Speaking in Tongues?  
Diagnosing the consistency of central banks’ official communication  

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This version: February 2014

Abstract

This paper develops a framework allowing to examine the diversity of the communication policies central banks use. The framework allows embedding the cases of inflation targeting or non-inflation targeting central banks, communicating their policies to wide or more restricted international markets, depending upon the international use of the currency they manage. Another dimension taken into account is the cultural heterogeneity of agents receiving the messages sent by the central banks, a dimension that can cover linguistic heterogeneity or different degrees of financial literacy of the receptors of the banks’ communicated messages. The model is then confronted to the empirical diversity of the communication by major central banks, and it is shown that the framework allows assessing the relevance of the policies they use with regard to the context they face.

Keywords: Central banks ; Communication ; Inflation Targeting ; Wordscores  
JEL Classification: E44, E58

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1 Introduction

Over the last decades, central banks around the world have introduced large changes in the conduct of their monetary policy. The move towards more central bank independence was followed by a request for greater transparency, and therefore, increased accountability. The communication policy implemented by central banks has therefore become an important instrument in their toolbox. An effective communication policy is more and more seen as a mean to enhance the predictability of monetary policy decisions, improve monetary policy’s effectiveness and, in the end, meet the objective of price stability (see, e.g., Issing, 1999, Woodford, 2001 or Mishkin, 2004).

However, the choice of a communication strategy, and of the tools used to implement it, does not only depend on the framework adopted (i.e., an inflation targeting regime or a non targeting one) but also of the environment in which the central bank operates (i.e., national or international audience or, more precisely, the use of the domestic currency in the international markets) as well as of the cultural heterogeneity of the public (a feature which can be related, e.g., to the linguistic diversity or to the degree of financial literacy of the audience).

Concerning, first, the audience of the central bank’s communication, it has become obvious that the globalization of trade and finance has induced an increased exposition of certain currencies. In a word, “xenocurrencies” are more numerous and more traded today (Thimann, 2008), and their managing central banks now have to expect their decisions to impact not only their own residents, but also international actors (themselves potentially of different kinds: fund managers, insurers, exporters, tourists, etc.). The impact of this on communication policies of central banks has not been fully investigated.

An illustration of this is of course the American dollar, whose overseas demand is so strong that at least half of the US currency circulates abroad (Judson, 2012). Since its inception, the euro has also internationalized, and rapidly so, reaching an important position in the international flows these last years (see, e.g., Gourinchas et al., 2012). Figures 1 and 2 illustrate the importance of the U.S. dollar, and the increasing share of the euro, in the conduct of international trade and finance. As shown in Figure 1, in the 1999-2012 period, 80%-90% of official foreign exchange reserves were held in U.S. dollars.
or euro currency. The U.S. dollar and the euro are also heavily used as means of effecting payments in international trade. An indication of this is that dollars and euros passed hands in 60% to 70% of all transactions in foreign-exchange markets (Figure 2).

Figure 1: Currency Composition of Official Foreign Exchange Reserves

![Currency Composition of Official Foreign Exchange Reserves](image)

Source: IMF (2013)

Figure 2: Currency distribution of global foreign exchange market turnover
Second, if the literature has considered the financial literacy of the general public and the understanding (and, in the end, endorsement) of monetary policy (see, e.g., van der Cruijsen et al., 2011), the implications on the communication policies of central banks have not really been taken into account. A determinant of this literacy may notably be that the language agents use in their everyday life may not be the same as the one used by the central bank. This may typically be the case in countries with a large population of immigrants (Canada, for example) or when the currency is used by agents with different cultural backgrounds and belongings (as in the Euro area or in the US). One can thus expect that the communication policies of central banks that act in such a context have to be different than for the ones that interact with a more homogeneous population (as the Bank of Japan, for example).

Finally, considering the monetary policy framework chosen, the adoption of an inflation target by many central banks in developed countries has contributed to dig the institutional differences between monetary institutions, and at least drives one to separate the targeting institutions from the non-targeting. This dimension has been the most studied and, although a consensus still has to be established on the relative benefits of
inflation targeting (see, e.g., Capistran and Ramos-Francia, 2009, Blattner et al., 2008, Mishkin and Schmidt-Hebbel, 2007), it has been shown that inflation targeters have a reinforced duty to anchor the agents’ expectations (Johnson, 2002; Levin et al., 2004; Vega and Winkelried, 2005; Gurkaynak et al., 2006). Communication is certainly crucial here, and the fact some non-targeting central banks appear to be more predictable than targeting ones (Willhelmsen and Zaghini, 2011) may be due to the fact that the non-targeting central banks (among which no less than the European Central Bank and the Federal Reserve) have overcome the absence of an inflation target in their strategy by a better communication policy.

Our presumption here is that the existence and relative importance of the three dimensions exposed here probably explain that Ehrmann and Fratzscher (2007) find a large variation in communication strategies across central banks and, more generally, that a consensus about an optimal communication strategy has not yet emerged (Blinder et al., 2008).

Of course, this has not forbidden the literature to test the effectiveness of central banks’ transparency and, thus, their different means of communicating their policy. For instance, Carlson et al. (2006) show that the communication apparatus built by the FOMC has improved the public’s ability to predict interest rate decision. Rosa (2009) finds that the tone of central bankers’ statements is an important explanatory variable of future changes in the ECB main refinancing rate, while Apel and Grimaldi (2012) observe that the sentiment and tone of Swedish central bank’s minutes is useful in predicting future policy decisions. For the Norges Bank, Holmsen et al. (2008) show that the publication of its interest rate forecasts improves the markets participants’ understanding of central bank’s reaction. Transparency being a component of what may constitute an optimal communication strategy, the literature has also brought some results. For example, Walsh (2007) stresses that more-accurate central bank forecasts of demand shocks reduce the optimal degree of transparency, while more-accurate forecasts of cost shocks increase it. Also, van der Crujsjsen et al. (2010) show that beyond the optimal level of transparency, the accuracy of private sector expectations starts to worsen.

