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GEOGRAPHY OR SKILLS

WHAT EXPLAINS FED WATCHERS' FORECAST ACCURACY OF US MONETARY POLICY?

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In 2006 all ECB publications feature a motif taken from the €5 banknote.

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CONTENTS

Abstract

The paper shows that there is a substantial degree of heterogeneity in forecast accuracy among Fed watchers. Based on a novel database for 268 professional forecasters since 1999, the average forecast error of FOMC decisions varies 5 to 10 basis points between the best and worst-performers across the sample. This heterogeneity is found to be related to both the skills of analysts – such as their educational and employment backgrounds – and to geography. In particular, there is evidence that forecasters located in regions which experience more idiosyncratic economic conditions perform worse in anticipating monetary policy. Moreover, systematic forecaster heterogeneity is economically important as it leads to greater financial market volatility after FOMC meetings. Finally, Fed communication may exert an influence on forecast accuracy.

JEL No.: E52, E58, G14

Keywords: monetary policy; forecast; Federal Reserve; FOMC; geography; skills; heterogeneity; survey data; communication; United States.

Non-technical summary

Information and geography play an important role in financial markets by affecting asset prices, trading behavior, and the location choice of financial firms. There is ample evidence in the literature that geography and information also matter when it comes to the performance of financial market analysts and the profitability of mutual fund investments. For instance, it has been shown that profits tend to be higher when funds invest in firms located near to the fund's offices, and market analysts perform better when they focus on firms close by

The present paper analyzes whether this role of information and geography extends to the way financial market participants anticipate US monetary policy. In particular, we ask to what extent geography, regional economic developments, and personal skills determine the ability of professional forecasters to predict monetary policy decisions by the US Federal Reserve.

The paper uses a novel dataset of 268 professional forecasters who are located across 98 cities in 15 countries, for FOMC decisions between February 1999 and September 2005. The dataset contains each forecaster's survey expectations for FOMC decisions, as well as information about the individual's forecasts of inflation and economic activity. Moreover, the data includes information related to analysts' skills, e.g. the type of institution, his or her position within that institution, employment record and educational background. We combine this dataset with information about the economic conditions specific to the region in which each individual is located.

As a key stylized fact, the degree of heterogeneity in the forecast performance across individuals is large: after grouping forecasters by performance over the full sample period, the absolute forecast error differs by 5 basis points (b.p.) between the best and the worst 10%. This difference rises to 10 b.p. when analyzing only those FOMC meetings that had some degree of heterogeneity across forecasters. We find such forecaster heterogeneity to be important, in the sense that heterogeneity of monetary policy expectations significantly raises financial market volatility in response to the announcement of monetary policy decisions.

What explains the heterogeneity in expectations across Fed watchers? As to *geography*, we find that regional economic developments matter, as forecasters make larger errors the more economic developments in their home region differ from their average. Moreover, the prediction error of those in New York City or in other financial centers, either in the USA or abroad, is about 2 b.p. lower. Forecasters who are located in or close to Washington DC do even better by exhibiting an error that is 4 b.p. lower.

A complementary finding is that differences in forecast performance are related to the *skills* of individual forecasters. We find that analysts who work for investment banks do better than others. Professional experience and education also matter for forecast accuracy: analysts who previously worked for the Federal Reserve's Board of Governors perform better, as do analysts with a Master's degree.

In addition, the empirical analysis shows that forecasters who do well in predicting monetary policy also do well in anticipating US inflation, providing the most direct piece of evidence that skills and individual background are significantly linked to the forecast accuracy.

Finally, we investigate the role of communication by the Federal Reserve for heterogeneity in forecast performance. We find that more communication reduces disparities in forecast performance stemming from differences in regional economic conditions, whereas we find that the superior forecast accuracy of some analysts is related to their ability to extract relatively more or better information from Fed communication.

1. Introduction

Information and geography play an important role in financial markets by affecting asset prices, trading behavior, and the location choice of financial firms. For instance, the home bias in international investments and consumption is influenced by information asymmetries regarding risks involved with foreign investment (see, e.g., Ahearne, Griever, and Warnock 2004, Portes and Rey 2005). Geography and information also matter when it comes to the performance of financial market analysts and the profitability of mutual fund investments. Profits tend to be higher when funds invest in firms located near to the fund's offices, and market analysts perform better when they focus on firms close by (e.g., Coval and Moskowitz 1999, Bae et al. 2005). Finally, geographic proximity and common socio-cultural attitudes remain highly relevant for explaining information asymmetries and economies of scale in information processing, which is among the arguments why financial companies agglomerate in international financial centers (e.g., Strauss-Kahn and Vives 2005).

The intended contribution of the present paper is to analyze whether this role of information and geography extends to the way financial market participants anticipate US monetary policy. In particular, we ask to what extent geography, regional economic developments, and personal skills determine the ability of professional forecasters to predict monetary policy decisions by the US Federal Reserve. While it is known that expectations on U.S. monetary policy differ across financial market analysts and participants (Swanson 2006), to our knowledge, this is the first paper that analyses this heterogeneity, rather than the mean or median in expectations about monetary policy, and its economic relevance and determinants.

The presence of systematic forecaster heterogeneity is important for at least two reasons. First, if heterogeneity of forecast accuracy prior to FOMC meetings leads to greater financial market volatility and uncertainty afterwards, this could distort investment decisions, make it harder for firms to raise funds, and, more generally, decrease the efficient allocation of capital in the economy. Indeed, we find evidence that observed differences in forecasting ability are highly relevant for financial market behavior, as heterogeneity of monetary policy expectations significantly raises financial market volatility. Second, the question of heterogeneity of monetary policy expectations is also important because modern central banks have undertaken substantial efforts over the past decade to enhance transparency and communicate with financial markets and the wider public. In fact, the credibility and thus the effectiveness of monetary policy crucially depend on financial markets' ability to understand monetary policy decisions and anticipate the future path of policy. In an extension to the main analysis, we therefore investigate how Fed communication affects the cross-sectional dispersion of interest rates forecasts.

The paper uses a novel dataset of 268 professional forecasters – covering many major investment banks, commercial banks and forecasting institutions – who are located across 98 cities in 15 countries, for FOMC decisions between February 1999 and September 2005. The dataset is extremely rich as it contains not only each forecaster's survey expectations for FOMC decisions, but also information about the individual's forecasts of other economic variables, such as inflation and economic activity. Moreover, the data includes information related to analysts' skills, e.g. the type of institution, his or her position within that institution, employment record and educational background. We combine this dataset with information about the economic conditions specific to the region in which each individual is located.

As a key stylized fact, the degree of heterogeneity in the forecast performance across individuals is large: after grouping forecasters by performance over the full sample period, the absolute forecast error by the group of the 10% of the worst forecasters is 5 basis points (b.p.) higher than that of the best decile of analysts, when measured across all FOMC meetings. This difference rises to 10 b.p. when analyzing only those FOMC meetings that had some degree of heterogeneity across forecasters. This is of the same order of magnitude we have found in a related analysis for the heterogeneity of forecasts of ECB monetary policy decisions (Berger, Ehrmann and

Fratzscher 2006) and given the frequency of forecasters' participation cannot be the result of pure chance. What is more, a significant part of this heterogeneity is systematic, that is, we find compelling empirical evidence that skills *and* geography play a significant and substantial role in explaining the predictability of monetary policy decisions by the Federal Reserve. Overall, this implies that there is indeed a substantial systematic and sizeable difference in the ability of individual analysts to anticipate FOMC policy decisions, in particular in times when FOMC decisions are harder to predict.

What explains the heterogeneity in expectations across Fed watchers? As to *geography*, we find that a number of locational factors systematically influence the ability of forecasters to anticipate US monetary policy. The forecast errors of analysts who are based in the Northeastern or Midwestern regions of the United States are significantly lower than those e.g. located in the South. In particular, the prediction error of those in New York City or in other financial centers, either in the USA or abroad, is about 2 b.p. lower. Forecasters who are located in or close to Washington DC, i.e. in immediate proximity of the Board of Governors of the Federal Reserve, do even better by exhibiting an error that is 4 b.p. lower, although there are only few such analysts in the sample. By contrast, other US-based analysts do not appear to perform better than their foreign counterparts. Also foreign analysts who operate in an English-language environment do only as well as those who work in a location where a different language is spoken.

Moreover, we find that forecasters take a local perspective in the sense that regional economic developments shape their forecasting ability for US monetary policy. In particular, forecasters make larger errors the more economic developments in their home region differ from their average. This finding applies to regional developments in inflation as well as income and employment growth.

Taken together, these findings underline that geography plays a substantial role in explaining the heterogeneity in the predictability of US monetary policy. But what does geography reflect? One hypothesis is that it reflects information asymmetries. Support for this hypothesis is provided in particular by the effect of regional economic factors, such as different inflation, income or employment growth rates, on forecast errors. Given that monetary policy decisions are made on the basis of nationwide economic developments, the fact that differences in regional economic conditions affect policy predictability implies that agents base their forecasts on different, and at least partly geography-related information sets.

A complementary hypothesis is that differences in forecast performance are related to the *skills* of individual forecasters. The overall skill set of an analyst is influenced by many factors, for instance by the resources of the forecaster's employer, his or her past professional experience or the educational background. We indeed find strong empirical evidence for the role of individual skills. First, analysts who work for investment banks do better than those in other financial and non-financial companies. This result may be related to the fact that the former may have more at stake and thus devote more resources to monetary policy analysis. Second, it is intriguing that analysts who have the position of Economist in their institution do better than forecasters with higher-ranking titles, in particular executives. Since we control for differences in the type of institution, one interpretation is that executives may be less specialized and be able to devote less time and resources to following the Fed and thus ultimately provide worse forecasts.

Third, professional experience and education matter for forecast accuracy. We find – probably not surprisingly – that analysts who previously worked for the Federal Reserve's Board of Governors perform in some cases significantly better, with up to 1.8 b.p. smaller forecast errors. Moreover, analysts with a Master's degree perform significantly better than those with other degrees. Interestingly, having a Ph.D. does not appear to provide analysts with any advantage in terms of better forecast accuracy, even when controlling for all other skill and geography variables, which could suggest that specialized technical skills may not be all that crucial for predicting monetary policy decisions.

A related result of the empirical analysis is that forecasters who do well in predicting monetary policy also do well in anticipating other economic developments, such as domestic inflation in the country. This provides a strong, and the most direct piece of evidence that skills and individual background are significantly linked to the forecast accuracy of monetary policy decisions.

