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FIRMS' EXPECTATIONS OF NEW ORDERS, EMPLOYMENT, COSTS AND PRICES: EVIDENCE FROM MICRO DATA

Lena Boneva, James Cloyne, Martin Weale and Tomasz Wieladek

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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

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JEL Classification: C23, C26, E31

Keywords: Firm expectations, pricing setting, rationality, survey data; inflation expectations

Lena Boneva - lena.boneva@bankofengland.co.uk
Bank of England and CEPR

James Cloyne - jcloyne@ucdavis.edu
UC Davies, NBER

Martin Weale - martin.weale@outlook.com
Kings College London, Centre for Macroeconomics

Tomasz Wieladek - tomaszwieladek@gmail.com
Barclays and CEPR

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Firms' Expectations of New Orders, Employment, Costs and Prices: Evidence from Micro Data*

Lena Boneva† James Cloyne‡ Martin Weale§ Tomasz Wieladek¶

January 2018

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Firms' expectations play a central role in forward-looking macroeconomic models, but little is known empirically about how these are formed or whether they matter. Using a novel panel data set of firms' expectations about new orders, employment, unit costs, prices and wage rates for the United Kingdom, we document a range of stylized facts about the properties of firms' expectations and their relationship with recent pricing decisions. Expected future price and wage growth are influenced by firm-specific and aggregate factors. Price expectations are more correlated with cost and inflation indicators, wage expectations are more correlated with activity indicators. Expectations of new orders are influenced by aggregate conditions, while expected employment and unit costs seem to be influenced more by firm-specific factors. We also provide micro evidence to support the idea that actual price movements are influenced by expected future price movements, although firms' expectations do not seem to be fully rational.

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Key words: Firm expectations, pricing setting, rationality, survey data, inflation expectations, New Keynesian Phillips Curve.

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†Bank of England and CEPR. Email: lena.boneva@bankofengland.co.uk

‡UC Davis, CEPR and NBER. Email: jcloyne@UCDavis.edu

§Kings College London and Centre for Macroeconomics. Email: martin.weale@outlook.com

¶Barclays. Email: tomaszwieladek@gmail.com

1 Introduction

Expectations play a central role in forward-looking macroeconomic models. Beliefs about the future matter for consumption and borrowing decisions of households, and for investment and pricing decisions of firms. Expectations play a key role in the transmission of monetary policy in the canonical New Keynesian framework and have featured in much of the recent monetary policy debate around the Zero Lower Bound and Forward Guidance (see, e.g., Woodford (2012)).

But, despite the central role of this mechanism in dynamic macroeconomics, there is still relatively little empirical evidence about what influences firms' expectations or whether these expectations matter in reality. Furthermore, although there is a range of well-used datasets that contain information on household and financial market expectations, data — and therefore empirical evidence — on the firm-side are much more scarce.[1] We help fill this gap using data set on firms' expectations from the Confederation of British Industry (CBI) in the United Kingdom.

The strength and novelty of the CBI survey is the panel structure and the rich set of expectation and outturn variables. These data contain expectations and outcomes for price growth, wage growth, new orders, employment, costs and capacity utilisation. This allows us to explore what factors seems to matter for expectations while controlling for a range of other influences. We are also able to exploit the dynamics in the data, for example, by examining whether past realizations affect expectations today and whether expectations about the future matter for current pricing decisions. Our panel approach allows us to use a range of fixed-effects and firm level controls to deal with possible confounders. Our objective is therefore to provide a range of stylized facts about the determinants and consequences of firms' expectations.

To understand how firms' expectations line up with the common theoretical assumptions, we focus our analysis around three key issues: information, forward-looking behaviour and rationality. First, how homogeneous are firms' beliefs and what factors can explain the variation in expectations across firms and across time? We show that there is considerable dispersion in beliefs across firms in the UK. Furthermore, there are important differences in which past outcomes are associated with price, wage, activity and cost expectations. We show that aggregate and firm-specific influences are both important for price and wage growth expectations. Expectations of new orders are more associated with aggregate factors, but employment and cost expectations are correlated with more firm-specific factors. This suggests important heterogeneity in the attention paid to different indicators when forming expectations about specific variables.

[1] Coibion et al. (2017), Coibion and Gorodnichenko (2014) and Coibion et al. (2015) are important and recent exceptions, as we discuss below.

Secondly, we explore whether firms' expectations matter for current pricing decisions. This mechanism is at the heart of many forward-looking macro models such as the New Keynesian model. Again, our firm level panel data allows to us explore this issue directly. We show that expectations do indeed seem to influence firms' pricing behaviour today. Thirdly, we explore whether firms' expectations are consistent with rational expectations. We show that the null hypothesis of rationality is rejected for most, if not all, the expectations variables. Taken together, these results cast doubt on a range of the informational and behavioural assumptions typically made in macroeconomics. Our evidence therefore provides a range of motivating evidence for future theoretical developments.

The way in which expectations are formed has recently attracted much attention and we contribute to this growing literature. On the household side, for example, Armantier et al. (2015) conduct an experiment to shed light on how inflation expectations affect decisions made by consumers. They document that expectations about the future affect decisions today but there is a significant amount of heterogeneity. Ichiue and Nishiguchi (2013) show that during the zero lower bound episode in Japan, households that expected higher inflation in the future reported that their household had increased consumption compared with one year ago but intended to decrease it in the future. Bachmann et al. (2013) conduct a similar study using US data but do not find any significant relationship between inflation expectations and consumer spending.

