-	**0.12*** **	-	**0.32** **
		(0.05)		(0.03)		(0.12)
δ	-	0.02***	-	0.01***	-	0.02
		(0.006)		(0.003)		(0.01)
Observations	182	182	102	102	80	80
D-W test	1.53	1.87	2	2.3	1.2	1.4
S.E. of regression	2.9	2.66	2.9	2.7	5.2	2.1
Adj. R^2	0.99	0.99	0.99	0.99	0.96	0.99

Heteroscedasticity-consistent (White correction) standard errors in parentheses. A significance level of 1%, 5%, and 10% is indicated by ***, **, and *, respectively.

Table 2 shows the results for the full period (1999-2014), the first subperiod (1999-2007) and the second one (2008-2014). The value of the Durbin-Watson test statistics show that there is no autocorrelation in the residuals, and the high value of the Adj.R^2 reveals the relevance of our estimation procedure. Moving to the estimations results, the value and the sign of the coefficients ρ, β, γ and δ seem relevant at a first sight. First, the value of the smoothing coefficient ρ is always very high ($0.86 < \rho < 0.93$) and significant at the 1% level in all periods. This reveals the smoothing behavior of the ECB when moving its policy rate through time, probably to avoid abrupt financial market reactions. Second, the coefficient linked to the inflation gap, β, is positive and significant at the 1% level most of the time. The value of β, which is higher than 1, means that the Taylor principle is respected and that ECB's monetary policy can be described as stabilizing. Third, the coefficient related to the output growth, γ, is positive and significant at the 1% level for most of the samples considered in the analysis. This shows that the ECB increases its repo rate when confronted to a positive variation of the output growth. Moreover, it is worth noting that the value of the coefficient γ is higher and more significant during the first subperiod (1999-2007) than the second one (2008-2014), while we do not observe a large difference in the attitude of the central bank towards the variation of the inflation gap. This reveals that the ECB slightly relaxed its monetary policy rule in the aftermath of the GFC, probably to allow a quick and better recovery of the output growth. Finally, the positive and significant value of the coefficient δ related to the variation of asset prices is in line with the empirical literature (Botzen and Marey, 2010), i.e., a positive variation of stock prices induces a slight increase in the ECB's policy rate.

The results of the augmented Taylor rule, which notably includes the lag of the MUI, MUI_{t-1}, show that the value of the coefficient linked to the lag of the MUI, θ, is positive, significant at the 1% level and with a relatively high value for the full and the second subperiods. This result suggests that the ECB responds to a high (low) level of the MUI regarding the effectiveness of its past policy decision by increasing (decreasing) its interest rate and by being more hawkish (dovish) through its policy-making procedure. If we consider that an increase of the MUI of ECB's policy actions might threaten its credibility with respect to financial market participants and the general public[13], this result is then in accordance with the one of Neuenkirch and Tillmann (2014), who show that central banks set higher interest rates in order to (re-)establish credibility, and Stephanos et al. (2014), who find that a higher level of credibility is associated with a lower interest rate. Moreover, this result also confirms the finding of Goldberg and Klein (2011), who suggest that the ECB uses its repo rate to influence market perceptions about its monetary policy.

Next, concerning the estimation of the first subperiod (1999-2007), even though the results show that the ECB did consider the perceived effectiveness of its past policy decisions through its decision-making process, the value of the coefficient θ is lower during that period than during the second subperiod. This might be explained by the fact that the ECB needed to establish

[13]Considering that a central bank is seen as credible if people believe that it will achieve its objectives (Blinder, 1999).

a reputation during the first years of the EMU, and thus, had to stick to a fixed policy rule and not to take into account the perception of its interest rate setting procedure by the general public and the financial markets. In other words, during the first years of the EMU, the ECB adopted a smoothing behavior when moving its repo rate, increased (decreased) its policy rate when confronted to an increase (decrease) of the expected inflation gap, the expected output growth and the asset prices, but slightly reacted to the perceived effectiveness of its past policy decisions.