This last point leads us to the next question: Are and, if so, how are geography and skills connected? It is possible that geography and skills are highly correlated and thus that what we measure as the effect of geography could at least in part reflect differences in the skill set of analysts, or vice versa? If, for instance, skilled analysts tended to move to New York City disproportionally, then the geography variable for New York City may pick up this concentration of skills, rather than information alone.[1] We therefore combine the analysis of skills and geography and find that the results basically remain unchanged when modeling both sets of variables simultaneously. In fact, some of the results for the role of geography are even somewhat strengthened in this combined analysis, underlining the robustness of the findings.

Finally, we investigate the question whether communication by the Federal Reserve has the potential to influence heterogeneity in forecast performance. The identification of communication effects is not without difficulties because traditional measures of central bank communication do not entail a geographic component, and the empirical approach has to rely on interaction terms. That said, Fed communication in some instances appears successful in reducing information asymmetries across market participants. For instance, we find that communication reduces disparities in forecast performance across analysts stemming from differences in regional economic conditions, whereas we find that the superior forecast accuracy of some analysts is related to their ability to extract relatively more or better information from Fed communication.

The paper is structured as follows. Section 2 offers a brief discussion of related literature, while Section 3 discusses in detail the data for the monetary policy forecasts. Section 4 starts by outlining the hypotheses related to geography and skills before presenting the empirical results. Section 5 analyses the effectiveness of Federal Reserve communication to address the heterogeneity in expectations across analysts. Section 6 concludes.

2. Related Literature

To the best of our knowledge, our focus on explaining the cross-section heterogeneity in monetary policy expectations for the Fed's FOMC is new. It is related to two well-established strands in the trade and finance literature looking at the role of information and geography, as well as to the emerging literature on central bank communication.

Information asymmetries and frictions are important determinants of the direction and intensity of trade in goods, trade in financial assets, and financial investment flows—see, among others, Froot and Stein (1991), Gordon and Bovenberg (1996), Portes, Rey, and Oh (2001), and Dvorak (2005). An interesting result in that line of research is that information asymmetries, in particular regarding risks involved with foreign investment, may also be responsible for the home bias in cross-country investment and consumption (e.g., Gehrig 1993, Ahearne, Griever, and Warnock 2004, Portes and Rey 2005).[2]

In a related discussion, Coval and Moskowitz (1999, 2001) argue that mutual fund investors are more profitable when investing in firms that are located geographically near to the fund's offices.

[1] Another equally likely possibility is that the causality runs in the opposite direction, i.e. that skilled analysts move to New York *because* of the information advantage they obtain from being in a financial center.

[2] Lewis (1999) and Karolyi and Stulz (2003) provide surveys of the home bias literature.

Somewhat along the same line, Bae et al. (2005) produce evidence that analysts working in closer proximity to firms hold an advantage in forecasting their performance even when controlling for the quality of information provided by firms. Similarly, investors who live near a firm's headquarter have been found to react in a similar manner to releases of public information on this firm (Feng and Seasholes 2004). Hau (2001) shows that traders located outside Germany in non-German speaking cities are less profitable on the German Security Exchange. Although he does not find evidence for higher profits by traders in financial centers, there appears to be an information advantage in case of proximity to corporate headquarters of a traded firm.

Information also influences location decisions by financial (and other) firms, with information-based agglomeration effects playing a major role in this case. For instance, Tschoegl (2000), Clark (2002), and Cook et al. (2004) show that centripetal forces matter most for financial services, even though centrifugal factors in Krugman's (1998) sense exist. This suggests that the need to service locally dispersed customers and advances in communication technology is outweighed by the chance to realize information spillovers and economies of scale in information processing through agglomeration in financial centers (Thrift 1994, Grote 2004). An additional factor seems to be common socio-cultural attitudes, including "face-to-face contact facilitated by social proximity" (Faulconbridge 2004, p. 237). The findings on location choice generalize across sectors. For instance, Strauss-Kahn and Vives (2005) show that firms generally prefer locating close to other headquarters in the same sector.

Finally, our paper touches upon the literature discussing the role of information, transparency, and communication for monetary policy. Central banks have a keen interest in guiding expectations of economic agents, in particular in financial markets; Blinder (1998) and Bernanke (2004), among others, stress the key role of communication in this regard.[3] An emerging empirical literature suggests that communication is indeed a powerful tool for this purpose.[4] Swanson (2006), whose paper is most closely related to our work, looks at the relation between Fed transparency and private and financial market interest rate forecasting between 1990 and 2003. He reports that improvements in transparency (e.g., the start of the regular release of meeting minutes or the introduction of statements on the economic outlook) helped making private forecasts on average more accurate and decreased their cross-sectional dispersion.[5]

The present paper focuses on the cross-sectional dispersion of forecast accuracy of FOMC monetary policy decisions. We contribute to the literature by showing that information, geography, and personal skills play an important role for the view financial market participants take on expected monetary policy action in the US and that markets act on these expectations. Moreover, we show that active Fed communication has a significant impact on the formation of interest rates forecasts and their cross-sectional dispersion.

3. Data on Monetary Policy Expectations

We start by describing our data for measuring expectations heterogeneity before proceeding to discuss the economic relevance of this heterogeneity in the expectations for financial market outcomes.

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[3] The communication channel is a particularly important policy instrument when nominal interest rates are close to their zero percent lower bound (see, e.g., Bernanke, Reinhart and Sack 2004, Woodford 2005).
[4] See, for instance, Guthrie and Wright (2000) on the Reserve Bank of New Zealand, Kohn and Sack (2004) on the Federal Reserve, Reeves and Sawicki (2005) on the Bank of England, and Ehrmann and Fratzscher (2005b) for a comparative study for the Federal Reserve, the Bank of England, and the ECB. Ehrmann and Fratzscher (2005a), Gürkaynak, and Sack and Swanson (2005) argue that it is in particular statements providing indications about the future policy path that move financial markets.
[5] Poole and Rasche (2000), Poole, Rasche, and Thornton (2002), and Lange, Sack, and Whitesell (2003) also discuss interest rate forecasting in the U.S.

3.1 Data characteristics

Our database consists of time-series information on monetary policy expectations and other variables for 268 professional forecasters – covering many major investment banks, commercial banks and forecasting institutions. The data comes from Bloomberg, which chooses which institutions and individuals to include in its survey of monetary policy expectations of the Federal Reserve. The survey consists of a simple question about what the analysts think will be the most likely policy decision of the FOMC in its next meeting. We have available forecasts for all FOMC meetings starting in 1999 until September 2005.

How good is the quality of the data on monetary policy decisions? Since the expectations data is survey based, one potential concern is about the effort individual analysts put into providing their input. However, there are a number of reasons suggesting that this is not a major concern. Most importantly, analysts are bound in their survey answers by their recommendations to clients. Hence an analyst for an investment bank, for instance, may find it hard to justify why he or she gave a recommendation different to the one of the survey.

A series of tests indicates that the forecasts surveyed by Bloomberg are indeed of high quality and, as we will show below, significantly linked to financial market behavior. One issue is whether there is a problem of self-selection in the surveys. The way the survey works is that analysts can provide their forecasts online at any time before the meeting. First, this could imply that the lead time, i.e. the number of days an analyst provides his or her forecast before an FOMC meeting is related to the degree of uncertainty surrounding the decision. We investigate this hypothesis by regressing the absolute forecast error $s_{i,t}$ for each analyst on FOMC meetings on the lead time, in number of days ($L_{i,t}$) with which he or she gives the forecasts, and find:

$$s_{i,t} = \underset{(0.0046)}{-0.0175} L_{i,t} + \varepsilon_{i,t},$$

where the absolute forecast error for each individual $s_{i,t}$ is defined as the absolute difference between the individual's forecast $r^e_{i,t}$ and the actual Fed funds target rate set by the FOMC r_t. The number in brackets shows the standard error of the parameter estimate. Given the discrete nature of this variable, which changes in steps of 25 b.p., an ordered probit model is used for the above regression. The result implies that a longer lead time is associated with a lower forecast error. This may suggest that analysts provide their forecasts at an earlier stage when decisions are easier to anticipate – and thus predictions turn out to be more accurate – while they enter their forecasts later, or revise them at a later stage, when FOMC decisions are harder to foresee. Figure 1 shows the evolution of the average absolute forecast errors and the average lead time over the horizon of the sample period, further stressing this last point as the lead time goes up in particular during periods when FOMC decisions appear to have been relatively easier to anticipate. The empirical work in the main body of the paper will control for such common swings in overall forecasting behavior by introducing fixed time (or FOMC meeting) effects.

Figure 1

Another quality issue could be self-selection, as not all analysts do regularly provide their forecasts. It could therefore be that some analysts choose to participate when FOMC decisions are generally easier to predict, and abstain when they consider them more uncertain. To investigate this possibility, we regress the average absolute forecast error across analysts for each FOMC meeting ($\overline{s_t}$) on the number of survey participants (F_t) for that FOMC meeting, which yields:

$$\overline{s_t} = \underset{(0.5281)}{1.6267} + \underset{(0.0981)}{0.0598} F_t + \varepsilon_t .$$

The OLS results show no significant relationship in the data between participation and the average forecast error across agents.

Figure 2

The main interest of the paper lies in understanding and explaining the cross-sectional differences across analysts' forecast performance of US monetary policy. How large and variable is this heterogeneity over time? Figure 2 shows the standard deviation of forecast errors across analysts for each FOMC meeting and the underlying average forecast mistake. While there is some variability in this measure over time, there is no clear trend or large outliers that can be identified.

This leads us to an important question for the empirical analysis: How large is the heterogeneity in forecast performance across individual analysts? Ranking all forecasters by their average absolute forecast errors over the full sample period, we find that the 10% with the best performance have on average a forecast error that is about 5 b.p. lower than the worst-performing 10%. However, as some decisions have been perfectly predicted by all market participants, a more informative comparison might look at forecast performance for the more difficult cases. Repeating this analysis therefore for all FOMC meetings where forecasters deviated in their predictions (and dropping observations for FOMC meetings without dissent), Figure 3 ranks all forecasters by their average absolute forecast errors over the full sample period, starting from the 10% with the lowest average errors in decile 1 to the 10% with the largest mistakes in decile 10. The figure shows a remarkable degree of heterogeneity that, in the light of the frequency of participation of forecasters, cannot be explained by chance alone: the best forecasters have on average a forecast error that is about 10 b.p. lower than the worst-performing analysts.[6]

Figures 3 – 4

In order to obtain a measure of cross-sectional heterogeneity robust with regard to self-selection (i.e., variations in participation of good or bad forecasters over time), we extract the time fixed effects. In other words, the time-corrected forecast errors are obtained as the residuals of regressing the absolute forecast error on a comprehensive set of time dummies (i.e., time fixed effects), which in essence just subtracts from each individual's error the average error across all individuals for each meeting. Figure 4 shows the distribution of these time-corrected forecast errors across analysts. It confirms the large degree of heterogeneity, which remains unchanged at roughly 10 b.p. between the best and the worst forecast performers.