Turning to work on firms, the closet paper to our work is probably Coibion et al. (2017) who collect new survey data on firms' inflation expectations for New Zealand. Their paper provides evidence against full information and rationality of firms' inflation expectations, including evidence of dispersion which seems to be related to inattention about recent macroeconomic conditions.[2] These New Zealand survey data are extremely rich but only contain 4 waves, which makes it harder to study dynamics over longer periods of time. Coibion et al. (2015) document the lack of anchoring of firms' inflation expectations around the inflation target and show that firms' expectations are quite dispersed. Afrouzi (2017) develops a model of oligopolistic competition and strategic inattention and shows that this can account for several facts about firms' expectations in New Zealand, including the dispersion in inflation expectations and the disagreement between industry and aggregate level expectations. Coibion and Gorodnichenko (2014) document that survey expectations of professional forecasters, firms, households and FOMC members are heterogeneous and react sluggishly to news, in keeping with the predictions from noisy information models. Finally, Bryan et al. (2014) use the FRB Atlanta's Business Inflation Expectations (BIE) survey of firms in the Sixth Federal Reserve District over three years.

[2]They also provide evidence that inattention can be explained by firms' incentive to track different macroeconomic indicators, consistent with rational inattention models where firms pay particular attention to news in variables that matter the most.

They evaluate how well these expectations compare to professional forecasters, how the content of these data compare to households' inflation expectations and how well these expectations predict future inflation. Our focus is different: we explore a range of expectations variables, not just prices, and seek to provide a range of stylized facts about the determinants of expectations and whether they matter for pricing outcomes.

Our paper also connects to the time-series literature on the New Keynesian Phillips Curve, a theory that relates current inflation to future expected inflation and real marginal cost (for example, Gali and Gertler (1999), Sbordone (2002) and Sbordone (2005)). But, in an exhaustive survey of this literature covering more than 100 papers, Mavroedis et al. (2014) argue that the time-series literature is subject to weak instrument problems. They conclude that economists may have learned all they can from macroeconomic data and suggest micro data may be helpful. Our use of panel micro data, therefore, fits with this recommendation.

The remainder of the paper proceeds in the following way: In the next section we describe the survey in more detail, discuss its reliability and describe some broad trends in firms' expectations. Section 3 then explores influences on expectations formation. The link between past price increases and expected future price increases is explored in Section 4. Finally, Section 5 evaluates the rationality of firms' expectations. Section 6 concludes.

2 Firm-Level Survey Data

2.1 The Industrial Trends Survey and its Properties

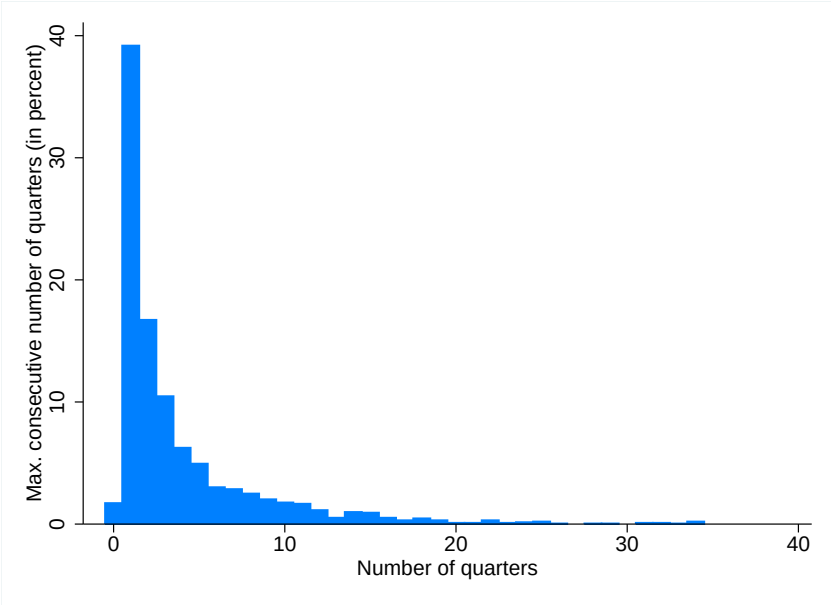
Our data come from the UK's Confederation of British Industry (CBI). The CBI runs a number of surveys but the most detailed for our purpose is the the quarterly *Industrial Trends Survey* which covers manufacturing firms. Although the full survey began in 1959, it was only in 2008 that the survey started to collect quantitative rather than purely qualitative data on past and expected future price movements. Our sample period is therefore from 2008Q3 to 2016Q3[3], although some variables are only available for part of the sample.[4]

As noted above, one of the advantages of ITS is its panel structure. We have eight years of quarterly data and, in principle, the cross-section dimension is large with around four to five hundred firms. That said, there is variation in the frequency for firms' responses and not all firms appear in the survey every quarter. Figure 1 shows the distribution of

[3]Very few data were collected in 2008 Q1 or 2008 Q2 so for practical purposes our data begin in 2008Q3.

[4]Data on output relative to capacity are, for example, available only from 2011Q1. Similarly, although the qualitative data on new orders, employment and costs have been collected for many years, they are available on a basis coherent with the data on price and wage expectations only from 2011Q1.

Figure 1: Maximum number of consecutive quarters



Notes: The figure shows the distribution of the maximal number of consecutive observations we observe for each firm.

the maximum number of consecutive quarters each firm is observed. There is a sizable number of firms for which we observe data for a few consecutive quarters and the panel is therefore unbalanced.[5] The number of exits and re-entrants is large relative to the sample size (there are periods of substantial, although often temporary, non-response by firms). In large part, the reason for this is that the ITS is intended to provide a rapid snap-shot of the state of the economy. Therefore, late respondents are only followed up within a set time frame after the official closing date of the survey. That time period usually amounts to one or two days.