Finally, the estimation results of the second subperiod (2008-2014) show that the ECB strongly reacted to the public perceptions of its policy actions in the aftermath of the financial crisis, as revealed by the positive and significant value of the coefficient θ. Hence, given that the media started monitoring the effectiveness of the measures introduced by the ECB, the monetary institution considered those criticisms in its decision-making process. Hence, an increase (decrease) of the MUI prompts the central bank to adopt a more hawkish (dovish) behavior by increasing (decreasing) its repo rate.

Therefore, the results show that the ECB pays a particular attention to the financial market and the general public perceptions of its policy decisions, as expressed by the newspapers articles, although more intensively since the GFC, and reacts to a variation in the MUI of its past decisions by moving its policy rate: a higher level of media's uncertainty regarding the effectiveness of ECB's policy decisions pushes the central bank to increase its interest rate, and a lower level of media's uncertainty is associated with a decrease of the interest rate.

V Additional Extensions

V.1 An Alternative Proxy for Measuring ECB's Perceived Effectiveness

Following the framework developed by Neuenkirch and Tillmann (2014), we consider that ECB's perceived effectiveness might also be measured by past deviations of inflation from the central bank's announced objective (2%)[14], and that the perceived effectiveness of the central bank deteriorates if it misses the announced rate. Therefore, we might expect the ECB to respond through its monetary policy to past deviations of inflation from its objective. We reformulate eq. (5) as follows:

$$i_t = \rho i_{t-1} + (1-\rho)[r^* + \beta E_t[\pi_{t+12} - \pi^* | \Omega_t] + \gamma E_t[y_{t+12} | \Omega_t] + \theta MUI_{t-1} + \eta(\overline{\pi}_{t-k} - \pi^*) + \delta z_{t-1}] + \varepsilon_t \tag{6}$$

where $(\overline{\pi}_{t-k} - \pi^*)$ is the alternative proxy measuring the perceived effectiveness of ECB's policy actions, and which reflects the average of past deviations of inflation from the ECB's inflation objective. For the inflation measure, we use the annual rate of change of the Harmonized Con-

[14] Neuenkirch and Tillmann (2014) call this measure the credibility loss term.

sumer Price Index (HICP) published by the ECB. Due to data constraints, i.e., the ECB started publishing data about the euro area HICP from 1997, we choose a lag length of 24 months ($k = 24$) to measure the average of past deviations of inflation from the inflation objective. In eq. (6), we expect the coefficient η to be positive and significant, which would indicate that this proxy feeds back positively into the current repo rate: an increase of past deviations of inflation from the objective pushes the central bank to increase its interest rate.

We choose to estimate eq. (6) for the full period only (1999-2014). For the first and the second subperiods (1999-2007, 2008-2014) , the variance inflation factor (VIF) reveals that there is a high level of multicollinearity between the independent variables[15] (VIF>5). As this multicollinearity can adversely affect the results of the regression analysis, we prefer to skip the estimation for both subperiods.

Table 3 belows details the results obtained.

Table 2: Estimation results

	Full period (1999-2014)	
	Standard Taylor Rule	Augmented Taylor Rule
α	0.07	-2.72***
	(0.34)	(0.64)
ρ	0.91***	0.88***
	(0.01)	(0.01)
β	1.57***	1.09***
	(0.39)	(0.21)
γ	1.47***	0.85***
	(0.20)	(0.17)
θ	-	**0.16*** **
		(0.05)
η	-	**0.41***
		(0.23)
δ	-	0.02***
		(0.005)
Observations	182	182
D-W test	1.53	1.71
S.E. of regression	2.9	2.72
Adj. R^2	0.99	0.99

Heteroscedasticity-consistent (White correction) standard errors in parentheses. A significance level of 1%, 5%, and 10% is indicated by ***, **, and *, respectively.

[15] Test results available upon request.

