

An Exploration of Heterogeneity in the Macroeconomic Expectations of Firms

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Abstract

Firms' expectations on macroeconomic uncertainty are heterogeneous. However, we find that regardless, an exogenous macroeconomic news shock has a strong effect on adjusting all firms' beliefs towards professional forecasts. This research aimed to understand how firm characteristics are associated with macroeconomic uncertainty. Initially, we find that firms in the transportation or construction industries or those who have less competitors, are less efficient, have a higher profit margin or who have less frequent discussion with their customers are associated with higher levels of macroeconomic uncertainty. These findings add to the existing literature on how expectations of firms are formed. Following this, we extend our analysis by using a RCT and examining how firms respond to an exogenous macroeconomic shock. We find that firms respond strongly to macroeconomic news, and there is limited heterogeneity in their reaction. The key exception to this is by industry groups. When interacting firm characteristics with industry groups, we find much larger degrees of heterogeneity. Our results support the Lucas Island Model hypothesis (1975), that agents form their aggregate beliefs based on environment specific information. Overall, these findings imply that central banks should consider how firm characteristics impact macroeconomic uncertainty, but nonetheless, uncertainty can be reduced universally through effective communication.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor used artificial intelligence tools or generative artificial intelligence tools (unless it is clearly stated, and referenced, along with the purpose of use), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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Chapter 1.

Introduction

It is intuitive that firms' expectations are heterogenous, and that uncertainty is economically important. However, this research is, to the best of our knowledge, the first of its kind to analyse the intersection of these points in-depth. Motivated by the growing literature stating the importance of macroeconomic uncertainty, and the empirical findings that agents exhibit heterogenous expectations, this research analyses how firm characteristics impact the macroeconomic expectations of firms. Research shows that increases in macroeconomic uncertainty cause negative economic outcomes (Coibion et al., 2024; Kumar et al., 2023) but how these expectations are formed remains an open question. We decide to explore this. Specifically, our research questions are:

1) How do firms form their expectations about macroeconomic conditions?

2) What are the heterogeneous effects of macroeconomic news on firms' expectations?

Through analysing these two questions, this research aims to have a meaningful contribution to the existing literature on firms' expectations formation and provide valuable insights for policy makers on the impacts of a news shock on macroeconomic expectations. To begin with, this study will analyse the heterogeneous beliefs of firms by utilising a range of different firm characteristics available in the data. After, we will evaluate the impact of macroeconomic news on firms' expectations. One of the main contributions of this study is that our results are causal as we use a randomised controlled trial (RCT) to analyse how a news shock caused firms to adjust their expectations. One of the major gaps in the existing literature is the formation of macroeconomic uncertainty expectations for firms. Therefore, this will be the focus of our analysis and where our research can provide a valuable contribution to field of expectations. The unique contributions of our research and the key results are as follows.

Firstly, this study is the first in our knowledge to use a wide range of firm characteristics to understand the potential heterogeneity in firms perceived macroeconomic uncertainty. By exploiting the large number of firm characteristics available in the data, this research can effectively compare where the greatest source of heterogeneity stems from. We find large degrees of heterogeneity in firms' initial expectations and that in particular, industry groups have a significant impact on firms' macroeconomic expectations. Firms in different industries have heterogenous beliefs, with professional services and manufacturing firms exhibiting lower

uncertainty, while transportation and construction firms appear to have higher levels of uncertainty. For other firm characteristics, having more competition, being more efficient, having a lower profit margin and a greater customer network are all associated with reduced levels of uncertainty. These findings suggest that in line with research on firms' inflation expectations (Baumann et al., 2024; Candia et al., 2024; Coibion et al., 2018), macroeconomic uncertainty beliefs are heterogeneous. Further, we hypothesise that industry groups are a driver for heterogeneity in firms' expectations.

Secondly, by using information treatments, this research examines how firms with different characteristics respond to an exogenous news shock. Studies on the macroeconomic uncertainty of New Zealand firms (Kumar et al., 2023) and European consumers (Coibion et al., 2024), similarly use a RCT to analyse how agents' macroeconomic uncertainty beliefs react to information treatments. However, both focus on the aggregate reaction to information treatments. This research extends the idea that firms react strongly to information treatments and analyses whether there are systematic differences in how firms respond to a news shock. The results show that while firm characteristics do have an impact on the reaction to receiving information, this result is weak. Our findings show that all firms react strongly to information treatments and suggests policy makers can reduce uncertainty universally through effective communication.

Thirdly, this study is the first of its kind to analyse the impact of industries on macroeconomic uncertainty in detail. Andrade et al. (2022a) suggest that firms form their macroeconomic expectations by observing industry specific information and extrapolating, which aligns with the Lucas Island model (1975). Our results support this hypothesis as we found that industry groups were the largest contribution to heterogeneity in macroeconomic uncertainty and the reaction to a news shock. Therefore, we decided to explore the impact of industries in more depth. Other literature has documented heterogeneity in firms' expectations by industry, for example, Candia et al. (2024), find, as do we, that firms in the professional services industry have lower inflation expectations than other firms. However, our research goes beyond this by analysing the impact of the interaction of industry and other firm characteristics on uncertainty. We find that when splitting firms into samples by their industry and another firm characteristic there is greater heterogeneity. Further, the RCT allows us to analyse how a news shock causes firms in different industries to adjust their beliefs. This information is particularly useful for policy makers who are looking to reduce uncertainty, as our analysis suggests specific groups policy makers can target.

Fourthly, the results document distinct differences between how firms form macro and microeconomic uncertainty expectations. Similar to macroeconomic uncertainty, firms' sales uncertainty is heterogeneous initially. This aligns with the results from Awano et al., (2018) who use a survey of British firms and show that firms who are younger, smaller, and less productive are more uncertain about their own future turnover growth. Further, we find that firms' reaction to an exogenous macroeconomic uncertainty shock on their sales uncertainty is heterogeneous.

Therefore, a macroeconomic news shock causes firms to adjust their microeconomic expectations, but the reaction is varied. This supports the idea that in forming firm-level expectations, firms underreact to macroeconomic shocks (Born et al., 2022). Our findings suggest that firms form their macro and micro beliefs jointly, but firms display substantial heterogeneity in their response to a macroeconomic news shock on their sales expectations. Future research could explore the mechanisms through which macroeconomic news influences firms' microeconomic beliefs.

Alongside the unique contributions of this study, many of the results from this research support findings from previous literature. To begin with, the results align with imperfect information theories (Maćkowiak & Wiederholt, 2009; Mankiw & Reis, 2002; Sims, 2003) of expectations formation, rather than the rational expectations hypothesis (Muth, 1961). Not only are firms uncertain, but they have varying levels of uncertainty which could be explained by rational inattention (Sims, 2003) or the sticky information model (Mankiw & Reis, 2002). Further, we find that firms are not fully informed, as they have a strong reaction to information treatments. This result rejects the rational expectations hypothesis (Muth, 1961), which would suggest that firms already incorporate all available information into their expectations.

The results also support the findings of previous authors on the heterogeneity in agents' expectations. Other authors have often observed heterogeneity in the inflation expectations of consumers (Mankiw et al., 2003; Coibion & Gorodnichenko, 2015a), firms (Coibion et al., 2018; Candia et al., 2024) and professional forecasters (Andrade & Bihan, 2013). We document that differences in firm characteristics, such as industry groups, competition, profit margin and efficiency are associated with heterogeneity in macroeconomic expectations. Therefore, we expand the findings of other authors by analysing how many types of firms' expectations exhibit heterogeneity. As raised by Bloom (2009), it is often difficult to separate uncertainty and mean movements, even though they have distinctly different impacts. Our research is influential as we analyse both mean and uncertainty impacts throughout, allowing us to separate these two effects.

The study is structured as follows. Chapter 2 provides an in-depth discussion on the past literature, providing context for the purpose of this analysis. Chapter 3 outlines the survey design and presents the results and implications for monetary policy. Chapter 4 concludes.

Chapter 2.

Literature Review

2.1. Introduction

Expectations as a topic has long been studied in economics. What people think is going to happen will influence how they react today. Therefore, it has been a central challenge to understand how expectations are formed, and the impact that this has on the economy. The rational expectations hypothesis (Muth, 1961) has been the prominent expectations model used in central banks, but recent empirical research has consistently shown deviations from this theory (Baumann et al., 2024; Coibion & Gorodnichenko, 2015a). In particular, heterogeneity is a key feature of expectations (Mankiw et al., 2003; Weber et al., 2022), and the rational expectations model does not account for this. Further, while prior research focused on the first moment (level) of expectations, the seminal work of Bloom (2009) highlighted the importance of second moment (uncertainty) expectations. Therefore, this literature review discusses the current empirical and theoretical evidence for how expectations are formed, and how macroeconomic uncertainty has become an increasingly relevant field of research.

Within the expectations literature, there continues to be significant debate about how expectations are formed theoretically. This is particularly relevant as many of the models used by policy makers are in support of the rational expectations hypothesis, developed by Muth (1961), despite strong empirical evidence that shows deviations from this theory (Coibion & Gorodnichenko, 2015a). Alternatively, imperfect information models such as sticky information (Mankiw & Reis, 2002) and rational inattention (Sims, 2003; Maćkowiak & Wiederholt, 2009) suggest that there is some cost involved in collecting information. These hypotheses for expectations formation have more empirical support (Armantier et al., 2016; Coibion et al., 2020), as agents update their expectations when given information that is publicly available.

The imperfect information models also allow for heterogeneity. The cost to some people will be bigger than others, highlighting that there can be systematic differences in expectations. This aligns with empirical research that consistently shows heterogeneity in expectations for consumers (Coibion et al., 2022; Weber et al., 2022), firms (Candia et al., 2024; Coibion et al., 2018) and professional forecasters (Conrad & Lahiri, 2023; Andrade et al., 2022b), as well as across these groups (Mankiw et al., 2003). There are many different hypothesised explanations for heterogeneity. One of the key hypotheses is that agents use local information such as supermarket and petrol prices for consumers (Coibion & Gorodnichenko, 2015b; D'Acunto et al., 2021c) and industry information for firms (Andrade et al., 2022a), to inform their aggregate expectations.

As more worldwide events have occurred which have dramatically increased the uncertainty of individuals and firms, it has been recognised that while level shocks are important, so are uncertainty shocks (Bloom, 2009). Research has shown that increases in uncertainty have many negative impacts on the economy. Baker et al. (2016) develop an economic policy uncertainty index to show how increases in economic policy uncertainty are associated with decreases in real economic activity. To examine the causal impacts of macroeconomic uncertainty, Kumar et al. (2023) discuss how increases in uncertainty cause a decline in investment, employment and prices for New Zealand firms. Also, Coibion et al. (2024) show that for EU consumers, increases in macroeconomic uncertainty cause a decline in spending, particularly luxury and non-durable goods, depressing the economy.

This chapter is organised as follows. Section 2.2. discusses different models for expectations formation. Section 2.3. focuses on literature which examines the observed heterogeneity in expectations across households, firms and professional forecasters. Section 2.4. analyses the relationship between uncertainty and policy. Section 2.5. discusses the theoretical and empirical methods for measuring macroeconomic uncertainty. Finally, section 2.6. highlights the current gap in the literature and the basis for examining the heterogeneity of macroeconomic uncertainty in our analysis.

2.2. Expectations Formation

2.2.1. Rational Expectations

The way in which households, firms and governments make decisions has been a point of interest in economic literature for many years. As discussed by Keynes (1936), people's expectations play a key role in determining their decisions and the aggregate demand function. Keynes believed that expectations were often subjective, based on how optimistic a person felt at the time. During the great depression of the 1930's this conclusion was supported. However, as economies expanded, new theories emerged and notably among these was the adaptive expectations theory developed by Friedman (1957) and Cagan (1956). Their theory suggests that expectations are formed solely based on past experiences, and the model weights information from more recent time periods more heavily than older ones to form future expectations.

Despite some theoretical (Nerlove, 1958) and empirical (Chow, 2011) arguments for the adaptive expectations model, in the 1970's the rational expectations hypothesis became the predominant expectations formation model. Originally proposed by Muth (1961), he discussed how the economic system as a whole does not waste information, and that people do not make systematic errors in their predictions. Contrary to Keynes, Muth believed that expectations were based on an informed prediction of economic outcomes and therefore the mean expectation of agents would

be the same as what economic theory predicts. This assumption formed the rational expectations hypothesis which states that people form their expectations based on all available information, past and present. Muth's theory aligned with adaptive expectations as previous experiences are accounted for, however it goes beyond this by also including present information.

Rational expectations gained significant traction during the 1970's after Muth's idea was developed by other authors. Lucas (1972) introduced rational expectations into the Philip's curve to suggest that not only is the trade-off between unemployment and inflation vertical in the long run (Friedman, 1968; Phelps, 1967;1968), but it is generally vertical in the short run too. This is because if people can anticipate the governments' actions under rational expectations, then unless a truly surprising event or a shock occurs, there will be no effect on employment or output, only prices.

Through analysing the policy implications of the rational expectations hypothesis, Sargent and Wallace (1975) introduced the policy-ineffectiveness proposition. Their theory suggests that monetary policy is not an effective tool in increasing output or employment because people are not systematically wrong and will be anticipating monetary policy decisions. This opposes Friedman's view that more government intervention is required, and instead suggests that government intervention is not successful unless it is truly surprising, supporting the ideas proposed by Lucas.

In the following decades, the prevailing assumption on expectations in many macroeconomic models was the rational expectations hypothesis (e.g. efficient market hypothesis, permanent income theory of consumption). Even despite the questions (McCallum, 1979) and extreme approximations (Maddock & Carter, 1982) of the rational expectations hypothesis. This highlights the importance of empirically verifying the theory. However, as survey evidence was disregarded at the time (Lucas, 1980; Machlup, 1946; Prescott, 1977), empirically measuring expectations was extremely difficult. This caused authors to only infer expectations through econometric methods which largely gave inconclusive results (Sargent, 1976; Nefci & Sargent, 1978).

Despite theoretical support for rational expectations, throughout the 1980's empirical evidence which directly measured expectations started to show strong consistent deviations from the theory (Chow, 1989; Figlewski & Wachtel, 1981; Lovell, 1986). These works concluded that people tend to exhibit adaptive expectations more than rational expectations, as they weight the past more heavily than is logical, and do not use all available information. Due to the lack of empirical support for rational expectations, this led to the rise of several other hypotheses which assume that people are rational but may be unable to gather full information as stated in rational expectations. These models show a convergence in the empirical and theoretical evidence.

2.2.2. Imperfect Information

Without disregarding rational expectations entirely, sticky information models (Mankiw & Reis, 2002) suggest that people do not update their information often, however when they do, they obtain rational expectations. This shows that often outdated information is used to form expectations and explains how random mistakes are made by agents. Research by Klenow & Willis (2007) provides empirical support for the sticky information model, by showing that prices do react to old information. This suggests that price-setters are not constantly updating their beliefs. Sticky information aligns with the notion that wages and prices are often sticky and resist changing as introduced by Keynes (1936). A key point underpinning sticky information is that there is some cost associated with collecting information, otherwise, a person would always stay up to date, in line with rational expectations.

This leads on to an alternative imperfect information model, the rational inattention hypothesis introduced by Sims (2003), as the cost in this model is attention. Due to people having limited time and attention spans, people are unable to collect all available information and must trade-off between precision in decision making and costs associated with collecting and processing information. Therefore, it is a rational decision and optimal for agents to only obtain some information instead of all and specifically, to choose the information to process. The rational inattention model allows for different cognitive abilities and reflects that both the amount of information and the nature of the information consumed will differ and inform decisions.

Over the last 20 years, access to information has grown with the internet, whilst attention and time constraints remain the same. This has contributed to the significant traction that rational inattention has gained. A key implication under the rational inattention model is that agents are sluggish to respond to new events because people are choosing what information to pay attention to, and some will not pay attention to the new information (Maćkowiak & Wiederholt, 2009). Therefore, when a macroeconomic shock occurs, expectations will be less responsive on average and policymakers should account for this when making decisions (Sims, 2010).

When the rational expectations model was proposed, little empirical evidence was presented to support the theory. However, in recent years research has consistently shown that the rational expectations is not a good model for real-world behaviour, favouring the imperfect information models instead. Results from Coibion and Gorodnichenko (2015a), who use surveys to document inflation expectations, strongly reject the null hypothesis of rational expectations. They suggest that systematic differences in expectations are due to information frictions, which supports the imperfect information models. Similarly, many subsequent surveys have found that by providing participants with publicly available information, participants change their beliefs (Armantier et al., 2016; Coibion et al., 2020; Roth & Wohlfart, 2020). This shows that agents were not entirely informed prior to the treatment, and therefore, provides support for imperfect information models.

The question of how firms set prices has long been studied in economics, and one of the theories used to explain this phenomenon is rational inattention. In a rational inattention model, incentives play an important role and it is suggested that firms pay more attention to idiosyncratic information. Therefore, nominal economic shocks have real effects on prices because firms are slow to respond, due to a lack of attention on aggregate information (Woodford, 2001). As raised by Maćkowiak and Weiderholt (2009) in their model, if firms allocate nearly all their attention to idiosyncratic shocks and little to the aggregate, this helps to explain why micro-level prices are flexible and macro-level prices are rigid, as observed in the data.

The policy implications of the rational inattention model are critical in light of recent crises such as the Global Financial Crisis and the Covid-19 pandemic as people do make mistakes and are not entirely informed (Maćkowiak et al., 2023). Unlike in the rational expectations model, agents are not 100% sure on what the future state will look like. As agents aren't processing all available information, and are unable to perfectly predict outcomes, they make mistakes (Matějka & McKay, 2015). This shows how uncertainty plays a key role with limited cognitive abilities. As attention is largely driven by incentives, as discussed by (Maćkowiak et al., 2023), if uncertainty increases, then agents are more incentivised to pay attention, and this alters their choice decisions to be more elastic (Maćkowiak & Wiederholt, 2009).

Alternative hypotheses which fall under the realm of imperfect information are bounded rationality (Sargent, 1999) and models of learning (Evans & Honkapohja, 1999; Orphanides & Williams, 2005). Bounded rationality explains that the proper form of the economic system can never be known, and therefore people make decisions based on their approximation of the economic system. Similarly, models of learning say that in each period people will revise their expectations through updating their own forecast, even if this forecast is inaccurate. Both models show inaccuracy in expectations due to the inability to know everything. Empirical research has also shown these models to be good predictors of people's expectations (Branch and Evans, 2006; Gabaix, 2014; Milani, 2007).

Despite the original theoretical basis for rational expectations, as many authors have pointed out, no matter how good a theory is, it must be supported by the data. Given the lack of empirical support for rational expectations compared to the imperfect information theories, in recent years, the literature has looked to imperfect information models to explain how people form their expectations instead. As discussed by Lucas (1976), the implications for policy are drastically different depending on the different expectation model used. Therefore, it is vital to accurately reflect how expectations are formed.

2.3. Heterogeneity in Expectations Formation

2.3.1. Heterogeneity Across Groups

A key feature of expectations formation is the heterogeneity in people's beliefs. This is supported by the real-world observations that people do have vastly different abilities and resources to collect information and form their decisions. While there is little scope for heterogeneity in rational expectations because people share the same information sets, it can be explained through rational inattention models where people chose to pay attention to different information.

By exploring the observation that people exhibit heterogeneous expectations, Haltiwanger & Waldman (1985), develop a model where people use different types of expectation models and show that the overall effect on the economy differs greatly when expectations are heterogeneous. The model consists of two different agents, where one shows rational expectations and the other present "incorrect" expectations. The result is that the overall outcome differs and is attenuated toward either the rational expectations or the incorrect expectations depending on the characteristics of the model. This shows that diverse expectations can lead to different outcomes and are therefore should be considered an important feature of economic models.

While traditional economic models have assumed rational expectations, Gabaix (2020) implements a heterogeneous agent model, to account for information frictions. The model uses cognitive discounting to show how with heterogeneity, the further in the future an event is, the more uncertain an agent will be, and their expectations converge to the steady state. Through using the heterogeneous agent model, Gabaix's model helps explain real world phenomenon. Rational expectations models are unable to answer the zero-lower bound and the "forward guidance problem" (Del Negro et al., 2012) where Gabaix's heterogeneous agent model does. It also shows how inflation targeting is not optimal, but fiscal stimulus is effective. Similarly, models which have tried to include heterogeneity in expectations have been tackled using finite-level planning (Woodford, 2019), and k-level thinking (Farhi & Werning, 2019).

To provide empirical evidence of heterogeneity in expectations formation, Mankiw et al. (2003) use surveys and document that expectations are vastly different, among different groups of people over time. Their research discusses how both professional forecasters and households disagree about inflation expectations, however the disagreement among households is about 2 to 3 times larger than for professional forecasters. Moreover, aggregate household expectations are subject to a significant upward bias which is driven largely by big right tails. In support of this, D'Acunto & Weber (2024) show that the average median forecast for US households is 2.24 percentage points lower than the mean from 2013 – 2024. This suggest that a number of survey participants hold extremely high inflation expectations, causing a substantial difference in the mean and median.

Supporting the idea that agents' expectations exhibit heterogeneity, Coibion & Gorodnichenko (2015a) utilise survey data of 12 different countries and measure a range of different

macroeconomic variables. They show that regardless of the region, macroeconomic variable, or group of people (households, professional forecasters, firms) heterogeneity in beliefs is persistent. Experimental evidence by Hommes (2011) shows that even in a lab environment where people are of a similar background (university students) and given the same information, due to different information processing approaches and past experiences, there is heterogeneity in expectations. This highlights the necessity to understand heterogeneity in expectations formation both across groups (households, firms, professional forecasters, central bankers) and within groups.

2.3.2. Households

Given the strong evidence that heterogeneity in expectations for households exists, it is critical to understand the characteristics that are associated with expectation formation. Work by Madeira & Zafar (2012) analyses the inflation expectations of households using surveys and finds that women, ethnic minorities, and less educated individuals are slower to adjust their expectations and rely more on their personal experience rather than current events. Also, low socioeconomic status has been shown to be associated with higher inflation expectations (Angelico & Di Giacomo, 2020; Das et al., 2019; De Bruin et al., 2010), and financial literacy is associated with lower inflation expectations (Burke & Manz, 2014; De Bruin et al., 2010).

A possible explanation as discussed by Souleles (2004) and Anderson (2008) is that women, ethnic minorities, and low-income individuals tend to have larger forecast errors in their inflation expectations than average, which leads to systematic heterogeneity in beliefs. Despite this, through using a panel dataset, Anderson (2008) shows that there is a learning effect. For those whose forecast is the most inaccurate in the first interview, they revise and improve their expectations the most in a second interview. This shows how when there is an incentive to revise expectations and pay attention, such as regular interviews on beliefs, people do.

Incentives are a driver in how attentive individuals are for all activities, and this includes attentiveness to inflation information. In countries where inflation has been historically low, information provided to firms and households has seen large revisions in their beliefs, compared to countries where inflation has been high (Cavallo et al., 2017; Weber et al., 2023). This shows how in environments where past inflation is low agents are less likely to pay attention to inflation information compared to agents who have experienced high inflation environments because it is less relevant to them. This supports the rational inattention expectation formation model as agents are rationally choosing not to pay attention to inflation when it is not impacting their life and decisions significantly.

Further, perceived inflation environment as discussed by Jonung (1981) and Weber et al. (2022), plays an important role in the formation of expectations as beliefs on recent past inflation is a strong predictor of household's inflation forecasts. Weber et al. (2022) discuss how for consumers who have high inflation expectations, this is because they believe that inflation is currently high,

although it may not be. This highlights the importance of informing consumers on current inflation if policymakers want to influence expectations and anchor inflation, as misperceptions of recent inflation could be driving high inflation expectation.

Media plays an important role in expectations formation as a key form of information for many households is the news that they choose to pay attention to. Conrad et al. (2022) use German survey data to show how socioeconomic factors heavily influence the news that consumers choose to pay attention to and in turn the news influences their expectations. Individuals who are younger, low income, or low education are more likely to not inform themselves about monetary policy through any form of media. Consumers who rely on traditional newspapers for information tend to be better informed about current inflation. As a result, their inflation expectations are generally lower, more accurate, and less uncertain compared to individuals who primarily use social media or do not engage with information about monetary policy in any form. Therefore, to communicate effectively to a wider number of households through news, Coibion et al. (2022) mention how the Central Bank of Jamaica have used music videos, and the Governor of the Bank of Finland has used Twitter extensively to convey monetary policy decisions rather than solely through traditional news outlets.

By using a randomised controlled trial (RCT) with over 20,000 consumers, Coibion et al. (2022) show how providing consumers with information – such as recent past inflation, FOMC’s inflation forecasts, FOMC’s targets or the FOMC’s entire statement – caused the average inflation expectation of households to decline by 1.2 percentage points. However, providing households with credible newspaper articles on the same information had half the result. This suggests that the central bank needs to directly reach consumers through their own channels rather than rely on news outlets to diffuse the message. Further, D’Acunto et al. (2021a) show that by having a more diverse policy committee, the central bank can reach more households as women who receive information from a female committee member are more likely to acquire further inflation information, thereby lowering their inflation expectations.

The Lucas Island model (1975) suggests that people live on their own island and make all decisions and form all expectations based on the information obtained in their island. Extending this, D’Acunto et al. (2021c) use surveys to show how households largely use environment specific evidence to form their macroeconomic expectations. Therefore, as all environments are heterogeneous, this will lead to heterogeneous expectations also. The main sources of information for US consumers from the surveys in 2015 and 2016 by D’Acunto et al. (2021c) are their own shopping experiences and the experiences of their friends and family. Replicated in a high-inflation environment in the US, D’Acunto & Weber (2024) document that still, households on average rank energy bills and their shopping experience as a more important source of information than all other sources, which includes government reports and media.

Supermarket shopping is a significant portion of many households weekly purchasing and as Cavallo et al. (2017) discuss, households do use supermarket price information to form their expectations. However, their memory of these prices can be highly inaccurate and introduces errors into their expectations. Interestingly, rather than the relative share of their income which is spent on the goods, D'Acunto et al. (2019) discuss how the frequency of purchase determines the weight of the purchase on agents' expectations formation. They also show that after controlling for the primary shopper in a household (often women), the difference in inflation forecasts for men and women disappears. Therefore, this provides evidence that inflation expectations for households are largely a function of their observed environment, which does not accurately reflect all consumer goods and is heterogeneous by nature.

The price volatility and the frequency of purchase is high for petrol. Therefore, many authors have discussed the influence of petrol prices on household expectations as consumers use petrol prices as a signal for aggregate conditions. In particular, Coibion & Gorodnichenko (2015b) discuss how more than half of the difference in inflation expectations for households compared to professional forecasters is due to oil prices. Similarly, Kilian & Zhou (2022) document that 42% of the heterogeneity in households' inflation expectations can be accounted for by petrol prices. While Binder (2018) finds that households inflation expectations and petrol prices are positively correlated, they suggest that this effect is short-term and spikes in the price of petrol will only impact households inflation expectations temporarily.

Although evidence suggests that the economic environment plays a major role in shaping expectations, heterogeneous cognitive abilities have also been shown to be the source for heterogeneous expectations among households. Through using IQ data from Finland, D'Acunto et al. (2019) show how controlling for IQ eliminates the previously discussed association between inflation expectations and education or income. Also, Cavallo et al. (2017) discuss how many individuals form their expectations using inaccurate sources despite inflation information being readily available. When providing consumers with information on supermarket prices and on inflation statistics, the majority of the participants assigned equal weight to both measures, rather than full weight on inflation statistics. This shows how cognitive constraints may be preventing households from forming their expectations in a fully rational way. These results suggest that effective monetary policy should tailor its information announcements to access groups with different cognitive abilities.

The relationship between consumer sentiment and expectations is evident as consumers are biased by their personal environment and beliefs. Conrad et al. (2022) highlight how the way consumers form expectations shows substantial bias from their current and past experiences. Similarly, Braggion et al. (2024) discuss how people who have experienced high inflation, such as in Germany in the 1920's, expect high inflation still today and there is a diffusion effect where

parents pass these experiences and expectations onto their children. This highlights how influenced expectations are by high inflation events, even if they occurred 100 years ago.

Given the subjective and biased nature of expectations, it is key to understand the relationship between consumer confidence and expectations. How sure people feel about the future state of the economy through current observations and confidence from past experiences shapes their macroeconomic expectations and spending decisions. Understanding the heterogeneity of macroeconomic uncertainty and how this will influence expectations has significant implications for how monetary policy is conducted. Effective monetary policy communication that reduces uncertainty may be able to decrease the heterogeneity in expectations and re-anchor inflation expectations for households (Coibion & Gorodnichenko, 2015a).

2.3.3. Firms

While firms' inflation expectations are less dispersed than households (Link et al., 2023), there is still a large amount of heterogeneity. Surveys have shown that firms expectations are distinct from both households and professional forecasters (Candia et al., 2024), but firms' expectations are more aligned with households, as both groups make large forecast errors. As firms set prices, employ people, and negotiate wages, these decisions play a significant role in the economy, and they are formed based on their expectations.

As with households, firm characteristics are associated with heterogenous expectations. Coibion et al. (2018) show that firms in New Zealand who have more competitors, who are planning to change their prices sooner or whose profit is impacted greatly by the relative change in price are more likely to stay up to date with inflation information. Afrouzi (2023) likewise finds that firms with more competitors are more likely to pay attention to aggregate variables, such as inflation. In their study, Coibion et al. (2018) also discuss how attention to inflation is likely the primary reason for differences in firms' beliefs. Many of the New Zealand firms surveyed stated that they believe inflation is not material to their business and this may help explain why firms are uninformed on current inflation. This aligns with surveys in New Zealand by Kumar et al. (2015), who document that media is the most widely used source for firms on inflation information, however, in countries with historically low inflation, such as New Zealand, media coverage on inflation is limited and not always a strong force in driving agents' inflation expectations (Haldane, 2017).

Attention to information can help explain many of the observed characteristics associated with differences in beliefs for firms. Yang (2022) shows that firms who sell a wide range of products are more likely to stay informed than others. They document that firms who sell a larger number of products have smaller forecast errors, and also have a greater willingness to pay for professional forecasts. The rational inattention theory suggests that firms who sell a wider range of products are incentivised to pay attention, and the empirical evidence supports this. As

Baumann et al. (2024) discuss, firm size is also associated with dispersion in inflation forecasts, with larger firms being more accurate than smaller firms. This could be as larger firms are more likely to have professional forecasters or subscribe to regularly receive macroeconomic information than smaller firms. Further, firms in specific industries such as the financial services industry have lower inflation expectations than others, such as in the food and drink industry (Candia et al., 2024). A possible explanation for this is that firms in some industries are more interrelated with the macroeconomy (such as financial services firms), meaning that it is more important for firms in these industries to pay attention. Therefore, there are a wide range of characteristics which have been observed in the data to be associated with differences in firms' beliefs.

Although firm characteristics are associated with heterogeneity in inflation expectations, the driving force of this is likely caused by the suggested attentiveness to information or other factors. Work by Bartiloro et al. (2019), suggests that the heterogeneity observed in Italian firms' inflation expectations is largely due to information stickiness and the business cycle rather than firm characteristics. When inflation is further from the central bank's target, dispersion in firms' expectations rises. Especially as many firms in low-inflation countries like the U.S. are inattentive on inflation information, with only 20% of CEOs in a recent survey of U.S. managers able to correctly estimate the FED's inflation target (Candia et al., 2024).

Similar to households, Weber et al. (2025) discuss how firms who are given identical information in low inflation countries react more than firms in high inflation countries, such as shown in Uruguay (Frache & Lluberas, 2017), aligning with the rational inattention model. However, Baumann et al. (2024) show how in the high-inflation environment of Europe 2023, firms continued to have a strong reaction to the information treatments provided. This suggests that countries with historically low inflation, that are currently in a high inflation environment are still uncertain and the sticky information model explains this well. This suggests that if the central bank can communicate inflation information effectively to firms, it can significantly reduce heterogeneity, even in high-inflation environments where the rational inattention model would suggest that firm managers should be well informed about inflation. In particular, Baumann et al. (2024) discuss how forward-looking information treatments were the most effective at reducing firms' inflation expectations to be in line with the central bank's target.

Recent research also suggests that firms form their expectations using mostly industry-level information rather than macroeconomic information (Andrade et al., 2022a). This helps explain why firms in some industries are more accurate than others (Candia et al., 2024). It is hypothesised that as households form information based on their local environment, similarly, firms use their industry environment to form expectations, leading to heterogeneity in expectations. By using this assumption, Gaballo (2018), shows that if firms infer macroeconomic variables through the price signals, they receive in purchasing inputs, the small amount of heterogeneity in

environments can create large amounts of uncertainty and price rigidity to aggregate conditions. This provides a potential explanation to how firm heterogeneity can occur and the flow-on effects it can create.

As the majority of recent research in the heterogeneity of expectations for firms uses surveys, Savignac et al. (2024) discuss how the position of the person within a firm who answers the survey matters. They find that for French firms, CEOs and CFOs have lower inflation expectations than other employees, even when controlling for gender, income, and education. This suggests that the price-setters are more informed about inflation and when conducting surveys, it is important to ensure consistency across the position of the respondent. As firm managers are influenced by their own shopping experiences (Kumar et al., 2015) when forming inflation expectations for the firm, it is especially important that the price-setters are the respondents of the survey, to ensure that expectations align with pricing decisions.

Heterogeneity in expectations is relevant as it informs the decisions made by firms. As discussed by Coibion et al. (2019), through using a randomised controlled trial (RCT) on Italian firms, higher inflation expectations leads firms to raise their prices, increase their demand for credit, employ fewer people and invest less. This result has similarly been documented in both New Zealand (Coibion et al., 2018) and France (Savignac et al., 2024). While all three studies found that increased inflation expectations saw firms raise their prices, in the New Zealand survey, higher inflation expectations were associated with higher employment, while in Italy and France the opposite is true. Coibion et al. (2020) suggest that this may be due to the perceived effect of inflation on other macroeconomic variables, due to the historical environment of each country. Therefore, the specific context of a country's historical and current macroeconomic environment matters, and this highlights how more studies from a variety of countries are needed to fully understand how heterogeneous expectations impact firm decisions.

Although the literature on firms' expectations is much thinner than for households, it is evident that heterogeneity for firms exists. Some strong hypotheses for the driver of heterogeneity in firm expectations are the rational inattention model and firms using industry-level information to inform their macroeconomic beliefs. As heterogeneity in expectations impacts the subsequent decisions made by firms, understanding both the drivers and the flow-on effects of expectations could improve the communication decisions of policy makers and positively impact the macroeconomy.

2.3.4. Professional Forecasters

Surveys documenting the expectations of professional forecasters have been around for a significantly longer time than for households and firms. The key reasons for this are twofold; they are generally easier to collect, and under the rational expectations model, the expectations of firms, households and professional forecasters will not be systematically different. As a result,

professional forecasters expectations have often been used as a proxy for all economic agents' expectations. However, these groups have heterogeneous expectations and therefore professional forecasters are not a good proxy for all agents in the economy. Compared to other groups, professional forecasters exhibit far more accuracy and far less heterogeneity in their beliefs, but there is still heterogeneity in professional forecasters beliefs.

While households and firms may form heterogeneous expectations due to a lack of attention and cognitive ability, professional forecasters should not be bound by the same constraints. However, as shown by Andrade & Bihan (2013), professional forecasters also exhibit heterogeneity in their expectations formation. Through using the European Central Bank Survey of Professional Forecasters, they discuss how professional forecasters, do not update their forecasts constantly, in line with the sticky information model, and they disagree about their forecasts when updated, as in rational inattention. This shows that, even groups of people who spend considerably more time on forming their expectations of macroeconomic variables, have heterogeneity.

In a review of the European Central Bank's Survey of Professional Forecasters, Bowles et al. (2007) discuss how forecasters systematically underestimated inflation and provide evidence for a large amount of heterogeneity in inflation, GDP growth, and unemployment expectations. While in the short-term their average inflation expectations fluctuate more, over the long-term there is an anchoring effect in line with the European Central Bank's inflation targets at just below 2%. These observations provide valuable insights into the heterogeneity in professional forecasters expectations.