3.2 Economic relevance of forecast heterogeneity

Why is the analysis of forecast heterogeneity important? The presence of systematic forecaster heterogeneity has potentially important consequences for the real economy. If differing forecast accuracy ex ante leads to greater financial market volatility and uncertainty ex post, firms may find it more difficult to make investment decisions or to raise funds. As a consequence, the allocation of capital to its most efficient uses in investment or production may be distorted.

Thus, before moving to the analysis of the determinants of this heterogeneity, it is worthwhile investigating the link between forecast heterogeneity and financial market behavior. The most natural way to address is this issue is by testing whether heterogeneity matters for the way financial markets respond to the release of the monetary policy decisions by the Federal Reserve.

[6] To verify the robustness of these differences, we exclude those forecasters from the sample who have participated in less than 25% of the forecasts over the sample period.

Our hypothesis is that more heterogeneity ex ante, if reflected in trading positions, should lead to more volatility in financial markets ex post, as there are more positions that need adjusting.

For that purpose, we test whether market volatility around the release of the FOMC decision, and in its aftermath, is related to the heterogeneity of the expectations expressed in the Bloomberg survey. We derive a measure for market volatility based on the S&P 500 stock index by calculating the standard deviation of 1-minute returns over three separate time windows.[7] The first window ranges from 13:45 to 14:45, and thus includes the release of the decision at 14:15. The other two windows range from 14:45 to 15:30 and from 15:30 to the close of the market, which is usually at 16:00, and thus capture trading in the aftermath of the decision. In this fashion, we construct one observation for our dependent variable per time window per FOMC meeting.

If t denotes the day of the FOMC meeting, and τ the time window analyzed, we aim to explain market volatility ($\sigma_{t,\tau}$) in response to the release of monetary policy decisions. Two determinants are of interest in our context: first, the *magnitude* of the surprise, as measured by the absolute mean forecast error reported in Bloomberg ($\bar{s}_t$), and second, the *heterogeneity* of market expectations, measured as the standard deviation of the surprises calculated across survey participant (ψ_t). In order to control for time variations in market volatility that are unrelated to monetary policy, we add another regressor, namely market volatility observed in the same time window on the preceding day, ($\sigma_{t-1,\tau}$). By using this particular time window, we ensure that our benchmark variable is not affected by time-of-the-day patterns in volatility. The model to be estimated is therefore as follows:

$$\sigma_{t,\tau} \quad = \quad \alpha + \beta\,\sigma_{t-1,\tau} + \gamma\,\bar{s}_t + \delta\,\psi_t + \varepsilon_{t,\tau} \qquad (1)$$

Note that the magnitude of the surprise and its heterogeneity are strongly correlated, with a correlation coefficient of 0.47. Accordingly, we perform regressions in three steps, by first including either one of the two explanatory variables $\bar{s}_t$ and ψ_t, and then both jointly.

Table 1

Table 1 reports the results of the three different estimated OLS models. It shows that the magnitude of the monetary policy surprise affects market volatility in the first and second time window under consideration. With larger surprises, market volatility increases. At the same time, however, also heterogeneity seems to increase market volatility, in line with our hypothesis. Comparing models (1) and (2), the latter explains a somewhat larger share of the variation in the data, as indicated by the higher R^2. This is mirrored in model (3), where only the heterogeneity variable is estimated significantly.

A second result is that the effect of heterogeneity in expectations on market volatility is estimated significantly even for the last time window, whereas the size of the surprise itself is no longer relevant. In line with our hypothesis, more heterogeneity in expectations raises market volatility. A back of the envelope calculation shows that the increase in volatility is sizeable. For the time window ranging from 14:45 to 15:30, market volatility increases relative to the preceding day by a factor of around 1.6 in case of zero heterogeneity. For the maximum amount of heterogeneity observed in the dataset, market volatility would increase by a factor of 2.2. For the last window, the results suggest a factor of 1.15 with no heterogeneity, compared to a factor of around 1.8 with maximum heterogeneity.

[7] Data for the S&P 500 index are taken from TickData Inc.

4. What explains heterogeneity in forecast accuracy?

The present section contains the core analysis of the paper. We start by outlining the empirical methodology and continue by discussing our hypotheses related to the role of geography and skills in influencing monetary policy forecasts. We then turn to the empirical findings and robustness checks.

4.1 Methodology and hypotheses

The main objective of the paper lies in understanding and explaining the cross-sectional differences across analysts' forecast performance of US monetary policy. The key focus is on analyzing how much of this heterogeneity in expectations can be attributed to geography and how much to the skills of individual analysts.

Our dependent variable is the absolute forecast error for each FOMC meeting by each individual analyst who has participated in the survey more than 10 times, $s_{i,t}$. As it turns out, in our sample period, $s_{i,t}$ is discrete, taking either the value of 0, 25 or 50 b.p. Therefore, we model the effect of our explanatory variables, $x_{k,i,t}$, using an ordered probit model of the form

$$\hat{s}_{i,t} = \alpha_t + \sum_{k=1}^{K} \beta x_{k,i,t} + \varepsilon_{i,t}, \qquad (2)$$

where $\hat{s}_{i,t}$ is an unobserved latent variable that relates to the observable forecast error according to the rule

$$\begin{aligned} s_{i,t} &= 0 \quad \text{if} \quad \hat{s}_{i,t} \le \kappa_0 \\ s_{i,t} &= 25 \quad \text{if} \quad \kappa_0 < \hat{s}_{i,t} \le \kappa_1 \\ s_{i,t} &= 50 \quad \text{if} \quad \hat{s}_{i,t} > \kappa_1. \end{aligned}$$

The κ's are unknown parameters to be estimated with the coefficient vector β, and $\varepsilon_{i,t}$ is a well-behaved error term.[8]

The model controls for time fixed effects by including a full set of time dummies α_t. As mentioned above, our focus is on the cross-sectional differences across analysts' forecast performance. We therefore want to control for the fact that some FOMC decisions may be more difficult to predict than others, and to avoid the resulting potential self-selection bias. Note that this also implies that the empirical findings are effectively based only on those FOMC meeting in which there was some cross-section heterogeneity.

Turning to the explanatory variables and the underlying hypotheses, geography provides a specific economic and informational environment in which individuals operate.[9] We would expect that in particular analysts who are located close to the Board of Governors, i.e. in or close to Washington DC, or in large financial centers such as New York City have an information

[8] Interpreting β can be difficult, especially when using explanatory dummy variables. For instance, depending on the cut-off points, a negative dummy coefficient could indicate that a 50 basis-point error is less likely but a 25 basis-point error is more likely when the variable takes the value 1. However, this case is not relevant in our sample. As a robustness check and to ease interpretation, we will report OLS results in addition to ordered probit estimates in what follows.
[9] As is common in the literature on trade in goods and financial assets, we approximate the availability and costliness of information through various measures of geographic "proximity".

advantage and thus perform better in forecasting US monetary policy than others. Such an information advantage could come from more direct contacts or interactions with the Federal Reserve, but it could also come from the fact that Washington DC and financial centers have a high concentration of institutions focused on issues related to monetary policy. Thus information sharing may be more efficient in such hubs, improving the forecast performance of analysts. More generally, it is possible that analysts located in the United States have better information about US monetary policy, e.g. through the easier and more diverse availability of various media, than analysts located abroad. Similarly, language may matter as one would expect that analysts working in an English-language environment have an information advantage over those working primarily in a foreign-language environment. As English is, however, widespread as a working language in particular among financial institutions also in non-English speaking countries, an English-language environment may in practice not provide much of a gain.

We use various locational variables for *geographic proximity*. First, the geographic coverage of the data is large, as our dataset includes 268 forecasters located across 98 cities in 15 countries. Tables 2 and 3 provide an overview of the geographic coverage.

Tables 2 – 3

A second type of geographic proximity that may play an important role is the specific local or regional economic environment analysts are operating in. Location choices of institutions often imply that their businesses are more strongly connected to regional clients or partners. Thus information about the immediate geographic surroundings may be better and more ample. Institutions may therefore (consciously or unconsciously) use this regional or local knowledge to help make inferences about economic developments elsewhere. For the anticipation of monetary policy, this means that analysts may be significantly influenced by their regional economic conditions when making predictions about US monetary policy. We have three such regional economic indicators – CPI inflation for the four US census regions (Northeast, Midwest, South and West), as well as personal income growth and employment growth for all US states – and can match these to the location of the analysts in our sample.[10] If analysts indeed incorporate a regional perspective, they may (mis-)interpret strong deviations of regional developments from their long-term average as indicative of US-wide changes. As a consequence, larger absolute deviations of current conditions from the regional "norm" might lead an analyst to make larger forecast errors.[11] A significant effect of this variable for analysts' forecast accuracy signals that analysts base their forecasts at least partially on local information.

Tables 4 – 5

Tables 4 and 5 give summary statistics for all of these variables, as well as a breakdown of the information between the USA and abroad (Table 4), and across the individual regions of the United States (Table 5). Out of the 268 analysts, 194 are located in the United States and 74 abroad. There are a number of interesting and noteworthy characteristics in the data. For instance, about one third of all forecasters are based in financial centers, in particular New York City, but also major financial hubs such as Chicago, London, Hong Kong, Frankfurt or Boston.

[10] Regional CPI data, while providing less cross-sectional variance than metropolitan area CPI data, poses fewer matching problems with forecaster locations across the US. CPI inflation and nonfarm payroll data (Source: Bureau of Labor Statistics) are available real time, on a monthly frequency. Personal income growth data are quarterly (Source: Bureau of Economic Analysis).

[11] Ideally, we would like to test the same hypothesis for US national aggregate data. Unfortunately, this is not possible in the framework of model (1), as any variable which varies only across time, and not across analysts is wiped out by the set of time dummies. We however include below the absolute deviation of current US economic developments from their long-term average for non-US residents in the sample.