Estimation results show that for the standard Taylor rule (column 1), the results obtained are obviously similar to those obtained in table 2, then, we do not need to comment further those findings. Concerning the augmented Taylor rule estimation (column 2), the coefficient linked to the alternative proxy measuring the perceived effectiveness of ECB's policy actions, η, feeds significantly and positively into the ECB's repo rate moves for the full period. Therefore, an increase of this proxy, defined as a positive past deviation of inflation from the ECB's inflation objective, is associated with an increase of the interest rate. This result is in accordance with the one of Neuenkirch and Tillmann (2014), who find similar results for a sample of five inflation targeting central banks (Australia, Canada, New Zealand, Sweden, and the United Kingdom). The rest of the parameters have the correct sign and are significant: (i) the smoothing parameter has a high value ($\rho = 0.88$), (ii) the ECB responds positively through its repo rate to a positive variation of the inflation gap ($\beta = 1.09$), the output gap ($\gamma = 0.85$) and the asset prices ($\delta = 0.02$), thus showing that they belong as an argument in the ECB's interest rate rule. Furthermore, Table 2 shows that the coefficient linked to the lag of the MUI, θ, is significant and positive. This result is in line with the main findings of the previous section, i.e., that the ECB reacts via its monetary policy to the perceived effectiveness of its past policy decisions, as expressed by the media coverage of its policy actions, i.e., a higher (lower) level of media uncertainty regarding the effectiveness of ECB's policy actions is associated with a more hawkish (dovish) monetary policy.

V.2 ECB's Unconventional Monetary Policy

Following the GFC, the use of interest rate policies has been accompanied by balance sheet policies, like e.g., an expansion of the list of assets eligible as collateral, longer-term liquidity provisions in the euro and other currencies and outright purchases of specific securities. The objective of these non-standard measures is to complement standard monetary measures and to avoid perverse effects in financial markets from an excessively deleveraging process (Bini-Smaghi, 2013). Even if during the first phase of the GFC (2008-2010), ECB measures were targeted at "enhanced credit support" (ECB, 2010), these measures were seen as "temporary in nature" (ECB, 2011). Therefore, although the sovereign crisis was worsening at that time, the ECB was reluctant to act as a lender of last resort for sovereigns. However, from mid-2011, there was a aggravation of the financial and sovereign crises (diabolic loop), which finally forced the ECB to became a lender of last resort for the banking system in the euro area. The ECB decided an extension of the maturities of LTROs which translated in an unlimited funding to the banking system, and took the form of different asset purchase programmes (SMP[16], CBPP2[17], OMT[18], VLTROs[19]).

Based on these observations, we introduce the unconventional policy measures that the ECB

[16]Securities Market Programme.
[17]Covered Bond Purchase Programme 2.
[18]Outright Monetary Transactions.
[19]Very Long-Term Refinancing Operations.

implemented in the estimation procedure. For that purpose, we replace the ECB's repo rate in the Taylor rule by the shadow rate developed by Wu and Xia (2016). The shadow rate is quantified using a Gaussian affine term structure model, and allows to study unconventional monetary policy's impact on the real economy. Their findings support the view expressed by Bullard (2012) and Krippner (2012), who advocated the potential of the shadow rate to describe the monetary policy stance when the interest rate reach its ZLB.
In the new estimation, we use then the shadow rate as a dependent variable instead of the ECB's repo rate. We run the regression for the subperiod 2011M05-2014M08 given that the ECB started acting as a lender of last resort from that period onwards:

$$i_{sh,t} = \rho i_{sh,t-1} + (1-\rho)[r^* + \beta E_t[\pi_{t+12} - \pi^* | \Omega_t] + \gamma E_t[y_{t+12} | \Omega_t] + \theta MIU_{t-1} + \delta z_{t-1}] + \varepsilon_t \quad (7)$$

where $i_{sh,t}$ is the ECB's shadow rate as measured by Wu and Xia (2016) and $\rho i_{sh,t-1}$ its lagged value. Right hand variables are similar to those in eq. (5). Table 3 below shows the results of the estimation.