As a consequence, the lack of a single communication strategy underlined by Blinder et al. (2008) is probably only a revelator of the fact that central banks try to manage
expectations in different ways because they have to, due to the different frameworks they have adopted and to the relative importance of the different types of audiences they have to communicate to. In Table 1, we synthethize the dimensions that communication policies of central banks have to take into account. As one can see, diversity rules, as few central banks are confronted with similar situations.

Our argument thus builds on these facts and we contend that each central bank has to adapt and design its communication strategy depending on the underlying environment it is confronted with: the presence of a multi-cultural factor - like in the euro area for instance (Berger et al., 2009) -, the adoption (or not) of an inflation target, and the pressures that it may undergo due to the internationalisation of its currency. Hence, we build on Morris and Shin’s (2002) model to embed explicitly the different dimensions outlined above, to check how it should impact communication strategies. We then confront the intuitions from the theoretical model to the actual communication of 7 central banks, representative of the different possible cases, which are summarized in Table 1. We then offer a diagnosis, comparing the theoretical optimal policy with the one actually used by these central banks.

### Table 1. Central banks’ characterization

<table>
<thead>
<tr>
<th>Central Bank</th>
<th>Currency internationalisation</th>
<th>Inflation Target</th>
<th>Number of spoken languages</th>
<th>Percentage of immigrants</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECB</td>
<td>24%</td>
<td>NO</td>
<td>16</td>
<td>8.1%</td>
</tr>
<tr>
<td>FED</td>
<td>62%</td>
<td>NO</td>
<td>3</td>
<td>14.4%</td>
</tr>
<tr>
<td>BoE</td>
<td>4%</td>
<td>YES</td>
<td>3</td>
<td>12%</td>
</tr>
<tr>
<td>BoJ</td>
<td>4%</td>
<td>NO</td>
<td>1</td>
<td>1.9%</td>
</tr>
<tr>
<td>BoC</td>
<td>n/a</td>
<td>YES</td>
<td>2</td>
<td>20.7%</td>
</tr>
<tr>
<td>Rikshbank</td>
<td>n/a</td>
<td>YES</td>
<td>1</td>
<td>15.9%</td>
</tr>
<tr>
<td>Norgesbank</td>
<td>n/a</td>
<td>YES</td>
<td>1</td>
<td>12%</td>
</tr>
</tbody>
</table>

Source: authors, based on BIS (2013), IMF (2013) and IOM (2013).

The remainder of the paper is thus organized as follows: Section 2 introduces the model. Section 3 tests the empirical accuracy of the model and presents the results, while section 4 concludes.
2 The Model

2.1 The central banks’ objectives

The argument is put in a standard framework, so as to facilitate comparisons with previous works and to avoid relying on debatable assumptions. As such, we look at the discretionary case and consider that a central bank that does not adopt an inflation targeting framework receives the following instantaneous loss function:

\[ LNT_t = \frac{1}{2} E \left[ (1 + \lambda) y_t^2 + (\delta - \lambda) (\pi_t - \pi^*)^2 \right] \]  

where \( \pi_t \) denotes the inflation rate at time \( t \), \( E_t \) the expectations operator, \( y_t \) the output gap, and where uncertainty about the central bank’s preferences is represented by the random variable \( \lambda \). It is assumed that \( \lambda \in [-1, \delta] \) and that \( E(\lambda) = 0; E(\lambda^2) = \sigma^2_\lambda \). In other words, there is an informational asymmetry between the central bank and the general public about the weight of the arguments in the monetary authority’s objective function, as in, e.g., Chortareas and Miller (2003) or Ciccarone and Marchetti (2012).

An inflation targeting central bank is assigned the following loss function, as in, for example, Walsh (2010):

\[ LIT_t = \frac{1}{2} E \left[ (1 + \lambda) y_t^2 + (\delta - \lambda) (\pi_t - \pi^*)^2 + h (\pi_t - \pi^T)^2 \right] \]  

The central bank, whatever the regime it has adopted, acts under the constraint of a standard Lucas-type supply function\(^1\):

\[ y_t = \pi_t - \pi^e_t - \varepsilon_t \]

where \( \pi^e_t \) denotes private sector expectations about the relevant state of inflation, and \( \varepsilon \) designates the supply shock, with zero mean and constant variance, \( \sigma^2_\varepsilon \).

Standard resolution by minimizing the loss function with regard to inflation delivers the inflation rate under each policy framework:

\(^1\)Fendel and Rülke (2012) and Abott and Martinez (2008) provide empirical evidence on the Lucas supply function for developed economies, showing that the inflation surprise positively correlates with the output gap.
\[
\pi^{NT}_t = \frac{(\delta - \lambda)^2 \pi^* - \alpha^2 (1 + \lambda)^2 \varepsilon_t}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2} + \frac{\alpha^2 (1 + \lambda)^2}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2} \pi^e_t
\] \hspace{1cm} (4)

\[
\pi^{IT}_t = \frac{(\delta - \lambda)^2 \pi^* - \alpha^2 (1 + \lambda)^2 \varepsilon_t + \chi^2 \pi^T}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2 + \chi^2} + \frac{\alpha^2 (1 + \lambda)^2}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2 + \chi^2} \pi^e_t
\] \hspace{1cm} (5)

It can be seen easily from the comparison of the two inflation rates that an inflation targeting regimes reduces the inflation bias, but distorts the policy response to supply shocks. This result, now standard (see Walsh, 2010), can however be mediated (and even reversed) by the uncertainty surrounding the central banks’ preferences. Inflation targeting is thus not necessarily a winning strategy in presence of uncertainty.