Geography		Skills	
Regional economic conditions:		**Macro forecast performance:**	
CPI inflation difference	Absolute difference between current regional inflation and its sample average	CPI inflation forecast	D=1 if the individual's average inflation forecast error is below sample median; D=0 otherwise or if no forecast is available
Income growth difference	Absolute difference between current regional income growth and its sample average	Industrial production forecast	D=1 if the individual's average industrial production forecast error is below sample median; D=0 otherwise or if no forecast is available
Employment growth difference	Absolute difference between current regional growth in non-farm payrolls and its sample average	**Individual background:**	
		Institution:	
Location:		Investment bank	D=1 if analyst works for such institution; D=0 otherwise
Distance to Federal Reserve	Distance from Washington DC (in 1000 km)	Commercial bank	D=1 if analyst works for such institution; D=0 otherwise
Washington DC	D=1 if analyst is located in Washington DC; D=0 otherwise	Forecast institution	D=1 if analyst works for such institution; D=0 otherwise
New York City	D=1 if analyst is located in New York City; D=0 otherwise	*Job position:*	
Financial center[12]	D=1 if analyst is located in Chicago, Boston, London, HK, Paris, Frankfurt, Madrid or S.Francisco	Economist	D=1 if analyst holds this job title; D=0 otherwise
USA	D=1 if analyst is located in neither DC, NYC or a US financial center, but resides in the US; D=0 otherwise	Senior Economist	D=1 if analyst holds this job title; D=0 otherwise
English language	D=1 if foreign analyst is located in Canada, UK, Ireland or Australia; D=0 otherwise	Chief Economist	D=1 if analyst holds this job title; D=0 otherwise
Northeast, Midwest, South, West	Regional dummies each for the four US census regions	Executive	D=1 if analyst holds this job title; D=0 otherwise
		Education:	
		Bachelor's degree	D=1 if analyst has this as highest degree; D=0 otherwise
		Master's degree	D=1 if analyst has this as highest degree; D=0 otherwise
		PhD degree	D=1 if analyst has this as highest degree; D=0 otherwise
		Employment history:	
		Fed Board of Governors	D=1 if analyst worked for this institution before; D=0 else
		Fed New York	D=1 if analyst worked for this institution before; D=0 else

[12] Note that the definition of financial centers here is clearly not all encompassing, and one could also argue for alternative definitions. However, the empirical findings presented below are robust to changing the set of cities defined as financial centers, i.e. when extending the set of cities or when reducing it – for instance, when including Philadelphia or excluding San Francisco etc.

Turning to the role of *skills*, we would expect that the forecast performance of analysts is closely linked to their personal skills and also the resources their institutions provide them with. First, the type of institution an analyst works for may matter. For instance, anticipating monetary policy decisions may be even more important for investment banks or specialized forecast institutions than for other financial or non-financial institutions. Second, we expect that the professional experience and employment record are also likely to have a significant effect on the performance of analysts in predicting Fed policy. In particular, someone who has previously worked for the Federal Reserve's Board of Governors may have a superior understanding of the functioning of the FOMC and its communication. Third, technical expertise may give analysts with a Master's or Ph.D. degree as an educational background an edge in the forecasts.

These personal characteristics are obviously rather indirect ways of approximating the skills and ability of analysts. But we also have a more direct measure of skills, namely the forecasts of other economic variables – CPI inflation and industrial production – for many of the analysts in our sample. As both variables are also highly relevant for monetary policy decisions, we would expect that analysts who perform well in predicting US inflation and industrial production are also better in anticipating US monetary policy decisions at that particular point in time. To capture the overall quality or skill level in the empirical implementation we focus on the relative quality of forecasters compared to the sample median across time and individuals.

Tables 4 and 5 offer some summary statistics for these skills-related variables. Some interesting features of the data emerge. For instance, there is some concentration of analysts across institutions as almost half of them work for investment banks. In comparison, the distribution across job positions is rather even, while a relatively large share of analysts who provide information have a Ph.D. or Master's degree. It should be noted that employment and education backgrounds are not available for several analysts. We therefore created a separate variable for these, included under "no information".

4.2 Empirical results

Our modeling strategy is to start by analyzing the role of geography in explaining forecast errors of US monetary policy, then to move to skills and finally to combine both sets of variables in a single model.

4.2.1 Geography

Table 6 presents the results for the geography variables in the ordered probit model, using different specifications. Model (1) shows the influence of distance, an often used proxy for information costs in the literature on trade in goods and financial assets. However, we find that greater distance from Washington DC, the seat of the Federal Reserve's Board of Governors, is not associated with a statistically significantly higher forecast error. In model (2), we ask whether there are differences across the four US regions and indeed find that analysts located in the Northeast and the Midwest perform significantly better than those of the excluded group from the model, in this case all non-US analysts. Part of the reason for this better performance may be that the Northeastern and Midwestern regions include most of the major financial centers of the United States, which may have an information advantage as major financial hubs.

Table 6

In model (3), we therefore test the role of specific locations. We find that analysts based in Washington DC, in New York City, and in other financial centers do better than analysts located elsewhere.[13] By contrast, forecasters in other US locations, or those based in countries with English as the main language do not appear to make smaller forecast errors than other foreign analysts (model (4)). What this suggests is that there are indeed strong information advantages in financial hubs, pointing to an important role of geographic "proximity".

The second proxy for the role of geography is the regional economic environment analysts operate in. Model (5) shows the point estimates for the absolute difference of CPI inflation, income growth and employment growth from their averages over the whole sample period. The results indicate that regional conditions indeed play a role, with larger deviations in inflation and employment growth leading to significantly higher forecast errors about US monetary policy.

Finally, model (6) combines the various location and regional conditions variables in a single estimation. The results are generally robust to this extension, though the effect of financial centers other than New York City does not remain statistically significant. On the other hand, the combined model identifies an additional, albeit only marginally significant, effect of deviations in regional income growth, with larger absolute deviations pointing to larger forecast errors. Estimates of the same model by OLS (i.e., ignoring the discrete nature of the forecast error) confirm the findings of the ordered probit models, with slight changes in the significance level of regional macroeconomic differences.

4.2.2 Skills

Table 7 gives the empirical results for the effects of various measures of analysts' skills and ability on forecast performance; first only for each category, then by combining the different skill proxies in a single model.

Table 7

Regarding institutional affiliations, in model (1) we find that analysts who work for investment banks have significantly lower forecast errors of FOMC decisions compared to the excluded benchmark group, namely analysts working for other financial or non-financial institutions and academics. The coefficient for individuals working for forecast institutions is slightly insignificant in this specification, although such analysts are found to perform marginally better in the more complete specification of model (6).

As to job classifications, forecasters with the job title of Economist, Senior Economist or Chief Economist appear to perform significantly better than analysts who are executives in their institutions and form the excluded category in the regression. This may seem somewhat surprising as one may expect that executives have more experience and thus should be able to predict US monetary policy decisions at least equally well. One interpretation is that executives have a multitude of tasks and therefore have less time to acquire or maintain the specific expertise to do well in anticipating FOMC decisions. The results may also be influenced by an omitted variable bias as, for instance, forecasters who have the title of an executive may disproportionally work for specific institution types, such as small think tanks or non-financial institutions, and thus do worse merely because of their affiliation. However, model (6) shows that the findings with regard to the superior performance of economists and chief economists are robust when controlling for the full set of institutional and other analyst characteristics.

In addition, the employment history matters for forecast performance. Model (3) shows that individuals who have worked for the Board of Governors in the past do a significantly better job

[13] Note that it is not straightforward to interpret the coefficients, due to the non-linear nature of the ordered probit model, as the coefficients give only the marginal effects at each variable's mean. We will return to a more detailed discussion of the marginal effects and their interpretation further below.

in anticipating FOMC decisions. Again, this finding is robust to controlling for the full set of skill determinants, as shown in model (6). This result suggests that having first-hand knowledge in the functioning and thinking of the Federal Reserve should provide an analyst with a valuable advantage compared to other analysts in predicting FOMC decisions.

Fourth, the educational background appears to also play a significant role. Interestingly, analysts with a Ph.D. – the excluded category in model (4) – do significantly worse than those with a Master's degree. Two possible explanations come to mind for this result. On the one hand, it may imply that specific technical expertise may not be crucial for being a good forecaster of US monetary policy. On the other hand, it may indicate that it is not the level of the degree, but the quality or type of degree – for which we do not have information – that explains this effect. For instance, those who have a Master's degree as their last degree may have an MBA, which in turn may signal something specific about the effort and qualifications of these analysts.

Finally, a much more direct proxy for the skills of analysts is their ability to forecast other economic variables, such as US inflation and industrial production developments. While there is no effect of the quality of industrial production forecasts on the accuracy of forecasts of monetary policy decisions, model (5) indicates that indeed analysts who are, on average, better in predicting the next inflation figure after an FOMC meeting than the sample median are also better in correctly anticipating the FOMC decision. Overall, this finding is probably the strongest direct evidence that skills matter for the forecast accuracy of US monetary policy.

Controlling for the robustness of results by re-estimating the combined model (6) using OLS corroborates the findings in general, as shown in column (7), with only one change: the superior performance of chief economists turns insignificant.

4.2.3 Geography versus skills

As the final part of the analysis, we include the various proxies for geography and for individual skills in the same model specification. It is important to combine the different categories in order to counter the possibility that geography and skills of analysts are not independent from one another. This may imply that what we measure as the effect of geography could at least in part reflect differences in the skill set of analysts, or vice versa effects of skills may represent the impact of geography. If, for instance, skilled analysts tended to move to New York City disproportionally, then the geography variable for New York City may pick up this concentration of skills, rather than information alone. However, the causality of this relationship could also be the reverse in that institutions move their analysts to New York or another major financial center precisely *because* of the information advantage they obtain from being there.

Table 8

Table 8 provides the empirical findings for this combined model. Overall, the results are mostly robust as most of the variables retain their statistical significance. In only a few cases do variables lose their statistical significance. For instance, the professional experience of having worked for the Federal Reserve before does enter the expanded ordered probit model only marginally significant. Only minor changes are apparent when non-US residents are dropped from the sample, as shown in the second set of results in Table 8. In this case, professional Fed experience regains its significance, whereas regional inflation differences become statistically insignificant.