As surveys of professional forecasters typically ask for forecasts of different time horizons, researchers have studied how long- vs short-term forecasts differ. Patton & Timmerman (2010) use the Consensus Economics survey from 1991 to 2008, to show how dispersion in forecasts is higher for longer time periods compared to shorter time periods. They suggest that this is primarily due to heterogeneity in forecasters prior beliefs and their models, which are more important for, and diverge as the time horizon increases. Conrad & Lahiri (2023) support this finding by showing that for professional forecasters, differences in beliefs drive heterogeneity in the long run whilst differences in interpretations of the same information drive heterogeneity in the short run.

Many professional forecasters appear to exhibit persistent views by being either consistently optimistic or pessimistic. As discussed by Malmendier et al. (2020), heterogeneity in expectations among FOMC members can be explained by their own individual inflation experiences. This biases them to be either optimistic or pessimistic. Similarly, Andrade et al. (2022b) show how even professional forecasters are subject to associative memory. A forecaster who is considering multiple models may choose one based on their personal experience or context. On the other hand, Batchelor (2007), discusses how using the Consensus Economics surveys, professional

forecasters may be either financially or reputationally incentivised to bias their forecast to be consistently either pessimistic or optimistic as a way to differentiate themselves.

Not only do professional forecasters disagree about their point estimate of inflation expectations, but their probabilistic distributions, representing how uncertain individual forecasters are, are heterogeneous and exhibit persistence (Boero et al., 2014). The relationship between uncertainty and disagreement for professional forecasters is key as often disagreement among professional forecasters has been used as a proxy for macroeconomic uncertainty, despite these two measures being distinctly different from one another (Zarnowitz & Lambros, 1987). Despite this, Lahiri & Sheng (2010) show that professional forecaster disagreement is a good proxy for uncertainty when the macroeconomic environment is stable because the perceived uncertainty from a shock is low.

Central bankers all generally have the same objectives, but there is evidence to suggest that still heterogeneity in expectations and beliefs persists. A study by Meade (2005), uses the transcripts of the US Federal Open Market Committee to show that while there is little disagreement in voting, the preceding discussion shows much larger amount of heterogeneity. On the other hand, a large body of literature has set out to discuss the most effective way for central banks to communicate (Blinder et al., 2008; Eusepi & Preston, 2010) and notably, as discussed by Ehrmann & Fratzscher (2005), unified communication from the central bank on monetary policy decreases uncertainty and increases the ability for market participants to anticipate monetary policy decisions. Therefore, whilst in central banks heterogeneity may be a key feature, the appearance of agreement is a useful mechanism in reducing uncertainty, and therefore true heterogeneity in beliefs is difficult to observe.

Overall, the heterogeneity in expectations formation is evident. Between groups, Weber et al. (2022), document that it is widely acknowledged that households and firms have more dispersed expectations than professional forecasters, and forecast confidence for professional forecasters is also higher. Within groups, characteristics are associated with differences in expectations which can often be explained by their environment, cognitive abilities or previous experiences and shows alignment with the sticky information and rational inattention models. However, much of the literature has focused on inflation expectations and the heterogeneity of a variety of different types of expectations should be explored in detail.

2.4. Uncertainty and Policy

2.4.1. The Policy Implications of Macroeconomic Uncertainty

Whilst expectations have been thoroughly studied in macroeconomics, the focus has largely been on inflation expectations. Another form of expectations, uncertainty, is an important factor in firms' and households' decision making. For example, if you are unsure about how much it will

rain tomorrow you might be more likely to cancel your picnic, compared to if you are quite certain it will not rain. Likewise, if a firm is unsure about the future state of the economy, it might take a ‘wait and see’ approach and decide not to expand its operations by investing in a new factory or hiring more workers right now. Whilst these conclusions appear to be common sense, it has only been recently through the seminal work of Bloom (2009) that economic literature has recognised the importance of measuring macroeconomic uncertainty and understanding the policy implications of fluctuations in uncertainty.

Through mapping volatility in financial markets to firm outcomes, Bloom (2009) proposes exogenous uncertainty shocks as the source of fluctuations in business cycles. Bloom’s work builds on literature that explains why uncertainty is important for the economy. For instance, the option value of waiting theory by Bernanke (1983), explains how in times of high uncertainty it is better to delay investment in large projects, as the potential losses from acting early can be substantial. Bernanke’s theory shows how there is value in the flexibility to wait and see, and this is reflected in finance as we place monetary value on the ability to wait through the financial instrument, options.

In Bloom’s 2009 paper, he shows empirically that increases in uncertainty are associated with a reduction in investment and employment for firms by analysing 17 short and sharp recessions found in the data from 1962 – 2008. He discusses the important implications for how economic policy is conducted as he finds that uncertainty shocks generate strong but temporary recessions. These findings align with events which increase widespread macroeconomic uncertainty such as 9/11, the Global Financial Crisis and, more recently, the Covid-19 pandemic and have motivated further research in the subject.

Prior to Bloom’s seminal work (2009), expectations research has primarily only considered the effect of a first moment or a level shock, such as an increase in inflation expectations. However, Bloom (2009) highlights the importance of the second moment, uncertainty in expectations, for policy and economic decision making. One of the key challenges raised by Bloom, is that first and second moment shocks often move together and are empirically difficult to separate. Therefore, both measuring second moment effects and understanding the implications of a second moment shock can be challenging.

Building off of the work by Bloom, many subsequent authors have found that increases in uncertainty will have adverse effects on the economy. For firms, Bloom’s results have been replicated to show that uncertainty shocks will decrease investment and employment (Kumar et al. 2023), alongside a decrease in prices, a reduction in sales and a reduced likelihood of opening new facilities or investing in new technology. For households, Coibion et al. (2024), discuss how increases in macroeconomic uncertainty will cause reductions in spending, in particular, on non-durable goods, package holidays and luxury goods. As consumption, investment and employment

are all key channels for economic growth, this highlights the serious impacts of uncertainty shocks on real economic outcomes.

While the qualitative results from Bloom (2009) and the impact on policy have largely been reinforced by subsequent work, some alternative suggestions have been made. Work from Jurado et al. (2015), finds that contrary to Bloom (2009), between 1960 – 2011, there were only 3 periods where uncertainty was greater than 1.65 standard deviations from its mean, representing deep recessions. Rather than short and sharp recessions which generated a bust-boom like impact, Jurado et al. (2015) discuss how their uncertainty shocks are persistent. This suggests that policymakers should be far more wary of uncertainty shocks than Blooms' predictions.

A key implication of uncertainty shocks for policymakers is that agents become less responsive to policy tools. This supports the findings from Jurado et al. (2015) that an uncertainty shock results in a deep recession. Aastveit et al. (2013) provide evidence for the policy ineffectiveness proposition with uncertainty by using different measures of uncertainty in the US. They further show that as uncertainty increases in the U.S. this will also decrease investment in Canada, the UK and Norway, although to a much lesser extent. This highlights the diffusion effect of uncertainty which according to Londono et al. (2024) is economically and statistically large and can largely be explained by trade channels. Therefore, not only does domestic uncertainty influence how consumers and firms respond to policy but increases in international uncertainty can affect domestic markets and complicate effective policy.

As uncertainty is a material issue for how central banks conduct monetary policy, the interconnectedness of communication and uncertainty is crucial. Although, there is no perfect approach to central bank communication, a key tool in the literature is transparency. Woodford (2005) discusses how monetary policy is significantly more effective when the public understands the central banks actions. As the FOMC increasingly became more transparent from 1996 onwards, this was associated with decreases in public uncertainty and allowed the FOMC to align and reach their policy targets. The two key mechanisms of transparent policy communication, according to Blinder et al. (2008), are “creating news” and “reducing noise”, both of which help manage the public's expectations. Reducing noise means decreasing aggregate uncertainty, and therefore the more effective the transparent communication, the lesser uncertainty and vice versa.

During business-as-usual, transparency in central bank communication is a useful mechanism for reducing uncertainty. However, it has also been shown that communication is an important tool for central banks during times of uncertainty (Geraats, 2002; Lehtimäki & Palmu, 2019). As discussed by Yıldırım-Karaman (2017), during an uncertainty shock the independence of the central bank is associated with less adverse outcomes compared to central banks who are not independent. He also finds in his empirical study of 43 countries between 1972 – 2009, that central

bank transparency reduces the adverse impacts of these uncertainty shocks, but to a lesser extent than central bank independence.

Uncertainty shocks impact the decisions made by agents in the economy and are an important aspect of macroeconomic expectations for policymakers to consider in achieving their targets. As heightened uncertainty has adverse effects on the economy it is important for the central bank to reduce this uncertainty in general. However, more research is required to understand the most effective way for central bankers to reduce macroeconomic uncertainty when an uncertainty shock does occur, especially as agents become less responsive to policy tools.

2.4.2. Economic Policy Uncertainty

Macroeconomic uncertainty encompasses uncertainty in a range of different macroeconomic factors. One element of this, economic policy uncertainty focuses on uncertainty around monetary policy decisions. This type of uncertainty is particularly relevant when understanding how agents perceive policy makers and their communication strategies. In particular, as economic policy uncertainty has risen significantly in recent years, this suggests that policy makers need more effective communication strategies.

Economic policy uncertainty research has gained significant traction in recent years with world events such as Brexit, anti-globalisation and the wars in Ukraine and Gaza highlighting the importance of stable economic policy for better economic outcomes. In light of this, Baker et al. (2016) created an Economic Policy Uncertainty Index (EPU) which uses a variety of different measures to determine the aggregate level of economic policy uncertainty for 29 different countries. The index historically has been highly correlated with world events such as wars and elections, and is also highly correlated with the VIX index, providing support for the measure as a proxy of policy uncertainty (Al-Thaqeb & Algharabali, 2019). Following the global financial crisis in 2008, the global EPU reached a record high. However, over the subsequent decade, policy uncertainty remained elevated and in April 2020, during the COVID-19 crisis, the EPU more than doubled its 2008 peak. Recently, in the early months of 2025, the global EPU has risen again above its highest levels during COVID-19.

As well as the global EPU, which was originally created by Baker et al. (2016), EPU's for many individual countries have since been created. Following the method outlined by Baker et al. (2016), an EPU for China (Davis et al., 2019), Japan (Arbatli et al., 2017), New Zealand (Ali et al. 2022) and many other countries in the OECD have been developed. The extensive research into developing these indices for many countries and understanding the various implications, provides significant support for the measure.

As with macroeconomic uncertainty, unexpected increases in economic policy uncertainty are associated with significant and persistent declines in real economic activity (Baker et al. 2016).

For firms, Kang et al. (2013), discuss how increases in the EPU decrease investment and this effect is greater during a recession. However, the largest 20% of firms don't change their investment decisions in times of increased policy uncertainty, showing heterogeneity in firms' actions. Likewise, increases in the EPU are associated with increases in unemployment (Caggiano et al. 2016), and the impact of an EPU shock on unemployment is 6 times higher during a recession than an expansion. These studies show an asymmetry in how firms respond to an EPU shock. Not only are they more sensitive in a recession, but firms are heterogeneous in their reaction, with firm size impacting their investment decisions.

Financial markets are also significantly impacted by economic policy uncertainty and as discussed by Mueller et al. (2017), exchange rates and policy uncertainty are highly connected. They show how on days where the FOMC announcements are made, market participants can earn excess financial returns by shorting the US dollar and going long on foreign currencies, which can be explained as compensation for the extra monetary policy uncertainty they bear. Also, the EPU impacts stock returns. On average, stocks decrease on days where policy changes are announced as positive impacts tend to be more expected than negative ones (Pástor & Veronesi, 2012), and in general, Brogaard & Detzel (2015) show how the EPU is positively correlated with stock market returns.

Overall, strong evidence exists that uncertainty has large, negative effects on the macroeconomic environment through multiple different channels. Therefore, it is key for policymakers to understand the most effective way to conduct policy in order to both reduce uncertainty in heightened periods, and to mitigate the risk of uncertainty shocks causing deep recessions.

2.5. Measuring Macroeconomic Uncertainty

2.5.1. Methods for Measuring Macroeconomic Uncertainty

Following on from work by Bloom (2009), subsequent researchers have tried to measure macroeconomic uncertainty empirically. However, as stated by Bloom (2014) "uncertainty is an amorphous concept" and therefore, there is no explicitly defined measure. Instead, a variety of different proxies have been used to measure macroeconomic uncertainty. While there has been disagreement about the most appropriate form of measurement, the qualitative results from all measures are generally the same (Baker & Bloom, 2013; Caldara et al., 2016). Macroeconomic uncertainty shocks have a significant impact on real economic outcomes.

The traditional method of measuring uncertainty uses financial market indicators of volatility, as used by Bloom (2009) to discuss 17 events associated with an excess in stock market volatility. In financial markets it is widely acknowledged that it is more difficult to predict prices when volatility increases, and therefore, volatility can be used to proxy uncertainty. Further, as shown

by Ramey & Ramey (1995), volatility and growth have a strong negative correlation. While volatility may increase due to increased risk-aversion and leverage (Bloom, 2014), these theoretical explanations do not appear to explain all the increase in volatility during recessions. As discussed by Schwert (1989), leverage affects account for only 10% of the increases in volatility during recessions and Bekaert et al. (2013) discuss how the largest component of the VIX index is uncertainty rather than risk aversion. While financial market indicators of volatility have been used as a good measure for uncertainty it has been critiqued for fluctuating in times where uncertainty does not because other factors do influence the measures (Jurado et al., 2015).

As the literature on macroeconomic uncertainty has grown other measures through observation have been used to proxy uncertainty such as natural disasters (Baker & Bloom, 2013). Through using disasters as exogenous shocks, Baker & Bloom (2013) discuss that both a level decrease and an uncertainty increase are associated with a decline in growth, with uncertainty having just as large, if not larger effects than the level changes. The disasters measure relies on the increase in newspaper coverage following the shock, to weight the size of the shock. Expanding on this concept, the frequency of words associated with uncertainty in newspapers has also been used as a proxy for uncertainty (Baker et al., 2016). This has been further developed into the Economic Policy Uncertainty Index which has been widely used across countries, as the data is comprehensive, publicly available and has been audited.

Alternative measures utilise different components of surveys to illicit aggregate uncertainty measures. This can be argued to be a more direct measure of agent's uncertainty, as it reflects their inability to forecast. Another advantage of this approach is the ability to identify uncertainty for different groups of people, such as households, firms, and professional forecasters. To measure aggregate uncertainty, the disagreement in expectations of professional forecasters has been widely used (Boreo et al., 2014; Zarnovitz & Lambros, 1987) because there is reduced information stickiness compared to households and firms.

Although some have argued that the disagreement among forecasters is not a good measure of uncertainty as it captures heterogeneity and disagreement rather than uncertainty, work by Bachmann et al. (2013) shows how the dispersion of forecast errors for firms and their disagreement is highly correlated, providing support for both measures. The dispersion in forecast errors reflect an inability to accurately forecast, showing that the economy is becoming more unpredictable. Jurado et al. (2015), utilise econometric techniques based on aggregate forecast dispersion to measure uncertainty. Their measure is highly regarded as it is an aggregation of thousands of data points, utilising 11 different macro variables, aiming to be a reference point as to whether other proxies for uncertainty are good measures or not.

2.5.2. Establishing Causation

As stated by Kocherlakota (2009), “the difficulty in macroeconomics is that virtually every variable is endogenous”. This highlights both the challenge and the importance of being able to show causal relationships in macroeconomics. Most macroeconomic variables have a relationship with one another but determining which variable causes the other is difficult. To help identify causal relationships in macroeconomics, a recent approach has been to use randomised controlled trials (RCTs), a method widely used in sciences. This approach allows for a direct comparison in a controlled environment between a group who receive a shock and a group whose environment doesn't change.

In terms of macroeconomic uncertainty, the recent literature has placed a clear emphasis on its importance, however, as Baker & Bloom (2013) discuss, are business cycles driving fluctuations in uncertainty or is uncertainty driving fluctuations in the business cycles? Contrary to prior literature, Bachmann et al. (2013) propose that while macroeconomic uncertainty fluctuates counter-cyclically, it is an outcome of exogenous shocks and not the cause. Therefore, it is necessary to understand whether uncertainty is a driver of business cycles or a by-product.

To identify a causal relationship, Bloom (2014) states that it is vital to separate uncertainty shocks (second moment) from closely correlated level shocks (first moment). Empirically this is difficult, however, recent attempts in the literature adopt survey-based approaches to tackle the identification problem. Kumar et al. (2023) and Coibion et al. (2024) conducted randomised controlled trials (RCTs) to show that exogenous variation in perceived macroeconomic uncertainty for firms (Kumar et al. 2023) and households (Coibion et al. 2024), affects their decisions. As these studies have a control group, this allows for the causal effect to be examined. Their results confirm prior conclusions, increases in macroeconomic uncertainty cause adverse business decisions with decreases in investment, employment and prices and adverse decisions by households with decreases in consumption. This provides evidence for exogenous macroeconomic uncertainty shocks as the source of fluctuations in business cycles.

The recent literature on macroeconomic uncertainty has shown that although there are an array of challenges when measuring uncertainty, increased levels of macroeconomic uncertainty cause a decline in real economic activity. Regardless of the measure used, the evidence that macroeconomic uncertainty shocks negatively impact the economy are strong. Furthermore, the global economy continues to face heightened uncertainty in many forms. Therefore, determining the most effective way for central banks to reduce uncertainty is imperative. This forms the motivation for our thesis. Not only do we wish to understand how macroeconomic expectations are formed, but our approach is novel by using a RCT to analyse the heterogeneous reaction of firms to a macroeconomic news shock.

2.6. Gaps in the Literature

The literature on macroeconomic uncertainty has expanded significantly in the last 15 years, but there is still much to be explored. One of the key findings is that macroeconomic uncertainty for firms has a causal impact on real economic outcomes (Kumar et al, 2023). This result underscores the importance of understanding how firms form their expectations on macroeconomic uncertainty. Also, the extensive literature highlighting heterogeneity in expectations, particularly inflation, paves the way to examine whether the formation of macroeconomic uncertainty expectations observes similar heterogeneity or not. Therefore, the following empirical analysis firstly seeks to understand how firms' expectations on macroeconomic uncertainty are formed, through analysing the impact of a wide range of firm characteristics on firms' beliefs. Secondly, we aim to determine whether firms have a heterogeneous reaction to a news shock by using a RCT. This will provide insight into how firms macroeconomic uncertainty expectations are formed, and how the central bank can manage or utilise the potentially heterogenous reactions to a news shock.

One of the key motivations for our study is the prior literature on inflation expectations which shows that firms have heterogenous beliefs on inflation. Some of the key firm characteristics which are associated with heterogeneity in inflation expectations are, the number of competitors (Coibion et al., 2018), firm size (Baumann et al., 2024), industry (Candia et al., 2024), and the product range (Yang, 2022). Based on these findings, we hypothesise that macroeconomic uncertainty, will similarly be impacted by firm characteristics. An analysis into how macroeconomic uncertainty expectations are formed for firms will be especially valuable for policy makers given the recent global increases in uncertainty and the proceeding negative effects this has had on macroeconomies.

As discussed by Andrade et al. (2022a), there is evidence that firms form their macroeconomic expectations using industry-level information. This aligns with research by Candia et al. (2024) who find that firms in different industries have heterogenous inflation expectations. Therefore, by investigating whether firms across different industries hold varying beliefs about macroeconomic uncertainty and how they respond to an exogenous shock, this research can explore the hypothesis of Lucas' Island model (1975) in the context of firms' uncertainty. Although Andrade et al. (2022a) suggest that firms' form expectations about the aggregate economy through making inferences from their industry information, the literature is yet to discuss which industries have the highest level of macroeconomic uncertainty, how firms in different industries react to macroeconomic news and how this relates to firm characteristics.

The macroeconomic models also emphasise the importance of firm size distributions over business cycles, and they also highlight the need to understand firm size distributions as a mechanism for monetary policy transmission. Gabaix (2011) discusses how the behaviour of large firms alone can explain fluctuations in growth. Recently, Crouzet & Mehrotra (2020) find strong evidence that small firms are more sensitive to changes in business cycles than large firms.

Ehrmann (2000) investigated the effects of monetary policy shocks on the business conditions of firms of several sizes. They find considerable asymmetry in their results, that is, firms of different sizes respond heterogeneously to monetary policy shocks. These studies show that firm size influences how firms react to the macroeconomic environment. Further, as Baumann et al. (2024) discuss, smaller firms tend to have more inaccurate inflation expectations, which could suggest smaller firms to also be more uncertain, as level effects often move with uncertainty.

Recently, literature has started to link the relationship between expectations and the productivity of firms. As David et al. (2016) discuss, if firms choose to allocate their resources in line with the imperfect information models, this leads to substantial losses in productivity and output. Therefore, this suggests that heterogeneous expectations can cause declines in efficiency for firms. In recent work Ropele et al. (2024), find that higher disagreement about inflation expectations leads to increased inefficiencies for firms. This highlights the potential relationship between uncertainty and efficiency, which can be explored in greater depth.

Coibion et al. (2018) emphasise how firms in New Zealand who have more competitors are more likely to stay up to date with inflation information, as does Afrouzi (2023). Therefore, as uncertainty and mean beliefs tend to move together (Bloom, 2009), we would expect that firms who have higher levels of uncertainty are associated with a less competitive environment. The findings of other researchers on inflation mean estimates are a valuable guide to understanding the macroeconomic uncertainty of firms. Further, looking at a wide range of firm characteristics for macroeconomic uncertainty can help tie together the existing research on firms' inflation expectations.

This study is unique and will contribute to the existing literature through three main channels. Firstly, we analyse a wide range of firm characteristics to gain a deep understanding into whether firms' expectations on macroeconomic uncertainty are heterogenous. This is unique as other research has only focused on one or two specific characteristics. Secondly, we use a RCT to document the causal effect of a news shock on firms' beliefs. Not only is this an emerging method in empirical macroeconomic studies, but this makes our study distinct from other research analysing heterogeneity in expectations. Thirdly, our study is unique in that we will look at both mean and uncertainty effects for GDP, inflation and sales. The effects of this are twofold; we will be able to separate the mean and uncertainty effect which is often an empirical challenge (Bloom, 2009), and we will be able to jointly consider both macro and microeconomic expectations.

The macroeconomic uncertainty literature shows clear causal evidence that increased perceived uncertainty negatively impacts economic outcomes (Coibion et al., 2024; Kumar et al., 2023). Given the emphasis on heterogeneity in inflation expectations and the impact of firm characteristics over business cycles in the literature, we hypothesise that there is heterogeneity in firms' expectations on macroeconomic uncertainty. Through using New Zealand survey data of

over 4,000 firms, this study aims to extend the findings of Kumar et al. (2023) by analysing how a wide range of firm characteristics impact the initial macroeconomic uncertainty of firms and also their response to an exogenous macroeconomic uncertainty shock.

Chapter 3.

Results

3.1. Introduction

The results from this analysis suggest that while firms do have heterogeneous beliefs on uncertainty, a news shock universally has a strong impact. This research conducts a detailed analysis on heterogeneous expectations for firms through examining the impact of a range of different firm characteristics on beliefs. We also use a randomised controlled trial (RCT) to examine the heterogeneous effect of information treatments on expectations. We find that while New Zealand firms initially have significantly different beliefs, their response to the information treatments are strong and display limited heterogeneity. Among many different firm characteristics, industry groups have the largest impact on both initial beliefs and firms' response to a news shock.

This analysis will allow us to present possible solutions to our research questions about how firms form their macroeconomic beliefs, and the adjustment in their expectations in response to a news shock. Through analysing how a range of different firm characteristics are associated with differences in expectations, we can gain more insight into what factors influence expectations. These findings are an important contribution to the literature as other authors have seldom discussed how firms form their macroeconomic uncertainty expectations, and in expectations literature broadly there is no definitive answer on how firms form their beliefs. Analysing the heterogeneous impacts of a news shock on firms' expectations is unique and using a RCT is a valuable contribution to the literature as it can show the causal impact.

Firstly, we examine firms' expectations prior to any treatments. We find that there is heterogeneity in how firms form their expectations with characteristics such as industry, size, competition, and profit margin being associated with different degrees of uncertainty. This is useful at the first stage, as it aligns with work by other authors that show that firms' expectations of other macroeconomic variables, such as inflation, are also heterogeneous (Baumann et al., 2024; Candia et al., 2024; Coibion et al., 2024). Further, it suggests that if policy makers are looking to reduce macroeconomic uncertainty, they could focus on firms who are in the construction or transportation industry or who have low competition or a low profit margin, as these groups are associated with a higher level of GDP and inflation uncertainty.

The survey uses a RCT to generate exogenous variation and provide some firms with information on professional forecasters' GDP expectations. We find that firms who receive information revise their expectations to align with the information they received on professional forecasters' expectations. This result in section 3.4. aligns with results from Kumar et al. (2023) who examine the aggregate effect of a news shock on expectations. Further, our results provide support for

research by Baumann et al. (2024) who discuss how in countries who have had historically low inflation, even when inflation is high, firms are inattentive to inflation information. This is what we find for firms in New Zealand, a historically low inflation country, where inflation was high in 2021.

Contrary to our results on firms' initial expectations, we find that nearly all firm characteristics have little-to-no impact on how firms adjust their macroeconomic expectations after a news shock. Industry groups is the one characteristic which we found to have a significant impact on firms' reaction to information treatments. When analysing a broad range of characteristics by using sub-samples, we found that while most characteristics had a weak impact on how firms changed their expectations with respect to the treatments, industry groups did exhibit heterogeneity. Therefore, it was decided to explore heterogeneity through industry groups in more detail, and the results in section 3.5. show that when analysing the interaction of industry with a range of different firm characteristics, the heterogeneity in expectations is even greater.

Another key finding from these results is evidence that firms form their macro and micro expectations differently, and that micro expectations are much more heterogeneous than macro. This could be due to firm managers overreacting to firm-level shocks, as discussed by Barrero (2021) but underreacting to macro shocks (Born et al., 2022). The results suggest that like macroeconomic uncertainty, microeconomic uncertainty is heterogeneous initially. However, the reaction to macroeconomic information treatments for firms' sales uncertainty are quite heterogeneous, and much less effective for some firms than others. Another potential reason for this is that macroeconomic shocks have a heterogeneous impact on sales, and this could be driving the observed heterogeneity in microeconomic expectations. Therefore, further research is needed to understand the mechanisms involved in firms transmitting macroeconomic information to their microeconomic expectations.

These results contribute to the existing literature by providing insight into how New Zealand firms' expectations are formed with a focus on heterogeneity. For policy makers who wish to reduce the macroeconomic uncertainty of firms, the results suggest that any type of information treatment will have a strong effect on all firms. However, there is heterogeneity regarding which firms are most uncertain to begin with, and despite primarily homogeneous reactions to the treatments, firms in different industries react more to some treatments than others.

This chapter is organised as follows. Section 3.2. discusses the survey used in this research and the summary statistics. Section 3.3. conducts analysis on whether firms' beliefs on uncertainty of GDP, inflation and their own sales are impacted by firm characteristics. Section 3.4. then discusses whether firms' expectations have a heterogeneous reaction to an exogenous shock. Section 3.5. presents results on how firms in different industries with different firm characteristics

react to the treatments, extending our previous findings. Finally, section 3.6. highlights the implications of this analysis for monetary policy.

3.2. Survey Design and Summary Statistics

3.2.1. Measuring Prior Beliefs

The data used in this analysis is from a survey of over 4,000 New Zealand firms. The survey was conducted for the research purposes of Kumar et al. (2023) to examine the macroeconomic uncertainty of New Zealand firms. Therefore, the information in the dataset is both robust and highly relevant to the purposes of this research, to analyse the heterogeneity in firms' macroeconomic uncertainty. The survey primarily collects data on firm characteristics, characteristics of the respondent (firm manager), and the firms' beliefs on micro and macroeconomic information. A detailed description of the data and how the survey was conducted can be found in Kumar et al. (2023).

Conducted between 2021 – 2022, macroeconomic uncertainty was generally considered high at this time in New Zealand, as firms and individuals were experiencing the tail end of the Covid-19 pandemic and the future state of the economy was unknown. From the survey, over 70% of firms would classify themselves as being extremely uncertain or quite uncertain. Therefore, this work adds to the existing literature on expectations in countries who currently face high uncertainty but have historically faced low uncertainty, such as documented by Baumann et al. (2024).

At the first stage, the beliefs of firms before any treatments are analysed. Throughout this analysis, firm beliefs will refer to the uncertainty and mean estimates of firms on GDP, inflation, and sales. To determine these beliefs, questions of the following form were asked:

Now we'd like you to think about what you perceive as the most pessimistic and most optimistic economic outlooks for New Zealand over the next 6 months. What do you think the lowest annualised GDP growth rate might be for this time period and what do you think the highest might be? (please provide an answer as % per year).

Lowest growth rate:% per year

Highest growth rate:% per year

A similar question was also asked for sales and inflation. From these questions the range in firms' beliefs for each of GDP, inflation and sales can be calculated as:

Range in beliefs = highest growth rate – lowest growth rate

which provides a measure for individual uncertainty. As we take the difference of two percentage estimates, the units for uncertainty in this analysis is in percentage points. Other authors have used individual probability distributions (Altig et al., 2020) or the standard deviation (Coibion et al., 2024) to measure the uncertainty of survey participants. However, an analysis of the same dataset, conducted by Kumar et al. (2023), uses the individual standard deviation, the range and the variance as a measure for each firms' uncertainty and finds that there is not an economically large difference in results with the three different methods. This suggests that range is also a good proxy for the individual uncertainty of GDP, inflation, and sales. We decided to use range as it is both simpler to interpret and measure.

To determine the mean estimates for individual firms, the mid-point of their highest and lowest expectation is calculated as:

$$\text{Mean belief} = (\text{highest growth rate} + \text{lowest growth rate}) / 2$$

This method of calculating the mean follows the triangular distribution, which implies that firms' beliefs are symmetric and therefore the middle of their range will be their mean. This assumption has similarly been made by Kumar et al. (2023) and Coibion et al. (2024) who also use the triangular distribution to calculate the mean in similar survey-based analyses of expectations. These papers also use the mean to identify first-moment shocks (where the level changes) and the cross-sectional dispersion to identify second-moment shocks (where uncertainty in the level changes). By separating these two effects, uncertainty shocks, without level changes can be analysed, which is often difficult in observation-based studies (Bloom, 2014).

The proxies for the mean and uncertainty expectations of GDP, inflation, and sales serve as the foundation for what this analysis refers to as prior beliefs. Although all of these variables are examined, the primary focus is on macroeconomic uncertainty and how these expectations are formed. Macroeconomic uncertainty is a very broad concept (Bloom, 2014), but uncertainty over GDP is widely considered an important component of macroeconomic uncertainty. Therefore, for the purpose of this analysis, GDP uncertainty will be primarily used as the proxy for macroeconomic uncertainty. Using GDP uncertainty to measure the macroeconomic uncertainty of survey participants has been used by other authors (Coibion et al., 2024; Kumar et al., 2023).

3.2.2. Measuring Firm Characteristics

To analyse heterogeneity, we use a wide range of firm characteristics, and examine whether the characteristics impact firms' expectations. Using a large number of firm characteristics allows us to better understand how firms' expectations are formed. The characteristics that we used in this analysis include the number of employees, the number of competitors, age, profit margin, industry, the value of total production, the value of professional forecasts, the value of network information and the number of discussions with customers per month. Alongside firm

characteristics that measure profitability and size, this research is unique in measuring characteristics which capture the effect of network and subjective valuations of macroeconomic information.

In the survey, firm characteristics, similar to macroeconomic expectations, were collected using an array of questions. For example, to determine the number of employees at a given firm, the following question was asked:

What is the total number of employees working at this firm?

Employment for firm:

Number:

Information on the value of total production, firm age and the number of competitors, was collected in a similar way. Collecting this information allows to use these firm demographics to measure heterogeneity. While for the most part these questions were asked in their simplest form so that they could be interpreted universally, there were some nuances. For example, for number of competitors the question asked was:

How many direct competitors does the firm face in its main product line?

Answer: *firms*

By being more specific and asking about the number of competitors in their main product line only, this minimises the impact that a broad product offering would have on the total number of competitors. This helps reduce the impact of multi-collinearity which is present with many of the firm characteristic variables.

For the network and value of information variables, to determine how much firms value professional forecasts, they were asked:

How much would you be willing to pay per year to have access to a monthly magazine of professional macroeconomic forecasts? *\$ per year*

This question is a digestible way of asking survey participants how much they would value receiving more information about macroeconomics. It is implied that if they are already receiving the optimal amount of information about the macroeconomy, their value of receiving this magazine would be zero, or close to. Secondly, the effect of networks in this analysis is primarily captured by the following two questions:

For a typical customer/supplier/peer, how many times do you talk about economic trends and conditions?

Talks with a typical customer per month:

Talks with a typical supplier per month:

Talks with a typical peer firm or competitor per month:

If you had to place a dollar value on the information that you acquire from suppliers, customers, peer firms, competitors and professional organizations about economic trends and conditions each year, how much do you think that \$ value would be? \$ per year

The frequency of discussions with customers / suppliers / peers allows us to analyse which of these relationships is associated with differences in beliefs. Further, the value that firms place on the information they receive from their network and professional organisations can show whether it is the frequency of talks or the value of their conversations that matters more. As networks play an important role in price setting (Hinnosaur, 2024), discussing the impact of networks on expectations is a novel contribution of this research.

The survey asked a wide range of questions, and therefore, variables can be created to measure characteristics which were not specifically asked about in the survey. For example, a proxy for profit margin as a percentage of sales was created by using the variables on input costs collected in the data. Firms were asked:

Out of the total revenues of the firm, what fraction is used for compensation of all employees and what fraction is used for the costs of materials and intermediate inputs (raw materials, energy inputs, etc.)?

	<i>Labour Costs</i>	<i>Energy Costs</i>	<i>Materials Costs</i>
<i>Share of total revenues:</i>%%%

Therefore, as firms report their labour, energy, and materials costs as a percentage of sales, their gross profit margin as a percentage of sales can be broadly defined as:

$$\text{Gross profit margin} = 1 - (\text{labour cost} + \text{energy cost} + \text{materials cost})$$

To validate this measure as a good proxy, Appendix A, shows the distribution of the calculated gross profit margin variable, and indicates that the lowest profit margin observed in the firms is 4.0% of sales and the highest is 79.9%. The shape appears to be broadly normally distributed and has a median of 39.8%. The Statistics New Zealand database on gross profit margin for all industries in 2023, has a median of 49.5%, a minimum of 4.0% and a maximum of 86.0% (Statistics New Zealand, 2023). Therefore, showing that the created proxy for margin appears to capture firms gross profit margin relatively well.

Another key characteristic of firms is their industry. In New Zealand, firms are classified using the ANZSIC framework and broadly speaking, New Zealand has a focus on service-based and agricultural industries (Mason, 2013). For the purposes of the survey, only private firms were included and those in the agricultural, energy and mining industries were excluded, due to greater

regulations and difficulty comparing these industries to others. From there, all firms that were included in the survey can be classified as professional services, manufacturing, construction, trade or transportation. Majority of the firms in the survey are in either the manufacturing (product based) or professional services (service based) industries.

The professional services industry in New Zealand is large, with approximately, 40% of all New Zealand firms being classified as a part of this sector (Statistics New Zealand, 2024). The types of firms who are included in this sector are insurance firms, real estate companies, scientific services, and administrative services. On the contrast, manufacturing firms are another important industry to New Zealand, with the sector making up 11% of national GDP (Ministry of Business, Innovation and Employment, 2020). While manufacturing in other countries may produce more textiles or cars, New Zealand manufacturing has a focus on food and beverages, transport equipment and machinery as well as chemicals (Ministry of Business, Innovation and Employment, 2020). For firms in the trade industry, this includes retail trade, wholesale trade and accommodation services. These can broadly be considered as business who sell the goods that manufacturers make. In both the construction and transportation sectors, these industries are defined as firms who are purely involved in transportation or construction activities. These industries play a key role in New Zealand's economy by supporting infrastructure development, which is increasingly important as the country's population is projected to grow (Statistics New Zealand, 2022).

3.2.3. Treatment Effects and Measuring Posterior Beliefs

After collecting the information from firms' on their prior beliefs and firm characteristics, firms were randomly allocated into four groups. These will be referred to as treatment and control groups. One group was not given any information and is therefore, the control group. By having a control group this ensures that other factors are not influencing the data, and this analysis can identify exogenous variation in the beliefs of firms and make casual inferences. Of the three groups that were given information, the first group, treatment 1, was informed about professional forecasters mean point estimate for GDP, specifically:

We are going to give you information from a group of leading experts about the economy. The average prediction among professional forecasters is that the New Zealand economy will grow 4% in 2021.