### 2.2 Private agents’ expectations

Adopting the point of view of any agent \(i\), her expectations process is of the following form:

\[
\pi^{e}_{i,t} = (1 - r) E_i(\pi^f_i) + r E_i(\pi^e_i)
\] \hspace{1cm} (6)

where \(\pi^f_i\) is the period inflation rate, conditional on the framework adopted by the central bank (targeting or non targeting, i.e., \(f = NT, IT\)), and \(\pi^e_i\) the average expectations of the whole set of private agents living in the economy. This form is of the same type as in Morris and Shin (2002), and the parameter \(r\) represents the importance agent \(i\) attaches to the “beauty contest” (that is, the strength with which the agent tries to second-guess the others’ expectations).

To inform their expectations, agents observe a public signal, \(p\), related to inflation:

\[
\text{Public signal} : p = \pi^f_t + \eta_t
\] \hspace{1cm} (7)

where \(\eta\) is normally distributed, with mean zero and variance \(\sigma_\eta^2\). Given the fact that the public signal is common knowledge, the best any agent can do is to second-guess what the others, the \(j\) agents, will anticipate. Hence, the expectation process can be rewritten as:
\[ \pi_{i,t}^e(p) = (1 - r) E_i(\pi_i^f | p_t) + r \int_0^1 E(\pi_j^f | p_t) d_j = p_t \]  

(8)

In addition to the public signal, the agents will take into account a private signal, \( s_{i,t} \). However, given the evidence that agents differ in their degree of financial literacy, as well as the fact that some domestic users of a currency do not necessarily share the language used by the central bank, they may not interpret the information given by the central bank in the same way, thus, some agents are considered as having more precise private signals. Berger et al. (2009) have made the case for the European monetary union while, e.g., Farvaque et al. (2013) have shown that the ECB is confronted with differing degrees of trust depending on the country of residence, but this can be generalized easily to all the central banks that have to communicate with people of different origins\(^2\), languages\(^3\), and backgrounds\(^4\). Agent's private signal can then be written as follows:

\[ Private \ signal \ : \ s_{i,t} = \pi_i^f + \pi_i^e + (1 - \rho) \kappa_{i,t} \]  

(9)

with \( \kappa_{i,t} \sim N(0; \sigma_\kappa^2) \) and \( \kappa_{i,t}^t \sim N(0; \sigma_{\kappa_t}^2) \). The combination of the private and public signal induces a best expectation of the following form (Morris and Shin, 2002):

\[ E_i(\pi_i^f | p_t, s_{i,t}) = \frac{\alpha p_t + \beta s_{i,t}}{\alpha + \beta} \equiv E_i(\pi_i^f) \]

where \( \alpha = 1/\sigma_\eta^2 \) and \( \beta = \gamma/ (\rho \gamma + (1 - \rho)) \sigma_\kappa^2 \) are the precision of the two information sources. Hence, a proportion \( \rho \) of the population has a better handling of the information delivered by the central bank, which translates in a smaller variance of the private signal processed by this share of the population.

Moreover, given the fact that some central banks have a wider scope in their communication process, if only because the currency they manage is more often used on international markets (see above and BIS, 2013), we include the possibility that central

\(^2\)Thinking of immigrants for example, one can consider the situation of Canada, where 20% of the population has a birthplace located out of the country.

\(^3\)The European situation may come to one’s mind, but the Fed has also to consider, for example, the situation of Puerto Rico.

\(^4\)Backgrounds can be related to one’s history (having known a situation of hyperinflation, for example), field of study, professional experience, etc. See Farvaque et al. (2013) for a discussion of these factors.
banks have to communicate to two types of agents. The first type is their “natural” destination, that is the people living in the currency area they manage, whose expectations process has been derived right up to here. The second type are the agents who use the currency they manage, if only for professional reasons (importers, exporters, fund managers, etc.), but do not live in the currency area (and for whom, as a consequence, their currency is not a “natural habitat”). This second type is considered here to discount further the central bank’s communication, by a factor equal to \( \chi \), and to rely more on information cascades or mimetic behavior (see, for example, Akerlof and Shiller, 2009).

In other words, considering that expectations are a linear function of signals, that the whole population follows a linear strategy, and that the foreigners discount the central bank’s communication more than the domestic ones, the expectational process of agent \( j \) (with \( j \neq i \)) is of the form:

\[
\pi_{j,t}^e (p, s_j) = \theta s_{j,t} + (1 - \theta) p_t,
\]

We thus get, by substituting the value of the signals in this expression:

\[
E(\pi_t^e) = \theta \left( \frac{\alpha p_t + \beta s_{j,t}}{\alpha + \beta} \right) + (1 - \theta) p_t = \left( \frac{\theta \beta}{\alpha + \beta} \right) s_{j,t} + \left( \frac{1 + \theta (\alpha - 1)}{\alpha + \beta} \right) p_t
\]

which delivers the optimal expectation for any agent \( i \) as:

\[
\pi_{i,t}^e (p, s_i) = (1 - r) (1 - \chi) E_i \left( \pi_t^f \right) + r (1 + \chi) E_i (\pi_t^e) = \beta \left( (1 - r) (1 - \chi) + \alpha r (1 + \chi) \right) s_{i,t} + \frac{[\alpha (1 - r) (1 - \chi) + (1 + \theta (\alpha - 1) r (1 + \chi))]}{\alpha + \beta} p_t
\]

with \( 0 \leq \chi < 1 \) denoting the discount related to the fact that foreigners acting on the international markets are relying more on second-guessing the average behavior when forming their own expectations.