In order to obtain a more direct proxy for the quantitative effect of each of the variables on the monetary policy forecast error, we estimate the same model using OLS. The results shown in the right-hand side columns of Table 8 support the previous qualitative and statistical findings for the geography variables. Quantitatively, according to the linear model, analysts based in New York or in another financial center perform on average about 2 b.p. better than others. This gain is even more pronounced for analysts based in Washington DC, who have on average a forecast error that is 4 b.p. lower.

The significance of most of the skill variables is also confirmed in the combined model. Institutions, job position and educational background all continue to exert a substantial impact on forecast accuracy. Equally importantly, analysts who do well in predicting the next inflation figure are also more accurate in predicting the next FOMC meeting. In fact, analysts who are better than the mean in forecasting inflation have a roughly 1.7 b.p. lower forecast error.

In summary, both geography and individual skills play a substantial role for the forecast accuracy of US monetary policy decisions. In particular the magnitude of the effects of several of the geography and skill proxies underline the overall large importance they have in explaining the heterogeneity in the ability of agents to anticipate policy decisions by the Federal Reserve.

5. The Role of Fed Communication

There is a rapidly growing literature on the importance of communication for the predictability of the Federal Reserve and other central banks (see Section 2). However, almost all of the studies in this literature concentrate on the mean or consensus expectations of financial markets. By contrast, our objective in this section is to analyze the effect of communication on the heterogeneity of expectations across individual market participants.

Heterogeneity of expectations is at least in part undesirable from a monetary policy perspective as it may create significant differences in the understanding of FOMC policy decisions and thus the transmission process of policy. A key question therefore is: what can a central bank do to affect this heterogeneity in expectations? In particular, what role does communication play in this regard? Communication is potentially a powerful tool not only to convey a particular policy message and alter the consensus or mean of expectations, but may also be used to influence the degree of heterogeneity among market participants. This section analyses to what extent Fed communication has exerted such an influence on the heterogeneity of expectations in the past, and through what channels this effect has functioned. More precisely, we ask whether communication policy can be used in a systematic manner so as to reduce this heterogeneity stemming from differences in geography and skills, and thus promote a more homogenous understanding of monetary policy.

We stress that the identification of effects of Fed communication on heterogeneity in forecast accuracy is not without difficulties. Traditional measures of Fed communication do not entail a geographic component (see below). As a result, the empirical approach has to rely on interaction terms – that is, we ask whether the effect of the variables explaining the heterogeneity of forecast accuracy varies as the Fed communicates. However, identification through interaction terms is an indirect approach that may or may not be sufficient to capture all effects of Fed communication. Ultimately, of course, this is an empirical question.

For this purpose, we take the data on communication by FOMC members developed in Ehrmann and Fratzscher (2006), and investigate the effect on the heterogeneity of expectations and its channels. Based on newswire service reports of statements about the monetary policy inclination by FOMC members during the inter-meeting period, two measures of Fed communication policy can be distinguished:[14]

First, we employ the frequency of Fed communication (measured as the number of statements recorded in the dataset during an inter-meeting period) as a proxy for the information content of

[14] A detailed outline and explanation of the data and its underlying methodology is provided in Ehrmann and Fratzscher (2006).

Fed communication for each inter-meeting period. The hypothesis is as follows: more information provided by the Federal Reserve should not only enhance the ability of market participants to anticipate the subsequent FOMC decision, but also reduce the heterogeneity in expectations across agents if this information is understood and processed by all agents in a similar way.

Second, we analyze the effect of communication dispersion, i.e. the extent of disagreement across individual FOMC members in an inter-meeting period (measured as $\Omega_t = \frac{\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left|C_i - C_j\right|}{\frac{1}{2}\cdot\left(N^2 - D\right)}$, with N the number of statements in the inter-meeting period that ends on meeting day t, C the statements classified as dovish, neutral or hawkish as {-1,0,+1}, and a dummy D with D=0 if N is an even number and D=1 if it is odd. This normalization allows us to obtain a dispersion measure that lies strictly between zero (no dispersion) and one. Our prior is that if there is a high degree of disagreement, then it should raise uncertainty about the upcoming FOMC policy decision and thus also increase the heterogeneity in expectations.

To test whether communication policy helps reduce the effects that differences in geography and skills have on the heterogeneity of expectations, we estimate an extension of model (2) which adds interaction variables of geography and skills/ability ($x_{k,i,t}$) with communication (c_t):

$$\hat{s}_{i,t} = \alpha_t + \sum_{k=1}^{K}\beta x_{k,i,t} + \sum_{k=1}^{K}\beta x_{k,i,t}c_t + \varepsilon_{i,t} \qquad (3)$$

Note that the communication variable c_t *alone* cannot be included in model (3) due to the inclusion of the time fixed effects α_t. Our key hypothesis of interest is H_0: $\gamma_k = 0$. Whenever γ_k is different from zero, the model identifies that Fed communication affects forecast heterogeneity; if the sign of a γ_k is opposite of the sign of the corresponding β_k (where k refers to the kth explanatory variable included in $X_{i,t}$), communication reduces heterogeneity; in the case of equally signed coefficients, it tends to enhance it instead. Recall from Tables 6-8 that most of the coefficients β_k of the benchmark models are negative – for instance, being located in a financial center reduces the forecast error $s_{i,t}$ of an analyst. This means that $\gamma_k > 0$ implies that a particular communication policy reduces or even eliminates the impact of a particular geographic or skill-related characteristic on the absolute forecast error. By contrast, $\gamma_k < 0$ entails that communication has the opposite effect of widening the information asymmetries and thus the dispersion in forecast accuracy. For the variables measuring regional macroeconomic disparities, the interpretation is reversed, as these yielded positive coefficients β_k in model (2).

Table 9

Table 9 shows the results for the interaction coefficients γ_k. A first central finding is that Fed communication appears to be successful in *reducing* the heterogeneity in forecast accuracy stemming from disparities in regional economic conditions. For instance, a higher frequency of communication reduces the effect of regional income growth differentials on the heterogeneity of forecast errors. Somewhat surprisingly, also a more dispersed communication flow from the Fed to the public helps analysts overcome some of the confusion stemming from diverging regional economic conditions. We interpret this result as being indicative that Fed communication indeed succeeds in reducing information asymmetries that come from the differences in regional economic conditions which influence agents' expectations about FOMC policy decisions.

A second finding is that Fed communication mostly *raises* the heterogeneity in forecast performance that stems from differences in the skills and abilities of individual analysts, as suggested by the mostly negative coefficients. For instance, communication reduces the forecast error of analysts working at investment banks, commercial banks and forecast institutions, i.e. those analysts who on average show lower forecast errors of US monetary policy decisions. Similar evidence is found for differences in education: analysts with Master's degrees benefit relatively more from Fed communication in terms of improved forecast performance. An interpretation of this result is that those analysts who are relatively good in anticipating FOMC policy decisions obtain these superior forecast skills at least partly from their ability to better extract information from Fed communication.

Finally, there is also some limited evidence that communication plays a role for geographic characteristics of analysts. In fact, Fed communication improves the forecast performance of analysts based in New York City or the United States; though in other cases the point estimates are not statistically significant.

In summary, Fed communication appears to reduce information asymmetries along some dimensions, but may increase it along others. On the one hand, the results suggest that communication can indeed be effective in reducing disparities in forecast performance across analysts stemming from differences in regional economic conditions. Thus communication in some instances appears successful in reducing information asymmetries across market participants. On the other hand, at least part of the superior forecast accuracy stemming from analysts' individual background appears to be related to their ability to extract more or better information from Fed communication.

6. Conclusions

Information and geography play an important role in financial markets by affecting asset prices, trading behavior, and the location choice of financial firms. This paper has asked whether this pattern extends to the expectation formation process regarding monetary policy decisions, by analyzing whether geography and to what degree personal skills determine the ability of professional forecasters to predict monetary policy decisions by the US Federal Reserve. Based on a novel dataset of 268 professional forecasters located across 98 cities in 15 countries, we found that the degree of heterogeneity in the forecast performance across individuals is large: the average absolute forecasts error by the group of the 10% of the worst forecasters is 5 b.p. higher than that of the best decile of analysts (10 b.p. if we focus on FOMC meetings where not all forecasters agreed). In fact, this is similar to the order of magnitude we have found in a related analysis for the heterogeneity of forecasts of ECB monetary policy decisions (Berger, Ehrmann and Fratzscher 2006).

The paper has demonstrated that this heterogeneity has important repercussions on trading behavior, with significant effects on market volatility. This could distort investment decisions of firms, make it more difficult for firms to raise funds for investment or production, and could decrease the efficient allocation of capital. But what explains the heterogeneity in forecasting accuracy? The paper has focused on the role of geography and skills of analysts in forecasting US monetary policy.

We show that a number of locational factors systematically influence the ability of forecasters to anticipate US monetary policy. In particular, the prediction error of those in Washington DC, New York City or in another financial center, either in the USA or abroad, is about 2 to 4 b.p. lower. Importantly, the paper has found that forecasters take a regional perspective in that regional economic developments shape their forecasting ability for US monetary policy. In particular, forecasters make larger errors the more economic developments in their home region differ from their average. This finding applies to regional developments in inflation as well as income and employment growth. The result is important as it underlines that monetary policy expectations exhibit a significant and systematic regional pattern in the United States.

As to the role of skills, a revealing point of the empirical analysis is that forecasters that are good in forecasting inflation also perform well in predicting monetary policy decisions. This provides a strong, and the most direct piece of evidence that skills and individual background are significantly linked to the forecast accuracy of monetary policy decisions. Moreover, analysts who work for investment banks or specialized forecast institutions or think tanks do better than those in other financial and non-financial companies. But also professional experience and education influence forecast accuracy, as does (albeit to a smaller degree) an employment history with the Federal Reserve's Board of Governors.

What do these findings imply for policy? First of all, it should be stressed that not all heterogeneity in expectations is necessarily undesirable from a policy perspective, in particular if such differences are the result of different degrees of investment in information gathering by analysts' institutions. Moreover, differential expectations about policy decisions may at times also provide useful information to policy-makers. Therefore, the primary nature of the analysis of the paper is a positive one, i.e. to document the magnitude and understand the determinants of the heterogeneity in monetary policy expectations.