The nature of the data therefore places two restrictions on our analysis. First, to exploit the panel structure of our data, we restrict attention to firms who appear for four or more consecutive quarters.[6] Secondly, there is an inconsistency in the time horizon for different variables. The data are quarterly but some variables refer to three month changes and others to twelve month changes (this is particularly true of the wage and price data). In order to avoid the risk of spurious results generated by serial correlation, we limit our analysis of the twelves-month variables to periods which do not overlap. Taken together, these factors mean that the number of usable observations per firm is somewhat smaller than would be the case were a complete quarterly panel available.

[5] Over the twenty-six quarters between 2008 and 2016 (for the price growth expectations variable) the average number of quarterly returns from each respondent is 7.5 but the median is 4. Out of the 1919 firms which reply to the survey over this period, only four firms provide complete records for the full sample period.

[6] We view the choice of four quarters as a reasonable trade-off. A larger number will limit the sample size, but with fewer we will not be able to exploit the panel fully.

2.2 Data on Past and Expected Future Wage and Price Growth

Given the attention paid to inflation and wage expectations in modern macroeconomic theory, we are particularly interested in the quantitative measures of firms' expected price and wage changes. The panel element to these questions is one of the most interesting aspects of this survey. But, the survey also contains useful information about firms' perceptions of price and wage changes over the past year. This combination of past changes and expected future changes will be very useful for our analysis. The key questions about prices are:

- What has been the percentage change over the past 12 months in your firm's own average output price for goods sold into UK markets?
- What is expected to occur over the next 12 months?

similar questions are asked about wages:

- What has been the percentage change over the past 12 months in your firm's wage/salary cost per person employed (including overtime and bonuses)?
- What is expected to occur over the next 12 months?

Firms can answer these the price questions by choosing one of ten buckets covering the range -10% to 10%, by answering zero or by entering their own answer manually. This gives a good degree of granularity.[7] Manual answers largely still fall within this range and to harmonize the reporting, we assign each manual answer to its corresponding bucket. If the manual answers lie outside the bucket ranges, they are allocated to the largest bucket on either side.[8]

Before making use of these data, it is useful to explore how well averages of these price and wage survey data line-up with other, official, time series. Figure 2A reports average expected and perceived price growth from the ITS together with output price growth over the last four quarters in the manufacturing sector (based on the official producer price index) and aggregate consumer price inflation (from the Office for National Statistics) over the same period. The picture presented by the ITS data is similar to that shown by the producer price output index. At the beginning of the financial crisis, expected and perceived price changes fell sharply to about -0.5% which is about the same as the observed value of producer price inflation in the manufacturing sector at this time.

Compared to output price inflation, the co-movement between expected and perceived price growth and official consumer price inflation is weaker, although the broad dynamics

[7] Specifically, the buckets are -8.1 to -10%; -6.1 to -8%; -4.1 to -6%; -2.1 to -4%; -0.1 to -2%; no change; 0.1 to 2%; 2.1 to 4%; 4.1 to 6%; 6.1 to 8% and 8.1 to 10%.

[8] This does not affect our results as fewer than 1% of all answers are entered manually.

over the period are still similar. In particular, there is a noticeable level difference between the ITS average measures and the aggregate CPI inflation series. Firms' expected own price changes average around 1%, which is below realized consumer price inflation rates during the period in question.[9] In terms of this level gap, which is evident in Figure 2A, the largest factor accounting for this difference is probably that output prices were less affected than consumer prices by the sharp rise in import prices following sterling's depreciation in 2007-8 together with the subsequent increase in raw material prices. Producer prices are also net of Value Added Tax.

Turning to the wage data, Figure 2B compares the survey data averages for actual and expected wage growth with the UK Office for National Statistics measure of Average Weekly Earnings for the private sector. The aggregate data cover regular pay only, which removes the volatility associated with bonus payments.[10] Even though the survey does not fully mirror the short-term movements shown by Average Weekly Earnings, it reflects the general decline in pay growth after the financial crisis.

The congruence between the aggregate properties of the ITS and the official data reassures us of the reliability of the survey, and echoes Lui et al. (2011). They examined the firms' responses about output movements in the period before the 2008-2009 recession, and showed that the qualitative answers were coherent with the answers the same firms provided in quantitative returns to the UK Office for National Statistics.

Another way to examine the quality of the survey is to count the number of firms that always provide the same answer.[11] Of the 1004 firms which respond three or more times, 63 give the same answer to the question about past price increases on every occasion. Out of the 672 which give six or more answers, twenty-one provide the same answer to the question each time. Forty-four of the sixty-three respondents in the first case and nineteen in the second case reported zero on each occasion.[12] This pattern of answers suggests there is little evidence that the survey is contaminated by firms providing formulaic responses.

Of course, an interesting feature of microeconomic data is not simply the averages but also the heterogeneity across firms. There is significant dispersion in firms' expectations and perceptions of price growth. Figure 3 shows the standard deviation of expected and past firm price growth in the ITS. The means of these series are reported again for reference. It is interesting that the degree of dispersion is relatively stable over time, despite