The second group, treatment 2, were told only about the uncertainty of professional forecasters. Specifically, the information they received was:

We are going to give you information from a group of leading experts about the economy. These professional forecasters are quite uncertain about the outlook for the New Zealand economy. The

average difference between their optimistic forecast and pessimistic forecast is approximately 3.1 percentage points for the 2021 GDP growth rate.

Therefore, by treatment 1 receiving information only about the mean and treatment 2 receiving information only about uncertainty, the first moment and second moment shocks can be separated. As identified by Bloom (2014), often it is empirically difficult to separate these two effects as a shock which causes a large increase in uncertainty would also be associated with a large decrease in the mean estimate of GDP. Through designing the treatments to separate these effects, the understanding of how information treatments affect firm uncertainty can be more precise.

The final group, treatment 3, was provided information on both the uncertainty of professional forecasters and their average. Specifically, they were told:

We are going to give you information from a group of leading experts about the economy. The average prediction among professional forecasters is that the New Zealand economy will grow 4% in 2021. They are quite uncertain about the economic outlook for the New Zealand economy. The average difference between their optimistic forecast and pessimistic forecast is approximately 3.1 percentage points for the 2021 GDP growth rate.

Through the three different information treatments used, it is possible to analyse the potential heterogeneous effects that each treatment might have. In particular, it is useful to be able to analyse what type of information has the greatest impact on uncertainty. This would be valuable information for policy makers trying to understand how best to provide information in order to reduce uncertainty.

As the survey seeks to understand whether the treatments changed the beliefs of firms, it is important to collect information on firms' beliefs after the treatments. These are referred to throughout this analysis as posterior beliefs. The questions asked to gather the posterior beliefs of firms are slightly differently to the questions used to gather the prior beliefs to avoid participants feeling as though they are repeating themselves. For example, the question to measure posterior beliefs of firms on GDP was:

What do you think the growth rate of the New Zealand economy will be over the next twelve months in each of the following scenarios:

<i>Your most pessimistic outlook:</i>	<i>.....% per year</i>
<i>Your somewhat pessimistic outlook:</i>	<i>.....% per year</i>
<i>Your middle-of-the-road outlook:</i>	<i>.....% per year</i>
<i>Your somewhat optimistic outlook:</i>	<i>.....% per year</i>
<i>Your most optimistic outlook:</i>	<i>.....% per year</i>

These questions were also asked to firms' for both inflation expectations and their own sales. From these questions, the mean estimate is provided as their middle-of-the-road estimate, and the uncertainty can once again be calculated as their range, or the difference between the most optimistic and most pessimistic value. Therefore, the posterior beliefs can be directly compared to the expectations in the first stage, the prior beliefs.

3.2.4. Summary Statistics

Table 1 provides the summary statistics for the 4,212 firms in the database. The firm manager or director was required to fill out the survey. This aligns with research by Savignac et al. (2024), that firm managers have different expectations to other employees, and therefore, when conducting surveys, it is important to ensure consistency in the position of the respondents. 67% of respondents were male, with the average respondent having a large amount of experience in the industry and at the firm. For managers, the median experience at their firm was 10 years and the median for experience in their industry was 25 years. The education of firm managers was generally high, with nearly 85% of firm managers having at least some further education out of high school.

Table 1*Descriptive Statistics*

	Mean	Median	St.Dev.
Manager demographics			
Male	0.67	1.00	0.47
Tenure at firm	10.26	10.00	6.19
Tenure in industry	26.72	25.00	12.59
Education			
Less than high school	0.01	0.00	0.11
High school diploma	0.15	0.00	0.36
Some college or associate degree	0.32	0.00	0.47
College diploma	0.32	0.00	0.47
Graduate studies (Masters or PhD)	0.20	0.00	0.40
Firm demographics			
Age	24.61	22.00	16.09
Number of employees	30.72	19.00	56.25
Competition	11.10	10.00	7.76
Estimated profit margin (%)	38.13	39.75	15.75
Production total (\$m)	34.90	16.50	86.90
Number of talks with customers per month	13.17	11.00	12.25
Value of professional forecasts (\$)	486.35	445.00	266.96
Value of information from network (\$)	248.87	210.00	177.35
Industry			
Professional services	0.36	0.00	0.48
Construction	0.02	0.00	0.15
Manufacturing	0.34	0.00	0.47
Trade	0.23	0.00	0.42
Transportation	0.05	0.00	0.21
Prior beliefs			
GDP uncertainty (% points)	5.87	5.50	2.98
Inflation uncertainty (% points)	5.30	5.10	2.44
Sales uncertainty (% points)	5.88	5.40	2.91

Note. Number of observations 4,212. Estimated profit margin is calculated as a percentage of their revenue using the provided input costs.

For the characteristics of the firm, the median age of firms surveyed was 22 years old, with the oldest firm in the dataset being 133 years old. The age of firms in the survey was generally normally distributed with a rightward skew as shown in Appendix B. The median number of competitors for firms in the survey is 10.00 and the mean is 11.10. The distribution exhibits a small rightward skew, as shown in Appendix C. Approximately, 95% of surveyed firms report

having less than 25 competitors, however the maximum reported number of competitors is 51. The median value of total production for firms was \$16,500,000 whereas the mean value was \$34,900,000. This suggests a significant rightward skew for total production and that while majority of firms in the survey were small, there are some exceptions.

In Table 1, the median number of employees for firms was 19 however the mean is much larger at 30.72. This suggests that the distribution for number of employees has a significant rightward skew. Although the survey excludes firms with less than 6 employees, this is otherwise broadly representative of the population of firms in New Zealand. The majority of businesses in New Zealand are small to medium sized enterprises (Infometrics, 2024) with nearly 70% of businesses reporting having no employees and only 1% reporting having 50 or more employees. Therefore, it is important to recognise that the firms surveyed are generally small, as is the population of New Zealand firms.

The network and value of information variables provide useful insight into how the firm interacts with their own industry and the macroeconomy. The number of talks with customers per month variable has a median of 11, showing that firms do interact with customers regularly and discuss economic trends. On average, every second business day. The value of professional forecasts shows how much the firm would be willing to pay on an annual basis for a monthly magazine of professional macroeconomic forecasts, with the median amount being \$445. As this value is greater than \$0, firms do place weight on information from professional forecasters. In comparison, the median value that firms place on the information they receive annually from their network of customers, suppliers, and peers is \$210. This highlights that despite many firms having a large network, they would value information received about macroeconomics more than the information they receive from their industry. It also suggests that firms are uncertain and would like to receive more information on macroeconomics than they currently do.

Around 70% of the firms in this dataset are either in the professional services industry (36%) or the manufacturing industry (34%), with the remaining firms in the survey in either the construction (2%), trade (23%) or transportation industries (5%). This was an intentional design of the survey, where all of the professional services and manufacturing firms in the population are included in the survey pool. The remaining make-up of firms was allocated based on how large their industry is relative to the others. The industries included in this survey are broadly representative of the New Zealand population of firms, with ~73% of all New Zealand firms being classified as one of these industries (Statistics New Zealand, 2024).

Finally, during the time that the survey was conducted, firms expressed high levels of uncertainty. The median GDP uncertainty is 5.50 percentage points, meaning that on average, the difference between firms lowest GDP estimate and highest GDP estimate was 5.50 percentage points. Similarly for inflation and sales uncertainty, uncertainty is high. The median inflation uncertainty

is 5.10 percentage points, and for sales uncertainty it is 5.40 percentage points. This aligns with how firms would classify their own expectations, as 70% of firms in the survey selected that they were extremely uncertain or quite uncertain about the macroeconomy in the next 6-12 months. This is also much greater than the average uncertainty of professional forecasters at the time which was 3.10 percentage points.

3.3. Heterogeneity in Expectations

3.3.1. Firm Characteristics on Expectations

To analyse how beliefs are formed by firms, at the first stage, uncertainty and mean estimates for GDP, inflation and sales are regressed against a range of firm characteristics available in the data. This will allow us to understand whether firm characteristics are an important factor for firms in forming their expectations and contribute to the existing literature. Kumar et al. (2023) examine the heterogeneity in decision making after a news shock, but they do not analyse the heterogeneity in expectations. Therefore, our results are distinct and expand the research by Kumar et al. (2023) by focusing on heterogeneity in expectations. The results in Table 2 are OLS regressions with heteroskedasticity robust standard errors in the form of:

$$\begin{aligned}
 \text{Prior belief} = & a_0 + b_0 \log(\text{employment}) + c_0 \text{margin} + d_0 \text{competition} & (1) \\
 & + e_0 \log(\text{age}) + f_0 \log(\text{production total}) + g_0 \text{customer network} \\
 & + h_0 \text{value of professional forecasts} \\
 & + i_0 \text{value of network information} + \text{error}_i
 \end{aligned}$$

where prior belief is the initial uncertainty or mean estimates of firms on GDP, inflation, or sales. In line with the literature on expectations more broadly, the initial beliefs of firms in New Zealand appear to be heterogeneous. As shown in Table 2, the point estimates and the uncertainty estimates of GDP, inflation and sales all have firm characteristics which are associated with variability in beliefs. This shows that firms who belong to a specific group are more informed or more certain about the macroeconomic environment or their own sales than others. Further, for the different types of expectations (GDP, inflation, sales) there is variability in which characteristics have an impact on the firms' beliefs, displaying heterogeneity across beliefs, as well as within. In particular, sales estimates differ the most from GDP and inflation estimates, suggesting that the way that firms think about and form their micro and macro beliefs are not the same. This aligns with work by Born et al. (2022), who show that in forming expectations, firms overreact to news on microeconomics but underreact to news on macroeconomics.

Table 2*Firm Characteristics on Initial Expectations*

	GDP mean	GDP uncertainty	Inflation mean	Inflation uncertainty	Sales mean	Sales uncertainty
Employment (log)	0.68*** (0.04)	1.35*** (0.08)	0.15*** (0.04)	0.30*** (0.07)	-0.35*** (0.05)	1.21*** (0.08)
Margin	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.05*** (0.00)	-0.01*** (0.00)	0.05*** (0.00)
Competition	-0.03*** (0.00)	-0.07*** (0.01)	-0.02*** (0.00)	-0.04*** (0.01)	-0.02*** (0.00)	0.04*** (0.01)
Age (log)	-0.00 (0.03)	0.06 (0.06)	-0.00 (0.00)	0.03 (0.05)	-0.01 (0.04)	-0.02 (0.06)
Production total (log)	-0.31*** (0.03)	-0.60*** (0.05)	0.01 (0.03)	-0.05 (0.05)	0.54*** (0.03)	-1.13*** (0.05)
Customer network	-0.00** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	0.00 (0.00)	-0.01** (0.00)
Value of professional forecasts	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.06)	-0.00 (0.00)	-0.00** (0.00)	0.00 (0.00)
Value of network information	0.00 (0.00)	0.00 (0.00)	0.00 (0.06)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Observations	3,986	3,986	3,986	3,986	3,986	3,986
r-squared	0.17	0.16	0.08	0.14	0.13	0.20

Note. The dependent variable is the initial point estimate, or the range between the lowest and highest expectation. The table reports estimates for prior beliefs, before any treatments, following specification 1. Robust standard errors are reported in parentheses.

In Table 2, employment, competition, margin, production total and customer network are statistically significant characteristics across nearly all beliefs. Generally, an increase in macro or micro uncertainty is associated with a decrease in competition, an increase in margin, a decrease in production, an increase in employment, and a decrease in customer network. This shows that firms have heterogeneous beliefs on GDP, inflation, and sales uncertainty, as expectations are associated with firm characteristics.

Firstly, by comparing the heterogeneity across different beliefs, this provides deeper insight into how expectations are formed. For GDP, inflation and sales, a decrease in the number of employees and an increase in the production total are associated with a significant decrease in uncertainty, but the magnitudes are different. Given employment and production total both capture firm size, we can interpret our results as an increase in employment, while holding production total constant, is associated with an increase in uncertainty and vice versa. Intuitively, this means that if inputs are increasing, while outputs stay the same, this can also be referred to as a decline in efficiency. Therefore, for GDP, inflation and sales, an increase in uncertainty is associated with a decline in efficiency for firms. This effect is much larger for GDP and sales uncertainty than for inflation.

For sales uncertainty on average, a 1 percentage point increase in employment, while holding production total constant is associated with a 1.21 percentage point increase in uncertainty and a 1 percentage point decrease in production total, while employment is held constant is associated with a 1.13 percentage point increase in sales uncertainty. This result aligns with the findings of Awano et al. (2018) who suggest that firms with lower productivity are more uncertain about their own future growth.

Across all three uncertainty beliefs, an increase in profit margin is associated with an increase in uncertainty. However, margin has a stronger effect on inflation and sales uncertainty than on GDP uncertainty. For both inflation and sales uncertainty, a 1% increase in profit margin is associated with an increase in uncertainty by 0.05 percentage points. Comparatively, for GDP uncertainty, a 1% increase in margin is associated with a 0.02 percentage point increase in uncertainty. As Coibion et al. (2018) discuss, firms pay more attention to inflation information if they have a lower average profit margin. These results suggest that while profit margin impacts uncertainty beliefs in the same way, profit margin has stronger impacts on inflation and sales uncertainty than GDP. As margin has a positive relationship with uncertainty for all beliefs, and efficiency has a negative relationship for all uncertainty beliefs, this suggest that there is a relationship between the formation of macro and micro beliefs.

There are similarities in how firms form their macro and micro expectations, but competition influences firms' beliefs heterogeneously. For GDP and inflation uncertainty, an increase in the number of competitors is associated with a reduction in uncertainty but for sales uncertainty, an increase in competition is associated with an increase in uncertainty. As shown in Table 2, an increase in the number of competitors by 1 is associated with a reduction in firms GDP uncertainty by 0.07 percentage points. Whereas for inflation this effect is smaller, an increase in the number of competitors by 1 is associated with a 0.04 percentage point reduction in inflation uncertainty. For sales, an increase in the number of competitors by 1 is associated with a 0.04 percentage point increase in uncertainty. In line with results from Coibion et al. (2018) on mean inflation expectations, the relationship between competition and macroeconomic expectations is negative. However, we find that competition has a much larger impact on GDP uncertainty than inflation, and that the relationship between sales uncertainty and competition is positive.

For some characteristics, they appear to have a similar impact on the different forms of expectations for firms, such as the number of discussions with customer network. For all uncertainty beliefs, an increase in the number of monthly discussions with customers is associated with a 0.01 percentage point decrease in uncertainty. This suggests that firms do discuss macroeconomic trends in a professional setting, and that firms use this information to develop their expectations on both micro and macro uncertainty expectations.

The impact of firm characteristics on each of GDP, inflation and sales uncertainty is distinctly different. However, one aspect that all forms of uncertainty expectations have in common, is that there are large degrees of heterogeneity. Both GDP and sales uncertainty are largely influenced by production total and employment, suggesting that efficiency is a driver of heterogeneity, while inflation uncertainty is not impacted the same. Rather for inflation uncertainty, margin has a large impact on uncertainty. This is similarly observed for sales uncertainty, but for GDP uncertainty competition has a larger impact than margin. Also, all three types of uncertainty expectations are impacted by customer network. Analysing the impact that firm characteristics have on expectations will help us to develop a richer understanding of how firms form their expectations.

3.3.2. Firm Characteristics on GDP Uncertainty Expectations

As the focus of this analysis is macroeconomic uncertainty, the main variable of interest is GDP uncertainty. As Table 2 outlines, at the 1% significance level, employment, profit margin, competition, production total, and customer network all influence the firm's GDP uncertainty. Firms who have a smaller number of competitors, decreased efficiency, less frequent discussions with their customer network, or a higher profit margin are associated with having higher macroeconomic uncertainty. Therefore, policy makers aiming to reduce the macroeconomic uncertainty of firms may wish to target firms with these characteristics, as they are associated with having a greater macroeconomic uncertainty initially.

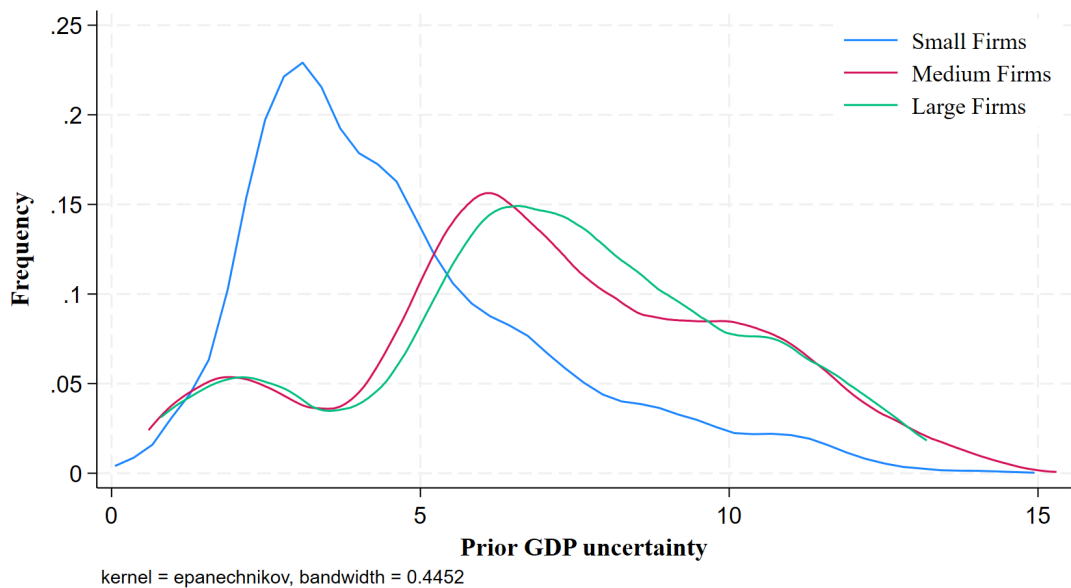
Similar to understanding why some firms are more informed about inflation than others, the rational inattention model (Sims, 2003) presents a good framework to understand why some firms may have greater macroeconomic uncertainty than others. In line with the results, firms who have a greater number of competitors, or who have a low margin may have reduced macroeconomic uncertainty as it is more pertinent for these firms to pay attention to macroeconomic conditions. For firms with more competition, they must be paying attention to the macroeconomic environment in order to gain customers through strong pricing and investment decisions (Afrouzi, 2023). Likewise, firms who have a lower margin are dependent on a high number of sales to make profit, therefore, they would be closely paying attention to macroeconomic factors which may affect demand for their products.

Another firm characteristic which is associated with differences in GDP uncertainty is the number of discussions firms have with their customers per month. Firms who have 1 more discussion a month with customers are associated with having lower GDP uncertainty by 0.01 percentage points. This suggests that there is a transmission of information from supplier to customer which is economically large and can be positively benefiting the economy. This finding adds to existing literature which investigates the relationship between a firm's network and their uncertainty. Leung & Sun (2021) find that when economic policy uncertainty increases, firms diversify their customer base. Similarly, Ozdagli & Weber (2017) suggest that production networks are a key

mechanism for transmitting monetary policy to firms. Therefore, adding to these findings, it can be inferred that by having more discussions with their customers, firms stay more informed thereby reducing their macroeconomic uncertainty.

In Appendix D, the correlation between each of the independent variables shows that there is likely to be a multicollinearity issue with these variables. While this may cause our standard errors to be unreliable, this should not bias our results (Lindner et al., 2020). Particularly notable is that multiple variables are capturing the effects of firm size with the number of employees and total production having a moderate correlation of 0.71. This means that in our multi-variable OLS regression, the coefficient on total production is not capturing the effect of firm size, but rather the impact of increasing total production while holding constant the number of employees. An increase in production without increasing number of employees can be seen as an increase in efficiency. Therefore, in Table 2 as there is a negative relationship between GDP uncertainty and total production and a positive relationship between GDP uncertainty and employment. Both of these results shows that an increase in uncertainty is associated with a decline in efficiency. This aligns with work by Ropele et al. (2024), who show that an increases in uncertainty cause a greater misallocation of resources for firms, resulting in greater inefficiencies.

Employment size in Table 2 allows us to evaluate the relationship between efficiency and GDP uncertainty. However, firm size is also associated with heterogenous GDP uncertainty beliefs. In Figure 1, the kernel density plots split by number of employees shows that firms with fewer employees are associated with lower GDP uncertainty, compared to medium and large firms. This could be related to the rational inattention model (Sims, 2003). By applying a similar reasoning to small firms as those who have more competitors, or have a lower margin, firms who have fewer employees have an increased likelihood of business death (Statistics New Zealand, 2024) and therefore may be paying more attention to macroeconomic information than larger firms. This can help explain why firms with fewer employees are associated with a lower level of macroeconomic uncertainty than firms with more employees.

Figure 1*Distribution of GDP Uncertainty by Employment Size*

Note. Employment size sub-categories are determined by: small ≤ 19 , $19 < \text{medium} \leq 49$, large > 50 .

In general, the results observed in Table 2 show heterogeneity in firms GDP uncertainty. This aligns with other empirical (Baumann et al., 2024) and theoretical studies (Andrade et al., 2022a) on how firms form their macroeconomic expectations. The rational inattention model, the impact of networks and the effect of uncertainty on efficiency are all useful hypotheses for the sources of this observed heterogeneity and should be explored in more detail.

3.3.3. *Heterogeneous Prior Beliefs by Industry*

By extending Lucas's Island model (1975), which says that people rely on local information to form beliefs about the aggregate, Andrade et al. (2022a) hypothesised that firms similarly use industry level information to inform their macroeconomic beliefs. Therefore, if firms rely on industry-specific information rather than macroeconomic information, we would expect that firms in different industries form different beliefs, since each industry has a unique environment. Dovern et al. (2023) expand on this hypothesis and find evidence that German firms do use local information to inform their aggregate beliefs about GDP mean estimates.

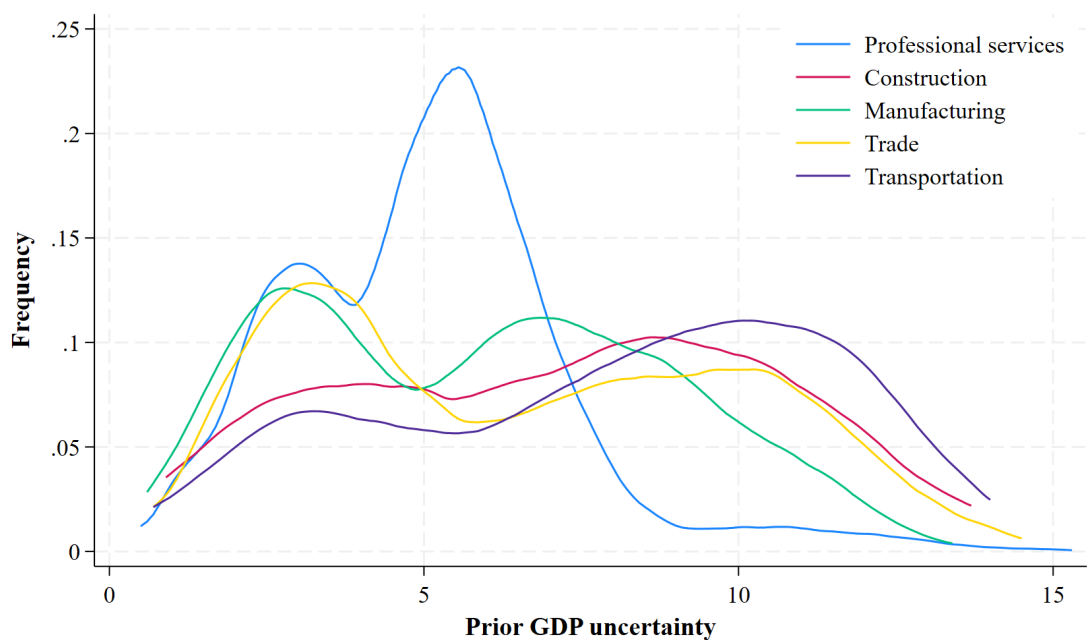
The industry groups included in this survey can broadly be defined as service based (professional services), product based (manufacturing) or a mix of these (trade, transportation, and construction). This shows that there are clear differences between what the firms in these industries offer to their customers, and similarly what is most important to them when setting

expectations. For example, over 60% of all New Zealand's exports are accounted for by the manufacturing sector (Ministry of Business, Innovation and Employment, 2020), suggesting that compared to firms in other industries, international news may be more important to manufacturing firms, and they will use this more in forming expectations. On the other hand, for firms in the construction industry, population growth is a large driver of growth for this industry as a growing population indicates more housing and infrastructure. Therefore, for construction firms, population growth would be a strong signal for microeconomic growth, and this may be transferred to their beliefs on macroeconomic growth also. As each industry faces a unique environment, if firms use micro information to form macro beliefs, as household do on inflation (Coibion & Gorodnichenko, 2015b; D'Acunto et al, 2021c), there will be heterogeneity.

Similar to Andrade et al.'s (2022a) findings, Figure 2 shows heterogeneity in the distribution of initial macroeconomic uncertainty by industry. Professional services firms on average have lower uncertainty with a peak at around 5.50 percentage points, and a second, smaller peak at around 3.00 percentage points. Manufacturing and trade firms also have a peak at 3.00 percentage points, but their distribution is much flatter than professional services firms. Transportation and construction firms on the other hand have a much more uniformly distributed GDP range. From Figure 2, it appears that on average professional services firms have the lowest GDP uncertainty, with more clustering around the mean than the other industries, who have quite dispersed ranges on GDP uncertainty.

Figure 2

Distribution of GDP Uncertainty by Industry



Appendix E supports the findings in Figure 2, with the median macroeconomic uncertainty by industry as the lowest for professional services at 5.10 percentage points. The median macroeconomic uncertainty for firms in the transportation industry is the highest at 8.35 percentage points. These results align with the findings of Candia et al. (2024) who show that professional services firms have lower macroeconomic uncertainty than other industries. Interestingly, while professional services firms have the lowest GDP uncertainty initially, manufacturing firms have the lowest inflation (4.60) and sales uncertainty (4.80). Therefore, while some industries are generally more certain than others across the different beliefs, there is heterogeneity across GDP, inflation and sales uncertainty beliefs by industry.

To test whether firms in one industry form beliefs which are different to another industry due to the previously discussed firm characteristics, separate regressions following specification (1) for each of the industries were conducted. The results recorded in Tables 3, and Appendix F, G, H, I, & J display strong heterogeneity across industries, which is distinctly different to the heterogeneity observed on other firm characteristics. As with other firm characteristics, there is heterogeneity both between forms of uncertainty expectations and within.

Table 3

Firm Characteristics on Initial Expectations by Industry for GDP Uncertainty

	Baseline	Professional services firms	Construction firms	Manufacturing firms	Trade firms	Transportation firms
Employment (log)	1.35*** (0.08)	1.50*** (0.16)	-0.76 (0.67)	0.03 (0.20)	1.25*** (0.23)	0.51 (0.55)
Margin	0.02*** (0.00)	0.00 (0.00)	-0.01 (0.04)	0.02 (0.01)	-0.00 (0.01)	-0.03 (0.03)
Competition	-0.07*** (0.01)	-0.04*** (0.01)	-0.14** (0.07)	-0.08*** (0.02)	-0.07*** (0.02)	-0.16*** (0.04)
Age (log)	0.06 (0.06)	-0.14* (0.07)	0.13 (0.35)	-0.03 (0.11)	0.11 (0.15)	0.12 (0.27)
Production total (log)	-0.60*** (0.05)	-1.17*** (0.15)	0.86 (0.64)	0.50*** (0.15)	-0.16 (0.13)	-0.20 (0.41)
Customer network	-0.01*** (0.00)	-0.01* (0.00)	-0.02 (0.05)	-0.00 (0.01)	-0.02 (0.01)	0.05 (0.03)
Value of professional forecasts	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
Value of network information	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)
Observations	3,986	1,424	91	1,349	942	180
r-squared	0.16	0.18	0.14	0.16	0.14	0.18

Note. The table reports estimates for prior GDP uncertainty, before any treatments, following specification 1. Robust standard errors are reported in parentheses.

When looking at firms in a specific industry and analysing the differences in beliefs between GDP, inflation and sales uncertainty, there are some notable results. For firms in the professional services industry, for GDP uncertainty in Table 3, efficiency has a large impact; a 1% decrease in total production, holding number of employees constant, is associated with a 1.17 percentage point increase in uncertainty. However, a much weaker effect is observed for professional services firms' inflation uncertainty. In Appendix H, a 1% decrease in total production is associated with an increase in inflation uncertainty by 0.16 percentage points. Therefore, despite these firms being in the same industry and these both being macroeconomic expectations, the relationship between efficiency and uncertainty differs for inflation and GDP.

One of the notable results for sales uncertainty, as shown in Appendix J, is that there is a stronger negative relationship between sales uncertainty and customer network for firms in the construction and trade industries than other industries. This mostly aligns with the results for GDP uncertainty in Table 3 and for inflation uncertainty in Appendix H, although the differences are not as large. This shows that for some characteristics, firms in one industry form beliefs the same way, even if there is heterogeneity in how the characteristic effects firms in different industries.

The largest exception to the heterogeneity by industries across the different beliefs is that for GDP and inflation uncertainty, the number of competitors is statistically significant and a negative coefficient across all industries. Representing that the number of competitors is associated with lower macroeconomic uncertainty regardless of industry. There is some variation in the magnitude of coefficient on competition, with the strongest effect observed for GDP and inflation uncertainty for firms in the transportation and construction sectors. For firms in transportation, as shown in Table 3, an increase in the number of competitors by one is associated with a 0.16 percentage point decrease in GDP uncertainty. As shown in Appendix H, an increase in the number of competitors by one is associated with a 0.08 percentage point decrease in inflation uncertainty. It is also interesting to note that although number of competitors had a positive impact on sales uncertainty in the aggregate, competition negatively effects manufacturing, professional services and construction firms, with firms who have more competition in these industries being less uncertain about their own sales. These results strongly support the research which shows the number of competitors is negatively associated with macroeconomic expectations empirically (Coibion et al., 2018) and theoretically (Afrouzi, 2023).

The effect of firm characteristics by industry for GDP uncertainty, in Table 3, shows a significant amount of heterogeneity. Although margin, and customer network were statistically significant at the 1% level for GDP uncertainty in the aggregate, this is not the case for the different industries. Margin is not statistically significant for any industry, and customer network is significant only at the 10% level for professional services. This indicates a high degree of variability. A possible explanation for why these characteristics are no longer significant within each industry, is that their effects may now be accounted for by the industry groups. For example, firms in the

manufacturing industry have a much lower median profit margin (21.0%) than other industries, such as professional services (45.5%). Therefore, rather than profit margin impacting expectations, firms with lower profit margins are associated with being in the manufacturing sector, and industry groups drive heterogeneous expectations.

Production total is significant at the 1% level for both professional services and manufacturing firms but has opposite signs. For professional services, a 1% increase in production total is associated with a 1.17 percentage point decrease in GDP range, supporting the idea that firms who are able to produce more with the same number of employees, are more efficient and this is associated with them being more certain. Further, we can see that the effect of a 1 percentage point increase in efficiency is economically large, as it is associated with a movement from the median GDP uncertainty range for professional services firms of 5.10 percentage points to 3.93 percentage points, which is a ~23% reduction from the median. This supports the findings of Ropele et al. (2024) who show that an increase in uncertainty causes a decrease in efficiency.

On the other hand, for firms who are in the manufacturing industry, a 1% increase in production total is associated with a 0.50 percentage point increase in GDP uncertainty. This contradicts the previous hypothesis that more efficient firms are also more certain. We will present two possible explanations for this result, but this is an area that future research could explore more. Firstly, it may be that for firms in the manufacturing industry if the number of employees stays the same but production increases, this is due to a capital increase which could be an omitted variable problem. As the manufacturing industry is much more capital intensive than the professional services industry, the potential omitted variable is important for understanding efficiency for manufacturing but not as much for other industries. This is supported by work by Mason (2013) who discusses how service-sector industries in New Zealand and Australia typically have a lower capital intensity, while sectors such as manufacturing have a higher capital intensity. Secondly, it is possible that industry specific factors are driving the heterogeneous effects of efficiency on expectations. In analysing the impact of firms' contracts on expectations, Kumar & Wesselbaum (2024) document that sectoral-level uncertainty affects contract use. This suggests that sectoral shocks can impact an array of decisions for firms, which would cause heterogeneous expectations for firms.

The number of employees was significant at the aggregate level for GDP uncertainty but is only significant for firms in the professional services and trade sectors when analysing by industry. For both professional services and trade firms, an increase in the number of employees is associated with a significant increase in uncertainty, showing the counter effect of production efficiency. As firms increase the number of employees, while holding constant production total, they become increasingly more inefficient, and it is hypothesised that firms who are inefficient are associated with having greater macroeconomic uncertainty. However, it is interesting to note that this effect may only be observed for firms in these industries. Further sectoral analysis could

discuss whether the relationship between efficiency and expectations is only observed for firms in specific industries.

The evidence for heterogeneity in various forms for firms' initial beliefs is strong. Firm characteristics are associated with having different beliefs on uncertainty, as observed in other empirical research on expectations of firms and households. There are strong differences between GDP, inflation and sales uncertainty and this highlights the need for more research into how firms form their macro and micro beliefs. Regarding the specific firm characteristics, the rational inattention model explains well many of these relationships, but the underlying causes of heterogeneity from the industries can be explored in more depth.

3.4. Treatment Effects

3.4.1. Aggregate Treatment Effects on Expectations

To identify how firms' expectations react to an exogenous shock, firms are treated with information on the expectations of professional forecasters. All firms' beliefs on GDP, inflation and their own sales are recorded before and after the treatments to analyse the effects that the treatments had on firms. The firms are randomly split into a four separate groups; a control group who receives no information, treatment 1 who receives information on professional forecasters GDP estimate (4% p.a.), treatment 2 who receive information on professional forecasters uncertainty about their forecast (range of 3.1 percentage points) and treatment 3 who receive information on both the point estimate and the uncertainty of professional forecasters.

It is expected that if firms place any value on the information they received during the treatments, they will revise their expectations in line with Bayesian learning such that:

$$\text{Posterior belief}_i = (1 - G) * \text{prior belief}_i + G * \text{signal}_i$$

This can be described as a weighted average of their prior belief and the new information with weight determined by the Kalman gain, G . For firms in the control group, we would expect their prior beliefs to match their posteriors as no information has been received, and therefore the signal should be zero and all weight will be on their priors. For firms in the treatment groups, if they place any value on the information received, we would expect their posterior belief to start to align with the new information. The more the firms trust and agree with the information provided, the more weight they will assign to the new information and the greater the convergence of firms' beliefs with the information on professional forecasters expectations.

To quantify the effects of the treatments, the posterior beliefs of firms are regressed on the prior beliefs, with dummy variables for the treatment groups and an interaction of the prior beliefs and treatments. This can be written as:

$$\begin{aligned}
\text{Posterior belief}_i = & a_0 + b_0 \text{prior}_i + c_0 \text{treatment } 1_i + d_0 \text{treatment } 2_i & (2) \\
& + e_0 \text{treatment } 3_i + f_0 \text{treatment } 3 * \text{prior}_i + g_0 \text{treatment } 2 * \text{prior}_i \\
& + h_0 \text{treatment } 3 * \text{prior}_i + \text{error}_i
\end{aligned}$$

Specification (2) allows for a non-linear reaction to the treatments. We would expect that for firms who initially had high beliefs, being in the treatments would reduce their posterior beliefs, and for firms who initially had low beliefs, being in the treatments may increase their posterior beliefs. The regression was conducted six times with the independent variable being GDP, inflation or sales uncertainty or mean. The results recorded in Appendix K are what will refer to as the “baseline” throughout this analysis. To determine the heterogeneous effects of a macroeconomics news shock on firms’ expectations, we will use the baseline estimates as our point of comparison. Therefore, we can discuss whether specific firm characteristics are associated with differences in beliefs, or if they approximately match the aggregate results.

The baseline estimates in Appendix K show that in line with the results from Kumar et al. (2023), the treatments have a strong effect on firms’ beliefs. For firms in the control group, their prior expectations predict their posterior expectations nearly 1 to 1, but for firms in the treatment groups, they place value on the information received and revise their beliefs towards the professional forecasters. Due to the treatments, firms who initially had high expectations, adjust their beliefs downwards and firms who initially had low expectations adjust their beliefs upwards, to match the information they received. As all the variables in Appendix K are statistically significant at the 1% level, firms in all three treatment groups strongly revised their beliefs to match the professional forecasters compared to the control group whose beliefs remained constant.