Table 3: Estimation results

	Unconventional Policy Period (2011M05-2014M08)
α	-4.85***
	(1.5)
ρ	0.54***
	(0.12)
β	0.67**
	(0.29)
γ	0.61*
	(0.33)
θ	**0.11****
	(0.05)
δ	0.03**
	(0.01)
Observations	40
D-W test	1.61
S.E. of regression	2.7
Adj. R^2	0.89

Heteroscedasticity-consistent (White correction) standard errors in parentheses. A significance level of 1%, 5%, and 10% is indicated by ***, **, and *, respectively.

First of all, the negative value of the natural rate (α) is high and significant. This negative

value reveals the ultra-accommodative stance of ECB's unconventional monetary policy following the worsening of the financial crisis. Moreover, the relatively low value of the smoothing parameter ($\rho = 0.54$) shows that the ECB was not reluctant in implementing its non-standard policy measures in an abrupt way, so as to improve financial markets' sentiments about euro area growth and inflation prospects.

The parameters related to the inflation gap (β) and the output growth (γ) have the correct sign and value, thus showing that the ECB respected its mandate of price and macroeconomic stability through its unconventional policy measures. Nevertheless, the Taylor principle is not respected, i.e. $\beta<1$, meaning that the monetary institution relaxed its policy reaction when facing a positive variation of the inflation gap. Indeed, the ECB might consider fighting inflation to be less important during a crisis period.

Concerning our variable of interest, θ, its positive value and high significance unveils ECB's reactivity when the media express criticisms of its implemented non-standard policy measures. In other words, when the media express a high (low) degree of uncertainty regarding the policy actions taken by the ECB, the monetary institution is less (more) prompt in implementing additional unconventional policy measures, which takes the form of a smaller (higher) negative value of the shadow rate. Finally, asset prices are also taken into account through ECB's non standard policy measures, i.e., an increase in stock prices pushes the ECB to reduce its non-standard policy measures (via a smaller negative value of the shadow rate), and vice-versa.

All in all, the findings of the robustness tests confirms that the ECB reacts to media's criticisms through its policy making procedure, and that it behaves hawkishly (dovishly) when the media express high (low) uncertainty regarding the effectiveness of its past policy decisions, or when there is past deviations of inflation from its inflation objective.

Conclusion

The outbreak of the GFC has pushed central banks to use new policy tools, referred as unconventional monetary policy measures. This period was also characterized by a particular monitoring of the press and the financial markets regarding the effectiveness of these policy measures. Using a novel methodology to measure the perceived effectiveness of ECB's policy actions from media's coverage of monetary policy decisions, this paper estimates the reaction function of the ECB when the perceived effectiveness of its past policy decision change through time. The main results reveal that the ECB reacts with a hawkish (dovish) monetary policy when media uncertainty regarding the effectiveness of its past policy action increases (decreases). These findings are robust when considering an alternative proxy of ECB's perceived effectivess and the unconventional policy measures in the estimation procedure. Hence, those results shows that public criticisms on the effectiveness of ECB's policy measures have an impact on the central bank's decision-making process, in particular since the GFC.

Bibliography

Amtenbrink, F., De Haan, J., (2003). "A non-transparent European Central Bank? Who is to blame?". Mimeo, University of Groningen.

Amtenbrink, F., De Haan, J., Waller, S., (2004). "The transparency and credibility of the European Central Bank". Journal of Common Market Studies, vol. 42(4), 775-794.

Autrup, S.L., Grothe, M. (2014). "Economic surprises and inflation expectations: has anchoring of expectations survived the crisis?" European Central Bank Working Paper Series, 1671.

Boeckx, J., Maarten, D., Peersmann, G., (2016). "Effectiveness and transmission of the ECB's balance sheet policies". International Journal of Central Banking (forthcoming).

Beechey, M. J., Johannsen, B. K., Levin, A. T. (2011). "Are long-run inflation expectations anchored more firmly in the Euro area than in the United States?" American Economic Journal: Macroeconomics, 104-129.