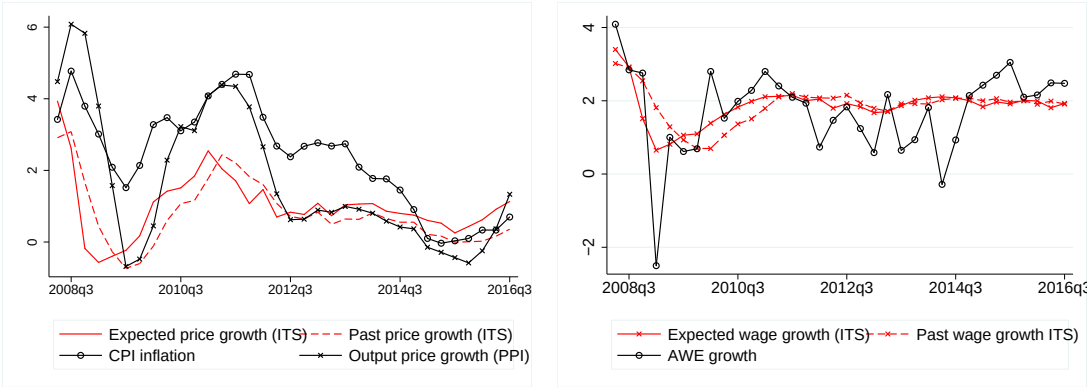
[9] A similar asymmetry has been documented for firms in New Zealand who systematically expect inflation to materialize above actual inflation (Coibion et al. (2017)).

[10] The effect of bonus payments is present even in the seasonally adjusted data.

[11] A study of qualitative survey data for output in the Netherlands found that about fifteen per cent of firms always gave the same answer. On discovering this, the Netherlands Bureau of Statistics approached respondents to ask why that was the case.

[12] A different concern is that some respondents may misinterpret the questions by answering "no change" when they mean that the rate of inflation rather than the price level has not changed, a recent answering practices survey conducted by the CBI suggests that this is not the case.

Figure 2: Perceptions and Expectations of Output Price and Wage Growth



(A) Price growth perceptions and expectations and inflation

(B) Wage growth perceptions and expectations

the aggregate fluctuations in inflation and the large movements average in expectations and actual price growth during the recession period. To explore the dispersion further, Figures 4A and 4B show the distribution of expected price and wage growth in the ITS. Most of the responses are between 0 and 5 percent, which seems very reasonable given the medium-term inflation target of 2 percent and the shorter-term variation in inflation observed in Figure 3. There are however, a sizable minority of responses outside this range, both negative and positive, and there is clear evidence of clustering at zero. In particular very few firms expect the wages that they pay to fall. This variation does not necessarily mean that the dispersion is noise or error, but instead that there are likely to be genuine reasons for why firms' price movements differ (different firm level shocks, different markets etc). Bryan et al. (2014), Coibion et al. (2015) and Afrouzi (2017) also provide evidence of dispersion in firms' inflation expectations, and this also seems to be the case for UK manufacturing firms'. For example, Coibion et al. (2017) identify inattention to recent conditions as a primary source of differences in expectations.

2.3 Data on Activity and Unit Costs

In addition to the data on expected and past changes in wages and prices, the survey collects a range of qualitative information about the past and recent future. Four topics in particular are of interest here.

New Orders: Excluding seasonal variations, what has been the trend over the last three months (expected trends for the next three months) with regard to the volume of new orders?

Figure 3: Cross-section Averages and Standard Deviations of Expected and Perceived Price Growth

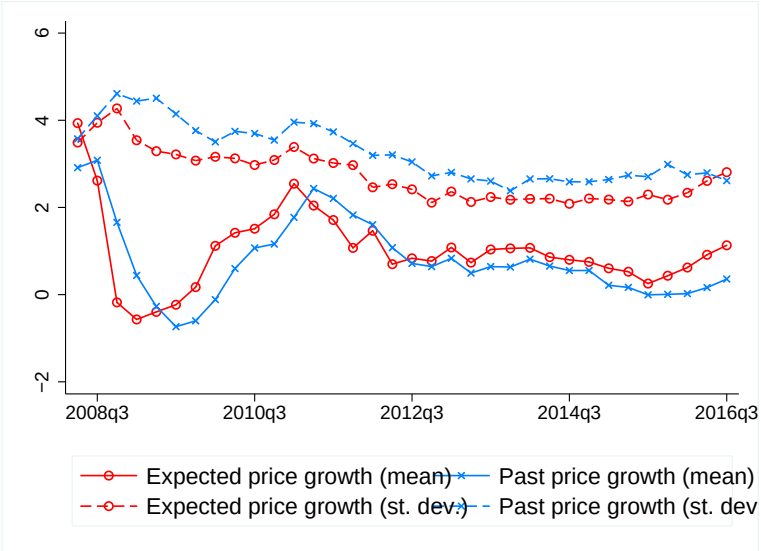
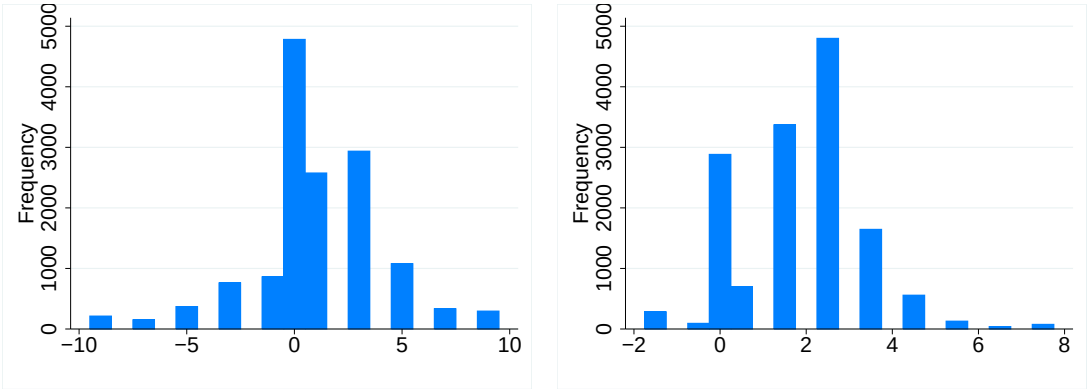


Figure 4: The Distribution of Expected Price and Wage Growth



(A) Expected Price Growth (B) Expected Wage Growth

Employment: Excluding seasonal variations, what has been the trend over the last three months (expected trends for the next three months) with regard to the volume of employment?