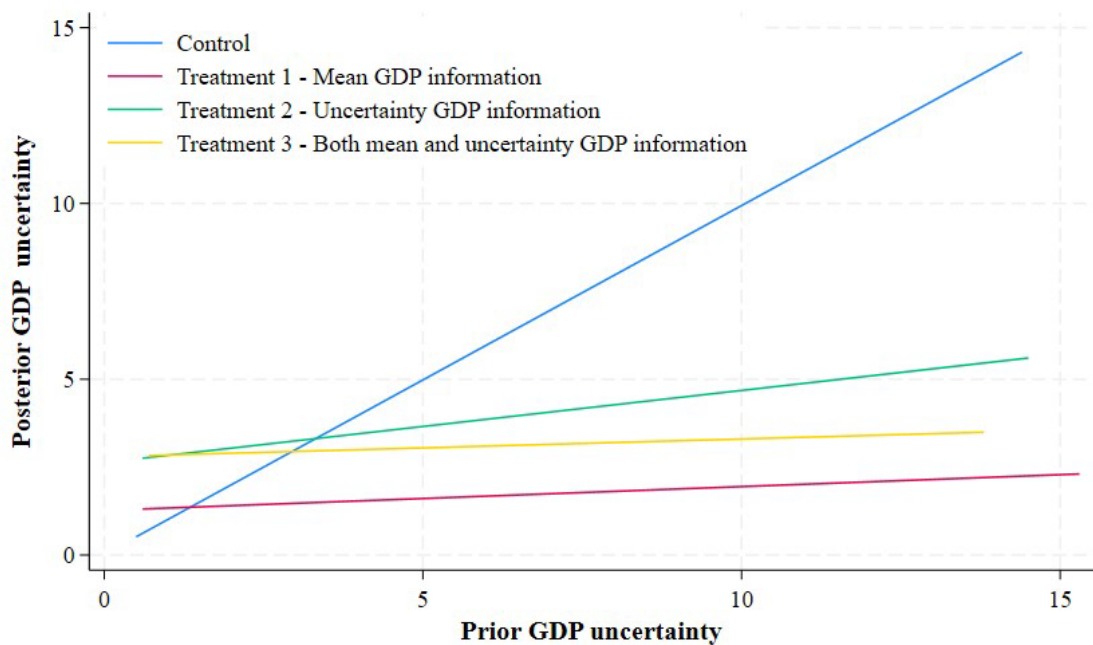
Given that the information provided was on GDP, we would expect this to influence firms GDP estimates the largest. This hypothesis was observed in the data as the magnitudes on GDP mean and uncertainty are larger than for inflation or sales. However, firms do transmit the information received on GDP to inform their beliefs on inflation and their own sales, showing an understanding of the relationship between all three variables.

For firms GDP uncertainty, the results in Appendix K show that firms reacted strongly in aggregate to the treatments. On average, the aggregate initial GDP uncertainty of firms was 5.50 percentage points. Receiving information on professional forecasters mean GDP estimate (treatment 1) caused firms to reduce their uncertainty to 1.69 percentage points. Being in treatment 2 caused a decrease to 3.77 percentage points on average and being in treatment 3 caused a decrease to 3.10 percentage points. This shows a large adjustment in beliefs for firms after receiving the treatments and that for firms who initially had the median level of GDP uncertainty, treatment 1 adjusted their uncertainty beliefs by the largest amount.

Figure 3 outlines graphically the relationship between the posterior and prior beliefs on GDP uncertainty by treatment group. Firms in the control group match their posterior and prior beliefs, with the slope of the line indistinguishable from 1. For firms in the different treatment groups their lines are flatter, and we see their posterior beliefs start to converge towards the uncertainty of professional forecasters, a range of 3.10 percentage points. We can see how with the treatments, the posterior beliefs on GDP uncertainty have fewer extreme values observed, and by providing firms with information, this caused them to change their own beliefs to match the information provided. Not only does this suggest that firms were inattentive to begin with, but it also suggests that policy makers can reduce firms' macroeconomic uncertainty by providing information to firms in a digestible and accessible way.

Figure 3

Treatment Effects on Firms GDP Uncertainty



3.4.2. *Analysing Heterogeneous Treatment Effects on Expectations*

The findings in Appendix K indicate that in aggregate, firms have a strong reaction to the information treatments. This is a valuable finding as discussed in depth by (Kumar et al., 2023). Given that firms' initial beliefs on macroeconomic uncertainty are heterogeneous, it would also be valuable to understand whether firms have a heterogeneous reaction to the treatments. If there is heterogeneity present in their reactions, this suggests that there is an underlying mechanism which is influencing how firms respond to the treatments. Several hypotheses for this could be that some firms are more attentive than others (Sims, 2003) or that some firms trust the information from professional forecaster less than others. This information would be particularly useful to policy makers, so that they can understand how to implement an effective information treatment to firms and achieve their goal of reducing their uncertainty. Therefore, we investigate the cross-section of firm characteristics and treatment impacts and determine whether there is heterogeneity in how firms interact with the treatments. By using sub-samples of firms with different characteristics and comparing these to the baseline expectations, the heterogeneous impacts of the treatments can be analysed.

For the expectations of firms, sub-samples were analysed separately along the following dimensions: employment size, profit margin, competition, age, total production, customer network, value of network information, value of professional forecasts and industry. For each characteristic, the sample was split into groups such as small, medium, and large, and separate regression following specification (2) were conducted. After running separate regressions for each sub-group, we compared these results to the baseline. This allowed us to understand whether firms who have a specific firm characteristic have a significantly different reaction to the treatments than the average firm.

One of the methods we used to evaluate if the firm characteristics had a significant impact on expectations was calculating a Wald statistic for testing multiple hypothesis (Wooldridge, 2020). This allowed us to examine whether the estimates obtained in the sub samples were different from the aggregate. The null hypothesis of our test was:

$$\text{Baseline estimate} = \text{sample A estimate} = \text{sample B estimate} = \text{sample C estimate}$$

which is equivalent to:

$$\text{Baseline estimate} - \text{sample A estimate} = 0$$

$$\text{Baseline estimate} - \text{sample B estimate} = 0$$

$$\text{Baseline estimate} - \text{sample C estimate} = 0$$

where sample estimates A, B and C are the sample parameters from each of the sub-groups (for example, large sized firms, medium sized firms, small sized firms). In effect, this is calculating whether each estimate obtained from the sub-samples can be said to be statistically different from

the baseline estimate. If the null hypothesis, that the estimates in each sample are not different to the baseline, is rejected, this provides evidence that firms have heterogeneous reaction to information treatments. Using this test is useful to help identify where a firm characteristic is statistically significant from the baseline, however, drawbacks of the Wald test include instability in small samples and assuming normality. Therefore, the results from the Wald statistics are a guide, but we conducted independent judgement on whether the estimates from individual sub-samples are economically significant.

Conducting the sub-sample analysis on GDP, inflation, and sales for the mean point estimate and for the range, shows that while some heterogeneity is observed, it is limited. Particularly for GDP and inflation, the effect of the treatments on firms' expectations appears to be mostly homogeneous. Therefore, this suggests that the treatments have a strong and meaningful impact on firms regardless of the specific characteristics of the firms. For policy makers, this suggests that if they can effectively communicate with firms by providing trustworthy and easy-to-digest information, this will reduce firms' uncertainty, regardless of whether the firms have one firm characteristic or another. The largest exception to this, as shown in Table 7, Table 9 and Table 13, is that firms in different industries appear to have heterogeneous reactions to the treatments.

3.4.3. Heterogeneous Treatment Impacts on Macroeconomic Uncertainty

For GDP uncertainty, although there were some notable differences in sub-samples, for the most part, the magnitudes were small. As can be observed in Appendix L, M, N, O & P there was no meaningful heterogeneity at all by age, margin, total production, customer network or value of network information. Also, Tables 4, 5, 6, & 7, show that there was some heterogeneity observed, although limited, for employment size, competition, value of professional forecasts and industry, as there are groups that reacted more to the treatments than others. Despite these minor differences, it appears that there is not widespread heterogeneity in how treatments impacted firm's GDP uncertainty. Therefore, this shows that the treatments had strong, meaningful impacts, regardless of the specific characteristics of firms'.

Table 4 outlines the heterogeneity by employment size for GDP uncertainty, which shows that small firms reacted more to the treatments than the baseline, particularly small firms in treatment 2. Although the magnitude of difference is not very large, this suggests that if policy makers were looking to reduce macroeconomic uncertainty by targeting specific groups, targeting firms with fewer employees would cause a stronger reaction to the treatments than a random group. It is possible that smaller firms are more receptive to receiving information on macroeconomics than larger firms and this accounts for the greater reaction. Relative to larger firms, small firms in the sample place ~3.00 percentage points more weight on macroeconomic information compared to industry information. This supports the idea that smaller firms generally value macroeconomic information more highly, leading them to respond strongly to macroeconomic information.

Table 4*Treatment Effects on GDP Uncertainty by Employment Size*

	Baseline	Small firms	Medium firms	Large firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.47*** (0.10)	1.06*** (0.19)	1.30*** (0.21)	0.11
Treatment 2	2.61*** (0.08)	2.98*** (0.08)	2.35*** (0.18)	2.87*** (0.24)	0.00***
Treatment 3	2.77*** (0.08)	2.91*** (0.09)	2.78*** (0.16)	2.44*** (0.27)	0.28
Prior range	0.99*** (0.00)	-0.99*** (0.00)	0.99*** (0.00)	0.98*** (0.01)	0.26
Prior range x treatment 1	-0.92*** (0.02)	-0.98*** (0.02)	-0.88*** (0.03)	-0.95*** (0.04)	0.08*
Prior range x treatment 2	-0.79*** (0.02)	-0.89*** (0.02)	-0.73*** (0.03)	-0.80*** (0.04)	0.00***
Prior range x treatment 3	-0.94*** (0.02)	-0.98*** (0.02)	-0.94*** (0.00)	-0.89*** (0.04)	0.32
Observations	4,212	2,163	1,489	560	-
r-squared	0.83	0.85	0.81	0.84	-

Note. Employment size sub-categories are determined by: small ≤ 19 , $19 < \text{medium} \leq 49$, large > 50 . The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

From the initial responses of firms on their macroeconomic uncertainty, firms who had a large number of competitors were generally more certain than those who had a small number of competitors. This can likely be attributed to the rational inattention model (Sims, 2003), whereby it is more important for firms with a high amount of competition to stay up to date. Further, as shown in Table 5, firms who have many competitors react more to the treatments than those who have a smaller number. For example, firms who have more competitors have a median GDP uncertainty of 4.20 percentage points. By being in treatment 2, those with more competitors, on average, adjust their expectations to 3.43 percentage points compared to the baseline who adjust their GDP uncertainty to 3.49 percentage points. By extending the rational inattention model, we would expect that firms with a high amount of competition are comfortable updating their beliefs frequently. Therefore, firms with a high amount of competition may react more to the treatments because they place more weight on macroeconomic information than other firms who may be more wary.

Table 5*Treatment Effects on GDP Uncertainty by Competition*

	Baseline	Low competition firms	Medium competition firms	High competition firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.18*** (0.17)	1.21*** (0.15)	1.42*** (0.13)	0.59
Treatment 2	2.61*** (0.08)	2.54*** (0.17)	2.52*** (0.13)	3.01*** (0.13)	0.01***
Treatment 3	2.77*** (0.08)	2.59*** (0.19)	2.89*** (0.11)	2.86*** (0.12)	0.40
Prior range	0.99*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.00)	0.07*
Prior range x treatment 1	-0.92*** (0.02)	-0.91*** (0.03)	-0.92*** (0.03)	-0.96*** (0.03)	0.64
Prior range x treatment 2	-0.79*** (0.02)	-0.77*** (0.03)	-0.76*** (0.03)	-0.90*** (0.03)	0.00***
Prior range x treatment 3	-0.94*** (0.02)	-0.90*** (0.03)	-0.98*** (0.02)	-0.96*** (0.03)	0.25
Observations	4,212	1,308	1,685	1,219	-
r-squared	0.83	0.83	0.82	0.83	-

Note. Competition sub-categories are determined by: low ≤ 5 , 5 < medium ≤ 15 , high > 15 . The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Table 6 outline the heterogenous effects of the treatments on the value that firm manger's place on professional forecasts and while the magnitudes in Table 6 are small, it is interesting to note that firms who place a medium value on professional forecasts react more to the treatments than the baseline. A possible explanation for this is that firms who place a high value on professional forecasts, and firms who place a low value on professional forecasts don't trust the information treatments as much, for different reasons. For firms who place a high value on professional forecasts, they are already informed and may have received other information which they trust more than the information news. This aligns with findings from Yang (2022) who discuss how firms who sell multiple products value information about monetary policy more and therefore they are paying greater attention to macroeconomic conditions. On the other hand, firms who place a low value on professional forecasts may value their own knowledge and beliefs more than the professional forecasts. This would result in them assigning a lower weight to the information from the treatments and reacting more mildly than other firms.

Table 6*Treatment Effects on GDP Uncertainty by Value of Professional Forecasts*

	Baseline	Low value of prof. forecasts firms	Medium value of prof. forecasts firms	High value of prof. forecasts firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.34*** (0.09)	1.51*** (0.11)	0.81*** (0.21)	0.03**
Treatment 2	2.61*** (0.08)	2.33*** (0.16)	2.85*** (0.09)	2.41*** (0.17)	0.02**
Treatment 3	2.77*** (0.08)	2.78*** (0.16)	2.81*** (0.11)	2.69*** (0.14)	0.74
Prior range	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.52
Prior range x treatment 1	-0.92*** (0.02)	-0.95*** (0.02)	-0.97*** (0.02)	-0.84*** (0.04)	0.05**
Prior range x treatment 2	-0.79*** (0.02)	-0.73*** (0.03)	-0.83*** (0.02)	-0.78*** (0.03)	0.07*
Prior range x treatment 3	-0.94*** (0.02)	-0.92*** (0.04)	-0.95*** (0.02)	-0.95*** (0.03)	0.92
Observations	4,212	1,230	1,790	1,192	-
r-squared	0.83	0.83	0.84	0.81	-

Note. Value of professional forecasts sub-categories are determined by: low \leq \$300, \$300 < medium \leq \$600, high > \$600. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

One of the key results from our analysis into the heterogeneous impacts of a news shock on firms' expectations is that firms in different industries have heterogeneous reactions to the treatments. As shown in Table 7, there are significant differences observed in how firms' GDP uncertainty responds to the treatments by industry. This emphasises the hypothesis from Andrade et al. (2022a), that firms use industry specific information to inform their macroeconomic expectations. Therefore, when a macroeconomic shock occurs, firms will respond heterogeneously because news impacts firms in each industry differently and they will have subjective valuations of the new macroeconomic information.

Table 7*Treatment Effects on GDP Uncertainty by Industry*

	Baseline	Professional services firms	Construction firms	Manufacturing firms	Trade firms	Transportation firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.22*** (0.21)	1.29*** (0.29)	1.35*** (0.09)	1.05*** (0.19)	0.98*** (0.34)	0.41
Treatment 2	2.61*** (0.08)	2.33*** (0.20)	2.19*** (0.44)	2.88*** (0.09)	2.49*** (0.16)	2.94*** (0.37)	0.00***
Treatment 3	2.77*** (0.08)	2.62*** (0.20)	1.27 (0.97)	2.74*** (0.09)	2.78*** (0.17)	2.61*** (0.34)	0.08*
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.98*** (0.00)	0.99*** (0.00)	0.99*** (0.01)	0.00***
Prior range x treatment 1	-0.92*** (0.02)	-0.90*** (0.05)	-0.99*** (0.03)	-0.95*** (0.02)	-0.89*** (0.04)	-0.90*** (0.07)	0.17
Prior range x treatment 2	-0.79*** (0.02)	-0.74*** (0.04)	-0.73*** (0.08)	-0.81*** (0.02)	-0.79*** (0.03)	-0.81*** (0.06)	0.64
Prior range x treatment 3	-0.94*** (0.02)	-0.90*** (0.05)	-0.71*** (0.19)	-0.91*** (0.02)	-0.97*** (0.03)	-0.97*** (0.03)	0.03**
Observations	4,212	1,517	93	1,426	984	192	-
r-squared	0.83	0.76	0.72	0.89	0.81	0.86	-

Note. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

In Table 7, professional services firms consistently react slightly less to the treatments than the aggregate, but only by a small magnitude of ~0.03 percentage points. On the other hand, firms in the transportation and construction industries react inconsistently to the treatments. For example, firms in the transportation industry had a stronger reaction to treatment 3 than the baseline while construction firms have a weaker reaction. Transportation firms had the highest level of initial GDP uncertainty, with a median of 8.35 percentage points and being in treatment 3 caused transportation firms to adjust their beliefs to 2.86 percentage points on average. Comparatively, the baseline only reduced their GDP uncertainty to 3.27 percentage points. For construction firms, they react less to treatment 3 than the baseline, and only move on average from their median of 7.20 percentage points to 3.36 percentage points. The baseline reduces their uncertainty to 3.20 percentage points. This also shows that although initially transportation firms were more uncertain than construction firms, being in treatment 3 causes the median transportation firm to be more certain than median construction firm.

The treatments affect the expectations of firms in all industries, as all firms converge towards the expectations of professional forecasters. However, there is heterogeneity within an industry in their reactions to the treatments. Notably, there is a lack of consistency in how an industry groups react to each of the different treatments, except for professional services firms. For example, firms

in the construction industry react more to treatment 1 but less to treatments 2 and 3, rather than consistently reacting less to all treatments, such as in the professional services industry. This suggests that policy makers should consider which type of news will be most effective for different groups of firms when conveying macroeconomic information.

Firms with different characteristics have heterogeneous expectations prior to the treatments. However, these results suggest that for the most part, expectations on GDP uncertainty homogeneously respond to the treatments. There is some heterogeneity observed when splitting firms by industry, but the overall impact continues to be that the firms' beliefs converge towards the expectations of professional forecasters.

3.4.4. Heterogeneous Treatment Effects on Sales and Inflation Uncertainty

While the analysis for inflation uncertainty showed very similar results to GDP uncertainty, the results on sales uncertainty differ, with significantly more heterogeneity present. We would expect that inflation and GDP uncertainty expectations align as firms form their macroeconomic beliefs jointly. However, in forming their microeconomic beliefs, firms underreact to macroeconomic shocks (Born et al., 2022) and this can help explain why firms' expectations on sales uncertainty are starkly different to GDP and inflation uncertainty expectations. For inflation uncertainty the dimensions along which there is the most heterogeneity are by employment size, competition, margin and industry, with the heterogeneity by industry even greater for inflation uncertainty than previously observed for GDP uncertainty. For sales uncertainty, there is heterogeneity in firms' reactions to the treatments along many different characteristics, including employment size, profit margin, number of competitors, age, total production, customer network, value of information and industry.

For the firm characteristics on inflation uncertainty, these mostly align with the results from GDP uncertainty and there is not a significant amount of heterogeneity. Appendix Q, R, S, T, U, V, & W show the impact of the treatments on firms' inflation uncertainty expectations by firm characteristics. The results for employment size, competition, age, production total, customer network, value of professional forecasts and value of network information show limited heterogeneity, in line with GDP uncertainty.

Notably, unlike for GDP uncertainty, low margin firms, as shown in Table 8, reacted less to the treatments compared to the baseline. For example, the median inflation uncertainty for low margin firms prior to the treatments was 4.40 percentage points. The treatments caused firms with a low margin to reduce their uncertainty to 3.77 percentage points in treatment 2 compared to the baseline of 3.67 percentage points. This suggests that low margin firms, who are more informed initially and have a lower inflation uncertainty, are less influenced by the treatments than others.

Table 8*Treatments Effects on Inflation Uncertainty by Profit Margin*

	Baseline	Low margin firms	Medium margin firms	High margin firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.50*** (0.12)	0.71*** (0.08)	0.69*** (0.11)	0.05**
Treatment 2	1.60*** (0.07)	1.48*** (0.13)	1.61*** (0.12)	1.37*** (0.13)	0.01**
Treatment 3	1.47*** (0.07)	1.23*** (0.16)	1.55*** (0.10)	1.59*** (0.13)	0.21
Prior range	0.99*** (0.00)	0.98*** (0.01)	0.99*** (0.01)	1.00*** (0.00)	0.01**
Prior range x treatment 1	-0.45*** (0.01)	-0.39*** (0.03)	-0.44*** (0.02)	-0.46*** (0.02)	0.03**
Prior range x treatment 2	-0.53*** (0.01)	-0.48*** (0.03)	-0.55*** (0.02)	-0.51*** (0.02)	0.02**
Prior range x treatment 3	-0.55*** (0.01)	-0.51*** (0.04)	-0.55*** (0.02)	-0.58*** (0.02)	0.14
Observations	4,212	1,446	1,695	1,071	-
r-squared	0.84	0.74	0.85	0.85	-

Note. Margin sub-categories are determined by: low $\leq 30\%$, $30\% < \text{medium} \leq 50\%$, high $> 50\%$. The table reports estimates for inflation uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

As shown in Table 9, for inflation uncertainty there is heterogeneity in how firms who are in different industries reacted to the treatments. Notably, both transportation and construction firms had similar prior levels of inflation uncertainty, which was higher than firms in other industries. The median for firms in the transportation industry was 6.40 percentage points and for those in the construction industry it was 6.70 percentage points. However, the adjustment in their inflation uncertainty from the treatments is not the same. From their prior median, transportation firms consistently have a stronger adjustment in their beliefs than the baseline, whereas construction firms are inconsistent. For treatment 3, transportation firms reduce their uncertainty to 4.25 percentage points, whereas the baseline is 4.35 percentage points. On the other hand, firms in the construction industry reduce their uncertainty from 6.70 percentage points to 4.85 percentage points if they are in treatment 3 while the aggregate reduces their uncertainty to 4.49 percentage points. Therefore, or inflation uncertainty, the average transportation firm has a strong reaction to treatment 3, while the average construction firm has a weak reaction. Furthermore, there is a large amount of variability in the treatment dummy variables for construction and transportation firms. This suggests that for firms in these industries who initially had very low uncertainty, they respond to the treatments differently to the baseline.

Table 9*Treatment Effects on Inflation Uncertainty by Industry*

	Baseline	Professional services firms	Construction firms	Manufacturing firms	Trade firms	Transportation firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.74*** (0.09)	0.81** (0.37)	0.68*** (0.12)	0.67*** (0.11)	0.10 (0.17)	0.01**
Treatment 2	1.60*** (0.07)	1.51*** (0.13)	0.79 (0.52)	1.45*** (0.15)	1.57*** (0.11)	1.43*** (0.34)	0.02**
Treatment 3	1.47*** (0.07)	1.63*** (0.10)	2.44*** (0.58)	1.22*** (0.17)	1.50*** (0.13)	1.82*** (0.29)	0.02**
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.97*** (0.01)	0.99*** (0.01)	1.00*** (0.00)	0.01***
Prior range x treatment 1	-0.45*** (0.01)	-0.43*** (0.02)	-0.46*** (0.07)	-0.44*** (0.03)	-0.47*** (0.02)	-0.38*** (0.03)	0.28
Prior range x treatment 2	-0.53*** (0.01)	-0.51*** (0.03)	-0.43*** (0.09)	-0.46*** (0.04)	-0.56*** (0.02)	-0.55*** (0.05)	0.03**
Prior range x treatment 3	-0.55*** (0.01)	-0.56*** (0.02)	-0.64*** (0.09)	0.52*** (0.04)	-0.57*** (0.02)	-0.62*** (0.04)	0.02**
Observations	4,212	1,517	93	1,426	984	192	-
r-squared	0.84	0.84	0.82	0.71	0.88	0.89	-

Note. The table reports estimates for inflation uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Also, manufacturing firms' beliefs on inflation uncertainty reacted to the treatments less in general than the aggregate. While the difference is not large, it suggests that firms in the manufacturing industry are less likely to transmit information from one macroeconomic variable (GDP) to inform expectations about another macroeconomic belief (inflation). This is contrasting to firms in other industries, like those in the trade industry who reacted more than the aggregate. Overall, these results on inflation uncertainty support the idea that there is limited heterogeneity in how firms with different characteristics update their macroeconomic expectations from the treatments, except for industries.

On the other hand, in analysing the treatment effects on sales uncertainty, research suggests (Barrero, 2021; Born et al., 2022) that firms don't form their macro and micro beliefs in the same way. Therefore, it is unsurprising that the heterogeneity in treatment effects for sales uncertainty is strikingly different from GDP uncertainty. In particular, there is a lot more observed heterogeneity in how the treatment effects influence sales uncertainty. The results documented in Tables 10, 11, 12, & 13 show the impact of the treatments on sales' uncertainty by profit margin, customer network, value of professional forecasts and industry. On the other hand, there was limited heterogeneity in firms' reaction to the treatments on their sales uncertainty by number of employees, competition, age, production total and value of network information, as can be found

in Appendix X, Y, Z, AA, & BB. Further, the heterogeneity observed through industry is significantly stronger than for GDP and inflation uncertainty. The Wald test statistics are statistically significant for all the estimates at the 1% level, other than for the control group.

Profit margin, as shown in Table 10, has some of the highest heterogeneity observed for the treatment effects on sales uncertainty. Firms who have a low profit margin react considerably less to the treatments than firms with a high profit margin. In particular, for firms with a low profit margin, being in treatment 2 is associated with a 0.30 percentage point increase in sales uncertainty with the term for the interaction of treatment 2 and prior uncertainty showing a 0.13 percentage point decrease. On the other hand, for firms with a high profit margin, treatment 2 is associated with a 1.06 percentage point increase in sales uncertainty and the interaction term is 0.29 percentage points. One possible explanation is that firms with lower profit margins were already paying attention to macroeconomic information, and therefore additional information does not significantly alter their sales expectations. Alternatively, low profit margin firms may generally weight macroeconomic information less when forming their sales beliefs.

Table 10

Treatment Effects on Sales Uncertainty by Profit Margin

	Baseline	Low profit margin firms	Medium profit margin firms	Large profit margin firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.42*** (0.08)	0.80*** (0.09)	0.99*** (0.13)	0.00***
Treatment 2	0.88*** (0.06)	0.30*** (0.04)	0.99*** (0.09)	1.06*** (0.12)	0.00***
Treatment 3	0.81*** (0.06)	0.42*** (0.05)	0.85*** (0.09)	0.90*** (0.14)	0.00***
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.58
Prior range x treatment 1	-0.24*** (0.01)	-0.17*** (0.02)	-0.25*** (0.02)	-0.27*** (0.02)	0.00***
Prior range x treatment 2	-0.26*** (0.01)	-0.13*** (0.01)	-0.27*** (0.02)	-0.29*** (0.02)	0.00***
Prior range x treatment 3	-0.24*** (0.01)	-0.16*** (0.01)	-0.25*** (0.02)	-0.27*** (0.03)	0.00***
Observations	4,212	1,446	1,695	1,071	-
r-squared	0.94	0.96	0.94	0.93	-

Note. Margin sub-categories are determined by: low $\leq 30\%$, $30\% < \text{medium} \leq 50\%$, high $> 50\%$. The table reports estimates for sales uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Another notable source of heterogeneity in how the treatments impacted firms' sales uncertainty is the number of discussions with their customer network, as shown in Table 11. For firms who have many discussions with their customer network per month, they react less to the treatments than firms who have fewer discussions with their customer network. This could be because firms who have more frequent discussions with their customers are already paying more attention to macroeconomic information. Wegner et al. (2023), show that during times of crises, with increased levels of uncertainty, firms are more likely to increase their networks, and this aligns with our findings in prior beliefs. Firms with large customer networks are associated with lower sales uncertainty (5.10 percentage points) initially compared to firms who have less frequent discussions with their customers (5.60 percentage points). Therefore, a lack of attention on macroeconomic information can cause firms to react more to treatments on their sales uncertainty beliefs.

Table 11

Treatment Effects on Sales Uncertainty by Number of Talks with Customers

	Baseline	Small customer network firms	Medium customer network firms	Large customer network firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.79*** (0.09)	0.84*** (0.09)	0.66*** (0.16)	0.07*
Treatment 2	0.88*** (0.06)	0.88*** (0.08)	1.05*** (0.10)	0.46*** (0.13)	0.00***
Treatment 3	0.81*** (0.06)	0.84*** (0.11)	0.85*** (0.08)	0.67*** (0.15)	0.32
Prior range	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	0.23
Prior range x treatment 1	-0.24*** (0.01)	-0.24*** (0.02)	-0.26*** (0.02)	-0.23*** (0.03)	0.14
Prior range x treatment 2	-0.26*** (0.01)	-0.25*** (0.02)	-0.29*** (0.02)	-0.18*** (0.03)	0.01***
Prior range x treatment 3	-0.24*** (0.01)	-0.25*** (0.02)	-0.25*** (0.02)	-0.23*** (0.03)	0.53
Observations	4,212	1,755	1,524	933	-
r-squared	0.94	0.94	0.94	0.94	-

Note. Customer network sub-categories are determined by: low ≤ 8 , $8 < \text{medium} \leq 20$, high > 20 . The table reports estimates for sales uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Contrary to this, firms who place a high value on macroeconomic information, as shown in Table 12, have a greater revision in their sales uncertainty estimates from the treatments than other groups. This could be because they value the macroeconomic information and translate this to be meaningful for their own sales estimates. This provides some interesting insights into how micro and macroeconomic beliefs for firms are connected. We can hypothesise that while firms on average underreact to macroeconomic shocks when forming their expectations (Born et al., 2022), firms who place a higher value on professional forecasts are associated with reacting more to macroeconomic shocks.

Table 12

Treatment Effects on Sales Uncertainty by Value of Professional Forecasts

	Baseline	Low value of prof. forecasts firms	Medium value of prof. forecasts firms	High value of prof. forecasts firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.65*** (0.11)	0.68*** (0.10)	1.03*** (0.10)	0.02**
Treatment 2	0.88*** (0.06)	0.86*** (0.09)	0.74*** (0.10)	1.11*** (0.11)	0.06*
Treatment 3	0.81*** (0.06)	0.70*** (0.15)	0.69*** (0.07)	1.07*** (0.11)	0.04**
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.99*** (0.00)	0.90
Prior range x treatment 1	-0.24*** (0.01)	-0.22*** (0.02)	-0.23*** (0.02)	-0.29*** (0.02)	0.04**
Prior range x treatment 2	-0.26*** (0.01)	-0.26*** (0.02)	-0.22*** (0.02)	-0.30*** (0.02)	0.05**
Prior range x treatment 3	-0.24*** (0.01)	-0.22*** (0.03)	-0.22*** (0.01)	-0.30*** (0.02)	0.03**
Observations	4,212	1,230	1,790	1,192	-
r-squared	0.94	0.94	0.95	0.93	-

Note. Value of professional forecasts sub-categories are determined by: low \leq \$300, \$300 < medium \leq \$600, high $>$ \$600. The table reports estimates for sales uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

As with GDP and inflation uncertainty, for sales uncertainty there is significant heterogeneity by industry, as shown in Table 13. In particular, firms in the trade industry consistently react more to the treatments than the aggregate, whereas manufacturing firms consistently react less to the treatments than the aggregate. Interestingly, this corresponds to the initial beliefs that firms report, as trade firms were the most uncertain on their sales (median of 8.70) for their priors, and manufacturing firms were the least uncertain on their prior sales (median of 4.80). Therefore, it is possible that for firms in the trade industry, they respond more to the treatments because they were paying less attention to begin with. This also might explain why firms in the trade industry had higher sales uncertainty at the first stage, and the opposite is true for manufacturing firms.

Table 13

Treatment Effects on Sales Uncertainty by Industry

	Baseline	Professional services firms	Construction firms	Manufacturing firms	Trade firms	Transportation firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.67*** (0.08)	0.39 (0.26)	0.31*** (0.05)	1.41*** (0.17)	0.86 (0.54)	0.00***
Treatment 2	0.88*** (0.06)	0.70*** (0.09)	1.65*** (0.39)	0.27*** (0.04)	1.61*** (0.14)	1.16*** (0.43)	0.00***
Treatment 3	0.81*** (0.06)	0.76*** (0.07)	1.14*** (0.39)	0.33*** (0.05)	1.20*** (0.17)	0.78*** (0.28)	0.00***
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	0.96*** (0.03)	0.47
Prior range x treatment 1	-0.24*** (0.01)	-0.24*** (0.02)	-0.11* (0.06)	-0.15*** (0.01)	-0.31*** (0.02)	-0.21* (0.11)	0.00***
Prior range x treatment 2	-0.26*** (0.01)	-0.25*** (0.02)	-0.37*** (0.08)	-0.12*** (0.01)	-0.33*** (0.02)	-0.28*** (0.08)	0.00***
Prior range x treatment 3	-0.24*** (0.01)	-0.25*** (0.02)	-0.27*** (0.09)	-0.13*** (0.01)	-0.29*** (0.02)	-0.20*** (0.06)	0.00***
Observations	4,212	1,517	93	1,426	984	192	-
r-squared	0.94	0.94	0.87	0.96	0.90	0.92	-

Note. The table reports estimates for sales uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Construction firms were inconsistent in how they responded to the treatments, with a lesser reaction to treatment 1 than the aggregate for their sales uncertainty, but a greater reaction than the aggregate to treatments 2 and 3. For construction firms in treatment 2, if the prior range was 0.00 percentage points (100% certain), the increase in their sales uncertainty range was 1.65 percentage points, compared to the aggregate of 0.88 percentage points. Also, as their prior range increased by 1.00 percentage points, firms in the construction industry in treatment 2 decreased their uncertainty by 0.37 percentage points, compared to the aggregate of 0.26 percentage points. Whereas for treatment 1, if the prior belief was 0.00 percentage points, construction firms increased their sales uncertainty by 0.39 percentage points, compared to the baseline of 0.77 percentage points, and as the prior sales uncertainty increased by 1.00 percentage points, posterior sales uncertainty decreased by 0.11 percentage points for firms in the construction industry compared to the aggregate of 0.24 percentage points. This supports the idea that for some industries, there is significant variation in how they respond to each treatment, whereas for other industries the reaction is more consistent across all information treatments.

Overall, the results on inflation and sales uncertainty show contrasting effects. For inflation uncertainty the results broadly align with the results for GDP uncertainty and suggest that firms react homogeneously along firm characteristics with the exception of industry classifications. For sales uncertainty, there is a lot more heterogeneity along many different dimensions. This not only supports the idea that macro and micro beliefs are formed differently but also suggests that there might be heterogeneity in the reaction to the treatments at a deeper level.

3.5. Further Analysis Treatment Effects by Industry

3.5.1. Interacting Firm Characteristics and Industries for the Impact on Treatments

The analysis in section 3.4., provided evidence that there was limited heterogeneity in how firms with different characteristics reacted to the treatments and updated their macroeconomic uncertainty. There was more heterogeneity observed for how the treatments impacted firms own sales uncertainty. Across GDP, inflation and sales uncertainty, industry groups had the largest impact on how firms reacted to the treatments. Due to this observation, we decided to analyse the impact of industries on the treatments in more detail by using the interaction of industries and other firm characteristics.

To conduct this analysis on uncertainty, sub-samples were created. These sub-samples show an intersection of the industry classifications and other firm characteristics such as employment size or profit margin as discussed throughout this analysis. Therefore, to analyse the impact of each characteristic with industry groups on expectations, firms were split into 10 groups. This comprises of a high-low split for each characteristic, which is then also split into the 5 industry

categories. For each characteristic we determined the cut-off point to split the firms into categories by using the median, allowing half of the total firms in each of the high/low categories. Once the entire sample-set had been divided into these different groups, regressions for each of the sub-samples were conducted following specification (2). This allowed us to examine whether the results from each of the samples differ significantly from the baseline or not, in line with the method in 3.4..

To prevent the sample from being divided into excessively small groups, firm characteristics have generally been categorised as either high or low. Firms with values below the median for a given characteristic are classified as low, while those above the median are classified as high. For example, the median for profit margin is 39.75, therefore, firms who are classified as having a high profit margin are those with a margin of 40% or greater, and those classed with a low profit margin are those with a margin of less than 40%. For each characteristic group, these are split into industries under the ANZSIC classification, resulting in 10 sub-samples to compare for each characteristic.