Belke, A., Freytag, A., Keil, J., Schneider, F., (2014). "The credibility of monetary policy announcements: Empirical evidence for OECD countries since the 1960s". International Review of Economics & Finance, vol. 33, 217-227.

Berger, H., Ehrmann, M., Fratzscher, M., (2011). "Monetary policy in the media". Journal of Money, Credit and Banking, vol. 43(4), 689-709.

Berger, H., Ehrmann, M., Fratzscher, M., (2013). "Extreme Views Make News", in: Sturm, J.E. and Siklos, P.L. (eds.), Central Bank Communication, Decision Making and Governance, Cambridge: MIT Press, 113120.

Blinder, A. S., (1999). "Central bank credibility: why do we care? How do we build it?" NBER Working Paper No. 7161.

Blinder, A. S., Krueger, A. B., (2004). "What does the public know about economic policy, and how does it know it?" NBER Working Paper No. 10787.

Blinder, A. S., Ehrmann, M., Fratzscher, M., De Haan, J., Jansen, D-J, (2008). "Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence". Journal of Economic Literature, vol. 46(4), 910-945.

Bordo, M. D., Siklos, P. L., (2015). "Central bank Credibility Before and After the Crisis". NBER Working Paper No. 21710.

Butler, A. W., Gurün, U. G., (2012). "Don't believe the hype: Local media slant, local advertising, and firm value". The Journal of Finance, vol. 67(2), 561-598.

Carroll, C. D., (2003). "Macroeconomic expectations of households and professional forecasters". the Quarterly Journal of economics, 269-298.

Castro, V., (2011). "Can central banks' monetary policy be described by a linear (augmented) Taylor rule or by a nonlinear rule?" Journal of Financial Stability, vol. 7(4), 228-246.

Clarida, R., Galí, J., Gertler, M., (1998). "Monetary policy rules in practice: some international evidence". European Economic Review, vol. 42(6), 1033-1067.

Dickey, D.A., Fuller, W.A. (1979). "Distribution of the Estimates for Autoregressive Time Series with a Unit Root". Journal of the American Statistical Association, vol. 74, 427431.

Doms, M.E., Morin, N.J., (2004). "Consumer sentiment, the economy, and the news media". FRB of San Francisco Working Paper, No. 09.
Dyck, A., Volchkova, N., Zingales, L., (2008). "The corporate governance role of the media: Evidence from Russia". Journal of Finance, vol. 63, 1093-1135.
Gambacorta, L., Hofmann, B., Peersman, G., (2014). "The Effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis". Journal of Money, Credit and Banking, vol. 46(4), 615-642.
Garcia, D., (2013). "Sentiment during Recessions". Journal of Finance, vol. 68, 1267-1300.
Gentzkow, M., Shapiro, J.M., (2010). "What Drives Media Slant? Evidence from U.S. Daily Newspapers". Econometrica, vol. 78, 35-71.
Gerberding, C., Worms, A., Seitz, F., (2005). "How the Bundesbank really conducted monetary policy: An analysis based on real-time data". North American Journal of Economics and Finance, vol. 16(3), 277-292.
Gerlach, S., (2007). "Interest rate setting by the ECB, 1999-2006: Words and deeds". International Journal of Central Banking, vol. 3(3), 1-46.
Gerlach-Kristen, P., Möessner, R., (2014). "Inflation Expectations, Central Bank Credibility and the Global Financial Crisis". Swiss Journal of Economics and Statistics, vol. 150(2), 55-87.
Goldberg, L. S., Klein, M. W., (2010). "Evolving Perceptions of Central Bank Credibility: The European Central Bank Experience". NBER International Seminar on Macroeconomics, 153-182.
Gorter, J., Jacobs, J., De Haan, J., (2008). "Taylor Rules for the ECB using Expectations Data". The Scandinavian Journal of Economics, vol. 110(3), 473-488.
Groseclose, T., Milyo, J., (2005). "A measure of media bias". The Quarterly Journal of Economics, 1191-1237.
Hayo, B., Neuenkirch, M., (2015). "Self-monitoring or reliance on media reporting: How do financial market participants process central bank news?" Journal of Banking & Finance, vol. 59, 27-37.
Hendry, S., (2012). "Central bank communication or the media's interpretation: What moves markets?" Bank of Canada Working Paper No. 2012-09.
Hoffmann, A., (2013). "Did the Fed and ECB react asymmetrically with respect to asset market developments?" Journal of Policy Modeling, vol. 35(2), 197-211.
Hórdahl, P., Tristani, O., (2014). "Inflation risk premia in the euro area and the United States". International Journal of Central Banking, vol. 10(3), 1-47.
Kearney, C., Liu, S., (2014). "Textual Sentiment in Finance: A Survey of Methods and Models". International Review of Financial Analysis, vol. 33, 171-185.
Lamla, M. J., Lein, S. M., (2014). "The role of media for consumers' inflation expectation formation". Journal of Economic Behavior & Organization, vol. 106, 62-77.
Lamla, M. J., Lein, S. M., (2015). "Information Rigidities, Inflation Perceptions, and the Media: Lessons from the Euro Cash Changeover". Economic Inquiry, vol. 53(1), 9-22.