Unit Costs: Excluding seasonal variations, what has been the trend over the last three months (expected trends for the next three months) with regard to costs per unit of output?

In contrast to the questions on wages and prices, the responses to the questions on new orders, employment and unit costs are qualitative. Respondents answer "Down", "No change" or "Up". As noted earlier, these questions relate to periods of three months

rather than periods of a year (the case for the price and wage variables). These quarterly data therefore do not refer to overlapping periods.

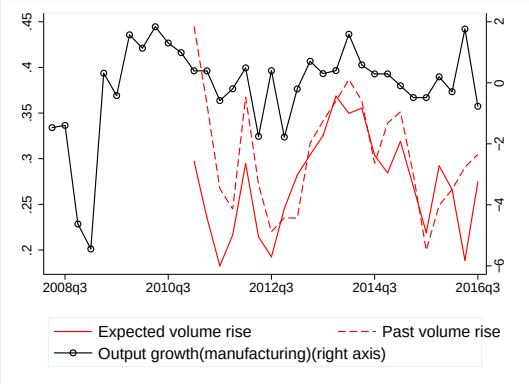
Finally, the survey asks a question on capacity:

Capacity utilisation: What is your current rate of operation as a percentage of full capacity? The response to this is quantitative.

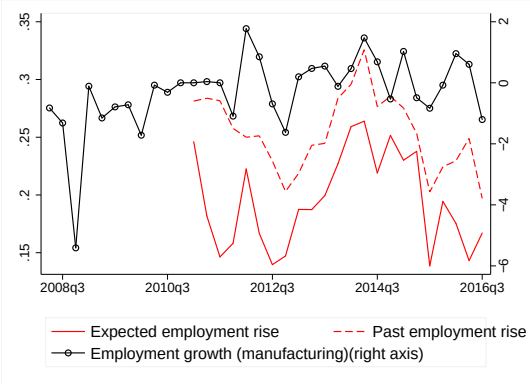
The qualitative nature of the data on orders, employment and costs has two implications. First, it means that, to use each as an explanatory variable we need to construct two dummy variables. The first takes a value of 1 when then response is "up" and 0 otherwise. The second takes a value of 1 when the response is "No change" and 0 otherwise. Thus both dummies take values of 0 when the response is "Down". We refer to these dummies for new orders as "Past orders rise" or "Past orders no change" respectively, with similar labels for employment and unit costs. Secondly, to examine influences on expectations, we would, in principle, need to use an ordered probit or logit model. It is not possible to set up such a model except by pooling the data and neglecting firm-specific effects due to the incidental parameter bias (Newman and Scott (1948)). When we study influences on expectations, therefore, we limit ourselves to a dummy variable which takes a value of 1 if the expectation is for up and 0 otherwise; we refer to this dummy as "Expected Orders", employment or costs respectively. We then examine the influences on this using a panel logit model with fixed effects.

Panels (A) to (C) of Figure 5 show respectively the proportions of firms reporting past and expected future increases in employment, new orders and unit costs. In each graph the left-hand axis indicates the proportions of the sample reporting a past or expected increase in the variable in question, while the right-hand axis shows the growth in the macro-economic variable to which we might expect the survey response to be related. Panel (D) shows the sample average figures for capacity utilisation on the left-hand axis with the unemployment rate on the right-hand axis. For the first three of these variables, the co-movement between recent experience and expectations is striking. In keeping with the results for wages and prices, the congruence of the survey indicators and the aggregate data is very reassuring of the reliability of the ITS. It is noticeable, however, that movements in reported capacity utilisation seem quite unrelated with the aggregate unemployment rate. To the extent that firms' marginal costs depend on their capacity utilisation, this suggests that labour market conditions may not be a good proxy for marginal cost.

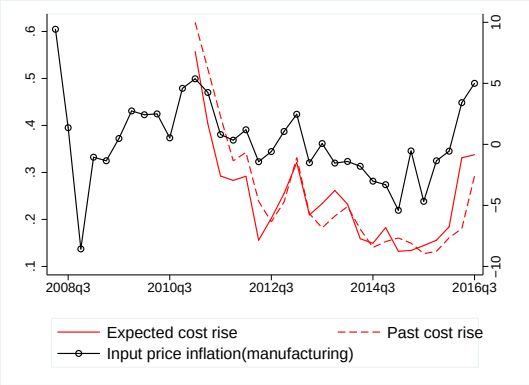
Figure 5: Cross-sectional Averages of Survey Data on New Orders, Employment, Unit Costs and Capacity Utilisation, together with Related Macroeconomic Variables



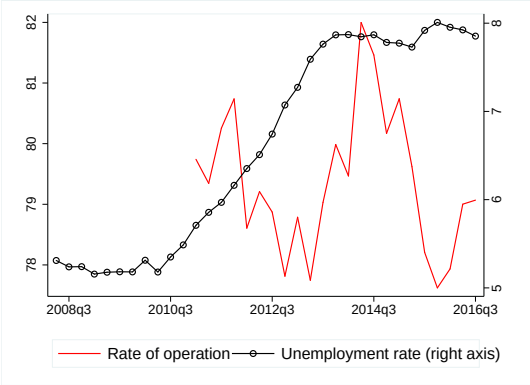
(A) Past and Expected New Orders Volume, and Manufacturing Output