This method has multiple advantages. Firstly, it is directly comparable to the method we used in our analysis in section 3.4. which allows for ease in comparing the results obtained from each section. Secondly, it pinpoints specific small groups and how they respond to the treatments, this is particularly useful for policy makers who wish to identify groups to target. Finally, this method can help us to determine the cause of heterogeneity in firms' reaction to a news shock. This is because we can analyse whether industry effects alone are associated with different reactions, or whether the source of heterogeneity is a wide range of firm characteristics.

In line with the previous sections, we analysed the intersection of industry and firm characteristics for employment size, competition, total production, customer network, value of professional forecasts and profit margin. In this section of the analysis, value of network information and age variables were excluded. This because there was very limited heterogeneity in both the initial expectations and in firms' reaction to the treatments on beliefs.

3.5.2. Interacting Firm Characteristics and Industries for the Impact of the Treatments on GDP Uncertainty

Splitting firms into different sub-samples along two different dimensions, provides a better picture as to the potential heterogeneous reactions to the treatments. Tables 14, 15, 16, 17, 18 & 19 show the treatment effects on GDP uncertainty by the different sub-samples. The industry categorisation is interacted separately with each of the firm characteristics for number of employees (Table 14), number of competitors (Table 15), total production (Table 16), customer network (Table 17), value of professional forecasts (Table 18), and profit margin (Table 19) to obtain the results. In each of these tables the results show heterogeneity in how firms with

different characteristics in different industries react to the information treatments by updating their GDP uncertainty estimates.

In Table 14, industry and employment size are interacted. The firms were split into high employment if they had 30 employees or greater, and small if they had below 30 employees. Following this, they were divided into their industry groups, creating 10 sub samples. These results using specification (2) show that there is a large amount of heterogeneity in how firms react to the treatments based on their size within their industry. For example, firms which are considered large and in the professional services industry react a lot less to treatments 1 & 2 than other firms. Large professional services firms with a prior GDP range of 0.00 percentage points adjust their GDP range upwards by 0.53 percentage points compared to the baseline of 1.25 percentage points if they are in Treatment 1. This aligns with previous observations that large firms react less to the treatments than others and that professional services firms react less to the treatments than others. However, this shows that not all large firms react to the treatments less (large firms in the manufacturing industry react more) and not all professional services firms react less, (small professional services firms are mostly in line with the baseline), but rather large professional services firms in particular react less to treatments 1 & 2. This is meaningful to policy makers as they can accurately target the specific groups who will react the most and therefore have the biggest impact.

Table 14*Treatment Effects on GDP Uncertainty by Industry and Number of Employees*

	Baseline	Small professional services firms	Small construction firms	Small manufacturing firms	Small trade firms	Small transportation firms	Large professional services firms	Large construction firms	Large manufacturing firms	Large trade firms	Large transportation firms
Treatment 1	1.25*** (0.09)	1.47*** (0.16)	1.31*** (0.30)	1.33*** (0.15)	1.02*** (0.23)	1.08*** (0.35)	0.53 (0.59)	0.93*** (0.35)	1.44*** (0.14)	1.39*** (0.46)	0.70 (0.68)
Treatment 2	2.61*** (0.08)	2.47*** (0.25)	2.09*** (0.57)	2.91*** (0.12)	2.58*** (0.17)	1.93*** (0.42)	1.94*** (0.38)	2.50*** (0.66)	2.92*** (0.18)	2.45*** (0.63)	3.66*** (0.51)
Treatment 3	2.77*** (0.08)	2.53*** (0.22)	3.06*** (0.10)	2.90*** (0.09)	2.82*** (0.15)	2.56*** (0.38)	2.92*** (0.42)	-3.04 (2.14)	2.72*** (0.19)	2.40*** (0.64)	2.48*** (0.55)
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.02)	0.99*** (0.01)	0.99*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	1.00*** (0.01)	0.97*** (0.01)	1.00*** (0.00)	0.99*** (0.01)
Prior range x treatment 1	-0.92*** (0.02)	-0.95*** (0.04)	-0.99*** (0.04)	-0.95*** (0.04)	-0.90*** (0.05)	-0.92*** (0.08)	-0.78*** (0.12)	-0.95*** (0.04)	-0.96*** (0.02)	-0.92*** (0.06)	-0.87*** (0.12)
Prior range x treatment 2	-0.79*** (0.02)	-0.78*** (0.06)	-0.72*** (0.12)	-0.83*** (0.03)	-0.82*** (0.04)	-0.66*** (0.08)	-0.66*** (0.07)	-0.76*** (0.09)	-0.81*** (0.03)	-0.73*** (0.08)	-0.90*** (0.07)
Prior range x treatment 3	-0.94*** (0.02)	-0.88*** (0.05)	-1.01*** (0.02)	-0.97*** (0.02)	-0.98*** (0.03)	-0.94*** (0.03)	-0.97*** (0.09)	-0.20*** (0.30)	-0.90*** (0.03)	-0.95*** (0.09)	-0.98*** (0.05)
Observations	4,212	1,164	55	818	798	96	353	38	608	186	96
r-squared	0.83	0.79	0.69	0.91	0.83	0.84	0.72	0.79	0.88	0.76	0.87

Note. Employment size sub-categories are determined by: small < 30, large ≥ 30. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

For the effects of competition without splitting by industry groups, firms with more competition react more to the treatments than others. However, in Table 15 the interaction of competition and industries shows that depending on the industry and the treatment group a firm is in, high competition may be associated with either a stronger reaction, or a weaker reaction. For firms in treatment 1, the strongest reaction to the treatments was by low competition construction firms, and high competition professional services firms. The weakest reaction to treatment 1 was from low competition professional services firms and high competition transportation firms. This suggests that the reaction to the treatments for firms in the professional services industry is highly influenced by competition, but this appears to primarily be the case for Treatment 1, and not treatments 2 & 3. For competition by industry, treatments 2 and 3, also show a large amount of heterogeneity. The strongest reaction to treatment 2 is by low competition transportation firms and high competition manufacturing firms. Interestingly, for both of these groups, firms react more strongly to treatment 2, than to treatment 3. This suggests that for firms who are in the transportation industry and face low competition and for firms who are in the manufacturing industry and face high competition, it is more effective to provide them with information only regarding uncertainty than to provide them with information regarding uncertainty and mean estimates. This is useful to policy makers, as it shows that depending on the industry and level of competition for firms, the most effective information treatments to reduce macroeconomic uncertainty will be different.

Table 15*Treatment Effects on GDP Uncertainty by Industry and Number of Competitors*

	Baseline	Low competition professional services firms	Low competition construction firms	Low competition manufacturing firms	Low competition trade firms	Low competition transportation firms	High competition professional services firms	High competition construction firms	High competition manufacturing firms	High competition trade firms	High competition transportation firms
Treatment 1	1.25*** (0.09)	0.55 (0.40)	1.79*** (0.61)	1.48*** (0.11)	1.44*** (0.46)	0.97 (0.69)	1.71*** (0.13)	0.91*** (0.15)	1.22*** (0.20)	1.28*** (0.17)	0.77** (0.39)
Treatment 2	2.61*** (0.08)	1.95*** (0.31)	2.36*** (0.43)	2.85*** (0.16)	1.89*** (0.45)	3.55*** (0.45)	2.56*** (0.29)	1.84* (0.96)	3.07*** (0.09)	2.80*** (0.16)	1.67*** (0.44)
Treatment 3	2.77*** (0.08)	2.38*** (0.38)	-0.58 (1.67)	2.71*** (0.14)	3.01*** (0.42)	2.57*** (0.58)	2.76*** (0.23)	3.44*** (0.44)	2.95*** (0.07)	2.70*** (0.17)	2.57*** (0.36)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.01)	0.98*** (0.01)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.98*** (0.01)	0.99*** (0.00)	0.98*** (0.01)
Prior range x treatment 1	-0.92*** (0.02)	-0.80*** (0.08)	-1.02*** (0.06)	-0.97*** (0.02)	-0.89*** (0.07)	-0.92*** (0.11)	-1.00*** (0.03)	-0.99*** (0.03)	-0.93*** (0.05)	-0.97*** (0.04)	-0.83*** (0.12)
Prior range x treatment 2	-0.79*** (0.02)	-0.67*** (0.06)	-0.77*** (0.06)	-0.80*** (0.03)	-0.69*** (0.06)	-0.90*** (0.07)	-0.79*** (0.07)	-0.64*** (0.20)	-0.88*** (0.02)	-0.86*** (0.04)	-0.61*** (0.08)
Prior range x treatment 3	-0.94*** (0.02)	-0.86*** (0.08)	-0.41*** (0.02)	-0.90*** (0.03)	-1.00*** (0.06)	-0.98*** (0.06)	-0.93*** (0.06)	-1.16*** (0.10)	-0.98*** (0.01)	-0.96*** (0.03)	-0.95*** (0.03)
Observations	4,212	632	46	776	308	101	885	47	650	676	91
r-squared	0.83	0.77	0.74	0.89	0.77	0.86	0.75	0.81	0.90	0.84	0.87

Note. Number of competitors sub-categories are determined by: low < 9, high > =9. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Although for the most part, in Table 16, the amount of heterogeneity in firms' reactions to the treatments is lesser for the interaction of total production and industry, for treatment 3 the results vary significantly. Firms in the manufacturing industry, on average, react more to the treatments than the aggregate, but firms who have a low production total in the manufacturing industry have a stronger reaction to the treatment than those with a high production total. From the median GDP uncertainty of 6.00 percentage points, firms in the manufacturing industry who have a low production total in treatment 3 revise their beliefs downwards to 3.05 percentage points, compared to the baseline of 3.13 percentage points. On the other hand, firms in the manufacturing industry who have a high production total only revise downwards to 3.36 percentage points, a weaker reaction to treatment 3 than manufacturing firms who have a high production total. This suggests that firms in one industry may have specific firm characteristics which causes a big impact on their uncertainty, while the same firm characteristic does not have a big impact on firms in another industry. Therefore, it is necessary to understand these mechanisms of heterogeneity to make informed judgements about policy implications.

Table 16*Treatment Effects on GDP Uncertainty by Industry and Total Production*

	Baseline	Low production professional services firms	Low production construction firms	Low production manufacturing firms	Low production trade firms	Low production transportation firms	High production professional services firms	High production construction firms	High production manufacturing firms	High production trade firms	High production transportation firms
Treatment 1	1.25*** (0.09)	1.49*** (0.29)	1.18*** (0.30)	1.47*** (0.10)	0.97*** (0.22)	1.04*** (0.31)	1.04*** (0.30)	1.22*** (0.35)	1.34*** (0.15)	1.54*** (0.40)	0.87 (0.87)
Treatment 2	2.61*** (0.08)	2.17*** (0.30)	1.82** (0.79)	3.07*** (0.09)	2.38*** (0.18)	2.40*** (0.40)	2.51*** (0.21)	2.52*** (0.43)	2.85*** (0.17)	3.15*** (0.38)	4.46*** (0.85)
Treatment 3	2.77*** (0.08)	2.58*** (0.28)	2.96*** (0.09)	2.99*** (0.06)	2.75*** (0.18)	3.27*** (0.25)	2.71*** (0.26)	-1.82 (2.12)	2.70*** (0.15)	2.87*** (0.40)	1.61** (0.78)
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.98*** (0.01)	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	1.01*** (0.00)	0.98*** (0.01)	1.00*** (0.00)	0.99*** (0.00)
Prior range x treatment 1	-0.92*** (0.02)	-0.93*** (0.07)	-0.98*** (0.04)	-0.99*** (0.02)	-0.88*** (0.04)	-0.93*** (0.05)	-0.88*** (0.06)	-0.98*** (0.04)	-0.94*** (0.03)	-0.95*** (0.06)	-0.87*** (0.16)
Prior range x treatment 2	-0.79*** (0.02)	-0.69*** (0.07)	-0.66*** (0.15)	-0.88*** (0.02)	-0.77*** (0.04)	-0.76*** (0.08)	-0.78*** (0.05)	-0.79*** (0.08)	-0.80*** (0.03)	-0.88*** (0.06)	-0.96*** (0.10)
Prior range x treatment 3	-0.94*** (0.02)	-0.86*** (0.07)	-1.00*** (0.02)	-0.99*** (0.01)	-0.96*** (0.03)	-1.02*** (0.03)	-0.93*** (0.06)	-0.36 (0.28)	-0.89*** (0.03)	-1.01*** (0.07)	-0.90*** (0.08)
Observations	4,212	495	50	641	824	123	1,022	43	785	160	69
r-squared	0.83	0.80	0.74	0.94	0.81	0.88	0.74	0.76	0.87	0.80	0.84

Note. Total production sub-categories are determined by: low < \$20,000,000, high > = \$20,000,000, where total production is the value of total production. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Compared to other characteristics, the magnitude of heterogeneity is lower for firms with different customer networks in different industries, as shown in Table 17. Nonetheless, these results show that it is an important variable to consider. This is useful because in the previous analysis on the effect of customer network on firms' reaction to the treatments, without grouping by industry, the results in Appendix O show that customer network does not have a meaningful impact. Therefore, grouping by industry and customer network, as in Table 17, provides evidence for customer network as a source of heterogeneity, when it did not previously. This also provides support for findings that during times of increased uncertainty, firms increase their customer base (Leung & Sun, 2021) and are involved in more networking (Wegner et al, 2023). These findings show a negative relationship between macroeconomic uncertainty and customer networks. The heterogeneity in Table 17, indicates that customer network has an impact on how firms respond to an exogenous macroeconomic uncertainty shock. As networks are a valuable way through which monetary policy is transmitted, the heterogeneous reactions to a news shock caused by customer network effects is important for policy makers.

Table 17*Treatment Effects on GDP Uncertainty by Industry and Customer Network*

	Baseline	Small network professional services firms	Small network construction firms	Small network manufacturing firms	Small network trade firms	Small network transportation firms	Large network professional services firms	Large network construction firms	Large network manufacturing firms	Large network trade firms	Large network transportation firms
Treatment 1	1.25*** (0.09)	1.32*** (0.27)	1.89*** (0.95)	1.30*** (0.10)	1.10*** (0.34)	0.78*** (0.47)	1.18*** (0.29)	1.08** (0.29)	1.37*** (0.14)	1.05*** (0.19)	1.23** (0.51)
Treatment 2	2.61*** (0.08)	2.09*** (0.34)	2.24*** (0.36)	2.76*** (0.21)	2.52*** (0.19)	3.35*** (0.47)	2.45*** (0.24)	2.13** (0.84)	2.93*** (0.09)	2.44*** (0.27)	2.42*** (0.59)
Treatment 3	2.77*** (0.08)	2.67*** (0.29)	-1.81 (1.72)	2.50*** (0.22)	2.98*** (0.20)	2.68*** (0.55)	2.59*** (0.27)	3.02*** (0.58)	2.85*** (0.08)	2.56*** (0.27)	2.58*** (0.43)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.01)	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	0.98*** (0.01)	0.99*** (0.00)	0.98*** (0.01)
Prior range x treatment 1	-0.92*** (0.02)	-0.91*** (0.06)	-1.04*** (0.09)	-0.95*** (0.02)	-0.88*** (0.06)	-0.90*** (0.10)	-0.90*** (0.07)	-0.98*** (0.04)	-0.95*** (0.03)	-0.92*** (0.04)	-0.91*** (0.09)
Prior range x treatment 2	-0.79*** (0.02)	-0.69*** (0.08)	-0.73*** (0.06)	-0.79*** (0.05)	-0.78*** (0.04)	-0.84*** (0.09)	-0.76*** (0.05)	-0.73*** (0.14)	-0.83*** (0.02)	-0.79*** (0.05)	-0.77*** (0.09)
Prior range x treatment 3	-0.94*** (0.02)	-0.91*** (0.06)	-0.24*** (0.23)	-0.87*** (0.05)	-1.00*** (0.04)	-0.99*** (0.06)	-0.89*** (0.06)	-1.09*** (0.14)	-0.94*** (0.02)	-0.94*** (0.05)	-0.96*** (0.04)
Observations	4,212	511	35	500	508	88	1,006	58	926	476	104
r-squared	0.83	0.77	0.73	0.89	0.79	0.87	0.76	0.81	0.89	0.83	0.85

Note. Customer network sub-categories are determined by: small < 8, large ≥ 8, where customer network is the number of discussions with their customers per month. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

For value of professional forecasts, as shown in Table 18, there is significant heterogeneity. A key result is that firms who are in the professional services industry who place a high value on professional forecasts consistently have weaker reactions to the treatments than the baseline. The underlying mechanism for this may be due to attention. It can be argued that firms who are paying attention to macroeconomic variables will value information on macroeconomics highly, but because they are paying attention, they will respond to the treatments less because they are already more informed. This aligns with research by Link et al. (2023), who use inflation expectations to show that firms who pay more attention to macroeconomic conditions are more confident in their beliefs, but these expectations tend to deviate more strongly away from the expectations of professional forecasters. Therefore, firms in the professional services industry who value macroeconomic information highly, may have a weaker response to the treatments as they are paying attention already, leading them to be more confident but also less responsive to information on professional forecasts.

Table 18*Treatment Effects on GDP Uncertainty by Industry and Value of Professional Forecasts*

	Baseline	Low value of forecasts professional services firms	Low value of forecasts construction firms	Low value of forecasts manufacturing firms	Low value of forecasts trade firms	Low value of forecasts transportation firms	High value of forecasts professional services firms	High value of forecasts construction firms	High value of forecasts manufacturing firms	High value of forecasts trade firms	High value of forecasts transportation firms
Treatment 1	1.25*** (0.09)	1.59*** (0.18)	2.19*** (0.62)	1.26*** (0.12)	1.23*** (0.23)	1.09*** (0.26)	0.88** (0.35)	0.75*** (0.16)	1.60*** (0.16)	0.94*** (0.27)	0.88 (0.69)
Treatment 2	2.61*** (0.08)	2.45*** (0.27)	0.46 (1.21)	2.76*** (0.12)	2.70*** (0.19)	2.78*** (0.59)	2.14*** (0.29)	2.73** (0.29)	3.19*** (0.14)	2.34*** (0.23)	3.14*** (0.42)
Treatment 3	2.77*** (0.08)	2.79*** (0.27)	-1.28 (2.07)	2.75*** (0.10)	2.78*** (0.30)	2.63*** (0.49)	2.48*** (0.28)	3.38*** (0.73)	2.75*** (0.17)	2.77*** (0.18)	2.57*** (0.47)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.01)	0.98*** (0.00)	0.99*** (0.00)	0.98*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	0.98*** (0.01)	0.99*** (0.00)	0.99*** (0.01)
Prior range x treatment 1	-0.92*** (0.02)	-0.98*** (0.04)	-1.06*** (0.05)	-0.93*** (0.03)	-0.94*** (0.04)	-0.97*** (0.04)	-0.84*** (0.08)	-0.95*** (0.03)	-0.99*** (0.02)	-0.86*** (0.06)	-0.84*** (0.12)
Prior range x treatment 2	-0.79*** (0.02)	-0.76*** (0.06)	-0.41** (0.21)	-0.79*** (0.03)	-0.83*** (0.04)	-0.75*** (0.10)	-0.70*** (0.06)	-0.84*** (0.05)	-0.88*** (0.02)	-0.76*** (0.05)	-0.88*** (0.07)
Prior range x treatment 3	-0.94*** (0.02)	-0.93*** (0.06)	-0.34 (0.30)	-0.92*** (0.02)	-0.95*** (0.06)	-0.98*** (0.05)	-0.88*** (0.06)	-0.87*** (0.18)	-0.90*** (0.04)	-0.99*** (0.03)	-0.96*** (0.04)
Observations	4,212	787	31	1,021	419	93	730	62	405	565	99
r-squared	0.83	0.76	0.72	0.88	0.82	0.90	0.77	0.82	0.91	0.80	0.84

Note. Value of professional forecasts sub-categories are determined by: low < \$500, high > = \$500. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

The results in Table 19, show a large amount of heterogeneity in how firms with different profit margins who are in different industries react to the treatments. In particular, manufacturing firms with a high profit margin have a stronger reaction to the treatments than the baseline. A manufacturing firm with a high profit margin has a median uncertainty of 7.80 percentage points, and by being in treatment 2, their uncertainty declines to 4.09 percentage points. For the baseline, being in treatment 2 would only cause uncertainty to reduce from 7.80 percentage points to 4.25 percentage points. As uncertainty gets larger, the difference between high margin manufacturing firms and the baseline, would get larger. However, it is key to note that firms were defined as having a high margin if the profit margin was 40% or greater, in line with the median profit margin of all firms of 39.75%, but firms in the manufacturing industry have a much lower median profit margin of 21%. Therefore, the sample size of high margin manufacturing firms is small at 19.

Table 19*Treatment Effects on GDP Uncertainty by Industry and Profit Margin*

	Baseline	Low margin professional services firms	Low margin construction firms	Low margin manufacturing firms	Low margin trade firms	Low margin transportation firms	High margin professional services firms	High margin construction firms	High margin manufacturing firms	High margin trade firms	High margin transportation firms
Treatment 1	1.25*** (0.09)	1.60*** (0.25)	0.57 (0.35)	1.34*** (0.09)	0.73 (0.83)	0.84 (0.59)	1.06** (0.27)	1.50*** (0.35)	3.64* (1.87)	1.08*** (0.17)	1.18*** (0.34)
Treatment 2	2.61*** (0.08)	3.13*** (0.10)	2.31*** (0.53)	2.87*** (0.10)	2.79*** (0.31)	2.54*** (0.55)	2.17*** (0.25)	1.90*** (0.59)	4.25*** (1.46)	2.48*** (0.17)	3.10*** (0.44)
Treatment 3	2.77*** (0.08)	2.50*** (0.27)	2.26** (0.91)	2.72*** (0.09)	2.36*** (0.30)	2.81*** (0.57)	2.66*** (0.24)	1.30 (0.98)	2.89*** (0.19)	2.88*** (0.16)	2.46*** (0.39)
Prior range	0.99*** (0.00)	1.00*** (0.01)	1.00*** (0.02)	0.98*** (0.00)	0.99*** (0.01)	0.99*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	1.00*** (0.01)	0.99*** (0.00)	0.99*** (0.01)
Prior range x treatment 1	-0.92*** (0.02)	-0.97*** (0.06)	-0.97*** (0.06)	-0.95*** (0.02)	-0.82*** (0.17)	-0.86*** (0.12)	-0.88*** (0.06)	-1.00*** (0.03)	-1.23*** (0.25)	-0.90*** (0.03)	-0.95*** (0.04)
Prior range x treatment 2	-0.79*** (0.02)	-0.95*** (0.02)	-0.78*** (0.09)	-0.81*** (0.02)	-0.85*** (0.07)	-0.79*** (0.10)	-0.70*** (0.05)	-0.68*** (0.11)	-1.02*** (0.13)	-0.78*** (0.03)	-0.82*** (0.07)
Prior range x treatment 3	-0.94*** (0.02)	-0.87*** (0.07)	-0.99*** (0.12)	-0.91*** (0.02)	-0.87*** (0.13)	-0.98*** (0.05)	-0.91*** (0.05)	-0.67*** (0.20)	-1.01*** (0.02)	-1.00*** (0.03)	-0.96*** (0.04)
Observations	4,212	499	22	1,407	128	70	1,043	73	19	888	122
r-squared	0.83	0.74	0.86	0.89	0.74	0.79	0.78	0.72	0.93	0.82	0.91

Note. Profit margin sub-categories are determined by: low < 40%, high ≥ 40%. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

High margin construction firms, on the other hand, react less to treatments 2 & 3 than the baseline. From the median prior uncertainty of 7.50 percentage points for high margin construction firms, by being in treatment 2, their uncertainty declines to 4.30 percentage points on average, whereas in the aggregate, uncertainty declines to 4.19 percentage points. Further, for treatment 3, for high margin construction firms, their uncertainty declines by a smaller amount to 3.78 percentage points, compared to 3.22 percentage points for the aggregate. Therefore, high margin construction firms react weakly to the treatments, in contrast to high margin manufacturing firms, who react strongly.

As discussed in section 3.3.2., firms with higher profit margins are associated with higher uncertainty in their prior GDP beliefs. This pattern holds within specific industries; in manufacturing, high margin firms have a median uncertainty of 7.80 percentage points, compared to 6.00 percentage points for low margin firms; in construction, the corresponding medians are 7.50 percentage points and 6.50 percentage points, respectively. Despite this, reactions to the treatments vary across manufacturing and construction sectors. Therefore, while the prior beliefs of construction firms and manufacturing firms with different profit margins are similar, their reaction to treatments is vastly different. High margin manufacturing firms have a stronger response to the treatments, while high margin construction firms respond less. This suggests that there is an underlying mechanism which would explain why firms respond heterogeneously to information treatments.

Overall, by analysing the impact that the intersection of industries and other firm characteristics have on macroeconomic expectations, this provides a clearer picture on how heterogenous expectations for firms are. The reaction of firms to receiving GDP information, on their GDP uncertainty, is still strong, showing the treatments have a large impact on all firms. However, there is evidence that the reactions of firms to the treatments are heterogenous, depending on their industry and specific characteristics, such as employment size, competition, and profit margin.

3.5.3. Interacting Firm Characteristics and Industries for the Impact of the Treatments on Inflation and Sales Uncertainty

In line with the previous findings in section 3.4., when splitting firms by industry and characteristic groups, the results for inflation uncertainty are economically similar to GDP uncertainty. In Appendix CC, DD, EE, FF, GG, & HH the results of the sub-samples for the effect of the treatments on inflation uncertainty are documented. In general, there is heterogeneity in how firms update their inflation beliefs from the treatments, but the results from the sub-samples consistently show that informing firms about GDP information causes them to adjust their inflation uncertainty. The results on inflation uncertainty have two key implications. Firstly, it supports the idea that expectations on macroeconomic variables are formed jointly, and secondly,

it provides insights into inflation expectations in countries who currently face high inflation, but historically faced low inflation.

Given that the results from the sub-sample analysis are similar for GDP uncertainty and for inflation uncertainty, this supports the idea that firms form their macroeconomic beliefs together as discussed by Candia et al. (2023). It also shows that providing firms with any macroeconomic information (such as GDP) will cause them to reduce their uncertainty for all other macroeconomic variables (such as inflation). Therefore, this provides evidence to support the idea that these variables are interlinked, and greater uncertainty in one macroeconomic variable will likely translate to greater uncertainty in other macroeconomic variables.

As all firms adjust their inflation expectations in response to the treatments, this supports the findings of Baumann et al. (2024), who show that firms in Europe with historically low inflation but currently experiencing high inflation respond strongly to inflation information. Our findings show that firms revised their beliefs about inflation uncertainty based on treatments focused on GDP. This suggests that in countries like New Zealand, which have a history of low inflation, firms may not be actively monitoring macroeconomic information even during periods of high inflation. This behaviour aligns with the sticky information model proposed by Mankiw and Reis (2002), which suggests that firms update their expectations infrequently and may form inflation uncertainty based on outdated or infrequent information updates.

For sales uncertainty, Appendix II, JJ, KK, LL, MM & NN show the results for the effect of the treatments by industry and firm characteristics. In section 3.4.4., the firm characteristics had a large impact on how firms reacted to the treatments for sales uncertainty, and when splitting firms into firm characteristic and industry groups, there continues to be heterogeneity. For sales uncertainty, the results from the interaction of industry and firm characteristics analysis are generally consistent with the findings on firm characteristics individually but provide deeper insight into the reactions of specific groups to the treatments.

When analysing the interaction of industry and employment size groups on sales uncertainty in Appendix II, firms who are small and in the construction industry have heterogeneous reactions to the different treatments. They react strongly to treatment 2 but react very weakly to treatments 1 & 3. This is an interesting contrast to construction firms who are large, who react strongly to all three treatments. This result builds from the previous observations in section 3.4.4., that construction firms have very different responses to each treatment in updating their sales uncertainty but suggests that this heterogeneous reaction to the treatments is for small construction firms, rather than all firms in the construction industry.

In Appendix NN, the interaction of profit margin and industry shows very heterogeneous reactions to the treatments on firms' sales uncertainty. Notably, low margin manufacturing firms consistently react weakly to the treatments, with the treatment dummy and the interaction of the

treatment with prior sales uncertainty, being roughly half of the aggregate result for all treatment groups. This supports results from section 3.4.4., that manufacturing firms respond weakly to the treatments in updating their sales uncertainty, as do low margin firms. Therefore, this analysis presents a clearer picture on which specific groups of firms react to the treatments more differently to the rest.

Although the overall strength of the treatments on sales uncertainty is generally lower, as the transmission of information received on macroeconomics to microeconomic beliefs is weak, there are some exceptions. In Appendix JJ, firms in the trade industry who have low competition react strongly to the treatments in updating their sales uncertainty, with a movement from the median of 7.50 percentage points to 6.44 percentage points if they are in treatment 1, to 6.35 percentage points if they are in treatment 2, and to 6.30 percentage points if they are in treatment 3. Similarly, in Appendix LL, for firms who have a large network and are in the trade industry, they revise their sales uncertainty from the median of 8.60 percentage points to 7.26 percentage points if they are in treatment 1, to 7.29 percentage points if they are in treatment 2, and to 7.23 percentage points if they are in treatment 3. This aligns with the results from Table 13, where trade firms consistently react more strongly to the treatments than other industries for sales uncertainty but highlights specific characteristics that strengthen this reaction. As trade firms have a greater sales uncertainty than other industries to begin with, it is a positive signal that they do react strongly to the treatments.

Overall, by splitting firms into industry and specific firm characteristics groups, this provides valuable insights into how these different groups respond to the treatments. As the results continue to show that firms do adjust their beliefs due to the treatments, this analysis verifies the findings of Kumar et al. (2023). However, there is heterogeneity observed in which groups have stronger or weaker reactions to the treatments than others, which is useful in showing which groups to target for the most effective monetary policy outcomes.

3.6. Implications for Monetary Policy

This research has several important implications for monetary policy. These can be summarised as, 1) firms initially have heterogenous expectations on uncertainty variables which are associated with firm characteristics, 2) firms react strongly to information treatments regardless of their specific firm characteristics, and 3) depending on the policy makers intended outcomes, there are specific groups that can be targeted to have the greatest impact.

Firstly, as discussed in section 3.3., in their prior beliefs', firms have heterogenous expectations on uncertainty. In particular, their beliefs are associated with specific firm characteristics such as employment size, competition, margin, and industry. Therefore, for central banks, it is important

to consider that some firms are much more uncertain than others, and while the rational expectations hypothesis (Muth, 1961) is still widely used, this analysis provides further evidence that this is not the empirical reality. Firms are not entirely informed, and therefore they face different levels of uncertainty. This supports the intention of policy makers such as the European Central Bank (De Guindos, 2024) in their move away from rational expectations.

We find that firm characteristics strongly impact the uncertainty of firms on GDP, inflation and sales. In particular, there is significant heterogeneity by industry group. As firms who are in the transportation and construction industries have the highest levels of macroeconomic uncertainty, policy makers may look to target these groups to reduce aggregate uncertainty. Similarly, firms who have low competition, low customer networks, low efficiency, or who have high profit margins are associated with having a higher level of macroeconomic uncertainty, and these groups could be targeted too. For central banks who are looking to reduce uncertainty, it is useful to know that as with firm and household inflation expectations, macroeconomic uncertainty is heterogenous. This means that there are some groups which are currently contributing more to the overall high level of macroeconomic uncertainty.

The second stylised fact, that firms react strongly to information treatments regardless of their specific firm characteristics, is potentially the most important for policy makers. The treatments had strong effects on adjusting firms' macroeconomic uncertainty, even when accounting for differences in firm characteristics. Given that elevated levels of macroeconomic uncertainty have been shown to have negative economic outcomes (Kumar et al., 2023; Coibion et al., 2024), policy makers should seek to reduce uncertainty. As shown in this analysis, there are mechanisms that policy makers can use to have a large impact on firms, such as providing information on professional forecasters macroeconomic estimates.

By applying a randomised controlled trial (RCT), we found that information treatments had a strong impact on firms. However, the method used in this analysis of treating firms with information is not able to be replicated by the central bank without overregulation and excessive costs. Therefore, while central banks should focus on reducing the uncertainty of firms by providing professional forecasts, the question remains; how can the central bank effectively provide this information to firms? D'Acunto et al. (2021b) show that households do not update their inflation expectations in response to forward-guidance announcements from the European Central Bank. With firms and households paying little attention to central bank decisions and announcements, there have been efforts to diversify how the central bank communicates. As examples, the Central Bank of Jamaica used music videos to communicate monetary policy (Coibion et al., 2022) and Twitter is increasingly being used as an effective and direct way for the central bank to communicate (Ehrmann & Wabitsch, 2022). Therefore, central banks can and should reduce the macroeconomic uncertainty of firms through communication, but the most effective method is still up for debate.

The final implication from this research for monetary policy, is that despite the strong reactions to the treatments by all firms, there is some heterogeneity, and therefore, policy makers can leverage this information and target specific groups. For policy makers looking to reduce macroeconomic uncertainty and target groups who will have the strongest reaction to an information treatment in general, small firms, firms in the manufacturing sector or firms who face a large amount of competition could be chosen. This is because these groups had a stronger reaction to the treatments than the baseline, as shown in section 3.4.. Also, as networks are an important mechanism for monetary policy transmission (La'O et al., 2022; Ozdagli & Weber, 2017), through providing specific groups with information, we hypothesise that even a small-scale news shock could have a far-reaching impact. As it is difficult for the central bank to implement a large-scale information treatment to all firms, this research provides insight into how policy makers could still run an effective intervention by targeting specific groups.

Also, by targeting firms with specific characteristics in specific industries, central banks could have even greater success in a large-scale programme to reduce uncertainty. For example, if the easiest form of communication for central banks is by using professional forecasters mean estimates of GDP, such as in treatment 1, firms that would react strongly to receiving this information are professional services firms with high competition, manufacturing firms with a high profit margin and construction firms who have fewer discussions with customers. On the other hand, providing firms with information on the uncertainty and mean estimates of GDP had the greatest impact (treatment 3) on adjusting firms expectations. If policy makers were to use this type of information, they should target firms who are low competition trade firms, small construction firms or small transportation firms to have the greatest impact. Therefore, this shows that depending on the exact objective of the central bank, they can use the results from this analysis to tailor their monetary policy and increase its effectiveness.

A key objective of this analysis is to add to the existing literature on how central banks can best communicate and provide information to positively influence the macroeconomy. The contributions from this research can be summarised as; providing evidence that firms' expectations on uncertainty are initially heterogenous, showing that firms react strongly to a news shock in updating their macroeconomic uncertainty, despite their heterogenous priors, and outlining that there are groups the central bank can target to have the greatest impact on reducing uncertainty. Therefore, we provide valuable insight into how firms form their macroeconomic uncertainty expectations, and how this knowledge can be harnessed by policy makers to improve monetary policy communication.

Chapter 4.

Conclusion

Overall, this analysis has uncovered many novel facts about the macroeconomic uncertainty expectations of firms. In response to our first research question, the results suggest that firms in New Zealand form heterogeneous expectations about macroeconomic conditions. Firm characteristics such as competition, profit margin and size impact the macroeconomic expectations of firms, and in particular, industry groups have the strongest impact on expectations. Regarding research question two, we find that there are limited heterogeneous effects of macroeconomic news on firms' macroeconomic expectations. Firms universally had strong reactions to the information treatments. Both of these results contribute to the literature on macroeconomic expectations and are valuable to policy makers who seek to effectively influence firms' expectations through monetary policy. A summary of our motivations, findings, implications, and suggestions for future research from this thesis are outlined below.

To begin our analysis, the literature review section outlined how expectations are formed. The prevailing theories have evolved from Muth's hypothesis (1961) of rational expectations, to the more empirically supported rational inattention (Sims, 2003; Maćkowiak & Wiederholt, 2009) and sticky information models (Mankiw & Reis, 2002). As the number of empirical studies increased, more authors documented the heterogeneity in expectations for households, firms and professional forecasters (Coibion & Gorodnichenko, 2015a; Mankiw et al., 2003). At the same time, the seminal work of Bloom (2009), ignited the discussion around the importance of uncertainty on the macroeconomy. This led to research on uncertainty, how it's measured (Baker & Bloom, 2013; Jurado et al., 2015), the impact on economies (Coibion et al., 2024; Kumar et al., 2023) and its importance for policy (Baker et al., 2016; Caggiano et al., 2016). Therefore, by expanding on previous research, this thesis analysed the cross-section of heterogeneity and macroeconomic uncertainty, two fields within the expectations literature that have rarely been discussed together.