### 2.3 Central banks’ communication effectiveness

Inserting this expectation process in the central bank’s control variable allows to analyze the impact of its communication according to the chosen framework (\( \pi_t^{NT} \) and \( \pi_t^{IT} \)) and
to the importance of the external markets for her currency. Formally, we have:

\[
E_t (\pi_t^{NT}) = \frac{(\delta - \lambda)^2 \pi^*}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2} + \frac{\alpha^2 (1 + \lambda)^2}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2} \pi_t^e \\
= \frac{(\delta - \lambda)^2 \pi^*}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2} + \frac{\alpha^2 (1 + \lambda)^2}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2} \\
\cdot \left\{ \frac{\beta ((1 - r) (1 - \chi) + \alpha r (1 + \chi))}{\alpha + \beta} s_{i,t} + \frac{[\alpha (1 - r) (1 - \chi) + (1 + \theta (\alpha - 1) r (1 + \chi))]_{p_t}}{\alpha + \beta} \right\}
\]

(11)

\[
E_t (\pi_t^{IT}) = \frac{(\delta - \lambda)^2 \pi^* + h^2 \pi^T}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2 + h^2} + \frac{\alpha^2 (1 + \lambda)^2}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2 + h^2} \pi_t^e \\
= \frac{(\delta - \lambda)^2 \pi^* + h^2 \pi^T}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2 + h^2} + \frac{\alpha^2 (1 + \lambda)^2}{\alpha^2 (1 + \lambda)^2 + (\delta - \lambda)^2 + h^2} \\
\cdot \left\{ \frac{\beta ((1 - r) (1 - \chi) + \alpha r (1 + \chi))}{\alpha + \beta} s_{i,t} + \frac{[\alpha (1 - r) (1 - \chi) + (1 + \theta (\alpha - 1) r (1 + \chi))]_{p_t}}{\alpha + \beta} \right\}
\]

(12)

which can be studied (through comparative statics) by differentiating with regard to our variables of interest, i.e., (i) the importance of the beauty contest parameter, \( r \), in the formation of expectations, (ii) the degree of internationalisation of the use of the domestic currency, \( \chi \), and (iii) the importance of the heterogeneity factor, \( \rho \).

A comparative statics analysis of these expressions delivers the following results :

• First, the results reveal no difference between the framework adopted by the central banks, targeting or no-targeting (hence the (\( \lambda \)) term in front of the results detailed below). As equations (4) and (5) show, as is standard in the literature, an inflation targeting central bank will benefit from a reduction in the inflation bias, conditionally on the degree of uncertainty about the bank’s preferences. On this ground alone, it seems that inflation targeting central banks could communicate less, relatively to the other central banks if their audience(s) has a good knowledge of their preferences and adopted framework. However, the impact of the other features of the contexts in which central banks operate could offset this benefit, as the other results show.

• Second, with regard to the beauty contest term, we have:
\[ \frac{\partial \pi^f}{\partial \gamma} = (\cdot) \left[ \frac{\beta((x-1)+1)}{\alpha+\beta} s_i + \frac{\alpha(x-1)+1}{\alpha+\beta} (1+\theta(a-1)) p \right], \] which is positive if \( \theta > \frac{\alpha^2-1}{\alpha-1} \).

In other words, the larger the weight of the reliance on the private signal by the “average” market participant (\( \theta \)), compared to the precision of the public signal sent by the central bank, the harder it will be for the central bank to respect her inflation objective in presence of a beauty contest among market participants. This first result is basically reminiscent of Morris and Shin’s (2002), and acts as a check of the conformity and consistency of the model with regard to the literature on the topic.

• Third, and also interestingly, with regard to the degree of internationalisation, we have:

\[ \frac{\partial^2 \pi^f}{\partial \gamma \partial \chi} = (\cdot) \left[ \frac{(1+\alpha)}{\alpha+\beta} s_i + \frac{\alpha+1+\theta(a-1)}{\alpha+\beta} p \right] > 0, \] which reveals that the (degree of) internationalisation of the currency and the beauty term combine their effect to make the control of its inflation objective harder for the central bank.\(^5\)

Hence, a central bank whose currency is largely internationalized will have to communicate more, and in a more precise way, to overcome the potential loss of control inflicted by the functioning of the market, both in terms of structure (degree of internationalization) and of behaviour (presence of the beauty term). Typically, as shown in Table 1, this case applies to the Fed and the ECB, and much less to the other central banks in the sample we study below. The latter two central banks should thus communicate more, or try to communicate even more effectively than their peers.