(B) Past and Expected Future Employment Growth



(C) Past and Expected Future Unit Cost Growth and Manufacturing Input Price Inflation



(D) Rate of Operation (Capacity Utilisation) and Unemployment

3 What influences firms' expectations?

In this section, we explore what factors might influence firms' price, wage, activity and cost expectations. Our interest is in the information that seems most relevant for the formation of different expectations. In standard macroeconomic models there is no distinction between aggregate and firm level information, and rationality means firms fully make use of all information available. In this section we ask two questions. First, do firms make use of all available information when forming expectations about particular variables (e.g. price growth or new orders), or are some factors more relevant than others? Secondly, do firms focus on aggregate conditions, or are firm-specific variables more relevant for their expectations formation?[13]

3.1 Expectations of Wage and Price Growth

How well can price and wage growth expectations be predicted by actual (reported) firm-level out-turns (e.g. new orders, employment, costs etc)? And are these more or less important than macroeconomic conditions in shaping firms' expectations? To answer these questions we consider the following regression:

$$E\pi_{i,t} = \alpha + \beta X_t + \gamma Z_{i,t} + \nu_i + e_{i,t} \tag{1}$$

where $E\pi_{i,t}$ is the specific measure of firm-level expected price or wage growth. X_t are industry-level and macroeconomic variables designed to capture the influence of aggregate factors. The aggregate variables we consider are price inflation in manufacturing as a whole and the Bank of England's four quarter ahead CPI inflation and GDP forecasts from the *Inflation Report* (IR). $Z_{i,t}$ are firm specific variables. Our approach is to see which backward-looking variables, proxying the state of the firm at the time expectations are formed, seem most correlated with expectations. $Z_{i,t}$ therefore includes the dummies for the change in new orders, employment and costs over the previous three months. We also include the current rate of operation and a firm-specific fixed effect (ν_i) which deals with unobserved time-invariant firm factors.

Table 1 reports the results. Columns 1 to 3 report the results for expected price growth; with the models estimated over a common sample. To examine the role of aggregate factors, the first column reports the results including aggregate variables only. Firms' expected price increases seem to be correlated with expected inflation and GDP growth at an aggrgate level (Bank of England forecast, as noted above) over the coming year. Taken at face value, this suggests that general expectations about aggregate demand and

[13] Afrouzi (2017) develops a model with oligopolistic competition and strategic inattention where firms may pay less attention to aggregate developments when forming their expectations.

inflation may be influencing firms' expected pricing behaviour.

The second column shows the effects of firm-specific influences. As one might expect in theory, there is a statistically significant relationship between the growth in new orders, cost growth, capacity utilisation and firms' expectations of future price increases.

The third column then shows the combined effects of the macro and micro variables. The results for the firm level variables remain significant, but the effects of the macroeconomic factors become less important and the effect of the GDP growth forecasts becomes insignificant. This suggests that firms' views about price-setting prospects are influenced by their own environment and the overall inflationary environment. Furthermore, both activity/demand variables and cost factors influence the extent to which firms expect to change their prices. The values of the Bayesian Information Criterion (BIC) are shown at the foot of the table. These suggest that the micro equation is much preferred to the macro equation. Relative to the micro equation, the addition of macro variables leads only to a slight improvement in the BIC. Accounting for firm-level variation is therefore important for understanding the expectations of firms.

Columns 4 to 6 of Table 1 reports a similar pattern for expected wage growth. Once firm-level variables are included the importance and significance of the macro variables decreases. Column 6 shows that firm level variables seem important predictors, as for price growth expectations. The coefficients on new orders and employment are similar to those in the price expectations equations, but there seems to be less of a role for costs and the rate of operation in explaining wage expectations. Of the macro variables, only the aggregate GDP forecast is significant. Expected wage growth therefore seems more related to demand, whereas expected price growth is more correlated with aggregate inflation and cost pressures. As with price expectations, the BIC statistics suggest that the micro equation is preferred to the macro equation. The inclusion of macro variables results in a marginal improvement in the BIC and the coefficients on the firm-level variables remain similar in columns 5 and 6. Firm-level factors seem important once more in accounting for firms' wage growth expectations

In summary, price and wage growth expectations seem to be associated with firm-specific factors, particularly rising new orders, rising employment, rising costs and a high rate of operation. Macro variables do not seem to provide much additional significant explanatory power, although it is interesting that aggregate forecasts of CPI inflation are significant predictors of firms' expected price growth, whereas aggregate forecasts of GDP growth are significant predictors of expected wage growth. In terms of the firm level variables, costs and the rate of operation matter more for expected price growth, suggesting that wage expectations are more tied to demand factors, and price expectations are more associated with inflation and cost factors. These differences may suggest a degree

of bounded rationality or inattention in the formation of expectations. These findings are consistent with Coibion et al. (2017) who document that expectations of firms in New Zealand are best described by noisy information and rational inattention models. This may also have implications for how monetary policy can shape expectations. Expectations of wages and prices may be affected differentially depending on how monetary policy influences aggregate inflation and GDP. We return to the issue of rationality below.