The empirical study utilised a survey of over 4,000 New Zealand firms. The analysis of firms' initial expectations showed significant heterogeneity. Firms who have low competition, a high profit margin, less frequent discussions with customers, are larger or who are less efficient are associated with higher levels of macroeconomic uncertainty. Also, firms who are in the professional services and manufacturing industries, on average, have lower uncertainty than firms in the trade, transportation, or construction industries. Further, the relationship between firm characteristics and macroeconomic uncertainty varies significantly across industries. These results show that the macroeconomic uncertainty of firms is heterogeneous. Not only does this contribute to the literature on how firms' expectations are formed, but it suggests that policy makers must account for heterogeneous expectations of firms in their models and forecasts.

The second stage to our empirical analysis randomly provided some firms with information on macroeconomic forecasts to understand whether firms have a heterogeneous reaction to a news shock. Through using a randomised controlled trial (RCT), we found that while there was some heterogeneity in how firms' macroeconomic uncertainty beliefs reacted to the treatments, this was limited. Across a range of different firm characteristics, the news shock caused all firms to adjust their beliefs, while those in the control group did not. If policy makers wish to target specific groups who would have a stronger adjustment in their expectations, our analysis suggests that those with fewer employees or more competition had a stronger reaction to the treatments than the aggregate. While this is useful, our key result is that a news shock universally causes firms to adjust their macroeconomic expectations, suggesting that policy makers can reduce uncertainty through effective communication.

In our analysis, given that industry groups appeared to have the greatest impact on both the initial beliefs of firms and in response to the news shock, we conducted further analysis into the reaction to the treatments by industry. Through interacting industry groups with other firm characteristics, we found that while the treatments continued to have a strong impact, there was more heterogeneity in how firms respond to the treatments. Of particular interest, is that these results highlighted how for firms in specific groups, one treatment may be more effective than another. This suggests that to be as effective as possible, monetary policy communication should be tailored to specific groups. These findings also provide support for the idea that firms form their beliefs on aggregate conditions using industry specific information, as suggested by Lucas (1975) and Andrade et al. (2022a).

Looking forward to areas for future research, this analysis has been pivotal at documenting the heterogeneity in firms' expectations, but the underlying source of this heterogeneity can still be explored in greater depth. Richer analysis to determine the mechanisms of how firms form their expectations, would be a valuable contribution to the existing literature. Based on our findings, we suggest that industry groups should be analysed in more detail, and in particular the hypothesis that firms form their expectations on macroeconomic variables through information received from their environment (Andrade et al., 2022a). This aligns with the Island Model hypothesis by Lucas (1975) which has been explored in depth for inflation expectations of households (D'Acunto et al., 2021c; D'Acunto & Weber, 2024). This hypothesis suggests that as each industry and country environment will be different, this causes heterogeneous expectations. Future research can explore this hypothesis by analysing firms both in different countries and different industries.

This thesis sought to explore the heterogeneity in firms' macroeconomic expectations. Through a detailed literature review and empirical analysis of a survey of New Zealand firms, the results are twofold; firms have heterogeneous beliefs on macroeconomic expectations, but firms universally have a strong response to a news shock on their macroeconomic uncertainty

expectations. Therefore, although firm characteristics are associated with differences in expectations, policy makers can reduce uncertainty through effective communication.

References

- Aastveit, K. A., Natvik, G. J. J., & Sola, S. (2013). Economic uncertainty and the effectiveness of monetary policy. *Norges Bank working Paper 17*.
<https://doi.org/10.2139/ssrn.2353008>
- Afrouzi, H. (2023). Strategic inattention, inflation dynamics, and the non-neutrality of money. *NBER Working Paper No. 31796*. <https://doi.org/10.2139/ssrn.4609865>
- Ali, S., Badshah, I., Demirer, R., & Hegde, P. (2022). Economic policy uncertainty and institutional investment returns: The case of New Zealand. *Pacific-Basin Finance Journal*, 74, 101797. <https://doi.org/10.1016/j.pacfin.2022.101797>
- Altig, D., Barrero, J. M., Bloom, N., Davis, S. J., Meyer, B., & Parker, N. (2020). Surveying business uncertainty. *Journal of Econometrics*, 231(1), 282–303. <https://doi.org/10.1016/j.jeconom.2020.03.021>
- Al-Thaqeb, S. A., & Algharabali, B. G. (2019). Economic policy uncertainty: A literature review. *The Journal of Economic Asymmetries*, 20(11), e00133.
<http://doi.org/10.1016/j.jeca.2019.e00133>
- Anderson, R. (2008). US Consumer Inflation Expectations: Evidence Regarding Learning, Accuracy and Demographics. *Centre for Growth and Business Cycle Research Discussion Paper 099*.
- Andrade, P., & Bihan, H. L. (2013). Inattentive professional forecasters. *Journal of Monetary Economics*, 60(8), 967–982. <https://doi.org/10.1016/j.jmoneco.2013.08.005>
- Andrade, P., Coibion, O., Gautier, E., & Gorodnichenko, Y. (2022a). No firm is an island? How industry conditions shape firms' expectations. *Journal of Monetary Economics*, 125(1), 40–56. <https://doi.org/10.1016/j.jmoneco.2021.05.006>
- Andrade, P., Pizzinelli, C., Roth, C., & Wohlfart, J. (2022b). Subjective Models of the macroeconomy: Evidence from experts and representative samples. *The Review of Economic Studies*, 89(6), 2958–2991. <https://doi.org/10.1093/restud/rdac008>
- Angelico, C., & Di Giacomo, F. (2019). Heterogeneity in inflation expectations and personal experience. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3369121>
- Arbatli, E., Davis, S., Ito, A., & Miake, N. (2017). Policy uncertainty in Japan. *NBER Working Paper No. 23411*. <https://doi.org/10.3386/w23411>
- Armantier, O., Nelson, S., Topa, G., van der Klaauw, W., & Zafar, B. (2016). The Price is Right: Updating Inflation Expectations in a Randomized Price Information Experiment.

The Review of Economics and Statistics, 98(3), 503–523.

https://doi.org/10.1162/rest_a_00499

- Awano, G., Bloom, N., Dolby, T., Mizen, P., Riley, R., Senga, T., Van Reenen, J., Vyas, J., & Wales, P. (2018). A firm-level perspective on micro- and macro-level uncertainty: An analysis of business expectations and uncertainty from the UK Management and Expectations Survey (ESCoE Discussion Paper No. 2018-10). *Economic Statistics Centre of Excellence (ESCoE)*.
- Bachmann, R., Elstner, S., Sims, E. R. (2013). Uncertainty and Economic Activity: Evidence from Business Survey Data. *American Economic Journal: Macroeconomics*. 5(2), 217–249. <https://doi.org/10.1257/mac.5.2.217>
- Baker, S. R., & Bloom, N. (2013). Does Uncertainty Reduce Growth? Using Natural Disasters as Natural Experiments. *NBER Working Paper No. 19475*.
<https://doi.org/10.3386/w19475>
- Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring Economic Policy Uncertainty. *The Quarterly Journal of Economics*, 131(4), 1593–1636. <https://doi.org/10.1093/qje/qjw024>
- Barrero, J. M. (2021). The micro and macro of managerial beliefs. *Journal of Financial Economics*, 143(2), 640–667. <https://doi.org/10.1016/j.jfineco.2021.06.007>
- Bartiloro, L., Bottone, M., & Rosolia, A. (2019). The Heterogeneity of the Inflation Expectations of Italian Firms along the Business Cycle. *International Journal of Central Banking*, 15(5), 175–205. <https://www.ijcb.org/journal/ijcb19q5a5.pdf>
- Batchelor, R. (2007). Bias in macroeconomic forecasts. *International Journal of Forecasting*, 23(2), 189–203. <https://doi.org/10.1016/j.ijforecast.2007.01.004>
- Baumann, U., Ferrando, A., Georgarakos, D., Gorodnichenko, Y., & Reinelt, T. (2024). Safe to update inflation expectations? New survey evidence on Euro area firms. *Working Paper Series 2949, European Central Bank*. <https://doi.org/10.2139/ssrn.4875504>
- Bekaert, G., Hoerova, M., & Lo Duca, M. (2013). Risk, uncertainty, and monetary policy. *Journal of Monetary Economics*, 60(7), 771–788.
<https://doi.org/10.1016/j.jmoneco.2013.06.003>
- Bernanke, B. S. (1983). Irreversibility, uncertainty, and cyclical investment. *The Quarterly Journal of Economics*, 98(1), 85. <https://doi.org/10.2307/1885568>
- Binder, C. C. (2018). Inflation expectations and the price at the pump. *Journal of Macroeconomics*, 58, 1–18. <https://doi.org/10.1016/j.jmacro.2018.08.006>

- Blinder, A. S., Ehrmann, M., Fratzscher, M., De Haan, J., & Jansen, D. (2008). Central Bank Communication and Monetary Policy: A Survey of Theory and evidence. *Journal of Economic Literature*, 46(4), 910–945. <https://doi.org/10.1257/jel.46.4.910>
- Bloom, N. (2009). The Impact of Uncertainty Shocks. *Econometrica* 77(3), 623–685. <https://doi.org/10.3982/ecta62>
- Bloom, N. (2014). Fluctuations in uncertainty. *The Journal of Economic Perspectives*, 28(2), 153–176. <https://doi.org/10.1257/jep.28.2.153>
- Boero, G., Smith, J., & Wallis, K. F. (2014). The measurement and characteristics of professional forecasters' uncertainty. *Journal of Applied Econometrics*, 30(7), 1029–1046. <https://doi.org/10.1002/jae.2400>
- Born, B., Enders, Z., Menkhoff, M., Müller, G. J., & Niemann, K. (2022). Firm Expectations and News: Micro v Macro. *CESifo Working Paper No. 10192*. <https://dx.doi.org/10.2139/ssrn.4324215>
- Bowles, C., Friz, R., Genre, V., Kenny, G., Meyler, A., & Rautanen, T. (2007). The ECB Survey of Professional Forecasters (SPF) - A Review After Eight Years' Experience. *ECB Occasional Paper No. 59*. <https://ssrn.com/abstract=967604>
- Braggion, F., Von Meyerinck, F., Schaub, N., & Weber, M. (2024). The Long-Term Effects of Inflation on inflation expectations. *NBER Working Paper No. 32160*. <https://doi.org/10.2139/ssrn.4731069>
- Branch, W. A., & Evans, G. W. (2006). A simple recursive forecasting model. *Economics Letters*, 91(2), 158–166. <https://doi.org/10.1016/j.econlet.2005.09.005>
- Brogaard, J., & Detzel, A. (2015). The Asset-Pricing implications of government economic policy uncertainty. *Management Science*, 61(1), 3–18. <https://doi.org/10.1287/mnsc.2014.2044>
- Burke, M. A., & Manz, M. (2014). Economic Literacy and Inflation Expectations: Evidence from a Laboratory Experiment. *Journal of Money Credit and Banking*, 46(7), 1421–1456. <https://doi.org/10.1111/jmcb.12144>
- Cagan, P. (1956): The Monetary Dynamics of Hyperinflation. In M. Friedman, (Ed.), *Studies in the Quantity Theory of Money* (pp. 25–117). University of Chicago Press.
- Caggiano, G., Castelnuovo, E., & Figueres, J. M. (2016). Economic policy uncertainty and unemployment in the United States: A nonlinear approach. *Economics Letters*, 151, 31–34. <https://doi.org/10.1016/j.econlet.2016.12.002>

- Caldara, D., Fuentes-Albero, C., Gilchrist, S., & Zakrajšek, E. (2016). The macroeconomic impact of financial and uncertainty shocks. *European Economic Review*, 88, 185–207. <https://doi.org/10.1016/j.euroecorev.2016.02.020>
- Candia, B., Coibion, O., & Gorodnichenko, Y. (2023). The macroeconomic expectations of firms. In *Handbook of Economic Expectations* (pp. 321–353). Academic Press. <https://doi.org/10.1016/B978-0-12-822927-9.00018-5>
- Candia, B., Coibion, O., & Gorodnichenko, Y. (2024). The inflation expectations of U.S. firms: Evidence from a new survey. *Journal of Monetary Economics*, 145, 103569. <https://doi.org/10.1016/j.jmoneco.2024.103569>
- Cavallo, A., Cruces, G., & Perez-Truglia, R. (2017). Inflation Expectations, Learning, and Supermarket Prices: Evidence from Survey Experiments. *American Economic Journal Macroeconomics*, 9(3), 1–35. <https://doi.org/10.1257/mac.20150147>
- Chow, G. C. (1989). Rational versus adaptive expectations in present value models. *The Review of Economics and Statistics*, 71(3), 376. <https://doi.org/10.2307/1926893>
- Chow, G. C. (2011). Usefulness of Adaptive and Rational Expectations in Economics. *CEPS Working Paper No .221*.
- Coibion, O., Georgarakos, D., Gorodnichenko, Y., Kenny, J., Weber, M. (2024). The Effect of Macroeconomic Uncertainty on Household Spending. *American Economic Review*, 114(3), 645–677. <https://doi.org/10.1257/aer.20221167>
- Coibion, O., & Gorodnichenko, Y. (2015a). Information Rigidity and the expectations formation Process: a simple framework and new facts. *American Economic Review*, 105(8), 2644–2678. <https://doi.org/10.1257/aer.20110306>
- Coibion, O., & Gorodnichenko, Y. (2015b). Is the Phillips Curve Alive and Well after All? Inflation Expectations and the Missing Disinflation. *American Economic Journal Macroeconomics*, 7(1), 197–232. <https://doi.org/10.1257/mac.20130306>
- Coibion, O., Gorodnichenko, Y., & Kumar, S. (2018). How do firms form their expectations? New survey evidence. *American Economic Review*, 108(9), 2671–2713. <https://doi.org/10.1257/aer.20151299>
- Coibion, O., Gorodnichenko, Y., Kumar, S., & Pedemonte, M. (2020). Inflation expectations as a policy tool? *Journal of International Economics*, 124, 103297. <https://doi.org/10.1016/j.jinteco.2020.103297>

- Coibion, O., Gorodnichenko, Y., & Ropele, T. (2019). Inflation Expectations and firm Decisions: new causal evidence*. *The Quarterly Journal of Economics*, 135(1), 165–219. <https://doi.org/10.1093/qje/qjz029>
- Coibion, O., Gorodnichenko, Y., & Weber, M. (2022). Monetary policy communications and their effects on household inflation expectations. *Journal of Political Economy*, 130(6), 1537–1584. <https://doi.org/10.1086/718982>
- Conrad, C., Enders, Z., & Glas, A. (2022). The role of information and experience for households' inflation expectations. *European Economic Review*, 143, 104015. <https://doi.org/10.1016/j.euroecorev.2021.104015>
- Conrad, C., & Lahiri, K. (2023). Heterogeneous Expectations among Professional Forecasters. *ZEW Discussion Papers, No. 23-062*. <https://doi.org/10.2139/ssrn.4654663>
- Crouzet, N., & Mehrotra, N. R. (2020). Small and Large Firms over the Business Cycle. *American Economic Review*, 110(11), 3549–3601. <https://doi.org/10.1257/aer.20181499>
- D'Acunto, F., Hoang, D., Paloviita, M., & Weber, M. (2019). Cognitive Abilities and Inflation Expectations. *AEA Papers and Proceedings*, 109, 562–566. <https://doi.org/10.1257/pandp.20191050>
- D'Acunto, F., Fuster, A., & Weber, M. (2021a). Diverse policy committees can reach underrepresented groups. *NBER Working Paper No. 29275*. <https://doi.org/10.2139/ssrn.3926956>
- D'Acunto, F., Hoang, D., & Weber, M. (2021b). Managing Households' Expectations with Unconventional Policies. *Review of Financial Studies*, 35(4), 1597–1642. <https://doi.org/10.1093/rfs/hhab083>
- D'Acunto, F., Malmendier, U., Ospina, J., & Weber, M. (2021c). Exposure to grocery prices and inflation expectations. *Journal of Political Economy*, 129(5), 1615–1639. <https://doi.org/10.1086/713192>
- D'Acunto, F., & Weber, M. (2024). Why Survey-Based subjective expectations are meaningful and important. *Annual Review of Economics*, 16(1), 329–357. <https://doi.org/10.1146/annurev-economics-091523-043659>
- Das, S., Kuhnen, C. M., & Nagel, S. (2019). Socioeconomic status and macroeconomic expectations. *Review of Financial Studies*, 33(1), 395–432. <https://doi.org/10.1093/rfs/hhz041>

- David, J. M., Hopenhayn, H. A., & Venkateswaran, V. (2016). Information, misallocation, and aggregate productivity *. *The Quarterly Journal of Economics*, *131*(2), 943–1005. <https://doi.org/10.1093/qje/qjw006>
- Davis, S. J., Liu, D., & Sheng, X. S. (2019). Economic Policy Uncertainty in China Since 1946: The View from Mainland Newspapers. *Working paper, August*.
- De Bruin, W. B., Vanderklaauw, W., Downs, J. S., Fischhoff, B., Topa, G., & Armantier, O. (2010). Expectations of inflation: the role of demographic variables, expectation formation, and financial literacy. *Journal of Consumer Affairs*, *44*(2), 381–402. <https://doi.org/10.1111/j.1745-6606.2010.01174.x>
- De Guindos, L. (2024, October 1). *Expectations surveys, central banks and the economy*. [Speech]. European Central Bank. <https://www.ecb.europa.eu/press/key/date/2024/html/ecb.sp241001~27385f20d3.en.html>
- Del Negro, M., Giannoni, M. P., & Patterson, C. (2012). The forward guidance puzzle. *FRB of New York Staff Report No. 574*. <https://doi.org/10.2139/ssrn.2163750>
- Dovern, J., Müller, L. S., & Wohlrabe, K. (2023). Local information and firm expectations about aggregates. *Journal of Monetary Economics*, *138*, 1–13. <https://doi.org/10.1016/j.jmoneco.2023.03.005>
- Ehrmann, M. (2000). Firm Size and Monetary Policy Transmission: Evidence from German Business Survey Data. *European Central Bank Working Paper No. 21*. <https://doi.org/10.2139/ssrn.355581>
- Ehrmann, M., & Fratzscher, M. (2005). How should central banks communicate? *European Central Bank Working Paper No. 557*. <https://doi.org/10.2139/ssrn.850944>
- Ehrmann, M., & Wabitsch, A. (2022). Central bank communication with non-experts – A road to nowhere? *Journal of Monetary Economics*, *127*, 69–85. <https://doi.org/10.1016/j.jmoneco.2022.02.003>
- Eusepi, S., & Preston, B. (2010). Central Bank Communication and Expectations Stabilization. *American Economic Journal Macroeconomics*, *2*(3), 235–271. <https://doi.org/10.1257/mac.2.3.235>
- Evans, G. W., & Honkapohja, S. (1999). Learning Dynamics. In *Handbook of Macroeconomics* (pp. 449-542). [https://doi.org/10.1016/S1574-0048\(99\)01010-1](https://doi.org/10.1016/S1574-0048(99)01010-1)
- Farhi, E., & Werning, I. (2019). Monetary policy, bounded rationality, and incomplete markets. *American Economic Review*, *109*(11), 3887–3928. <https://doi.org/10.1257/aer.20171400>

- Figlewski, S., & Wachtel, P. (1981). The formation of inflationary expectations. *The Review of Economics and Statistics*, 63(1), 1. <https://doi.org/10.2307/1924211>
- Frache, S., & Lluberas, R. (2017). New information and inflation expectations among firms. *Documentos De Trabajo 2017013, Banco Central del Uruguay*. <https://ideas.repec.org/p/bku/doctra/2017013.html>
- Friedman, M. (1957). III. the permanent income hypothesis. In *Princeton University Press eBooks* (pp. 20–37). <https://doi.org/10.1515/9780691188485-005>
- Friedman, M. (1958). The Role of Monetary Policy. *The American Economic Review*, 58(1), 1–17. <http://www.jstor.org/stable/1831652>
- Gabaix, X. (2011). The granular origins of aggregate fluctuations. *Econometrica*, 79(3), 733–772. <https://doi.org/10.3982/ecta8769>
- Gabaix, X. (2014). A Sparsity-Based model of bounded rationality *. *The Quarterly Journal of Economics*, 129(4), 1661–1710. <https://doi.org/10.1093/qje/qju024>
- Gabaix, X. (2020). A Behavioural New Keynesian Model. *American Economic Review*, 110(8), 2271–2327. <https://doi.org/10.1257/aer.20162005>
- Gaballo, G. (2018). Price Dispersion, Private Uncertainty, and Endogenous Nominal Rigidities. *The Review of Economic Studies*, 85(2), 1070–1110. <https://doi.org/10.1093/restud/rdx043>
- Geraats, P. M. (2002). Central Bank Transparency. *The Economic Journal*, 112(483), F532–F565. <https://doi.org/10.1111/1468-0297.00082>
- Haldane, A. G. (2017, March 31). *A little more conversation - A little less action*. [Speech]. Bank of England. <https://www.bankofengland.co.uk/speech/2017/a-little-more-conversation-a-little-less-action>
- Haltiwanger, J., & Waldman, M. (1985). Rational Expectations and the Limits of Rationality: An Analysis of Heterogeneity. *American Economic Review*, 75(3), 326–340. <https://ideas.repec.org/a/aea/aecrev/v75y1985i3p326-40.html>
- Hinnosaar, T. (2023). Price Setting on a Network. *CEPR Discussion Paper 18073*. <https://doi.org/10.2139/ssrn.3172236>
- Hommes, C. (2011). The heterogeneous expectations hypothesis: Some evidence from the lab. *Journal of Economic Dynamics and Control*, 35(1), 1–24. <https://doi.org/10.1016/j.jedc.2010.10.003>
- Infometrics. (2024, February). *Size of business units*. <https://rep.infometrics.co.nz/new-zealand/business/size-of-businesses>

- Jonung, L. (1981). Perceived and expected rates of inflation in Sweden. *American Economic Review*, 71(5), 961–968. <http://www.jstor.org/stable/1803477>
- Jurado, K., Ludvigson, S. C., & Ng, S. (2015). Measuring uncertainty. *American Economic Review*, 105(3), 1177–1216. <https://doi.org/10.1257/aer.20131193>
- Kang, W., Lee, K., & Ratti, R. A. (2013). Economic policy uncertainty and firm-level investment. *Journal of Macroeconomics*, 39, 42–53. <https://doi.org/10.1016/j.jmacro.2013.10.006>
- Keynes, J. M. (1936). *General Theory of Employment, Interest and Money*. Macmillan
- Kilian, L., & Zhou, X. (2022). Oil prices, gasoline prices, and inflation expectations. *Journal of Applied Econometrics*, 37(5), 867–881. <https://doi.org/10.1002/jae.2911>
- Klenow, P. J., & Willis, J. L. (2007). Sticky information and sticky prices. *Journal of Monetary Economics*, 54, 79–99. <https://doi.org/10.1016/j.jmoneco.2007.06.003>
- Kocherlakota, N. (2009). Some Thoughts on the State of Macro. *Minneapolis Fed mimeo*.
- Kumar, S., Afrouzi, H., Coibion, O., & Gorodnichenko, Y. (2015). Inflation Targeting Does Not Anchor Inflation Expectations: Evidence from Firms in New Zealand. *Brookings Papers on Economic Activity*, 2015(2), 151–225. <https://doi.org/10.1353/eca.2015.0007>
- Kumar, S., Gorodnichenko, Y., & Coibion, O. (2023). The effect of macroeconomic uncertainty on firm decisions. *Econometrica*, 91(4), 1297–1332. <https://doi.org/10.3982/ecta21004>
- Kumar, S., & Wesselbaum, D. (2024). Contracts and Firms' Inflation Expectations. *Review of Economics and Statistics*, 106(1), 246–255. https://doi.org/10.1162/rest_a_01115
- Lahiri, K., & Sheng, X. (2010). Measuring forecast uncertainty by disagreement: The missing link. *Journal of Applied Econometrics*, 25(4), 514–538. <https://doi.org/10.1002/jae.1167>
- La'O, J., & Tahbaz-Salehi, A. (2022). Optimal monetary policy in production networks. *Econometrica*, 90(3), 1295–1336. <https://doi.org/10.3982/ECTA18627>
- Lehtimäki, J. O., & Palmu, M. (2019). Central Bank Communication and Monetary Policy Predictability under Uncertain Economic Conditions. *Journal of Central Banking Theory and Practice*, 8(2), 5–32. <https://doi.org/10.2478/jcbtp-2019-0011>
- Leung, W. S., & Sun, J. (2021). Policy Uncertainty and Customer Concentration. *Production and Operations Management*, 30(5), 1517–1542. <https://doi.org/10.1111/poms.13335>
- Link, S., Peichl, A., Roth, C., & Wohlfart, J. (2023). Attention to the macroeconomy. *CEPR Discussion Paper No. 18699*. <https://doi.org/10.2139/ssrn.4669798>

- Lindner, T., Puck, J., & Verbeke, A. (2020). Misconceptions about multicollinearity in international business research: Identification, consequences, and remedies. *Journal of International Business Studies*, 51(3), 283–298. <https://doi.org/10.1057/s41267-019-00257-1>
- Londono, J. M., Ma, S., & Wilson, B. A. (2024). The global transmission of real economic uncertainty. *Journal of Money Credit and Banking*, 57(5), 1103–1133. <https://doi.org/10.1111/jmcb.13161>
- Lovell, M. C. (1986). Tests of the rational expectations hypothesis. *American Economic Review*, 76(1), 110–124. <https://www.jstor.org/stable/1803477>
- Lucas, R. E. (1972). Expectations and the neutrality of money. *Journal of Economic Theory*, 4(2), 103–124. [https://doi.org/10.1016/0022-0531\(72\)90142-1](https://doi.org/10.1016/0022-0531(72)90142-1)
- Lucas, R. E. (1975). An equilibrium model of the business cycle. *Journal of Political Economy*, 83(6), 1113–1144. <https://doi.org/10.1086/260386>
- Lucas, R. E. (1976). Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy*, 1, 19–46. [https://doi.org/10.1016/s0167-2231\(76\)80003-6](https://doi.org/10.1016/s0167-2231(76)80003-6)
- Lucas, R. E. (1980). Methods and Problems in Business Cycle Theory. *Journal of Money Credit and Banking*, 12(4), 696. <https://doi.org/10.2307/1992030>
- Machlup, F. (1946). Marginal Analysis and Empirical Research. *American Economic Review* 36 (4), 519–554. <https://www.jstor.org/stable/1801722>
- Maćkowiak, B., Matějka, F., & Wiederholt, M. (2023). Rational Inattention: A Review. *Journal of Economic Literature*, 61(1), 226–73. <https://doi.org/10.1257/jel.20211524>
- Maćkowiak, B., & Wiederholt, M. (2009). Optimal Sticky Prices under Rational Inattention. *American Economic Review*, 99(3), 769–803. <https://doi.org/10.1257/aer.99.3.769>
- Maddock, R., & Carter, M. (1982). A Child's Guide to Rational Expectations. *Journal of Economic Literature*, 20(1), 39–51. <https://www.jstor.org/stable/2724658>
- Madeira, C., & Zafar, B. (2012). Heterogeneous inflation expectations, learning, and market outcomes. *FRB of New York Staff Report No. 536*. <https://doi.org/10.2139/ssrn.1989115>
- Malmendier, U., Nagel, S., & Yan, Z. (2020). The making of hawks and doves. *Journal of Monetary Economics*, 117, 19–42. <https://doi.org/10.1016/j.jmoneco.2020.04.002>
- Mankiw, N. G., & Reis, R. (2002). Sticky Information versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve. *The Quarterly Journal of Economics*, 117(4), 1295–1328. <https://doi.org/10.1162/003355302320935034>

- Mankiw, N. G., Reis, R., & Wolfers, J. (2003). Disagreement about Inflation Expectations. *NBER Macroeconomics Annual*, 18, 209–248. <https://doi.org/10.1086/ma.18.3585256>
- Mason, G. (2013). *Investigating New Zealand–Australia productivity differences: New comparisons at industry level* [Working Paper 2013/02]. New Zealand Productivity Commission. <https://www.treasury.govt.nz/sites/default/files/2024-05/pc-wp-nzpc-nz-australia-productivity-working-paper-2013.pdf>
- Matějka, F., & McKay, A. (2015). Rational inattention to discrete choices: a new foundation for the multinomial Logit model. *American Economic Review*, 105(1), 272–298. <https://doi.org/10.1257/aer.20130047>
- McCallum, B. T. (1979). The current state of the Policy-Ineffectiveness debate. *American Economic Review*, 69(2), 240–245. <https://www.jstor.org/stable/1801650>
- Meade, E. E. (2005). The FOMC: Preferences, Voting, and Consensus. *Federal Reserve Bank of St. Louis Review*, 87(2), 93–101. <https://doi.org/10.20955/r.87.93-101>
- Milani, F. (2007). Expectations, learning and macroeconomic persistence. *Journal of Monetary Economics*, 54(7), 2065–2082. <https://doi.org/10.1016/j.jmoneco.2006.11.007>
- Ministry of Business, Innovation and Employment. (2020, May 25). *Manufacturing fact sheet*. <https://www.mbie.govt.nz/assets/manufacturing-factsheet.pdf>
- Mueller, P., Tahbaz-salehi, A., & Vedolin, A. (2017). Exchange rates and monetary policy uncertainty. *The Journal of Finance*, 72(3), 1213–1252. <https://doi.org/10.1111/jofi.12499>
- Muth, J. F. (1961). Rational expectations and the theory of price movements. *Econometrica*, 29(3), 315. <https://doi.org/10.2307/1909635>
- Neftci, S., & Sargent, T. J. (1978). A little bit of evidence on the natural rate hypothesis from the U.S. *Journal of Monetary Economics*, 4(2), 315–319. [https://doi.org/10.1016/0304-3932\(78\)90009-0](https://doi.org/10.1016/0304-3932(78)90009-0)
- Nerlove, M. (1958). Adaptive expectations and Cobweb phenomena. *The Quarterly Journal of Economics*, 72(2), 227. <https://doi.org/10.2307/1880597>
- Orphanides, A., & Williams, J. C. (2005). Inflation scares and forecast-based monetary policy. *Review of Economic Dynamics*, 8(2), 498–527. <https://doi.org/10.1016/j.red.2005.01.005>

- Ozdagli, A. K., & Weber, M. (2017). Monetary Policy Through Production Networks: Evidence from the Stock Market. *CESifo Working Paper Series No. 6486*. <https://doi.org/10.2139/ssrn.2988894>
- Pástor, L., & Veronesi, P. (2012). Uncertainty about Government Policy and Stock Prices. *The Journal of Finance*, 67(4), 1219–1264. <https://doi.org/10.1111/j.1540-6261.2012.01746.x>
- Patton, A. J., & Timmermann, A. (2010). Why do forecasters disagree? Lessons from the term structure of cross-sectional dispersion. *Journal of Monetary Economics*, 57(7), 803–820. <https://doi.org/10.1016/j.jmoneco.2010.07.001>
- Phelps, E. S. (1967). Phillips Curves, Expectations of Inflation and Optimal Unemployment over Time. *Economica*, 34(135), 254–281. <https://doi.org/10.2307/2552025>
- Phelps, E. S. (1968). Money-Wage dynamics and Labor-Market equilibrium. *Journal of Political Economy*, 76(4, Part 2), 678–711. <https://doi.org/10.1086/259438>
- Prescott, E. C. (1977). Should control theory be used for economic stabilization? *Carnegie-Rochester Conference Series on Public Policy*, 7, 13–38. [https://doi.org/10.1016/0167-2231\(77\)90017-3](https://doi.org/10.1016/0167-2231(77)90017-3)
- Ramey, G., & Ramey, V. A. (1995). Cross-Country evidence on the link between volatility and growth. *American Economic Review*, 85(5), 1138–1151. <https://www.jstor.org/stable/2950979>
- Ropele, T., Gorodnichenko, Y., & Coibion, O. (2024). Inflation Expectations and Misallocation of Resources: Evidence from Italy. *American Economic Review Insights*, 6(2), 246–261. <https://doi.org/10.1257/aeri.20230201>
- Roth, C., & Wohlfart, J. (2020). How Do Expectations About the Macroeconomy Affect Personal Expectations and Behaviour. *The Review of Economics and Statistics*, 102(4), 731–748. https://doi.org/10.1162/rest_a_00867
- Sargent, T. J. (1976). A classical macroeconomic model for the United States. *Journal of Political Economy*, 84(2), 207–237. <https://doi.org/10.1086/260429>
- Sargent, T. J. (1999). The conquest of American inflation. In *Princeton University Press eBooks*. <https://doi.org/10.1515/9780691186689>
- Sargent, T. J., & Wallace, N. (1975). “Rational” expectations, the optimal monetary instrument, and the optimal money supply rule. *Journal of Political Economy*, 83(2), 241–254. <https://doi.org/10.1086/260321>

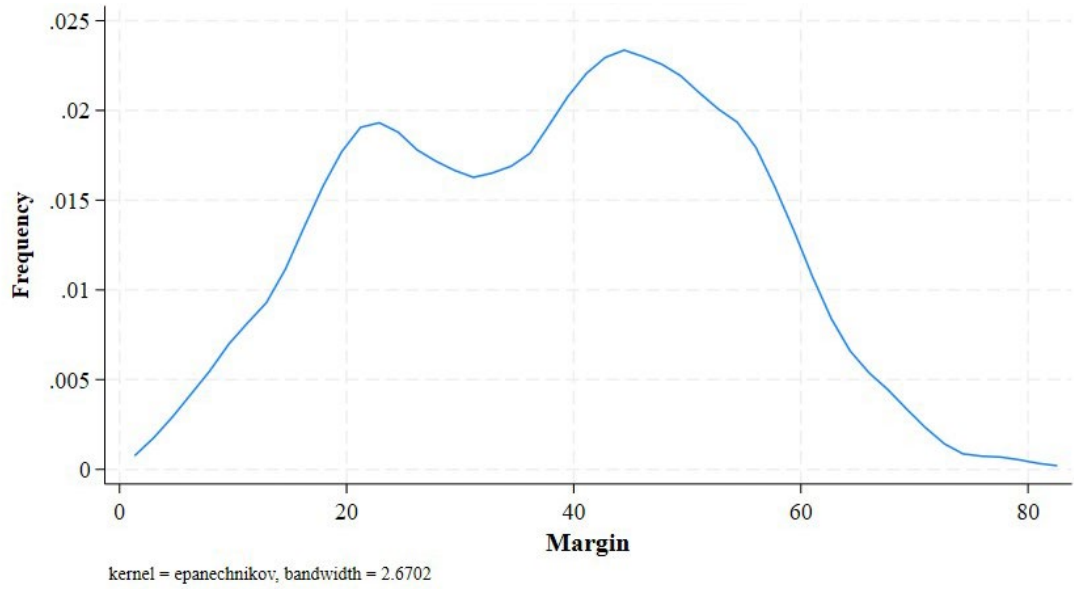
- Savignac, F., Gautier, E., Gorodnichenko, Y., & Coibion, O. (2024). Firms' Inflation Expectations: New Evidence from France. *Journal of the European Economic Association*. <https://doi.org/10.1093/jeea/jvae015>
- Schwert, G. W. (1989). Why does stock market volatility change over time? *The Journal of Finance*, 44(5), 1115–1153. <https://doi.org/10.1111/j.1540-6261.1989.tb02647.x>
- Sims, C. A. (2003). Implications of rational inattention. *Journal of Monetary Economics*, 50(3), 665–690. [https://doi.org/10.1016/s0304-3932\(03\)00029-1](https://doi.org/10.1016/s0304-3932(03)00029-1)
- Sims, C. A. (2010). Rational inattention and monetary economics. In *Handbook of monetary economics* (pp. 155–181). <https://doi.org/10.1016/b978-0-444-53238-1.00004-1>
- Souleles, N. S. (2004). Expectations, Heterogeneous Forecast Errors, and Consumption: Micro Evidence from the Michigan Consumer Sentiment Surveys. *Journal of Money Credit and Banking*, 36(1), 39–72. <https://doi.org/10.1353/mcb.2004.0007>
- Statistics New Zealand. (2022). *National population projections: 2022(base)–2073*. <https://www.stats.govt.nz/information-releases/national-population-projections-2022base2073>
- Statistics New Zealand. (2023). *Business performance benchmarker* [Data set]. <https://www.stats.govt.nz/experimental/business-performance-benchmarker/>
- Statistics New Zealand. (2024). *New Zealand business demography statistics: At February 2024* [Data set]. <https://www.stats.govt.nz/information-releases/new-zealand-business-demography-statistics-at-february-2024/>
- Weber, M., D'Acunto, F., Gorodnichenko, Y., & Coibion, O. (2022). The Subjective inflation Expectations of Households and Firms: Measurement, determinants, and implications. *The Journal of Economic Perspectives*, 36(3), 157–184. <https://doi.org/10.1257/jep.36.3.157>
- Weber, M., Candia, B., Afrouzi, H., Ropele, T., Lluberas, R., Frache, S., Meyer, B., Kumar, S., Gorodnichenko, Y., Georgarakos, D., Coibion, O., Kenny, G., & Ponce, J. (2025). Tell me something I don't already know: learning in Low and High-Inflation settings. *Econometrica*, 93, 229–264. <https://doi.org/10.2139/ssrn.4515596>
- Wegner, D., Foguesatto, C. R., & Zuliani, A. L. (2023). Firm performance in uncertain times: the importance of networking capabilities. *Journal of Small Business and Enterprise Development*, 30(2), 369–389. <https://doi.org/10.1108/jsbed-03-2022-0135>
- Woodford, M. (2001). The Taylor rule and optimal monetary policy. *American Economic Review*, 91(2), 232–237. <https://doi.org/10.1257/aer.91.2.232>