At the same time, some of the analysis has some normative implications, though these can be no more than tentative and suggestive. Clearly, it is desirable for central banks to disseminate information and knowledge as equally as possible across agents not least because a high degree of heterogeneity is likely to result in financial market uncertainty and volatility. The identification of communication effects in our framework is not without difficulties because traditional measures of central bank communication do not entail a geographic component and the empirical approach has to rely on indirect means. Nevertheless, our empirical findings indicate that Fed communication policies have indeed been successful in reducing disparities in forecast performance stemming from differences in regional economic conditions. However, communication appears to have been less successful in addressing those disparities that stem from differences in skills of analysts. In particular the fact that such heterogeneity is linked to regional factors, which significantly influence forecasters' expectations, raises many issues for policy-makers, such as the choice of communication tools and strategies to enhance a more homogenous understanding of monetary policy.

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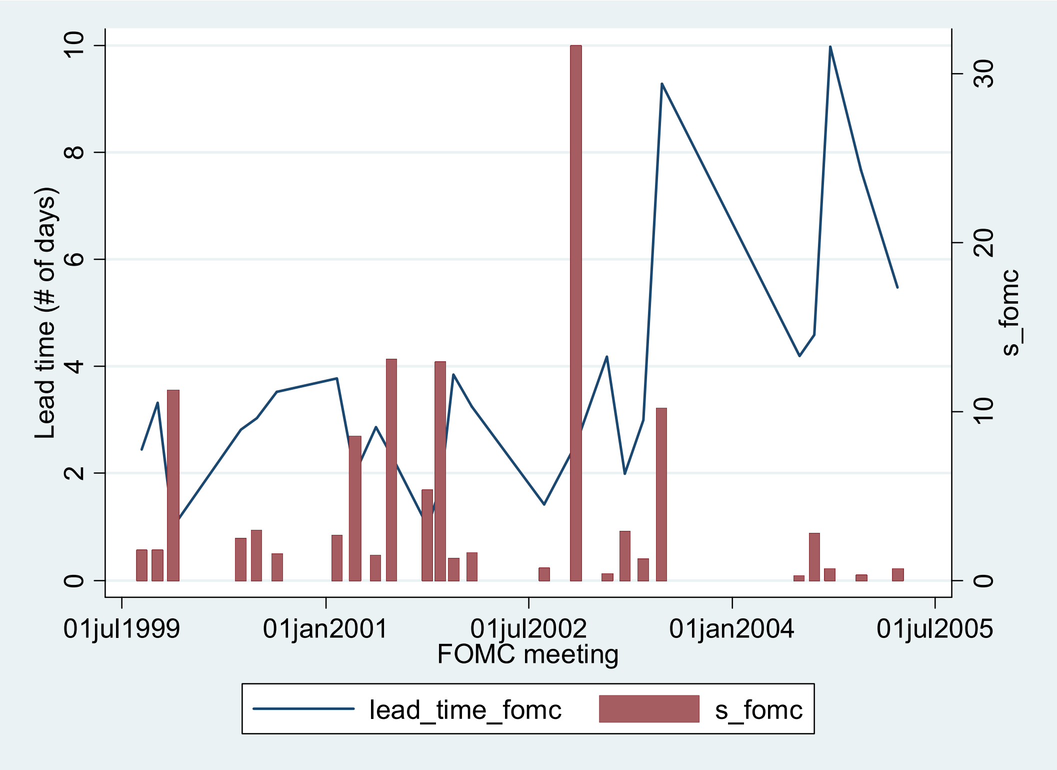
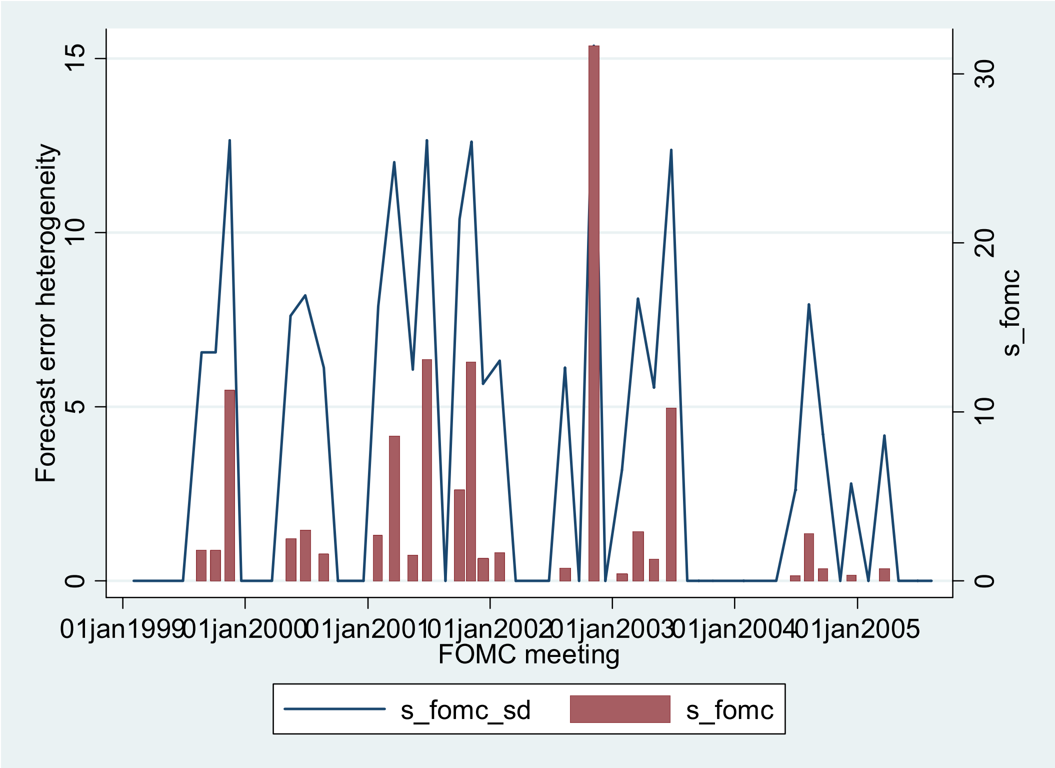
Figure 1: Distribution of forecast errors over time and lead time of forecast decisions



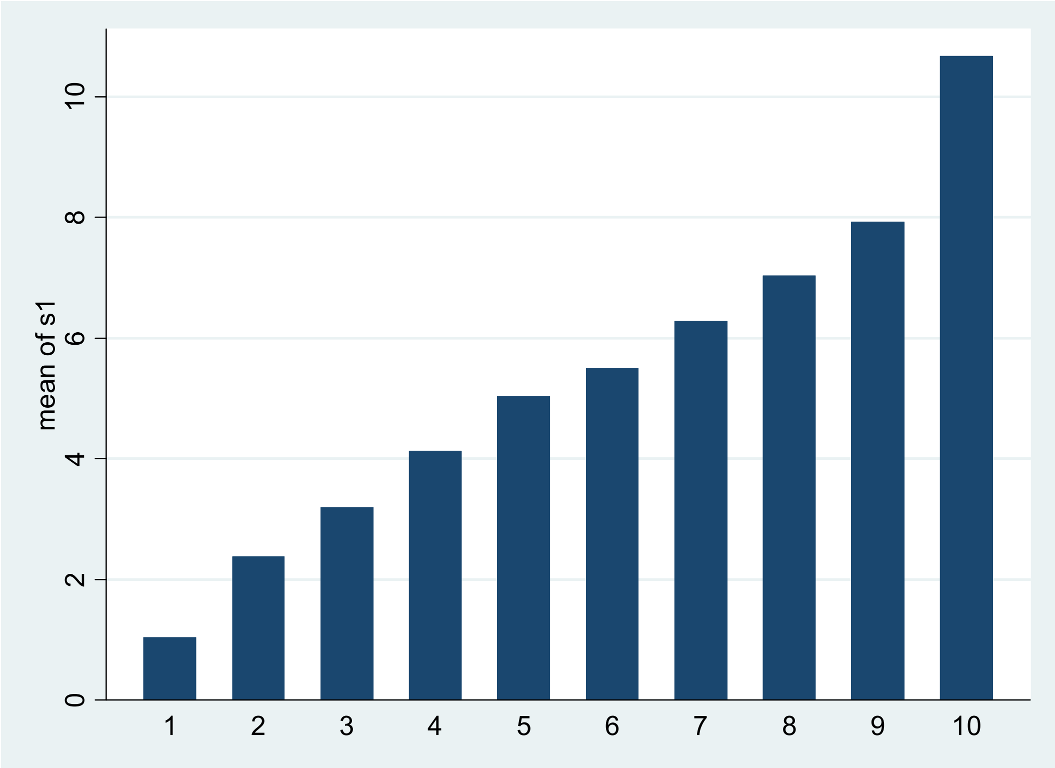
Note: The solid line (left y-axis) shows the average number of days before an FOMC meeting that the forecasters have provided their monetary policy forecasts. The bars (right y-axis) show the average absolute forecast error in b.p. across individual forecasters for each FOMC meeting.

Figure 2: Forecast error heterogeneity and distribution of forecast errors over time



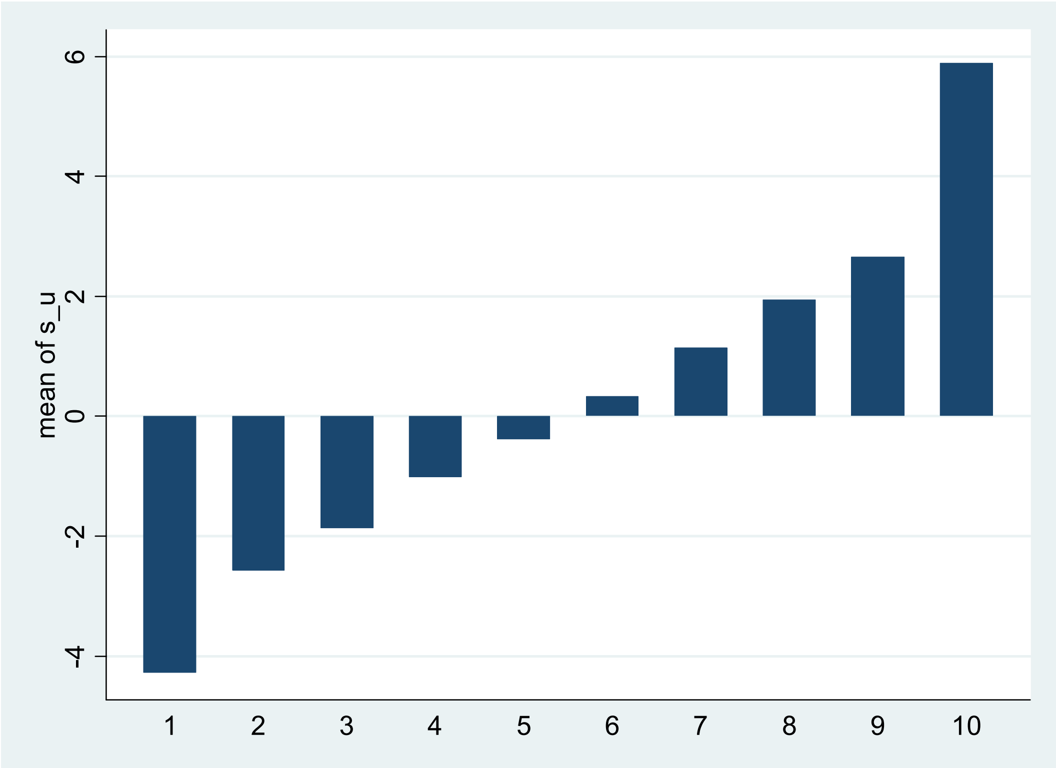
Note: The solid line (left y-axis) shows the standard deviation of the absolute forecast errors across individual forecasters by FOMC meeting. The bars (right y-axis) show the average absolute forecast error in b.p. across individual forecasters for each FOMC meeting.