Table 1: Determinants of price and wage expectations

	(1) Exp. Price Growth	(2) Exp. Price Growth	(3) Exp. Price Growth	(4) Exp. Wage Growth	(5) Exp. Wage Growth	(6) Exp. Wage Growth
Inflation (manufacturing)	0.058*		0.033	0.011		0.003
	(2.17)		(1.28)	(0.91)		(0.26)
IR inflation forecast	0.605**		0.343**	0.215**		0.111
	(5.04)		(2.92)	(3.43)		(1.85)
IR GDP forecast	0.495**		0.277	0.412**		0.291**
	(3.29)		(1.83)	(5.40)		(3.94)
Past orders rise		0.506**	0.433*		0.460**	0.426**
		(2.86)	(2.42)		(4.92)	(4.64)
Past orders unchanged		0.413**	0.371*		0.202**	0.181*
		(2.68)	(2.39)		(2.60)	(2.37)
Past employment rise		0.504*	0.467*		0.468**	0.445**
		(2.38)	(2.19)		(4.08)	(3.89)
Past employment unchanged		0.222	0.221		0.231*	0.223*
		(1.21)	(1.21)		(2.50)	(2.42)
Past cost rise		2.007**	1.800**		0.415**	0.374**
		(6.52)	(5.94)		(3.61)	(3.18)
Past cost unchanged		1.018**	0.981**		0.194	0.197
		(3.72)	(3.63)		(1.80)	(1.82)
Rate of operation		0.023**	0.023**		0.010**	0.010**
		(3.31)	(3.33)		(3.67)	(3.60)
Constant	-1.449**	-2.565**	-3.813**	0.529*	0.478*	-0.381
	(-2.72)	(-4.39)	(-4.84)	(2.03)	(2.18)	(-1.17)
Observations	2180	2180	2180	2179	2179	2179
BIC	8676.0	8545.9	8544.3	5584.9	5464.5	5460.5

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Notes: The Table reports parameter estimates from estimating the determinants of firms' price growth expectations (equation (1)). Robust t-statistics are reported in parenthesis.

3.2 Expectations of New Orders, Employment and Unit Costs

Having explored our quantitative measures of expected price and wage growth, we now turn to new orders, employment and cost expectations. As noted in Section 2.3, these variables are trichotomous with three categories reflecting a rise, no change and a fall which is challenging econometrically. As explained there, we convert these trichotomous variables into dichotomous variable which distinguish a rise from no change/ a fall. Specifically we estimate the following logit discrete choice model that is not plagued by the incidental parameter bias:

$$P(Ey_{i,t} = 1|\mathbf{X}_{i,t}) = F(\Gamma\mathbf{X}_{i,t}) \tag{2}$$

where

$$\Gamma\mathbf{X}_{i,t} = \alpha + \beta X_t + \gamma Z_{i,t} + \nu_i + e_{i,t} \tag{3}$$

Ey_{it} is the specific measure of the change in expected new orders, employment and costs. X_t are industry and macroeconomic variables. Again, we include price inflation in manufacturing and the Bank of England's four quarter ahead inflation and GDP forecasts from the *Inflation Report*. $Z_{i,t}$ are the same firm specific variables as in the previous section, together with past price and wage growth. Table 2 reports the marginal impact of each variable on the probability of reporting an expected increase in the variable in question. The marginal effects are evaluated assuming that the fixed effects take a value of zero.

As before, we examine the influence of macroeconomic variables and forecasts and then turn to the firm-specific data. The first three columns of Table 2 consider the factors influencing expectations of new orders. Column 1 shows that, of the macro-economic variables, aggregate forecasts of GDP growth (from the Bank of England) are significanty correlated with the expected change in new orders (significant at the five per cent level). The official CPI inflation forecast does not have a significant effect. In column 2, we see that the only significant firm-specific variable is whether firms reported past growth in new orders. When the macro and micro variables are combined in the column 3, we find that only forecast GDP growth retains its significance. In contrast to the results for price and wage expectations, the macro equation has a lower BIC than the micro or combined equations. This ranking suggests that firms see their prospects for new orders in terms of developments in the whole economy rather than their own recent experience.

Columns 4, 5 and 6 in Table 2 consider employment expectations. When only macro indicators are considered (column 4) both aggregate forecast GDP growth and aggregate forecast inflation appear as significant influences on the probability that firms will expect a rise in employment. Looking only at micro variables (column 5), past movements in new orders play a more clearly defined role than was the case with expected growth

in new orders. Firms reporting an increase/no change in new orders were significantly more likely to expect employment to rise than those that reported a past fall in new orders. Past employment movements, in contrast, do not seem to exert a significant influence on expected future employment movements. When macro and micro variables are combined, none of the variables are significant. The BIC for the micro equation is, however, materially lower than for either the macro equation or the combined equation. This suggests that the decision to change employment is more related to firm specific factors and correlated with the growth in new orders.

Finally, columns 7, 8 and 9 of Table 2 examine unit cost expectations. In terms of the macro variables (column 7) forecast CPI inflation is associated with a higher probability that firms expect costs to rise. This is interesting, and in keeping with the results for expected wage growth. Forecast GDP growth is not significant. In terms of the firm specific variables (column 8), the only significant indicator is whether firms have just experienced a rise in unit costs. When the macro and micro variables are combined, past movements in costs retain their significance while the macro variables lose significance. The BIC statistics suggest that the micro equation should be preferred. Expectations of future unit costs expectations seem to be formed on the basis of local experience rather than on the aggregate outlook for CPI inflation.

In summary, employment expectations seem to be related the change in past firm-level order volumes, while expected costs are correlated with the past change in firm costs. Expectations of new orders, however, seem to be influenced by aggregate demand conditions. This suggests that expectations of new orders will be affected by the macroeconomy, including monetary policy, but these aggregate influences might affect employment and cost expectations only through their effect on firm-level variables. Some expectations are therefore more directly correlated with aggregate conditions, while others may be influenced only indirectly.