- Woodford, M. (2005). Central Bank communication and policy effectiveness. *NBER Working Paper No. 11898*. <https://doi.org/10.3386/w11898>
- Woodford, M. (2019). Monetary policy analysis when planning horizons are finite. *NBER Macroeconomics Annual*, 33, 1–50. <https://doi.org/10.1086/700892>
- Wooldridge, J. M. (2020). *Introductory Econometrics: a Modern Approach* (7th ed.). Cengage
- Yang, C. (2022). Rational inattention, menu costs, and multi-product firms: Micro evidence and aggregate implications. *Journal of Monetary Economics*, 128, 105–123. <https://doi.org/10.1016/j.jmoneco.2022.04.004>
- Yıldırım-Karaman, S. (2017). Uncertainty shocks, central bank characteristics and business cycles. *Economic Systems*, 41(3), 379–388. <https://doi.org/10.1016/j.ecosys.2016.09.004>
- Zarnowitz, V., & Lambros, L. A. (1987). Consensus and uncertainty in economic prediction. *Journal of Political Economy*, 95(3), 591–621. <https://doi.org/10.1086/261473>

Appendices

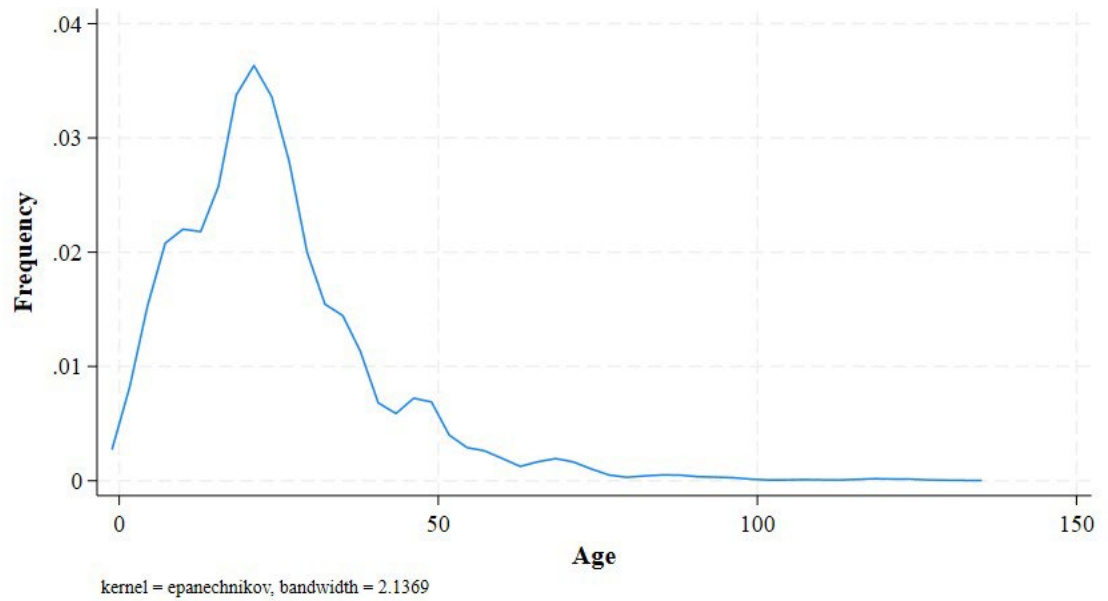
Appendix A

Distribution of Proxy for Gross Profit Margin



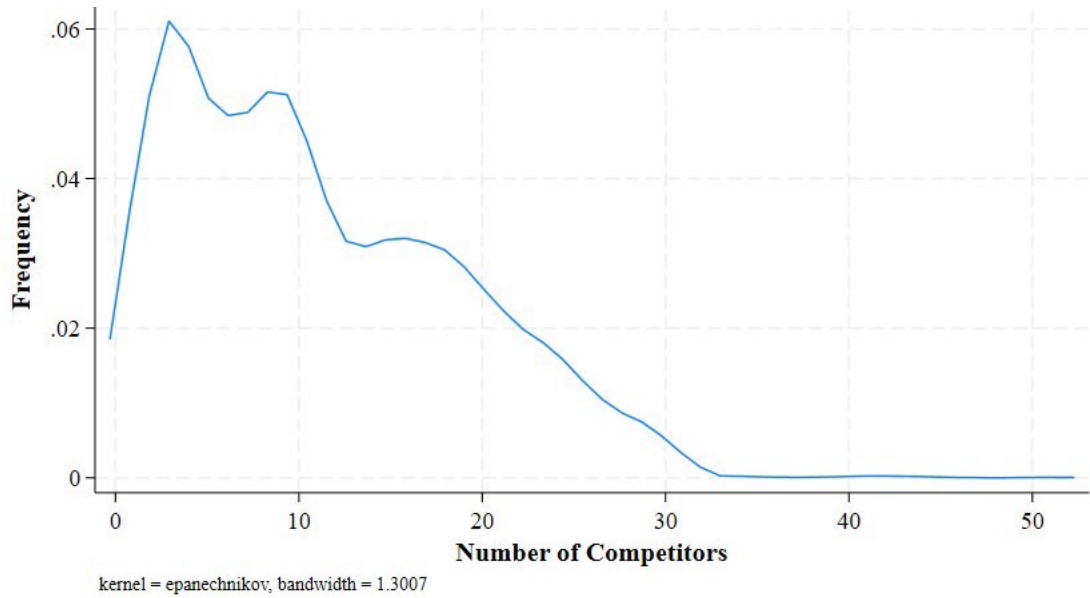
Appendix B

Distribution of Age



Appendix C

Distribution of Number of Competitors



Appendix D

Correlation Matrix for the Firm Characteristics

	No. of employees	Margin	Competition	Age	Total production	Customer network	Value of prof. forecasts	Value of info.
No. employees	1.00							
Margin	0.07	1.00						
Competition	-0.63	-0.02	1.00					
Age	0.11	-0.08	-0.08	1.00				
Total production	0.71	0.06	-0.51	0.05	1.00			
Customer network	0.01	-0.08	-0.04	-0.02	0.16	1.00		
Value of prof. forecasts	-0.01	0.18	0.03	0.00	-0.03	-0.04	1.00	
Value of info.	0.01	0.06	0.00	0.02	-0.02	0.07	0.68	1.00

Note. Number of employees, age and total production are logged variables.

Appendix E

Summary Statistics for Prior Uncertainty Beliefs by Industry

	GDP uncertainty			Inflation uncertainty			Sales uncertainty		
	Mean	Median	St.Dev.	Mean	Median	St.Dev.	Mean	Median	St.Dev.
Professional services	5.05	5.10	2.17	5.75	5.50	2.55	5.14	5.00	2.22
Construction	7.13	7.20	3.36	6.55	6.70	2.93	5.46	5.50	1.67
Manufacturing	5.89	6.00	3.00	4.23	4.60	1.48	4.80	4.80	1.91
Trade	6.57	6.50	3.43	5.76	5.20	2.76	8.70	8.70	3.44
Transportation	7.94	8.35	3.46	6.49	6.40	2.68	5.58	5.50	1.94

Note. Number of observations is 4,212. Uncertainty is measured as the range in their lowest and highest estimate and expressed in percentage points.

Appendix F

Firm Characteristics on Initial Expectations by Industry for GDP Mean

	Baseline	Professional services firms	Construction firms	Manufacturing firms	Trade firms	Transportation firms
Employment (log)	0.68*** (0.04)	0.87*** (0.09)	-0.32 (0.39)	0.01 (0.11)	0.79*** (0.12)	-0.19 (0.27)
Margin	0.02*** (0.00)	0.00 (0.00)	-0.01 (0.02)	0.00 (0.01)	-0.01 (0.00)	-0.01 (0.01)
Competition	-0.03*** (0.00)	-0.02*** (0.01)	-0.08** (0.03)	-0.04*** (0.01)	-0.04*** (0.01)	-0.10*** (0.02)
Age (log)	-0.00 (0.03)	-0.06 (0.04)	0.12 (0.23)	-0.06 (0.06)	-0.01 (0.08)	0.10 (0.14)
Production total (log)	-0.31*** (0.03)	-0.57*** (0.08)	0.40 (0.27)	0.24*** (0.08)	-0.10 (0.07)	-0.09 (0.21)
Customer network	-0.00** (0.00)	-0.00 (0.00)	-0.03 (0.02)	0.00 (0.00)	-0.00 (0.01)	0.03** (0.01)
Value of professional forecasts	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00* (0.00)	-0.00** (0.00)	0.00 (0.00)
Value of network information	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00** (0.00)	-0.00 (0.00)
Observations	3,986	1,424	91	1,349	942	180
r-squared	0.17	0.18	0.20	0.13	0.18	0.21

Note. The table reports estimates for initial beliefs, before any treatments, following specification 1. Robust standard errors are reported in parentheses.

Appendix G

Firm Characteristics on Initial Expectations by Industry for Inflation Mean

	Baseline	Professional services firms	Construction firms	Manufacturing firms	Trade firms	Transportation firms
Employment (log)	0.15*** (0.04)	0.35*** (0.10)	-0.14 (0.36)	0.16* (0.09)	0.20* (0.11)	-0.05 (0.21)
Margin	0.02*** (0.00)	0.01** (0.00)	-0.03 (0.02)	0.01* (0.01)	0.00 (0.01)	0.01 (0.01)
Competition	-0.02*** (0.00)	-0.02*** (0.01)	-0.07*** (0.03)	-0.02** (0.01)	-0.01 (0.01)	-0.03** (0.02)
Age (log)	-0.00 (0.00)	0.01 (0.05)	-0.05 (0.18)	-0.03 (0.05)	0.10 (0.06)	0.04 (0.13)
Production total (log)	0.01 (0.03)	0.06 (0.08)	-0.13 (0.26)	-0.04 (0.07)	0.04 (0.06)	-0.04 (0.17)
Customer network	-0.01*** (0.00)	-0.01** (0.00)	-0.01 (0.02)	0.00 (0.00)	-0.01** (0.01)	0.01 (0.01)
Value of professional forecasts	-0.00 (0.06)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00* (0.00)	0.00 (0.00)
Value of network information	0.00 (0.06)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00** (0.00)	-0.00 (0.00)
Observations	3,986	1,424	91	1,349	942	180
r-squared	0.08	0.10	0.11	0.04	0.04	0.03

Note. The table reports estimates for inflation means, before any treatments, following specification 1. Robust standard errors are reported in parentheses.

Appendix H

Firm Characteristics on Initial Expectations by Industry for Inflation Uncertainty

	Baseline	Professional services firms	Construction firms	Manufacturin g firms	Trade firms	Transportatio n firms
Employment (log)	0.30*** (0.07)	0.97*** (0.16)	-0.50 (0.80)	-0.09 (0.10)	0.81*** (0.20)	0.46 (0.42)
Margin	0.05*** (0.00)	0.01 (0.01)	-0.03 (0.03)	0.01 (0.01)	-0.01 (0.01)	0.03 (0.02)
Competition	-0.04*** (0.01)	-0.05*** (0.01)	-0.11** (0.05)	-0.02*** (0.01)	-0.04*** (0.01)	-0.08** (0.03)
Age (log)	0.03 (0.05)	-0.02 (0.08)	0.32 (0.35)	-0.02 (0.06)	0.35*** (0.12)	0.17 (0.21)
Production total (log)	-0.05 (0.05)	-0.16 (0.13)	0.21 (0.56)	0.17** (0.08)	-0.06 0.11	-0.28 (0.31)
Customer network	-0.01*** (0.00)	-0.01 (0.00)	-0.04 (0.04)	0.00 (0.00)	-0.01 (0.01)	0.03 (0.02)
Value of professional forecasts	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00*** (0.00)	0.00 (0.00)
Value of network information	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)
Observations	3,986	1,424	91	1,349	942	180
r-squared	0.14	0.15	0.09	0.05	0.10	0.11

Note. The table reports estimates for inflation uncertainty, before any treatments, following specification 1. Robust standard errors are reported in parentheses.

Appendix I

Firm Characteristics on Initial Expectations by Industry for Sales Mean

	Baseline	Professional services firms	Construction firms	Manufacturing firms	Trade firms	Transportation firms
Employment (log)	-0.35*** (0.05)	0.22** (0.10)	-0.30 (0.35)	0.06 (0.09)	-0.06 (0.15)	0.35 (0.24)
Margin	-0.01*** (0.00)	0.01* (0.00)	0.03 (0.02)	-0.01 (0.01)	0.01* (0.01)	-0.00 (0.01)
Competition	-0.02*** (0.00)	-0.02*** (0.01)	-0.06** (0.02)	-0.01 (0.01)	0.02 (0.01)	-0.06*** (0.02)
Age (log)	-0.01 (0.04)	0.02 (0.05)	0.16 (0.22)	0.04 (0.05)	-0.01 (0.09)	0.03 (0.13)
Production total (log)	0.54*** (0.03)	-0.17** (0.08)	0.13 (0.28)	0.01 (0.07)	0.49*** (0.08)	-0.19 (0.19)
Customer network	0.00 (0.00)	0.00 (0.00)	-0.00 (0.02)	-0.00 (0.00)	0.00 (0.01)	0.00 (0.01)
Value of professional forecasts	-0.00** (0.00)	-0.00* (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.00** (0.00)	0.00 (0.00)
Value of network information	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00** (0.00)	-0.00* (0.00)
Observations	3,986	1,424	91	1,349	942	180
r-squared	0.13	0.03	0.18	0.01	0.08	0.15

Note. The table reports estimates for initial beliefs, before any treatments, following specification 1. Robust standard errors are reported in parentheses.

Appendix J

Firm Characteristics on Initial Expectations by Industry for Sales Uncertainty

	Baseline	Professional services firms	Construction firms	Manufacturi ng firms	Trade firms	Transportati on firms
Employment (log)	1.21*** (0.08)	0.97*** (0.17)	-0.26 (0.41)	-0.06 (0.13)	0.29 (0.25)	-0.36 (0.35)
Margin	0.05*** (0.00)	-0.00 (0.01)	-0.02 (0.02)	0.01* (0.01)	-0.02* (0.01)	-0.00 (0.02)
Competition	0.04*** (0.01)	-0.01 (0.01)	-0.02 (0.03)	-0.03*** (0.01)	0.03 (0.02)	0.02 (0.03)
Age (log)	-0.02 (0.06)	-0.02 (0.08)	-0.19 (0.20)	-0.05 (0.08)	-0.08 (0.15)	-0.26 (0.16)
Production total (log)	-1.13*** (0.05)	-0.54*** (0.12)	0.35 (0.35)	0.19* (0.10)	-0.85*** (0.13)	0.31 (0.24)
Customer network	-0.01** (0.00)	0.00 (0.00)	-0.01 (0.03)	0.00 (0.00)	-0.02 (0.01)	0.00 (0.02)
Value of professional forecasts	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)
Value of network information	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
Observations	3,986	1,424	91	1,349	942	180
r-squared	0.20	0.05	0.08	0.05	0.09	0.05

Note. The table reports estimates for initial sales uncertainty, before any treatments, following specification 1. Robust standard errors are reported in parentheses.

Appendix K

Baseline Expectations with Treatments

	GDP mean	GDP uncertainty	Inflation mean	Inflation uncertainty	Sales mean	Sales uncertainty
Treatment 1	3.80*** (0.05)	1.25*** (0.09)	0.87*** (0.06)	0.71*** (0.06)	0.16*** (0.04)	0.77*** (0.06)
Treatment 2	1.27*** (0.06)	2.61*** (0.08)	1.14*** (0.07)	1.60*** (0.07)	0.23*** (0.04)	0.88*** (0.06)
Treatment 3	3.75*** (0.04)	2.77*** (0.08)	1.18*** (0.07)	1.47*** (0.07)	0.18*** (0.04)	0.81*** (0.06)
Prior mean	0.97*** (0.01)		1.00*** (0.01)		0.94*** (0.01)	
Prior mean x treatment 1	-0.94*** (0.01)		-0.32*** (0.01)		-0.11*** (0.01)	
Prior mean x treatment 2	-0.60*** (0.02)		-0.34*** (0.02)		-0.13*** (0.02)	
Prior mean x treatment 3	-0.93*** (0.01)		-0.37*** (0.01)		-0.11*** (0.02)	
Prior range		0.99*** (0.00)		0.99*** (0.00)		0.99*** (0.00)
Prior range x treatment 1		-0.92*** (0.02)		-0.45*** (0.01)		-0.24*** (0.01)
Prior range x treatment 2		-0.79*** (0.02)		-0.53*** (0.01)		-0.26*** (0.01)
Prior range x treatment 3		-0.94*** (0.02)		-0.55*** (0.01)		-0.24*** (0.01)
Observations	4,203	4,212	4,212	4,212	4,212	4,212
r-squared	0.80	0.83	0.85	0.84	0.94	0.94

Note. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses

Appendix L

Treatment Effects on GDP Uncertainty by Age

	Baseline	Low age firms	Medium age firms	High age firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.16*** (0.17)	1.39*** (0.11)	1.13*** (0.18)	0.48
Treatment 2	2.61*** (0.08)	2.45*** (0.15)	2.64*** (0.11)	2.74*** (0.16)	0.31
Treatment 3	2.77*** (0.08)	2.88*** (0.14)	2.83*** (0.11)	2.60*** (0.15)	0.52
Prior range	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.86
Prior range x treatment 1	-0.92*** (0.02)	-0.92*** (0.04)	-0.95*** (0.02)	-0.90*** (0.03)	0.64
Prior range x treatment 2	-0.79*** (0.02)	-0.76*** (0.03)	-0.80*** (0.02)	-0.79*** (0.03)	0.52
Prior range x treatment 3	-0.94*** (0.02)	-0.98*** (0.03)	-0.94*** (0.02)	-0.91*** (0.03)	0.53
Observations	4,212	1,147	1,952	1,086	-
r-squared	0.83	0.83	0.84	0.80	-

Note. Age sub-categories are determined by: young ≤ 15 , 15 < medium ≤ 30 , high > 30. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix M

Treatments Effects on GDP Uncertainty by Profit Margin

	Baseline	Low margin firms	Medium margin firms	High margin firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.40*** (0.09)	1.26*** (0.16)	1.02*** (0.19)	0.30
Treatment 2	2.61*** (0.08)	2.83*** (0.09)	2.56*** (0.14)	2.44*** (0.17)	0.03**
Treatment 3	2.77*** (0.08)	2.71*** (0.09)	2.73*** (0.14)	2.88*** (0.17)	0.70
Prior range	0.99*** (0.00)	0.98*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.04**
Prior range x treatment 1	-0.92*** (0.02)	-0.96*** (0.02)	-0.92*** (0.03)	-0.89*** (0.04)	0.38
Prior range x treatment 2	-0.79*** (0.02)	-0.81*** (0.02)	-0.76*** (0.03)	-0.77*** (0.03)	0.13
Prior range x treatment 3	-0.94*** (0.02)	-0.90*** (0.02)	-0.95*** (0.03)	-0.97*** (0.03)	0.24
Observations	4,212	1,446	1,695	1,071	-
r-squared	0.83	0.88	0.82	0.79	-

Note. Margin sub-categories are determined by: low $\leq 30\%$, $30\% < \text{medium} \leq 50\%$, high $> 50\%$. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix N

Treatments Effects on GDP Uncertainty by Total Production

	Baseline	Low total production firms	Medium total production firms	High total production firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.32*** (0.11)	1.06*** (0.21)	1.33*** (0.13)	0.71
Treatment 2	2.61*** (0.08)	2.57*** (0.13)	2.61*** (0.13)	2.66*** (0.13)	0.94
Treatment 3	2.77*** (0.08)	2.94*** (0.09)	2.70*** (0.17)	2.62*** (0.14)	0.25
Prior range	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.80
Prior range x treatment 1	-0.92*** (0.02)	-0.95*** (0.02)	-0.87*** (0.04)	-0.94*** (0.03)	0.39
Prior range x treatment 2	-0.79*** (0.02)	-0.78*** (0.03)	-0.79*** (0.03)	-0.80*** (0.02)	0.94
Prior range x treatment 3	-0.94*** (0.02)	-0.98*** (0.02)	0.90*** (0.04)	-0.92*** (0.03)	0.14
Observations	4,212	1,481	1,131	1,600	-
r-squared	0.83	0.85	0.79	0.83	-

Note. Value of total production sub-categories are determined by: low \leq \$10,000,000, \$10,000,000 < medium \leq \$30,000,000, high > \$30,000,000. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix O

Treatments Effects on GDP Uncertainty by Customer Network

	Baseline	Low number of conversations with customers firms	Medium number of conversations with customers firms	Large number of conversations with customers firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.29*** (0.14)	1.02*** (0.14)	1.63*** (0.12)	0.01***
Treatment 2	2.61*** (0.08)	2.60*** (0.11)	2.63*** (0.14)	2.58*** (0.12)	0.97
Treatment 3	2.77*** (0.08)	2.78*** (0.13)	2.67*** (0.12)	2.89*** (0.13)	0.35
Prior range	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.98*** (0.01)	0.28
Prior range x treatment 1	-0.92*** (0.02)	-0.93*** (0.03)	-0.90*** (0.03)	-0.98*** (0.02)	0.14
Prior range x treatment 2	-0.79*** (0.02)	-0.78*** (0.02)	-0.79*** (0.03)	-0.78*** (0.02)	0.97
Prior range x treatment 3	-0.94*** (0.02)	-0.94*** (0.03)	-0.94*** (0.03)	-0.95*** (0.03)	0.73
Observations	4,212	1,755	1,524	933	-
r-squared	0.83	0.82	0.83	0.84	-

Note. Customer network sub-categories are determined by: low ≤ 8 , $8 < \text{medium} \leq 20$, high > 20 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix P

Treatments Effects on GDP Uncertainty by Value of Network Information

	Baseline	Low value of network information firms	Medium value of network information firms	High value of network information firms	Joint test p-value
Treatment 1	1.25*** (0.09)	1.17*** (0.17)	1.44*** (0.09)	1.13*** (0.17)	0.26
Treatment 2	2.61*** (0.08)	2.50*** (0.15)	2.69*** (0.10)	2.63*** (0.16)	0.62
Treatment 3	2.77*** (0.08)	2.83*** (0.14)	2.80*** (0.12)	2.63*** (0.15)	0.39
Prior range	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.53
Prior range x treatment 1	-0.92*** (0.02)	-0.92*** (0.04)	-0.96*** (0.02)	-0.90*** (0.04)	0.24
Prior range x treatment 2	-0.79*** (0.02)	-0.77*** (0.03)	-0.80*** (0.02)	-0.80*** (0.03)	0.71
Prior range x treatment 3	-0.94*** (0.02)	-0.94*** (0.03)	-0.95*** (0.03)	-0.93*** (0.03)	0.48
Observations	4,212	1,396	1,670	1,146	-
r-squared	0.83	0.81	0.85	0.81	-

Note. Value of network information sub-categories are determined by: low ≤ 150 , $150 <$ medium ≤ 300 , high > 300 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix Q

Treatment Effects on Inflation Uncertainty by Employment Size

	Baseline	Small firms	Medium firms	Large firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.53*** (0.08)	0.71*** (0.11)	0.87*** (0.14)	0.00***
Treatment 2	1.60*** (0.07)	1.70*** (0.10)	1.40*** (0.12)	1.41*** (0.25)	0.05*
Treatment 3	1.47*** (0.07)	1.24*** (0.09)	1.46*** (0.13)	1.43*** (0.16)	0.00***
Prior range	0.99*** (0.00)	0.99*** (0.00)	1.00*** (0.01)	1.01*** (0.00)	0.00***
Prior range x treatment 1	-0.45*** (0.01)	-0.39*** (0.02)	-0.46*** (0.02)	-0.47*** (0.03)	0.00***
Prior range x treatment 2	-0.53*** (0.01)	-0.55*** (0.03)	-0.51*** (0.02)	-0.49*** (0.05)	0.07*
Prior range x treatment 3	-0.55*** (0.01)	-0.47*** (0.02)	-0.58*** (0.02)	-0.56*** (0.03)	0.00***
Observations	4,212	2,163	1,489	560	-
r-squared	0.84	0.81	0.85	0.83	-

Note. Employment size sub-categories are determined by: small ≤ 19 , $19 < \text{medium} \leq 49$, large > 50 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix R

Treatment Effects on Inflation Uncertainty by Competition

	Baseline	Low number of competitors firms	Medium number of competitors firms	Large number of competitors firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.78*** (0.12)	0.74*** (0.08)	0.53*** (0.10)	0.15
Treatment 2	1.60*** (0.07)	1.44*** (0.15)	1.57*** (0.10)	1.72*** (0.14)	0.35
Treatment 3	1.47*** (0.07)	1.36*** (0.13)	1.44*** (0.10)	1.39*** (0.12)	0.00***
Prior range	0.99*** (0.00)	1.00*** (0.01)	1.00*** (0.00)	0.99*** (0.00)	0.11
Prior range x treatment 1	-0.45*** (0.01)	-0.47*** (0.02)	-0.45*** (0.02)	-0.40*** (0.02)	0.09*
Prior range x treatment 2	-0.53*** (0.01)	-0.51*** (0.03)	-0.53*** (0.02)	-0.55*** (0.03)	0.38
Prior range x treatment 3	-0.55*** (0.01)	-0.56*** (0.02)	-0.56*** (0.02)	-0.49*** (0.03)	0.01***
Observations	4,212	1,308	1,685	1,219	-
r-squared	0.84	0.85	0.85	0.81	-

Note. Competition sub-categories are determined by: low ≤ 5 , 5 < medium ≤ 15 , high > 15 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix S

Treatment Effects on Inflation Uncertainty by Age

	Baseline	Young firms	Medium age firms	Old firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.70*** (0.10)	0.73*** (0.08)	0.69*** (0.11)	0.96
Treatment 2	1.60*** (0.07)	1.72*** (0.14)	1.55*** (0.11)	1.52*** (0.11)	0.65
Treatment 3	1.47*** (0.07)	1.60*** (0.13)	1.53*** (0.10)	1.25*** (0.11)	0.16
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	0.44
Prior range x treatment 1	-0.45*** (0.01)	-0.45*** (0.02)	-0.45*** (0.02)	-0.43*** (0.02)	0.87
Prior range x treatment 2	-0.53*** (0.01)	-0.55*** (0.03)	-0.53*** (0.02)	-0.51*** (0.02)	0.67
Prior range x treatment 3	-0.55*** (0.01)	-0.57*** (0.03)	-0.57*** (0.02)	-0.51*** (0.02)	0.23
Observations	4,212	1,174	1,952	1,086	-
r-squared	0.84	0.84	0.84	0.83	

Note. Age sub-categories are determined by: young ≤ 15 , 15 < medium ≤ 30 , high > 30. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix T

Treatment Effects on Inflation Uncertainty by Production Total

	Baseline	Low total production firms	Medium total production firms	High total production firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.62*** (0.09)	0.80*** (0.11)	0.76*** (0.10)	0.42
Treatment 2	1.60*** (0.07)	1.71*** (0.09)	1.57*** (0.16)	1.47*** (0.13)	0.48
Treatment 3	1.47*** (0.07)	1.48*** (0.10)	1.50*** (0.15)	1.40*** (0.11)	0.59
Prior range	0.99*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.42
Prior range x treatment 1	-0.45*** (0.01)	-0.44*** (0.02)	-0.46*** (0.02)	-0.45*** (0.02)	0.40
Prior range x treatment 2	-0.53*** (0.01)	-0.57*** (0.02)	-0.52*** (0.03)	-0.51*** (0.03)	0.24
Prior range x treatment 3	-0.55*** (0.01)	-0.56*** (0.02)	-0.54*** (0.03)	-0.55*** (0.02)	0.70
Observations	4,212	1,481	1,131	1,600	-
r-squared	0.84	0.84	0.83	0.83	-

Note. Value of total production sub-categories are determined by: low \leq \$10,000,000, \$10,000,000 < medium \leq \$30,000,000, high > \$30,000,000. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix U

Treatment Effects on Inflation Uncertainty by Customer Network

	Baseline	Low number of conversations with customers firms	Medium number of conversations with customers firms	Large number of conversations with customers firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.66*** (0.09)	0.71*** (0.09)	0.80*** (0.13)	0.75
Treatment 2	1.60*** (0.07)	1.78*** (0.08)	1.40*** (0.13)	1.54*** (0.14)	0.08*
Treatment 3	1.47*** (0.07)	1.43*** (0.10)	1.54*** (0.10)	1.38*** (0.18)	0.84
Prior range	0.99*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	1.00*** (0.00)	0.83
Prior range x treatment 1	-0.45*** (0.01)	-0.45*** (0.02)	-0.44*** (0.02)	-0.45*** (0.03)	0.84
Prior range x treatment 2	-0.53*** (0.01)	-0.59*** (0.02)	-0.48*** (0.03)	-0.50*** (0.03)	0.01***
Prior range x treatment 3	-0.55*** (0.01)	-0.55*** (0.02)	-0.57*** (0.02)	-0.53*** (0.04)	0.87
Observations	4,212	1,755	1,524	933	-
r-squared	0.84	0.86	0.84	0.78	-

Note. Customer network sub-categories are determined by: low ≤ 8 , $8 < \text{medium} \leq 20$, high > 20 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix V

Treatment Effects on Inflation Uncertainty by Value of Professional Forecasts

	Baseline	Low value of prof. forecasts firms	Medium value of prof. forecasts firms	High value of prof. forecasts firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.78*** (0.09)	0.70*** (0.09)	0.65*** (0.10)	0.77
Treatment 2	1.60*** (0.07)	1.60*** (0.12)	1.58*** (0.12)	1.56*** (0.13)	0.42
Treatment 3	1.47*** (0.07)	1.55*** (0.12)	1.47*** (0.09)	1.36*** (0.14)	0.70
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.00)	0.99*** (0.01)	0.61
Prior range x treatment 1	-0.45*** (0.01)	-0.47*** (0.02)	-0.44*** (0.02)	-0.44*** (0.02)	0.58
Prior range x treatment 2	-0.53*** (0.01)	-0.53*** (0.02)	-0.52*** (0.03)	-0.54*** (0.03)	0.50
Prior range x treatment 3	-0.55*** (0.01)	-0.56*** (0.02)	-0.56*** (0.02)	0.54*** (0.03)	0.75
Observations	4,212	1,230	1,790	1,192	-
r-squared	0.84	0.84	0.83	0.84	-

Note. Value of professional forecasts sub-categories are determined by: low \leq \$300, \$300 < medium \leq \$600, high $>$ \$600. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix W

Treatments Effects on Inflation Uncertainty by Value of Network Information

	Baseline	Low value of network information firms	Medium value of network information firms	High value of network information firms	Joint test p-value
Treatment 1	0.71*** (0.06)	0.81*** (0.08)	0.67*** (0.09)	0.65*** (0.12)	0.59
Treatment 2	1.60*** (0.07)	1.65*** (0.11)	1.56*** (0.12)	1.55*** (0.14)	0.58
Treatment 3	1.47*** (0.07)	1.52*** (0.12)	1.52*** (0.10)	1.29*** (0.12)	0.43
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.00)	0.99*** (0.01)	0.29
Prior range x treatment 1	-0.45*** (0.01)	-0.48*** (0.02)	-0.43*** (0.02)	-0.43*** (0.02)	0.22
Prior range x treatment 2	-0.53*** (0.01)	-0.54*** (0.02)	-0.52*** (0.03)	-0.53*** (0.03)	0.67
Prior range x treatment 3	-0.55*** (0.01)	-0.54*** (0.03)	-0.56*** (0.02)	-0.54*** (0.02)	0.64
Observations	4,212	1,396	1,670	1,146	
r-squared	0.84	0.85	0.83	0.84	

Note. Value of network information sub-categories are determined by: low ≤ 150 , $150 < \text{medium} \leq 300$, high > 300 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix X

Treatment Effects on Sales Uncertainty by Employment Size

	Baseline	Small firms	Medium firms	Large firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.77*** (0.07)	0.78*** (0.12)	0.79*** (0.14)	0.66
Treatment 2	0.88*** (0.06)	0.92*** (0.07)	0.82*** (0.11)	0.78*** (0.12)	0.75
Treatment 3	0.81*** (0.06)	0.73*** (0.09)	1.04*** (0.09)	0.73*** (0.12)	0.05*
Prior range	0.99*** (0.00)	0.99 (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.54
Prior range x treatment 1	-0.24*** (0.01)	-0.24*** (0.01)	-0.25*** (0.02)	-0.25*** (0.03)	0.90
Prior range x treatment 2	-0.26*** (0.01)	-0.26*** (0.02)	-0.25*** (0.02)	-0.22*** (0.02)	0.53
Prior range x treatment 3	-0.24*** (0.01)	-0.22 (0.02)	-0.30*** (0.02)	-0.22*** (0.03)	0.01***
Observations	4,212	2,163	1,489	560	-
r-squared	0.94	0.95	0.93	0.95	-

Note. Employment size sub-categories are determined by: small ≤ 19 , $19 < \text{medium} \leq 49$, large > 50 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix Y

Treatment Effects on Sales Uncertainty by Competition

	Baseline	Small competition firms	Medium competition Firms	Large competition firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.76*** (0.11)	0.73*** (0.10)	0.85*** (0.09)	0.23
Treatment 2	0.88*** (0.06)	0.79*** (0.12)	0.86*** (0.09)	0.96*** (0.10)	0.66
Treatment 3	0.81*** (0.06)	0.83*** (0.10)	1.02*** (0.08)	0.54*** (0.12)	0.01***
Prior range	0.99*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.58
Prior range x treatment 1	-0.24*** (0.01)	-0.24*** (0.02)	-0.24*** (0.02)	-0.25*** (0.02)	0.30
Prior range x treatment 2	-0.26*** (0.01)	-0.24*** (0.02)	-0.26*** (0.02)	-0.26*** (0.02)	0.64
Prior range x treatment 3	-0.24*** (0.01)	-0.25*** (0.00)	-0.30*** (0.02)	-0.18*** (0.02)	0.00***
Observations	4,212	1,308	1,685	1,219	-
r-squared	0.94	0.93	0.94	0.95	-

Note. Competition sub-categories are determined by: low ≤ 5 , 5 < medium ≤ 15 , high > 15 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix Z

Treatment Effects on Sales Uncertainty by Age

	Baseline	Young firms	Medium age firms	Old firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.78*** (0.11)	0.73*** (0.09)	0.81*** (0.11)	0.75
Treatment 2	0.88*** (0.06)	0.79*** (0.09)	0.85*** (0.09)	1.12*** (0.14)	0.21
Treatment 3	0.81*** (0.06)	0.55*** (0.12)	0.93*** (0.09)	0.99*** (0.08)	0.02**
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.00)	0.99*** (0.00)	0.43
Prior range x treatment 1	-0.24*** (0.01)	-0.25*** (0.02)	-0.24*** (0.02)	-0.24*** (0.02)	0.64
Prior range x treatment 2	-0.26*** (0.01)	-0.24*** (0.02)	-0.25 (0.02)	-0.30*** (0.03)	0.21
Prior range x treatment 3	-0.24*** (0.01)	-0.19*** (0.03)	-0.27*** (0.02)	-0.28*** (0.02)	0.03**
Observations	4,212	1,174	1,952	1,086	-
r-squared	0.94	0.95	0.94	0.94	-