• Finally, with regard to the parameter measuring the heterogeneity of the circulating area, we get:

\[
\frac{\partial \pi^f}{\partial \rho} = \frac{\partial \pi}{\partial \beta} \frac{\partial \beta}{\partial \rho} \cdot \frac{\partial \pi}{\partial \beta} = \frac{\partial \pi}{\partial \beta} \cdot \frac{-\gamma (\gamma-1) \sigma^2}{(\rho^2 + (1-\rho)) \sigma^2} \left[ \frac{(\alpha-1) s_i + (1+\theta)(a-1)(1+\chi)}{(\alpha+\beta)^2} \right] \left[ \frac{-\gamma (\gamma-1) \sigma^2}{(\rho^2 + (1-\rho)) \sigma^2} \right] \]

which is positive if \( \alpha (1-r)(1-\chi) + (1+\theta)(a-1)(1+\chi) < 0 \). For most of the plausible range for the parameters involved in this expression, it will have a positive sign. This shows that the relative degree of cultural heterogeneity (and /

\(^5\)Note that we have \( \frac{\partial^2 \pi^f}{\partial \chi} = (\cdot) \left[ \frac{r(1+\alpha)-1}{\alpha+\beta} s_i + \frac{\alpha(r-1)+r(1+\theta(a-1))}{\alpha+\beta} p \right], \) which is positive if: \( \frac{\alpha(1-r)(1+\alpha)}{1+\theta(a-1)} > 1 \), confirming the role of the beauty term in the influence of \( \chi \).
or of financial illiteracy) threatens the efficacy of the central bank’s communication, as it will be harder for her to reach her objective the more heterogeneous the audience will be. As a consequence, communication by central banks will be all the more important in more heterogeneous contexts, be they linked to the spread of a currency over a large territory (as in the European monetary union) or to large differences in financial literacy. To sum up, more internationalized currencies should induce central banks to communicate more (at least, they should try to communicate more effectively than their peers who are less confronted with this feature). This is also the case for central banks facing more heterogenous (or less literate) audiences. Importantly, our framework reveals that inflation targeting does not systematically act as a one-stop shopping solution, as uncertainty on the central bank’s preferences can compensate its benefits.

3 Assessing the consistency of central banks’ communication

As revealed by the theoretical framework, the degree of internationalisation of a currency and the presence of a multi-cultural factor in a monetary union can have a destabilizing effect on the inflation rate, whether the central bank has adopted an inflation targeting regime or a not. Therefore, though all central banks have to disseminate public information in a consistent way, the pressure is even stronger if they manage a xeno-currency in a multi-cultural environment. Hence, our aim now is to examine whether central banks’ communication has remained consistent over time, in order to reduce the various discrepancies that may exist between agents’ expectations, and if the more exposed central banks…

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6 A side result of our framework is thus that in countries with lower degrees of education, as a proxy to financial literacy, the central bank should increase and sharpen their communication. The framework has thus also some relevance for emerging and developing countries, although our empirical analysis below does not include central banks from these categories of countries.

7 This is confirmed by the derivative with regard to the precision of information by the most literate part of the population, as we have: \[ \frac{\partial \varepsilon_f}{\partial \beta} = \frac{\partial \varepsilon_f}{\partial \beta} = \frac{\partial \varepsilon_f}{\partial \beta} \cdot \left[ \frac{(1-\rho)^2 \sigma_b^2}{\langle \frac{\rho \sigma_b}{(1-\rho)^2 \sigma_b^2} \rangle^2} \right] = \left[ \frac{\rho}{(\alpha-\beta)^2} \cdot (1-r) \cdot (1-\chi) \cdot (1+\chi) \cdot s_1 - \frac{\alpha(1-r)(1-\chi)}{(\alpha-\beta)^2} \cdot \rho \cdot \frac{(1-\rho)^2 \sigma_b^2}{\langle \frac{\rho \sigma_b}{(1-\rho)^2 \sigma_b^2} \rangle^2} \right] \text{ which is positive if } \alpha (1-r) (1-\chi) + (1 + \theta (\alpha - 1) r (1 + \chi)) < 0. \text{ As can be seen, this condition is the same as the one applying to } \rho. \]
banks have managed to be more consistent than their less exposed peers.

3.1 The method, and the ECB as an illustrative case

In order to test for such consistency, we focus on a central instrument in the arsenal central banks use to communicate, their “Monthly Bulletin” (or its equivalent) and apply the Wordscores methodology to these texts. Introduced by Laver et al. (2003), this technique, which relies on computerized content analysis, compares the patterns of words used in a set of “reference texts” (i.e., with known policy positions) with words contained in a series of “virgin texts”, to estimate their respective policy positions. Words are then treated as data (Krippendorff, 2004)\(^8\) and the assumption is simply that the relative frequencies of the use of specific words provide information (here, on monetary decisions). The reliability of the approach is enhanced by removing the human factor from the coding process and, practically, Wordscores can be implemented using a command line version for Stata\(^9\). Hence, the approach allows to check if different agents may have a similar expectation about the future stance of the monetary policy, by relying on the same public signal. Given that the ECB faces an heterogeneous audience and manages a currency that is relatively internationalized, we consider it as a typical case for exposing the Wordscores method.

However, the meaning of a specific word often depends on the context in which it is used. For instance, while the word “growth” appears to be a positive signal, the phrase “slow growth” does not. Therefore, we here rely on two-word combinations of a noun and an adjective in this analysis, such as “lower inflation” or “higher unemployment”.

The method requires estimates of the positions of the references texts by, for example, using a dimension tightening/easing. Wordscores then provide estimates of the “score” of a two-word combination, based on its relative frequency in the set of reference texts where the combination was followed by a tightening/easing monetary policy. These estimates

\(^8\)According to Laver et al. (2003): “this method treats the texts not as discourses to be read, understood and interpreted for meaning, but as collections of word data containing information about the position of the texts’ authors on predefined policy statements”. This approach differs notably from other comparable methods in that it does not use predefined coding dictionaries as in Bligh and Hess (2010), nor subjective judgments by human coders (as in, e.g., Bulir et al., 2010).

\(^9\)See http://www.tcd.ie/Political_Science/wordscores/ for more details on the method.
will then serve as the basis (reference) for estimating policy stances in the set of virgin texts.