Lamla, M. J., Sturm, J.-E., (2013). "Interest rate expectations in the media and central bank communication". KOF Working Papers No. 334.
Loughran, T., McDonald, B., (2011). "When is a liability not a liability? Textual analysis, dictionaries, and 10Ks". The Journal of Finance, vol. 66(1), 35-65.
Mullainathan, S., Shleifer, A., (2005). "The market for news". American Economic Review, 1031-1053.
Neuenkirch, M., (2014). "Federal Reserve communications and newswire coverage". Applied Economics, vol. 46(25), 3119-3129.
Neuenkirch, M., Tillmann, P., (2014). "Inflation targeting, credibility, and non-linear Taylor rules". Journal of International Money and Finance, vol. 41, 30-45.
Orphanides, A., (2001). "Monetary policy rules based on real-time data". American Economic Review, 964-985.
Sauer, S., Sturm, J.E., (2007). "Using Taylor rules to understand European Central Bank monetary policy". German Economic Review, vol. 8(3), 375-398.
Schmeling, M., Wagner, C., (2015). "Does central bank tone move asset prices?" Available at SSRN 2629978.
Sims, C. A., (2003). "Implications of rational inattention". Journal of monetary Economics, vol. 50 (3), 665-690.
Solomon, D. H., (2012). "Selective Publicity and Stock Prices". Journal of Finance, vol. 67, 599-638.
Soroka, S. N., Stecula, D. A., Wlezien, C., (2015). "It's (change in) the (future) economy, stupid: economic indicators, the media, and public opinion". American Journal of Political Science, vol. 59(2), 457-474.
Stephanos, P., Sidiropoulos, M., Spyromitros, E., (2014). "Determinants of Central Bank Credibility and Macroeconomic Performance: Evidence from Eastern European and Latin American Countries". Eastern European Economics, vol. 52(4), 5-31.
Strohsal, T., Winkelmann, L., (2015). "Assessing the anchoring of inflation expectations". Journal of International Money and Finance, vol. 50, 33-48.
Szczerbowicz, U., (2015). "The ECB unconventional monetary policies: have they lowered market borrowing costs for banks and governments?". International Journal of Central Banking, vol. 11(4), 91-127.
Taylor, J. B., (1993). "Discretion versus policy rules in practice". In Carnegie-Rochester conference series on public policy, vol. 39, 195-214. North-Holland.
Tetlock, P. C., (2007). "Giving Content to Investor Sentiment: The Role of Media in the Stock Market". Journal of Finance, vol. 62, 1139-1168.
Wälti, S., (2012). "Trust no more? The impact of the crisis on citizens' trust in central banks". Journal of International Money and Finance, vol. 31(3), 593-605.
Walsh, C. E., (2004). "Implications of a changing economic structure for the strategy of monetary policy". UC Santa Cruz SCCIE Working Paper 03-18.