Note. Age sub-categories are determined by: young ≤ 15 , 15 < medium ≤ 30 , high > 30. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix AA

Treatment Effects on Sales Uncertainty by Production Total

	Baseline	Low total production firms	Medium total production firms	High total production firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.90*** (0.09)	0.85*** (0.12)	0.59*** (0.09)	0.01***
Treatment 2	0.88*** (0.06)	1.02*** (0.09)	1.05*** (0.12)	0.57*** (0.10)	0.00***
Treatment 3	0.81*** (0.06)	0.90*** (0.11)	0.86*** (0.13)	0.69*** (0.08)	0.18
Prior range	0.99*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.00)	0.76
Prior range x treatment 1	-0.24*** (0.01)	-0.25*** (0.02)	-0.26*** (0.03)	-0.22*** (0.02)	0.03**
Prior range x treatment 2	-0.26*** (0.01)	-0.27*** (0.02)	-0.30*** (0.03)	-0.20*** (0.02)	0.00***
Prior range x treatment 3	-0.24*** (0.01)	-0.25*** (0.02)	-0.26*** (0.03)	-0.22*** (0.02)	0.25
Observations	4,212	1,481	1,131	1,600	-
r-squared	0.94	0.95	0.93	0.94	-

Note. Value of total production sub-categories are determined by: low \leq \$10,000,000, \$10,000,000 < medium \leq \$30,000,000, high > \$30,000,000. The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix BB

Treatments Effects on Sales Uncertainty by Value of Network Information

	Baseline	Low value of network information firms	Medium value of network information firms	High value of network information firms	Joint test p-value
Treatment 1	0.77*** (0.06)	0.81*** (0.11)	0.64*** (0.08)	0.93*** (0.13)	0.14
Treatment 2	0.88*** (0.06)	0.95*** (0.10)	0.67*** (0.10)	1.10*** (0.11)	0.02**
Treatment 3	0.81*** (0.06)	0.73*** (0.12)	0.68*** (0.07)	1.09*** (0.12)	0.02**
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.99*** (0.00)	0.37
Prior range x treatment 1	-0.24*** (0.01)	-0.25*** (0.02)	-0.23*** (0.02)	-0.26*** (0.02)	0.26
Prior range x treatment 2	-0.26*** (0.01)	-0.27*** (0.03)	-0.22*** (0.02)	-0.29*** (0.02)	0.05*
Prior range x treatment 3	-0.24*** (0.01)	-0.22*** (0.03)	-0.22*** (0.02)	-0.29*** (0.02)	0.07*
Observations	4,212	1,396	1,670	1,146	-
r-squared	0.94	0.94	0.95	0.93	-

Note. Value of network information sub-categories are determined by: low ≤ 150 , $150 <$ medium ≤ 300 , high > 300 . The table reports estimates for beliefs after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix CC

Treatment Effects on Inflation Uncertainty by Industry and Number of Employees

	Baseline	Small professional services firms	Small construction firms	Small manufacturing firms	Small trade firms	Small transportation firms	Large professional services firms	Large construction firms	Large manufacturing firms	Large trade firms	Large transportation firms
Treatment 1	0.71*** (0.06)	0.78*** (0.10)	0.66* (0.37)	0.41*** (0.15)	0.65*** (0.12)	-0.15 (0.20)	0.39 (0.23)	2.75*** (0.43)	1.10*** (0.18)	0.71*** (0.23)	0.39 (0.33)
Treatment 2	1.60*** (0.07)	1.55*** (0.15)	1.09*** (0.40)	1.63*** (0.18)	1.56*** (0.12)	1.21*** (0.39)	1.18*** (0.30)	-0.60 (1.33)	1.13*** (0.27)	1.39*** (0.30)	1.80*** (0.43)
Treatment 3	1.47*** (0.07)	1.60*** (0.12)	2.86*** (0.61)	1.25*** (0.24)	1.52*** (0.14)	1.34*** (0.47)	1.65*** (0.20)	1.33 (1.03)	1.05*** (0.28)	1.12*** (0.29)	2.14*** (0.34)
Prior range	0.99*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.96*** (0.02)	0.99*** (0.01)	1.00*** (0.00)	1.00*** (0.00)	0.99*** (0.00)	0.99*** (0.01)	1.00*** (0.01)	1.00*** (0.04)
Prior range x treatment 1	-0.45*** (0.01)	-0.43*** (0.02)	-0.43*** (0.07)	-0.37*** (0.04)	-0.46*** (0.02)	-0.32*** (0.05)	-0.41*** (0.04)	-0.78*** (0.07)	-0.53*** (0.04)	-0.48*** (0.03)	-0.44*** (0.05)
Prior range x treatment 2	-0.53*** (0.01)	-0.51*** (0.03)	-0.50*** (0.07)	-0.52*** (0.05)	-0.55*** (0.02)	-0.58*** (0.05)	-0.49*** (0.05)	-0.20 (0.20)	-0.40*** (0.06)	-0.56*** (0.04)	-0.56*** (0.05)
Prior range x treatment 3	-0.55*** (0.01)	-0.55*** (0.02)	-0.70*** (0.08)	-0.51*** (0.07)	-0.55*** (0.03)	-0.54*** (0.08)	-0.57*** (0.03)	-0.50*** (0.16)	-0.49*** (0.06)	-0.57*** (0.04)	-0.68*** (0.04)
Observations	4,212	1,164	55	818	798	96	353	38	608	186	96
r-squared	0.84	0.83	0.77	0.69	0.88	0.87	0.84	0.89	0.73	0.89	0.90

Note. Employment size sub-categories are determined by: small < 30, large ≥ 30. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix DD

Treatment Effects on Inflation Uncertainty by Industry and Number of Competitors

	Baseline	Low competition professional services firms	Low competition construction firms	Low competition manufacturing firms	Low competition trade firms	Low competition transportation firms	High competition professional services firms	High competition construction firms	High competition manufacturing firms	High competition trade firms	High competition transportation firms
Treatment 1	0.71*** (0.06)	0.34** (0.15)	1.13** (0.52)	0.91*** (0.17)	0.65*** (0.24)	0.14 (0.29)	0.83*** (0.12)	0.28 (0.58)	0.39** (0.16)	0.64*** (0.11)	0.17 (0.18)
Treatment 2	1.60*** (0.07)	1.18*** (0.22)	0.67 (0.68)	1.13*** (0.22)	1.28*** (0.28)	1.18*** (0.45)	1.61*** (0.18)	0.84 (0.63)	1.74*** (0.22)	1.67*** (0.11)	1.84*** (0.40)
Treatment 3	1.47*** (0.07)	1.57*** (0.17)	2.87*** (0.90)	1.26*** (0.23)	1.27*** (0.25)	2.44*** (0.40)	1.54*** (0.13)	2.17*** (0.64)	1.10*** (0.27)	1.53*** (0.15)	1.06** (0.42)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.98*** (0.01)	0.98*** (0.02)	1.00*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.96*** (0.02)	1.00*** (0.00)	1.00*** (0.00)
Prior range x treatment 1	-0.45*** (0.01)	-0.40*** (0.02)	-0.53*** (0.07)	-0.50*** (0.04)	-0.47*** (0.04)	-0.38*** (0.05)	-0.42*** (0.03)	-0.35** (0.14)	-0.35*** (0.04)	-0.46*** (0.02)	-0.42*** (0.04)
Prior range x treatment 2	-0.53*** (0.01)	-0.48*** (0.04)	-0.42*** (0.10)	-0.41*** (0.05)	-0.51*** (0.04)	-0.51*** (0.05)	-0.51*** (0.04)	-0.45*** (0.20)	-0.54*** (0.06)	-0.57*** (0.02)	-0.62*** (0.06)
Prior range x treatment 3	-0.55*** (0.01)	-0.57*** (0.03)	-0.70*** (0.15)	-0.54*** (0.05)	-0.56*** (0.04)	-0.71*** (0.05)	-0.53*** (0.03)	-0.60*** (0.09)	-0.47*** (0.08)	-0.56*** (0.03)	-0.50*** (0.08)
Observations	4,212	632	46	776	308	101	885	47	650	676	91
r-squared	0.84	0.84	0.87	0.73	0.88	0.89	0.82	0.78	0.68	0.88	0.89

Note. Number of competitors sub-categories are determined by: low < 9, high > =9. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix EE

Treatment Effects on Inflation Uncertainty by Industry and Total Production

	Baseline	Low production professional services firms	Low production construction firms	Low production manufacturing firms	Low production trade firms	Low production transportation firms	High production professional services firms	High production construction firms	High production manufacturing firms	High production trade firms	High production transportation firms
Treatment 1	0.71*** (0.06)	0.69*** (0.16)	0.59 (0.36)	0.33* (0.18)	0.69*** (0.11)	0.09 (0.16)	0.73*** (0.11)	2.98*** (0.52)	0.97*** (0.15)	0.70** (0.28)	0.12 (0.41)
Treatment 2	1.60*** (0.07)	1.67*** (0.18)	1.03* (0.53)	1.81*** (0.21)	1.61*** (0.11)	1.44*** (0.38)	1.38*** (0.18)	0.35 (0.85)	1.13*** (0.22)	1.50*** (0.29)	1.49** (0.67)
Treatment 3	1.47*** (0.07)	1.63*** (0.21)	3.29*** (0.64)	1.08*** (0.27)	1.47*** (0.13)	1.97*** (0.42)	1.60*** (0.12)	0.92 (0.84)	1.29*** (0.23)	1.61*** (0.41)	1.58*** (0.36)
Prior range	0.99*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	0.94*** (0.02)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	0.96*** (0.04)	1.00*** (0.01)
Prior range x treatment 1	-0.45*** (0.01)	-0.40*** (0.03)	-0.43*** (0.07)	-0.35*** (0.04)	-0.47*** (0.02)	-0.38*** (0.03)	-0.44*** (0.02)	-0.80*** (0.08)	-0.50*** (0.03)	-0.45*** (0.05)	-0.38*** (0.07)
Prior range x treatment 2	-0.53*** (0.01)	-0.53*** (0.04)	-0.49*** (0.09)	-0.57*** (0.06)	-0.57*** (0.02)	-0.58*** (0.05)	-0.50*** (0.03)	-0.35** (0.15)	-0.40*** (0.05)	-0.53*** (0.06)	-0.50*** (0.08)
Prior range x treatment 3	-0.55*** (0.01)	-0.55*** (0.04)	-0.77*** (0.10)	-0.47*** (0.07)	-0.56*** (0.02)	-0.65*** (0.06)	-0.56*** (0.02)	-0.46*** (0.12)	-0.55*** (0.05)	-0.60*** (0.07)	-0.57*** (0.05)
Observations	4,212	495	50	641	824	123	1,022	43	785	160	69
r-squared	0.83	0.85	0.77	0.66	0.88	0.90	0.83	0.88	0.74	0.88	0.87

Note. Total production sub-categories are determined by: low < \$20,000,000, high > = \$20,000,000, where total production is the value of total production. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix FF

Treatment Effects on Inflation Uncertainty by Industry and Customer Network

	Baseline	Small network professional services firms	Small network construction firms	Small network manufacturing firms	Small network trade firms	Small network transportation firms	Large network professional services firms	Large network construction firms	Large network manufacturing firms	Large network trade firms	Large network transportation firms
Treatment 1	0.71*** (0.06)	0.77*** (0.15)	0.63** (0.30)	0.53*** (0.19)	0.57*** (0.17)	0.20 (0.21)	0.73*** (0.11)	0.80 (0.50)	0.78*** (0.15)	0.76*** (0.12)	-0.12 (0.27)
Treatment 2	1.60*** (0.07)	1.70*** (0.16)	1.51 (0.44)	1.63*** (0.18)	1.62*** (0.16)	1.77*** (0.47)	1.43*** (0.17)	-0.06 (0.79)	1.35*** (0.21)	1.50*** (0.14)	0.77 (0.47)
Treatment 3	1.47*** (0.07)	1.71*** (0.17)	0.79 (1.03)	1.35*** (0.29)	1.47*** (0.20)	1.34*** (0.33)	1.59*** (0.13)	3.07*** (0.71)	1.15*** (0.21)	1.55*** (0.16)	2.20*** (0.40)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.98*** (0.02)	0.98*** (0.02)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.96*** (0.01)	1.00*** (0.00)	1.00*** (0.00)
Prior range x treatment 1	-0.45*** (0.01)	-0.44*** (0.03)	-0.51*** (0.05)	-0.43*** (0.05)	-0.46*** (0.03)	-0.42*** (0.03)	-0.43*** (0.02)	-0.41** (0.10)	-0.44*** (0.03)	-0.48*** (0.02)	-0.32*** (0.06)
Prior range x treatment 2	-0.53*** (0.01)	-0.58*** (0.03)	-0.55*** (0.08)	-0.52*** (0.05)	-0.58*** (0.03)	-0.61*** (0.06)	-0.48*** (0.04)	-0.31*** (0.13)	-0.45*** (0.05)	-0.53*** (0.03)	-0.44*** (0.06)
Prior range x treatment 3	-0.55*** (0.01)	-0.59*** (0.03)	-0.44*** (0.13)	-0.57*** (0.07)	-0.55*** (0.04)	-0.59*** (0.06)	-0.55*** (0.03)	-0.74*** (0.13)	-0.49*** (0.05)	-0.60*** (0.03)	-0.65*** (0.06)
Observations	4,212	511	35	500	508	88	1,006	58	926	476	104
r-squared	0.83	0.87	0.91	0.75	0.87	0.90	0.82	0.81	0.68	0.89	0.89

Note. Customer network sub-categories are determined by: small < 8, high ≥ 8, where customer network is the number of discussions with their customers per month, following specification 2. The table reports estimates for GDP uncertainty after treatments. Robust standard errors are reported in parentheses.

Appendix GG

Treatment Effects on Inflation Uncertainty by Industry and Value of Professional Forecasts

	Baseline	Low value of forecasts professional services firms	Low value of forecasts construction firms	Low value of forecasts manufacturing firms	Low value of forecasts trade firms	Low value of forecasts transportation firms	High value of forecasts professional services firms	High value of forecasts construction firms	High value of forecasts manufacturing firms	High value of forecasts trade firms	High value of forecasts transportation firms
Treatment 1	0.71*** (0.06)	0.79*** (0.12)	1.27*** (0.47)	0.55*** (0.13)	0.70*** (0.13)	-0.10 (0.19)	0.68*** (0.13)	0.80 (0.50)	0.78*** (0.15)	0.76*** (0.12)	-0.12 (0.27)
Treatment 2	1.60*** (0.07)	1.49*** (0.13)	0.13 (0.77)	1.48*** (0.17)	1.53*** (0.16)	0.93 (0.71)	1.56*** (0.27)	-0.06 (0.79)	1.35*** (0.21)	1.50*** (0.14)	0.77 (0.47)
Treatment 3	1.47*** (0.07)	1.68*** (0.15)	1.75*** (0.45)	1.18*** (0.23)	1.85*** (0.15)	1.98*** (0.49)	1.59*** (0.14)	3.07*** (0.71)	1.15*** (0.21)	1.55*** (0.16)	2.20*** (0.40)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	0.96*** (0.01)	1.00*** (0.00)	1.00*** (0.00)	0.99*** (0.00)	1.00*** (0.00)	0.96*** (0.01)	1.00*** (0.00)	1.00*** (0.00)
Prior range x treatment 1	-0.45*** (0.01)	-0.44*** (0.02)	-0.55*** (0.07)	-0.41*** (0.03)	-0.49*** (0.02)	-0.36*** (0.04)	-0.43*** (0.03)	-0.41** (0.10)	-0.44*** (0.03)	-0.48*** (0.02)	-0.32*** (0.06)
Prior range x treatment 2	-0.53*** (0.01)	-0.51*** (0.03)	-0.33*** (0.14)	-0.47*** (0.04)	-0.55*** (0.03)	-0.47*** (0.09)	-0.51*** (0.05)	-0.31*** (0.13)	-0.45*** (0.05)	-0.53*** (0.03)	-0.44*** (0.06)
Prior range x treatment 3	-0.55*** (0.01)	-0.55*** (0.03)	-0.54*** (0.08)	-0.51*** (0.06)	-0.64*** (0.02)	-0.63*** (0.07)	-0.57*** (0.03)	-0.74*** (0.13)	-0.49*** (0.05)	-0.60*** (0.03)	-0.65*** (0.06)
Observations	4,212	787	31	1,021	419	93	730	62	405	565	99
r-squared	0.83	0.85	0.90	0.71	0.90	0.84	0.83	0.79	0.70	0.87	0.93

Note. Value of professional forecasts sub-categories are determined by: low < \$500, high > = \$500. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix HH

Treatment Effects on Inflation Uncertainty by Industry and Margin

	Baseline	Low margin professional services firms	Low margin construction firms	Low margin manufacturing firms	Low margin trade firms	Low margin transportation firms	High margin professional services firms	High margin construction firms	High margin manufacturing firms	High margin trade firms	High margin transportation firms
Treatment 1	0.71*** (0.06)	0.75*** (0.13)	0.97 (1.34)	0.69*** (0.12)	1.15*** (0.28)	-0.47 (0.34)	0.70*** (0.11)	0.78** (0.36)	1.16*** (0.22)	0.58*** (0.11)	0.36** (0.16)
Treatment 2	1.60*** (0.07)	1.66*** (0.18)	1.18** (0.47)	1.45*** (0.15)	2.16*** (0.22)	0.89* (0.48)	1.37*** (0.16)	0.81 (0.67)	-0.66 (2.13)	1.50*** (0.12)	1.68*** (0.43)
Treatment 3	1.47*** (0.07)	1.32*** (0.19)	0.79 (0.61)	1.22*** (0.18)	1.70*** (0.32)	1.37*** (0.51)	1.74*** (0.12)	2.84*** (0.66)	2.70*** (0.77)	1.50*** (0.14)	2.07*** (0.38)
Prior range	0.99*** (0.00)	0.99*** (0.00)	1.01*** (0.01)	0.97*** (0.01)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.00*** (0.00)	1.27*** (0.01)	0.99*** (0.01)	1.00*** (0.00)
Prior range x treatment 1	-0.45*** (0.01)	-0.42*** (0.03)	-0.43 (0.29)	-0.44*** (0.03)	-0.54*** (0.05)	-0.28*** (0.07)	-0.43*** (0.02)	-0.47** (0.05)	-0.45*** (0.06)	-0.45*** (0.02)	-0.43*** (0.02)
Prior range x treatment 2	-0.53*** (0.01)	-0.51*** (0.04)	-0.55*** (0.13)	-0.47*** (0.04)	-0.63*** (0.03)	-0.51*** (0.08)	-0.50*** (0.03)	-0.43*** (0.11)	-0.18 (0.39)	-0.54*** (0.02)	-0.57*** (0.06)
Prior range x treatment 3	-0.55*** (0.01)	-0.49*** (0.04)	-0.45*** (0.10)	-0.52*** (0.04)	-0.60*** (0.06)	-0.55*** (0.09)	-0.58*** (0.02)	-0.69*** (0.11)	-0.93*** (0.18)	-0.57*** (0.02)	-0.66*** (0.05)
Observations	4,212	499	22	1,407	128	70	1,043	73	19	888	122
r-squared	0.83	0.84	0.67	0.71	0.88	0.89	0.84	0.86	0.83	0.88	0.90

Note. Profit margin sub-categories are determined by: low < 40%, high > = 40%. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix II

Treatment Effects on Sales Uncertainty by Industry and Number of Employees

	Baseline	Small professional services firms	Small construction firms	Small manufacturing firms	Small trade firms	Small transportation firms	Large professional services firms	Large construction firms	Large manufacturing firms	Large trade firms	Large transportation firms
Treatment 1	0.77*** (0.06)	0.63*** (0.09)	-0.05 (0.13)	0.35*** (0.06)	1.44*** (0.19)	1.01* (0.59)	0.77*** (0.12)	1.78*** (0.46)	0.26*** (0.09)	1.44*** (0.35)	0.47 (0.52)
Treatment 2	0.88*** (0.06)	0.81*** (0.09)	1.56*** (0.48)	0.35*** (0.06)	1.64*** (0.16)	1.65*** (0.45)	0.59*** (0.15)	2.23* (1.31)	0.15** (0.06)	1.93*** (0.43)	0.46 (0.42)
Treatment 3	0.81*** (0.06)	0.83*** (0.10)	0.14 (0.11)	0.44*** (0.06)	1.21*** (0.21)	1.05*** (0.30)	0.67*** (0.09)	2.31*** (0.74)	0.20** (0.08)	1.30*** (0.26)	0.51 (0.51)
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.98*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	0.98*** (0.01)	1.00*** (0.00)	1.01*** (0.01)	0.99*** (0.00)	1.00*** (0.01)	0.94*** (0.05)
Prior range x treatment 1	-0.24*** (0.01)	-0.23*** (0.02)	-0.01 (0.03)	-0.16*** (0.02)	-0.31*** (0.03)	-0.24* (0.13)	-0.26*** (0.02)	-0.37*** (0.10)	-0.13*** (0.02)	-0.35*** (0.05)	-0.13 (0.10)
Prior range x treatment 2	-0.26*** (0.01)	-0.28*** (0.02)	-0.33*** (0.09)	-0.14*** (0.01)	-0.33*** (0.02)	-0.35*** (0.08)	-0.22*** (0.03)	-0.51** (0.26)	-0.09*** (0.01)	-0.41*** (0.06)	-0.15* (0.08)
Prior range x treatment 3	-0.24*** (0.01)	-0.27*** (0.02)	-0.02 (0.02)	-0.16*** (0.02)	-0.28*** (0.03)	-0.24*** (0.06)	-0.23*** (0.02)	-0.49*** (0.13)	-0.10*** (0.02)	-0.32*** (0.04)	-0.16 (0.11)
Observations	4,212	1,164	55	818	798	96	353	38	608	186	96
r-squared	0.94	0.93	0.97	0.96	0.90	0.92	0.96	0.67	0.96	0.90	0.93

Note. Employment size sub-categories are determined by: small < 30, large ≥ 30. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix JJ

Treatment Effects on Sales Uncertainty by Industry and Number of Competitors

	Baseline	Low competition professional services firms	Low competition construction firms	Low competition manufacturing firms	Low competition trade firms	Low competition transportation firms	High competition professional services firms	High competition construction firms	High competition manufacturing firms	High competition trade firms	High competition transportation firms
Treatment 1	0.77*** (0.06)	0.66*** (0.14)	0.53* (0.27)	0.28*** (0.07)	1.49*** (0.24)	0.34 (0.46)	0.68*** (0.09)	0.54 (0.54)	0.37*** (0.07)	1.41*** (0.22)	1.07* (0.63)
Treatment 2	0.88*** (0.06)	0.72*** (0.11)	2.02** (0.97)	0.20*** (0.06)	1.47*** (0.26)	0.37 (0.49)	0.67*** (0.16)	1.66*** (0.54)	0.35*** (0.07)	1.74*** (0.18)	1.76*** (0.52)
Treatment 3	0.81*** (0.06)	0.76*** (0.10)	1.02** (0.35)	0.24*** (0.07)	1.05*** (0.17)	0.20 (0.41)	0.75*** (0.10)	1.23** (0.63)	0.41*** (0.07)	1.36*** (0.26)	1.01*** (0.32)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.01*** (0.01)	1.00*** (0.00)	0.99*** (0.00)	0.93*** (0.06)	1.00*** (0.00)	0.98*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	0.99*** (0.01)
Prior range x treatment 1	-0.24*** (0.01)	-0.24*** (0.03)	-0.15*** (0.05)	-0.14*** (0.02)	-0.34*** (0.03)	-0.11 (0.09)	-0.23*** (0.02)	-0.12 (0.11)	-0.17*** (0.02)	-0.30*** (0.03)	-0.26* (0.14)
Prior range x treatment 2	-0.26*** (0.01)	-0.25*** (0.02)	-0.45** (0.20)	-0.10*** (0.01)	-0.35*** (0.04)	-0.12 (0.10)	-0.24*** (0.04)	-0.35*** (0.09)	-0.14*** (0.02)	-0.33*** (0.02)	-0.37*** (0.08)
Prior range x treatment 3	-0.24*** (0.01)	-0.27*** (0.02)	-0.24*** (0.08)	-0.12*** (0.01)	-0.30*** (0.03)	-0.07 (0.08)	-0.24*** (0.02)	-0.29** (0.14)	-0.15*** (0.02)	-0.29*** (0.03)	-0.26 (0.07)
Observations	4,212	632	46	776	308	101	885	47	650	676	91
r-squared	0.94	0.95	0.86	0.96	0.90	0.94	0.94	0.88	0.96	0.90	0.92

Note. Number of competitors sub-categories are determined by: low < 9, high > =9. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix KK

Treatment Effects on Inflation Uncertainty by Industry and Total Production

	Baseline	Low production professional services firms	Low production construction firms	Low production manufacturing firms	Low production trade firms	Low production transportation firms	High production professional services firms	High production construction firms	High production manufacturing firms	High production trade firms	High production transportation firms
Treatment 1	0.77*** (0.06)	0.75*** (0.15)	-0.02 (0.15)	0.38*** (0.07)	1.47*** (0.18)	1.04* (0.61)	0.63*** (0.09)	1.64*** (0.45)	0.25*** (0.07)	1.28*** (0.45)	0.38 (0.65)
Treatment 2	0.88*** (0.06)	0.65*** (0.10)	1.76*** (0.40)	0.36*** (0.07)	1.60*** (0.16)	1.39*** (0.46)	0.71*** (0.13)	0.99 (0.85)	0.19*** (0.06)	1.92*** (0.46)	0.54 (0.68)
Treatment 3	0.81*** (0.06)	0.91*** (0.22)	0.24* (0.13)	0.43*** (0.07)	1.26*** (0.20)	0.77*** (0.25)	0.72*** (0.07)	2.56* (1.31)	0.24*** (0.07)	0.98*** (0.27)	0.60 (0.55)
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.98*** (0.02)	1.00*** (0.00)	0.99*** (0.01)	0.99*** (0.01)	1.00*** (0.00)	1.00*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	0.91*** (0.08)
Prior range x treatment 1	-0.24*** (0.01)	-0.24*** (0.03)	-0.01 (0.03)	-0.16*** (0.02)	-0.31*** (0.02)	-0.24* (0.13)	-0.24*** (0.02)	-0.35*** (0.10)	-0.14*** (0.02)	-0.32*** (0.07)	-0.13 (0.12)
Prior range x treatment 2	-0.26*** (0.01)	-0.23*** (0.02)	-0.38*** (0.07)	-0.14*** (0.02)	-0.33*** (0.02)	-0.32*** (0.09)	-0.25*** (0.03)	-0.24 (0.19)	-0.10*** (0.01)	-0.40*** (0.08)	-0.17 (0.13)
Prior range x treatment 3	-0.24*** (0.01)	-0.27*** (0.05)	-0.04* (0.03)	-0.16*** (0.02)	-0.29*** (0.03)	-0.18*** (0.05)	-0.25*** (0.02)	-0.50** (0.21)	-0.11*** (0.01)	-0.27*** (0.05)	-0.19* (0.10)
Observations	4,212	495	50	641	824	123	1,022	43	785	160	169
r-squared	0.94	0.93	0.94	0.96	0.90	0.93	0.95	0.79	0.96	0.88	0.91

Note. Total production sub-categories are determined by: low < \$20,000,000, high > = \$20,000,000, where total production is the value of total production. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix LL

Treatment Effects on Sales Uncertainty by Industry and Customer Network

	Baseline	Small network professional services firms	Small network construction firms	Small network manufacturing firms	Small network trade firms	Small network transportation firms	Large network professional services firms	Large network construction firms	Large network manufacturing firms	Large network trade firms	Large network transportation firms
Treatment 1	0.77*** (0.06)	0.60*** (0.12)	0.90*** (0.28)	0.36*** (0.10)	1.28*** (0.25)	1.10 (0.77)	0.72*** (0.09)	0.35 (0.28)	0.28*** (0.05)	1.50*** (0.23)	0.30 (0.19)
Treatment 2	0.88*** (0.06)	0.76*** (0.15)	0.33 (0.27)	0.35*** (0.07)	1.40*** (0.20)	0.30 (0.41)	0.67*** (0.12)	2.06*** (0.47)	0.23*** (0.06)	1.79*** (0.20)	1.54*** (0.47)
Treatment 3	0.81*** (0.06)	0.79*** (0.10)	1.70** (0.81)	0.30*** (0.09)	1.21*** (0.26)	0.36 (0.49)	0.77*** (0.08)	0.89** (0.40)	0.34** (0.06)	1.21*** (0.22)	1.03*** (0.27)
Prior range	0.99*** (0.00)	1.00*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	0.99*** (0.00)	0.91*** (0.06)	1.00*** (0.00)	1.00*** (0.01)	0.99*** (0.00)	0.99*** (0.01)	1.00*** (0.01)
Prior range x treatment 1	-0.24*** (0.01)	-0.21*** (0.03)	-0.20*** (0.06)	-0.15*** (0.02)	-0.29*** (0.03)	-0.24 (0.15)	-0.26*** (0.02)	-0.10 (0.07)	-0.14*** (0.01)	-0.33*** (0.03)	-0.10** (0.05)
Prior range x treatment 2	-0.26*** (0.01)	-0.25*** (0.03)	-0.09 (0.06)	-0.13*** (0.02)	-0.30*** (0.03)	-0.10 (0.08)	-0.24*** (0.03)	-0.44*** (0.08)	-0.11*** (0.01)	-0.36*** (0.03)	-0.35*** (0.09)
Prior range x treatment 3	-0.24*** (0.01)	-0.27*** (0.02)	-0.37*** (0.15)	-0.13*** (0.02)	-0.28** (0.04)	-0.14 (0.10)	-0.25*** (0.02)	-0.20** (0.10)	-0.13*** (0.01)	-0.30*** (0.03)	-0.24*** (0.05)
Observations	4,212	511	35	500	508	88	1,006	58	926	476	104
r-squared	0.94	0.95	0.93	0.96	0.90	0.91	0.94	0.85	0.96	0.90	0.94

Note. Customer network sub-categories are determined by: small < 8, high ≥ 8, where customer network is the number of discussions with their customers per month. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix MM

Treatment Effects on Sales Uncertainty by Industry and Value of Professional Forecasts

	Baseline	Low value of forecasts professional services firms	Low value of forecasts construction firms	Low value of forecasts manufacturing firms	Low value of forecasts trade firms	Low value of forecasts transportation firms	High value of forecasts professional services firms	High value of forecasts construction firms	High value of forecasts manufacturing firms	High value of forecasts trade firms	High value of forecasts transportation firms
Treatment 1	0.77*** (0.06)	0.75*** (0.11)	0.46 (0.42)	0.34*** (0.06)	1.19*** (0.24)	0.35** (0.15)	0.58*** (0.10)	0.28 (0.25)	0.22*** (0.06)	1.58*** (0.24)	1.35* (0.74)
Treatment 2	0.88*** (0.06)	0.72*** (0.16)	3.02 (1.94)	0.30*** (0.05)	1.59*** (0.26)	1.23*** (0.26)	0.68*** (0.09)	1.47*** (0.34)	0.19** (0.08)	1.64*** (0.16)	1.06* (0.56)
Treatment 3	0.81*** (0.06)	0.80*** (0.12)	1.48*** (0.53)	0.35*** (0.06)	0.91*** (0.33)	0.64*** (0.20)	0.73*** (0.07)	0.44** (0.42)	0.27*** (0.07)	1.35*** (0.18)	0.96** (0.44)
Prior range	0.99*** (0.00)	1.00*** (0.00)	1.00*** (0.01)	1.00*** (0.00)	0.98*** (0.01)	0.99*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	1.00*** (0.00)	1.00*** (0.00)	0.94*** (0.05)
Prior range x treatment 1	-0.24*** (0.01)	-0.25*** (0.02)	-0.20*** (0.06)	-0.16*** (0.02)	-0.29*** (0.03)	-0.10*** (0.03)	-0.22*** (0.02)	-0.08 (0.05)	-0.12*** (0.02)	-0.33*** (0.03)	-0.31** (0.15)
Prior range x treatment 2	-0.26*** (0.01)	-0.26*** (0.03)	-0.09 (0.06)	-0.12*** (0.01)	-0.32*** (0.03)	-0.28*** (0.05)	-0.24*** (0.02)	-0.35*** (0.07)	-0.10*** (0.02)	-0.34*** (0.02)	-0.26** (0.11)
Prior range x treatment 3	-0.24*** (0.01)	-0.26*** (0.03)	-0.37*** (0.15)	-0.14** (0.01)	-0.24*** (0.05)	-0.17*** (0.04)	-0.24*** (0.02)	-0.10 (0.10)	-0.12*** (0.02)	-0.32*** (0.02)	-0.24*** (0.09)
Observations	4,212	787	31	1,021	419	93	730	62	405	565	99
r-squared	0.94	0.93	0.84	0.96	0.91	0.96	0.95	0.90	0.96	0.90	0.90

Note. Value of professional forecasts sub-categories are determined by: low < \$500, high > = \$500. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

Appendix NN

Treatment Effects on Sales Uncertainty by Industry and Margin

	Baseline	Low margin professional services firms	Low margin construction firms	Low margin manufacturing firms	Low margin trade firms	Low margin transportation firms	High margin professional services firms	High margin construction firms	High margin manufacturing firms	High margin trade firms	High margin transportation firms
Treatment 1	0.77*** (0.06)	0.64*** (0.15)	-0.44** (0.19)	0.31*** (0.05)	1.35** (0.61)	1.44** (0.68)	0.68*** (0.09)	0.44 (0.29)	-1.78* (0.97)	1.44*** (0.17)	-0.12 (0.31)
Treatment 2	0.88*** (0.06)	0.96*** (0.11)	0.85* (0.44)	0.27*** (0.04)	2.47*** (0.59)	0.70* (0.40)	0.65*** (0.11)	1.95*** (0.42)	0.07 (0.88)	1.51*** (0.15)	1.19** (0.50)
Treatment 3	0.81*** (0.06)	0.66*** (0.13)	2.58** (1.22)	0.34*** (0.05)	1.52*** (0.51)	0.54** (0.24)	0.79*** (0.09)	0.81*** (0.31)	0.63** (0.26)	1.18*** (0.18)	1.06** (0.48)
Prior range	0.99*** (0.00)	1.00*** (0.01)	1.00*** (0.01)	1.00*** (0.00)	1.01*** (0.01)	0.99*** (0.01)	1.00*** (0.00)	0.99*** (0.01)	1.06*** (0.02)	0.99*** (0.01)	0.94*** (0.05)
Prior range x treatment 1	-0.24*** (0.01)	-0.23*** (0.03)	0.07** (0.03)	-0.15*** (0.01)	-0.30*** (0.08)	-0.33*** (0.13)	-0.24*** (0.02)	-0.13** (0.06)	0.36* (0.19)	-0.32*** (0.02)	-0.00 (0.07)
Prior range x treatment 2	-0.26*** (0.01)	-0.30*** (0.03)	-0.21** (0.10)	-0.12*** (0.01)	-0.40*** (0.06)	-0.18** (0.07)	-0.24*** (0.02)	-0.42*** (0.08)	-0.07 (0.17)	-0.32*** (0.02)	-0.29*** (0.09)
Prior range x treatment 3	-0.24*** (0.01)	-0.23*** (0.03)	-0.51** (0.22)	-0.13*** (0.01)	-0.33*** (0.06)	-0.18*** (0.05)	-0.27*** (0.02)	-0.20*** (0.07)	-0.18*** (0.04)	-0.28*** (0.03)	-0.25** (0.10)
Observations	4,212	499	22	1,407	128	70	1,043	73	19	888	122
r-squared	0.94	0.93	0.88	0.96	0.91	0.94	0.95	0.88	0.96	0.90	0.92

Note. Profit margin sub-categories are determined by: low < 40%, high > = 40%. The table reports estimates for GDP uncertainty after treatments, following specification 2. Robust standard errors are reported in parentheses.