More precisely, the Wordscores methodology is defined as follows (Laver et al., 2003):

\[
Probability_{w,r} = \frac{Frequency_{w,r}}{\sum_r Frequency_{w,r}} \quad (13)
\]

\[
Wordscore_w = \sum_r Probability_{w,r}.Value_r \quad (14)
\]

where \( w \) denotes a two-word combination in the set of reference texts, denoted by \( r \), and \( Value_r \) denotes the assigned value of the reference text. For instance, assume that the two-word combination “high vigilance” appears 10 times in the set of reference texts as followed by a tightening policy\(^{10}\) and twice in by an easing policy\(^{11}\). Then, the probability of “high vigilance” followed by tightening in the set of reference texts (i.e., \( Probability_{(w:high\ vigilance,r: tightening)} \)) will be 0.84 \((= \frac{10}{10+2})\), while the probability of “high vigilance” followed by easing (i.e., \( Probability_{(w:high\ vigilance,r: easing)} \)) will be 0.16 \((= \frac{2}{10+2})\).

Using these probabilities, the wordscore of “high vigilance” is:

\[
Wordscore_{(w:high\ vigilance)} = Probability_{(w:high\ vigilance,r: easing)}.Value_{(r:easing)} + Probability_{(w:high\ vigilance,r: tightening)}.Value_{(r:tightening)}
= 0.16.(-1) + 0.84.(1) = 0.68
\]

Therefore, if a virgin text contains the combination “high vigilance”, Wordscores assumes that it contributes 0.68 to the virgin text’s estimation policy. Point estimates on the policy dimension are generated for virgin texts, being computed as the mean of the scores of the combinations, weighted by their relative frequencies within these texts. This procedure also computes confidence intervals, delivering a measure of the uncertainty associated with each position score. In a nutshell, this technique matches virgin texts probabilistically, given their patterns of words usage, to reference texts with known policy positions.

Finally, it is obviously crucial for the validity of the approach to select the reference texts appropriately. They should provide enough information on the different policies

\(^{10}\)denoted with a value of \(+1\).

\(^{11}\)denoted with a value of \(-1\).
dimensions for which one would like to evaluate where the virgin texts lie. Therefore, the reference texts should be used in the same context as the virgin ones, i.e., Wordscores requires similarity between the set of reference texts and the set of virgin ones. We thus consider the years 1999-2005 as a learning period for agents, given that there has been enough variations in terms of the number of policy (and notably, policy rates) changes, the direction of changes, and changes in the central banks’ vocabulary as well. This recognizes that there is a need of flexibility for central banks in the way they communicate their policy decisions, given that their objectives and priorities may evolve over time. Two cases in point are the clarification by the ECB, in May 2003, of its monetary policy strategy, when it stressed the importance of the role of money in its policy (Berger et al., 2011), and the discussion of the quarterly macroeconomic projections made by the Eurosystem staff since June 2004. These have led the ECB to use new words to describe its monetary policy decisions (Jansen and De Haan, 2010). Therefore, central banks’ communications from the 1999-2005 period are considered as the reference texts, as they contain enough information about policies dimensions, and they are used to estimate the policy positions of the virgin texts from 2006 onwards.

Wordscores requires the reference texts to be coded. Given that we are interested in the ability of different agents to have similar expectations using the same signals, we rely on the central banks’ policy decision following the previous signal to code the reference texts on the policy dimension, ranging between easing or tightening. For instance, in December 2005, after the increase of the ECB’s main refinancing rate of 0.25 basis point, the statement of the ECB on November 2005 is coded +0.25. Therefore, we analyze the ability of agents to predict the future direction of the policy rate at time $t+1$ following the words contained in the statement at time $t$. Then, Wordscores computes the policy decision of the ECB in January 2006 by analyzing the words contained in the ECB’s statement of December 2005.

The ECB uses various instruments to communicate with different target groups. We here consider that the editorial of the *Monthly Bulletin* is a relevant source of information for central bank watchers. Not only do they contain an explanation of why interest rates were changed (or not), plus a summary statement of the Governing Council’s view of the economy (hence, self-containing the information released by the President’s press
conference), but other central banks also make use of similar texts during the period under review (see below). The editorials of the *Monthly Bulletin* of the ECB from the period 1999 to 2005 form the set of reference texts, while the posterior ones form the set of virgin texts. Figure 3 provides a comparison between the estimated policy positions of virgin texts obtained through the Wordscores methodology with the actual policy decisions of the ECB.

*Figure 3. Results of the Wordscores approach for the period 2006-2014, ECB*

The dark bars show the Wordscores simulation results for the virgin texts, i.e., the policy dimension of the introductory statements between January 2006\textsuperscript{12} to January 2014 and the grey bars show the change of the main refinancing rate of the ECB. The figure also shows the 95\% confidence interval around the scores. The bars indicate the timing and direction of changes of both the ECB’s rate and the Wordscores simulation. The ECB’s key interest rate and the Wordscores simulation have remarkably similar evolutions. There has been a persistent increase of the ECB’s rate from the beginning of 2006 until mid 2007, followed by a downward trend from mid 2008 until the beginning of 2009. The Wordscores simulated rate accurately reproduces these movements, only relying on the words contained in the editorials of the *Monthly Bulletin*. After this

\textsuperscript{12}It is worth to remind that the estimated policy position for January 2006 for instance is obtained by analyzing the editorial of December 2005.
period, and until mid 2011, the rate did not vary and the Wordscores policy estimation is also lying around 0. Finally, the increase and decrease of the ECB’s rate in the beginning and the end of 2011, respectively, are properly predicted as well. Therefore, the analysis reveals that the ECB’s communication has remained quite consistent, using a constant vocabulary to send signals related to its policy decisions. Given that the ECB acts in a context marked by the strong internationalization of the euro and by a relatively large degree of heterogeneity (see table 1), such a constancy can only help agents to predict more accurately the direction of the future path of its policy rate, as could be expected from our theoretical framework.