Figure 3: Distribution of forecast errors across individual forecasters



Note: The figure shows the average absolute forecast error in b.p. by individual forecaster, ranging from the decile with the lowest forecast errors in decile 1 to those 10% with the highest prediction error in decile 10, for those FOMC meetings in which there was heterogeneity in expectations across individual forecasters.

Figure 4: Distribution of *time-corrected* forecast errors across individual forecasters, FOMC meetings with expectations heterogeneity



Note: The figure shows the average absolute *time-corrected* forecast error in b.p. by individual forecaster, ranging from the decile with the lowest forecast errors in decile 1 to those 10% with the highest prediction error in decile 10, for those FOMC meetings in which there was heterogeneity in expectations across individual forecasters.

Table 1: The effect of monetary policy surprises and heterogeneity in expectations on the S&P 500

	(1)		(2)		(3)	
	coef.	*std. err.*	coef.	*std. err.*	coef.	*std. err.*
			13:45-14:45			
Absolute surprise	0.135 **	*0.055*	--	--	0.074	*0.054*
Heterogeneity	--	--	0.238 ***	*0.062*	0.187 ***	*0.070*
Volatility, preceding day	0.668 **	*0.299*	0.639 **	*0.247*	0.658 **	*0.258*
# observations	54		54		54	
R^2	0.202		0.269		0.301	
			14:45-15:30			
Absolute surprise	0.079 **	*0.037*	--	--	0.042	*0.031*
Heterogeneity	--	--	0.141 ***	*0.045*	0.113 **	*0.045*
Volatility, preceding day	1.100 ***	*0.221*	1.090 ***	*0.207*	1.090 ***	*0.210*
# observations	54		54		54	
R^2	0.488		0.525		0.540	
			15:30-16:00			
Absolute surprise	0.018	*0.024*	--	--	-0.009	*0.020*
Heterogeneity	--	--	0.076 ***	*0.023*	0.082 ***	*0.027*
Volatility, preceding day	0.579 ***	*0.145*	0.588 ***	*0.126*	0.600 ***	*0.135*
# observations	54		54		54	
R^2	0.298		0.374		0.376	

Note: The table explains volatility of the S&P 500 returns on FOMC announcement days through the magnitude of the monetary policy surprise (measured by the absolute mean forecast error in the Bloomberg survey), the heterogeneity in market expectations (measured by the standard deviation of the individual forecast errors) and volatility during the identical time window on the preceding trading day. FOMC releases are made at 14:15. Standard errors are robust to heteroskedasticity. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively..

Table 2: Country coverage

Australia	Germany	Sweden
Canada	Ireland	Switzerland
China	Italy	The Netherlands
Denmark	Portugal	United Kingdom
France	Spain	United States

Table 3: City coverage

Albany	Copenhagen	Jupiter	New Canaan	Saint Louis
Amsterdam	Danville	Kennesaw	New Haven	Saint Petersburg
Ann Arbor	Detroit	King of Prussia	New York City	Salt Lake City
Arlington	Dublin	Leeds	Newport Beach	San Francisco
Atlanta	East Lansing	Lexington	Northville	Silicon Valley
Baltimore	El Paso	Lisbon	Oakland	Stamford
Berlin	Essen	Lisle	Omaha	Stockholm
Birmingham	Fairfield	Little Rock	Ottawa	Stuttgart
Bonn	Frankfurt am Main	London	Paris	Sydney
Boston	Greenwich	Los Angeles	Pasadena	Tempe
Boulder	Hamburg	Lugano	Pepper Pike	Toronto
Bridgeport	Hannover	Madrid	Philadelphia	Utrecht
Burlington	Hoboken	McLean	Phoenixville	Valhalla
Calabasas	Holland	Menomonee Falls	Pittsburgh	Vineland
Chapel Hill	Hong Kong	Milan	Potomac	Washington DC
Charlotte	Honolulu	Milwaukee	Princeton	West Chester
Chicago	Houston	Minneapolis	Raleigh	Wilmington
Cleveland	Islandia	Montreal	Richmond	Zug
College Park	Jacksonville	Muenchen	Rome	
Columbus	Jersey City	Murfreesboro	Rye	

Table 4: Summary statistics, US and foreign forecasters

	All					USA		Foreign	
	# obs	mean	std. dev.	min.	max.	# obs	mean	# obs	mean
Dependent variable:									
Monetary policy forecast error	268	3.17	4.49	0	25	194	3.40	74	2.56
Location:									
Distance to Federal Reserve	268	2.06	2.70	0	13.11	194	0.75	74	5.71
Washington DC	268	0.05	0.22	0	1	194	0.07	74	0.00
New York City	268	0.26	0.44	0	1	194	0.35	74	0.00
Financial center	268	0.17	0.37	0	1	194	0.13	74	0.27
USA	268	0.72	0.45	0	1	194	1.00	74	0.00
English language	268	0.81	0.40	0	1	194	1.00	74	0.30
Foreign	268	0.28	0.45	0	1	194	0.00	74	1.00
Regional economic conditions:									
CPI inflation difference	268	0.571	0.211	0.030	1.496	194	0.580	74	0.547
Income growth difference	268	0.021	0.010	0.001	0.063	194	0.023	74	0.017
Employment growth difference	268	0.014	0.007	0.000	0.040	194	0.015	74	0.011
Individual background									
Institution:									
Investment bank	268	0.47	0.50	0	1	194	0.51	74	0.35
Commercial bank	268	0.23	0.42	0	1	194	0.12	74	0.51
Forecast institution	268	0.15	0.36	0	1	194	0.19	74	0.04
Other institution	268	0.16	0.36	0	1	194	0.18	74	0.09
Job position:									
Economist	268	0.12	0.33	0	1	194	0.08	74	0.24
Senior Economist	268	0.07	0.26	0	1	194	0.08	74	0.05
Chief Economist	268	0.26	0.44	0	1	194	0.30	74	0.15
Executive	268	0.18	0.38	0	1	194	0.20	74	0.14
No information	268	0.36	0.48	0	1	194	0.34	74	0.42
Education:									
Bachelor's degree	268	0.04	0.20	0	1	194	0.04	74	0.04
Master's degree	268	0.19	0.39	0	1	194	0.22	74	0.09
PhD degree	268	0.21	0.41	0	1	194	0.27	74	0.04
No information	268	0.56	0.50	0	1	194	0.46	74	0.82
Employment history:									
Fed Board of Governors	268	0.04	0.20	0	1	194	0.06	74	0.00
Fed New York	268	0.02	0.15	0	1	194	0.03	74	0.00
No Fed experience	268	0.59	0.49	0	1	194	0.60	74	0.57
No information	268	0.35	0.48	0	1	194	0.31	74	0.43
Macro forecast performance									
CPI inflation forecast	121	0.001	0.007	-0.002	0.069	76	0.000	45	0.003
Industrial production forecast	126	0.000	0.001	-0.006	0.004	77	0.000	49	-0.001

Note: "No information" means that individuals have not provided any entry for a particular item.

Table 5: Summary statistics, by US region

	Northeast		Midwest		South		West	
	# obs	mean	# obs	mean	# obs	mean	# obs	mean
Dependent variable:								
Monetary policy forecast error	100	3.05	32	3.13	45	3.55	17	6.13
Location:								
Distance to Federal Reserve	100	0.36	32	0.97	45	0.48	17	3.70
Washington DC	100	0.00	32	0.00	45	0.29	17	0.00
New York City	100	0.68	32	0.00	45	0.00	17	0.00
Financial center	100	0.10	32	0.34	45	0.00	17	0.27
USA	100	1.00	32	1.00	45	1.00	17	1.00
English language	100	1.00	32	1.00	45	1.00	17	1.00
Foreign	100	0.00	32	0.00	45	0.00	17	0.00
Regional economic conditions:								
CPI inflation difference	100	0.541	32	0.680	45	0.597	17	0.571
Income growth difference	100	0.027	32	0.014	45	0.022	17	0.019
Employment growth difference	100	0.016	32	0.012	45	0.014	17	0.014
Individual background								
Institution:								
Investment bank	100	0.65	32	0.34	45	0.27	17	0.67
Commercial bank	100	0.11	32	0.22	45	0.07	17	0.07
Forecast institution	100	0.15	32	0.22	45	0.29	17	0.13
Other institution	100	0.09	32	0.22	45	0.38	17	0.13
Job position:								
Economist	100	0.10	32	0.03	45	0.07	17	0.07
Senior Economist	100	0.11	32	0.09	45	0.02	17	0.07
Chief Economist	100	0.32	32	0.31	45	0.27	17	0.27
Executive	100	0.16	32	0.31	45	0.20	17	0.20
No information	100	0.31	32	0.25	45	0.42	17	0.40
Education:								
Bachelor's degree	100	0.04	32	0.06	45	0.04	17	0.00
Master's degree	100	0.24	32	0.28	45	0.13	17	0.20
PhD degree	100	0.30	32	0.16	45	0.36	17	0.07
No information	100	0.42	32	0.50	45	0.47	17	0.73
Employment history:								
Fed Board of Governors	100	0.08	32	0.03	45	0.04	17	0.00
Fed New York	100	0.06	32	0.00	45	0.00	17	0.00
No Fed experience	100	0.61	32	0.63	45	0.58	17	0.53
No information	100	0.25	32	0.34	45	0.38	17	0.47
Macro forecast performance								
CPI inflation forecast	56	0.000	8	0.000	7	0.000	5	0.000
Industrial production forecast	56	0.000	8	-0.001	8	0.000	5	-0.002

Note: "No information" means that individuals have not provided any entry for a particular item.