Interestingly, as can be seen in Figure 3, the Wordscores methodology does not preclude forecasts of relatively strong variations, nor of negative policy rates. This lies in contrast to the need for central banks to smooth interest rates changes, if only to prevent troubles in financial markets (Woodford, 2003) and to their consideration of a Zero Lower Bound for their policy rate. The relative discrepancy between these features and the forecasts obtained from Wordscores does not mean that the latter is “wrong” but, on the contrary, reveals that the messages conveyed by the ECB can sometimes be hard to interpret and / or that they are not always followed by the appropriate (i.e. expectable) deeds\textsuperscript{13,14}. This is all the more troubling given that this bank is confronted with a multicultural audience, and should be all the more attentive to communicate clearly, as the above framework reveals.

Figure 4 delivers another view of the results, displaying the cumulative Wordscores value (i.e. the sum of all previous values of the Wordscores estimations and of the current value.) and the behavior of the ECB’s policy rate. Clearly, the time courses of both series are closely related to each other and evolve in the same direction, showing the qualitatively good forecasts obtained with the Wordscores methodology. Interestingly, the correlation grows over time, revealing the increased consistency of the ECB’s communication through its editorials. We now turn to other central banks, to assess the relevance of this approach

\textsuperscript{13}Given that agents are aware of the policy constraints faced by the central banks, the Wordscores methodology remains a relevant approach to predict the directions of future changes in the policy rate. 

\textsuperscript{14}Interestingly, this observation occurs for the KOF monetary policy communicator as well, which predicts larger variations of the key interest rate, but is still broadly in line with the qualitative evolution of the MRR.
for central banks facing different contexts than the ECB.

**Figure 4. ECB main refinancing rate and cumulative Wordscores estimates**

3.2 Are other central banks more consistent than the ECB?

We replicate the Wordscores approach for a set of inflation targeting and non targeting central banks in developed countries, facing different contexts in terms of cultural (and language) heterogeneity. As shown in Table 1, the sample includes Canada, Norway, Sweden, and the United Kingdom for the IT central banks\(^\text{15}\), and Japan and the United States for the NT ones. Compared with the ECB, each of these central banks acts in a different environment, all of them coinciding with different values of the model’s parameters.

For the Bank of Canada, we rely on the “Fixed Announcements Dates” press releases, which were introduced in November 2000, whereby it announces decisions on its target for the overnight policy rate on eight pre-specified dates each year. The release includes the reasons underlying the policy decision, a forward-looking policy guidance, and the Council’s view of the economic outlook. For the Bank of England, we use the Monetary Policy Committee minutes, which deliver an assessment of the economic conditions in

the national and international markets, and reflect the policy actions conditional upon future developments of macroeconomic variables. For the Norges Bank, the Press releases of the Executive Board’s monetary policy decision are used. Each Press release contains forecasts of inflation, the output gap and other variables, along with an assessment of the general economic situation. Concerning the Riksbank, we use the Minutes of the Executive Board’s monetary policy meeting, as they report the views of all MPC members about the economic outlook and the future path of key variables. For the FED, we rely on the Federal Open Market Committee post-meeting statement, as it contains the Committee’s view about future economic development and an outlook on the future federal funds target rate. Finally, we use the Monthly Report of Recent Economic and Financial Developments for the Bank of Japan, which contains The Bank releases a summary of economic and financial developments, which form the basis of the decision on the guideline for money market operations.

As for the ECB, for the Wordscores simulation, we consider the releases from 1999 until 2005 as the set of “reference texts”, and the releases published afterward as “virgin texts. Figures 5 to 10 below show the results of the Wordscores approach for these central banks.

**Figure 5. BoC interest rate and cumulative Wordscores estimates**

![BoC interest rate and cumulative Wordscores estimates](image)

**Figure 6. BoE interest rate and cumulative Wordscores estimates**
Figure 7. FED interest rate and cumulative Wordscores estimates

Figure 8. BoJ interest rate and cumulative Wordscores estimates
On the one hand, it appears that the cumulative Wordscores estimates for the Bank of Canada, the Federal Reserve and the Bank of England replicate accurately the moves and directional changes of their respective interest rates, although with a large variance in some cases. We interpret these results as confirming that, given that these central banks receive important scrutiny from international markets (i.e., agents from financial markets in different countries pay a particular attention to the policy guidance they provide) and have strong ties with foreign exchange markets, they need their messages to be understood uniformly by heterogeneous agents (as the ECB) to avoid excessive volatility in exchange
markets and to achieve their objectives of price stability. This explains the consistency
trait of their communication policy. On the other hand, the result for the Bank of Japan
(and to a less extent for the FED) is interesting in the sense that it illustrates one caveat
of the methodology emphasized before: given that the BoJ decreased its interest rate
at the end of 2008 to 0.1 basis point, it was confronted to the Zero Lower Bound issue,
as it could not decrease further its interest rate (without risking of being in a situation
of liquidity trap), even though its communication policy had an accommodative stance.
Therefore, the Wordscores cumulative value for the BoJ decreases and remains negative
from 2008 onwards, while the value of the interest rate did not change throughout this
period.