Table 6: The role of *geography* for the accuracy of forecasts of FOMC monetary policy decisions

	Location								Regional conditions		Combined		Combined - OLS	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.
Location:														
Distance	0.029	*0.021*												
Western US region			-0.120	*0.285*										
Southern US region			0.148	*0.179*										
Midwestern US region			-0.266 *	*0.158*										
Northeastern US region			-0.264 **	*0.118*										
Washington DC					-0.823 **	*0.391*	-0.832 **	*0.402*			-1.139 ***	*0.415*	-3.659 ***	*1.232*
New York City					-0.427 ***	*0.110*	-0.436 ***	*0.144*			-0.585 ***	*0.162*	-2.658 ***	*0.816*
Financial center					-0.437 ***	*0.127*	-0.441 ***	*0.152*			-0.530 ***	*0.161*	-2.137 ***	*0.823*
USA							-0.010	*0.147*			-0.063	*0.152*	-0.488	*0.786*
English language							-0.037	*0.213*			-0.011	*0.219*	0.070	*1.027*
Regional conditions:														
CPI inflation difference									0.353 **	*0.171*	0.310 *	*0.175*	2.706 **	*1.186*
Income growth difference									-1.491	*5.472*	10.029 *	*5.911*	32.04	*31.67*
Employment growth difference									9.712 *	*5.127*	14.623 ***	*5.582*	70.81 **	*27.73*
# of observations	1323		1323		1323		1323		1323		1323		1323	
McFadden's adj. R^2	0.326		0.328		0.338		0.335		0.328		0.339		0.463	
Cragg-Uhler (Nagelkerke) adj. R^2	0.494		0.500		0.509		0.509		0.498		0.518		--	
McKelvey & Zavoina's R^2	0.496		0.506		0.521		0.521		0.502		0.536		--	

Notes: The table shows results of the ordered probit model (2) in columns (1) to (6), and of a corresponding OLS model in column (7). The variable USA denotes forecasters located in the US, but neither in Washington DC, New York City or another financial center. The variable English language captures non-US forecasters residing in an English-speaking country. The variables for regional economic conditions are calculated as the absolute deviation of regional conditions from the respective regional average over the sample period.. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively.

Table 7: The role of *individual skills* for the accuracy of forecasts of FOMC monetary policy decisions

	Individual background								Macro forecast performance		Combined		Combined - OLS	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.	coef.	std. err.
Individual background														
Institution:														
Investment bank	-0.492 ***	*0.150*									-0.386 **	*0.162*	-1.822 **	*0.829*
Commercial bank	-0.165	*0.162*									-0.122	*0.165*	-0.551	*0.903*
Forecast institution	-0.223	*0.170*									-0.306 *	*0.182*	-1.516 *	*0.964*
Job position:														
Economist			-0.550 **	*0.252*							-0.572 **	*0.261*	-2.509 **	*1.181*
Senior Economist			-0.405 **	*0.197*							-0.220	*0.218*	-1.035	*1.084*
Chief Economist			-0.397 **	*0.157*							-0.311 *	*0.167*	-1.441	*0.912*
No information			-0.123	*0.168*							-0.068	*0.184*	-0.249	*0.994*
Employment history:														
Fed Board of Governors					-0.423 *	*0.237*					-0.522 **	*0.256*	-2.391 **	*0.952*
Fed New York					-0.120	*0.181*					-0.104	*0.210*	-0.588	*1.025*
No information					0.026	*0.125*					-0.066	*0.140*	-0.689	*0.716*
Education:														
Bachelor's degree							-0.151	*0.254*			-0.179	*0.285*	-0.869	*1.320*
Master's degree							-0.244 **	*0.124*			-0.417 ***	*0.140*	-1.905 ***	*0.673*
No information							0.049	*0.113*			-0.030	*0.136*	-0.058	*0.698*
Macro forecast performance														
CPI inflation forecast									-0.437 ***	*0.156*	-0.447 ***	*0.162*	-1.633 ***	*0.631*
Industrial production forecast									0.082	*0.154*	0.126	*0.157*	0.589	*0.692*
# of observations	1323		1323		1323		1323		1323		1323		1323	
McFadden's adj. R^2	0.333		0.330		0.326		0.327		0.329		0.335		0.463	
Cragg-Uhler (Nagelkerke) adj. R^2	0.503		0.502		0.497		0.498		0.498		0.524		--	
McKelvey & Zavoina's R^2	0.511		0.510		0.500		0.501		0.503		0.542		--	

Notes: The table shows results of the ordered probit model (2) in columns (1) to (6), and of a corresponding OLS model in column (7). The variables for the macro forecast performance are dummies, taking the value of one if the absolute difference is *smaller* than the mean across all observations over the whole sample period and for all individuals, and the value of zero if this difference is *larger*. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively.

Table 8: *Geography* versus *individual skills*: explaining the accuracy of forecasts of FOMC monetary policy decisions

	Ordered probit			Ordered probit, excluding foreigners			OLS		
	coef.		std. err.	coef.		std. err.	coef.		std. err.
Location:									
Washington DC	-1.148	**	*0.452*	-0.961	**	*0.411*	-4.023	***	*1.447*
New York City	-0.380	**	*0.192*	-0.288	**	*0.146*	-2.090	**	*0.976*
Financial center	-0.459	***	*0.173*	-0.398	**	*0.185*	-2.196	***	*0.853*
USA	-0.089		*0.190*				-0.752		*0.963*
English language	0.101		*0.236*				0.421		*1.089*
Regional economic conditions:									
CPI inflation difference	0.379	**	*0.181*	0.207		*0.190*	2.806	**	*1.161*
Income growth difference	10.596	*	*6.026*	11.182	*	*5.930*	32.597		*32.043*
Employment growth difference	13.482	**	*5.691*	13.151	**	*5.756*	62.426	**	*27.536*
Individual background									
Institution:									
Investment bank	-0.429	**	*0.178*	-0.378	**	*0.189*	-1.916	**	*0.896*
Commercial bank	-0.181		*0.195*	-0.097		*0.223*	-0.859		*0.992*
Forecast institution	-0.355	*	*0.193*	-0.311		*0.202*	-1.541		*0.966*
Job position:									
Economist	-0.480	*	*0.270*	-1.132	**	*0.504*	-2.047	*	*1.194*
Senior Economist	-0.137		*0.233*	-0.241		*0.268*	-0.673		*1.089*
Chief Economist	-0.165		*0.184*	-0.413	**	*0.203*	-0.765		*0.943*
No information	0.014		*0.201*	-0.257		*0.216*	0.127		*1.027*
Employment history:									
Fed Board of Governors	-0.409		*0.258*	-0.496	**	*0.252*	-1.820	*	*0.969*
Fed New York	-0.087		*0.210*	-0.091		*0.213*	-0.402		*1.036*
No information	-0.086		*0.142*	0.020		*0.185*	-0.810		*0.704*
Education:									
Bachelor's degree	-0.140		*0.291*	0.225		*0.341*	-0.760		*1.317*
Master's degree	-0.398	***	*0.147*	-0.359	**	*0.148*	-1.744	**	*0.684*
No information	-0.030		*0.145*	-0.102		*0.157*	0.041		*0.708*
Macro forecast performance									
CPI inflation forecast	-0.459	***	*0.166*	-0.525	***	*0.190*	-1.733	***	*0.641*
Industrial production forecast	0.157		*0.160*	0.121		*0.178*	0.647		*0.708*
# of observations	1323			1056			1323		
McFadden's adj. R^2 (OLS: adj. R^2)	0.339			0.299			0.470		
Cragg-Uhler (Nagelkerke) adj. R^2	0.540			0.511			--		
McKelvey & Zavoina's R^2	0.567			0.540			--		

Notes: See tables 7 and 8 for the definition of the variables. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively.

Table 9: The role of Federal Reserve communication policy for geography and skills

	Number of Fed statements			Fed communication dispersion		
	coef.		std. err.	coef.		std. err.
Location:						
Washington DC	-0.345		*0.400*	-1.199		*1.462*
New York City	-0.363	**	*0.168*	-0.570		*0.703*
Financial center	-0.099		*0.171*	-0.532		*0.749*
USA	-0.410	**	*0.198*	-1.434		*0.892*
English language	0.149		*0.272*	1.221		*1.333*
Regional economic conditions:						
CPI inflation difference	-0.025		*0.166*	-0.336		*0.981*
Income growth difference	-0.897	**	*0.422*	-2.782	**	*1.198*
Employment growth difference	-0.029		*0.169*	0.318		*0.730*
Individual background						
Institution:						
Investment bank	-0.538	***	*0.210*	-2.961	***	*0.799*
Commercial bank	-0.848	***	*0.229*	-3.757	***	*0.934*
Forecast institution	-0.596	***	*0.232*	-2.751	***	*0.933*
Job position:						
Economist	0.684	**	*0.271*	2.265	*	*1.166*
Senior Economist	0.296		*0.237*	1.195		*0.914*
Chief Economist	0.356	*	*0.198*	1.142		*0.802*
No information	0.309		*0.217*	0.410		*0.866*
Employment history:						
Fed Board of Governors	-0.186		*0.239*	-1.078		*0.880*
Fed New York	-0.152		*0.168*	-0.179		*0.726*
No information	-0.178		*0.148*	-0.043		*0.610*
Education:						
Bachelor's degree	0.021		*0.291*	-1.240		*1.098*
Master's degree	-0.378	***	*0.145*	-1.751	***	*0.594*
No information	-0.167		*0.154*	-0.730		*0.602*
Macro forecast performance						
CPI inflation forecast	-0.106		*0.138*	-0.953		*0.602*
Industrial production forecast	-0.115		*0.171*	0.651		*0.486*
# of observations	868			868		
McFadden's adj. R^2	0.309			0.316		
Cragg-Uhler (Nagelkerke) adj. R^2	0.584			0.590		
McKelvey & Zavoina's R^2	0.633			0.620		

Notes: The table shows the coefficients for the listed variables, interacted with the corresponding communication variable in each column from model (3), obtained from ordered probit estimates. See tables 7 and 8 for the definition of the non-interacted variables. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively.

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