Finally, the results for the Riksbank and the Norges bank reveal that the consistency
of their press releases and statements can hardly be helpful for predicting the future path
of their respective policy rate. These results do not mean that these central banks are not
predictable, as many empirical studies find that other forms of their communication policy
help predict the next policy decision (e.g., speeches, interviews, interest rate forecast..., see Holmsen et al., 2008 or Apel and Grimaldi, 2012). However, given that these central
banks do not have the constraints the ECB and other major central banks have\(^{16}\), i.e.,
the presence of agents from different countries and with different languages which are
attentive to the messages they provide, they do not need to be as consistent in the way
they communicate their policy decisions. This explains the fact that the Wordscores
approach can replicate with accuracy the moves of the ECB’s rate and the FED’s FFR
inter alia, but fails to reproduce the changes of the policy rate of the other central banks.
In other words, it seems that the constraints faced by the different central banks in
our sample are relatively well understood, and that their communication has a degree
of consistency (and, thus, of predictability) that lies in conformity with the audience(s)
they target.

This is confirmed by the comparative statistics displayed in Table 2, which reveal the
effectiveness of the Wordscore approach for the various central banks we consider. As
shown in Table 2, the central banks which have to deal with an heterogeneous audience

\(^{16}\)The FED, the BoE, the BoC.
and a strongly internationalized currency are more likely to have a consistent communication policy than the ones which are less subject to these pressures. Therefore, different agents located in different areas can better predict the future path of their policy rates using the same public signal. Thus, it seems that these central banks have considered the constraints they face and their potential impact on the volatility of the inflation rate when setting their communication policy. The results confirm that there is no a single communication framework that is optimal for all central banks, given the different environments in which they have to define and implement their monetary policies.

### Table 2. Summary statistics

<table>
<thead>
<tr>
<th>Currency area</th>
<th>Correlation</th>
<th>Covariance</th>
<th>Average</th>
<th>Median</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area</td>
<td>ECB interest rate</td>
<td>0.83</td>
<td>2.38</td>
<td>1.89</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Wordscore value</td>
<td></td>
<td></td>
<td>4.24</td>
<td>3.91</td>
</tr>
<tr>
<td>Canada</td>
<td>BoC interest rate</td>
<td>0.89</td>
<td>2.3</td>
<td>1.9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Wordscore value</td>
<td></td>
<td></td>
<td>3.44</td>
<td>2.74</td>
</tr>
<tr>
<td>England</td>
<td>BoE interest rate</td>
<td>0.88</td>
<td>4.58</td>
<td>2.42</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Wordscore value</td>
<td></td>
<td></td>
<td>4.31</td>
<td>4.17</td>
</tr>
<tr>
<td>United States</td>
<td>FED interest rate</td>
<td>0.84</td>
<td>5.73</td>
<td>1.59</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Wordscore value</td>
<td></td>
<td></td>
<td>0.84</td>
<td>0</td>
</tr>
<tr>
<td>Japan</td>
<td>BoJ interest rate</td>
<td>0.55</td>
<td>0.04</td>
<td>0.20</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>Wordscore value</td>
<td></td>
<td></td>
<td>-0.5</td>
<td>-0.7</td>
</tr>
<tr>
<td>Sweden</td>
<td>Riksbank interest rate</td>
<td>0.32</td>
<td>0.79</td>
<td>1.96</td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>Wordscore value</td>
<td></td>
<td></td>
<td>-2.3</td>
<td>-2.5</td>
</tr>
<tr>
<td>Norway</td>
<td>Norgesbank interest rate</td>
<td>-0.21</td>
<td>-0.74</td>
<td>2.8</td>
<td>2.25</td>
</tr>
<tr>
<td></td>
<td>Wordscore value</td>
<td></td>
<td></td>
<td>3.53</td>
<td>2.67</td>
</tr>
</tbody>
</table>

#### 3.3 A robustness check for the period 2009-2014

The financial crisis of 2008 has led the ECB and other major central bankers to use new specific words to describe their non standard measures, and to be confronted to the Zero Lower Bound for some of them. Therefore, we expand the set of our reference texts to 2008 and analyse the subsequent simulations from 2009 onwards, to check whether the stance of their communication policy has changed during that period. Figure 11 below shows the Wordscores simulation when extending the set of reference texts to 2008.
The results reveal an interesting feature of the communication trait of the central banks during the financial crisis. Given that most of them have lowered their policy instruments at a very low level, they started to use non-conventional policy measures
to stimulate the economic recovery, and to give a forward guidance about the durability of these measures. Therefore, it is without surprise that their communication have an accommodative stance during that time, and thus, that the Wordscores estimates have a negative value while the interest rate do not move. It is also worth noting that the trend of these negative values decrease from mid-2013, which means that these central banks start talking about a potential exit strategy from their non-standard measures\textsuperscript{17}. Concerning the Norges bank and the Riksbank, we obtain similar results as in the previous section, i.e., they seem to utilize different instruments to provide forward guidance. Garvin et al. (2013) give a theoretical relevance of the stimulative effect of central bank forward guidance when the nominal interest rate is stuck at its zero lower bound, they show that it lowers the expected nominal interest rate and increases current consumption when households expect a recovery.

4 Conclusion

Given that the ECB, the Fed and other major central banks are implementing a monetary policy that has an international impact, it is a challenge for these institutions to be understood uniformly when explaining their monetary policy decisions. In this paper, we highlight the negative effects induced by the presence of a multi-cultural factor, and the internationalisation of a currency, when communicating about monetary policy. Afterward, we use the Wordscores methodology to assess if these central banks’ communication policy remained consistent through time to tackle these negative effects. Our results show that these central banks have used a similar lexicon to explain their policy decisions, and that this has probably allowed heterogeneous agents to understand uniformly the message they convey.

References


\textsuperscript{17}For instance, Ben Bernanke, the previous Fed chairman stated in June 2013 that the U.S. Federal reserve may be done with its monetary stimulus next year.