Table 2: Determinants of New Orders, Employment and Cost Expectations

	(1) Exp. New Orders	(2) Exp. New Orders	(3) Exp. New Orders	(4) Exp. Employment	(5) Exp. Employment	(6) Exp. Employment	(7) Exp. Unit Costs	(8) Exp. Unit Costs	(9) Exp. Unit Costs
Inflation (manufacturing)	-0.000		0.001	0.001		-0.000	0.012		0.008
	(-0.02)		(0.25)	(0.30)		(-0.13)	(1.80)		(1.17)
IR inflation forecast	0.023		0.017	0.028**		0.012	0.082**		-0.007
	(1.44)		(0.77)	(2.85)		(1.42)	(4.51)		(-0.22)
IR GDP forecast	0.073**		0.070**	0.054**		0.024	0.019		-0.067
	(6.90)		(2.76)	(3.61)		(1.54)	(0.88)		(-1.53)
Past orders unchanged		-0.050	-0.039		0.110*	0.031		0.043	0.051
		(-1.10)	(-1.08)		(2.09)	(1.09)		(1.21)	(1.23)
Past orders rise		0.180**	0.118		0.247**	0.070		-0.014	-0.012
		(3.72)	(1.79)		(2.64)	(1.17)		(-0.34)	(-0.25)
Past employment unchanged		0.005	-0.002		-0.057	-0.019		0.026	0.037
		(0.10)	(-0.05)		(-1.26)	(-0.96)		(0.63)	(0.73)
Past employment rise		0.033	0.022		0.004	-0.001		0.059	0.062
		(0.56)	(0.51)		(0.10)	(-0.08)		(1.15)	(1.03)
Rate of operation		0.000	0.000		0.001	0.000		0.001	0.001
		(0.18)	(0.13)		(1.45)	(1.33)		(0.56)	(0.68)
Past cost unchanged		-0.042	-0.031		0.017	0.007		0.038	0.035
		(-0.69)	(-0.64)		(0.41)	(0.50)		(0.70)	(0.52)
Past cost rise		-0.107	-0.082		-0.005	-0.005		0.404**	0.462**
		(-1.63)	(-1.31)		(-0.10)	(-0.34)		(4.92)	(7.08)
Pst. wages		0.009	0.007		-0.005	-0.001		-0.010	-0.008
		(0.70)	(0.70)		(-0.49)	(-0.26)		(-0.83)	(-0.61)
Past inflation		0.002	-0.000		0.012	0.003		0.003	0.003
		(0.24)	(-0.05)		(1.80)	(0.99)		(0.63)	(0.45)
Observations	1064	1054	1040	887	864	851	1057	1057	1035

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Notes: The Table reports marginal effects from estimating the determinants of firms' new orders, employment and unit costs expectations (equations (2)-(3)). Robust t-statistics are reported in parenthesis.

4 Do expectations affect price and wage setting behaviour?

So far, we have explored which factors seem to predict firm's expectations for a range of variables. But, do these expectations actually matter for outcomes? In most modern macroeconomic models expectations of firms are crucial for determining pricing behaviour and aggregate inflation dynamics. In the New Keynesian model, for example, inflation today is related expected future inflation and real marginal cost. The central bank's ability to control expectations about the future can then dramatically improve inflation outcomes today. In this section we therefore ask: Are firms forward-looking in their price setting behaviour?

Much empirical work has been devoted to exploring this question using macro data. And, as discussed earlier, a large body of literature has focused on estimating the New Keynesian Phillips Curve directly. But this literature has faced a number of challenges. It is unclear how to measure expectations and various options (such as using realized outcomes, aggregate survey measures or forecasts from a statistical model) are endogenous with respect to inflation in the aggregate. It is therefore necessary to instrument for inflation expectations (and marginal costs) but these instruments tend to be weak. In an exhaustive survey of this literature covering more than a hundred papers, Mavroedis et al. (2014) argue that the macro literature is somewhat inconclusive.

Our data show direct measures of firms' expectations and are panel data. These features help tackle some of the issues that arise in time-series applications. Through a range of fixed effects we are also to control for a range of confounders. We control for macro shocks with time fixed effects, industry shocks with industry-time fixed effects, and individual level characteristics with firm fixed effects. The remaining concern is that firm specific, time varying shocks, might be driving both expectations and actual pricing behaviour. Here again, the richness of the survey helps and we can include the full range of firm specific controls considered in Section 3.

4.1 Econometric specification

The first challenge we face is that the survey asks for growth rates over the past twelve months and expected future growth rates over the coming twelve months. It would be incorrect to treat these variables as though they described quarterly expected and actual price movements, raising a question of how to handle the temporal aggregation in the data. We address the issue by assuming that decisions are made on a quarterly basis. The hypothesis we wish to examine is that actual price or wage increases over the last quarter depend on expected future price increases over the next quarter. Thus the

expression we ideally wish to examine is:

$$\pi_{i,t} = \beta E_{i,t}\pi_{i,t+1} + \gamma_x x_{i,t} + v_{i,t} \tag{4}$$

A firm-level equation like this could be derived from the New Keynesian model with Rotemberg pricing.[14] In this case the variable $x_{i,t}$ reflects the time varying price markup (the inverse of real marginal cost). We do not have any clear choice for such a variable in our dataset, but if we are willing to regard the x variables in a less structural manner, we can think of this as a vector $\mathbf{X}_i$ with a range of firm-specific controls and fixed effects that help deal control for common firm-specific factors.

As noted above, our expectations data refer to a period of 12 months, but the model set-up above would be quarterly. To address this problem we aggregate equation 4 by summing four successive equations. This leads to the following expression:

$$\pi^4_{i,t} = \beta E_{t-3}\pi^4_{i,t+1} + \gamma_{x,k}\sum_{k=0}^{3}\mathbf{X}_{i,t-k} + u_{i,t} \tag{5}$$

where the superscript 4 indicates that the variable relates to the growth rate over the preceding four quarters. The expectations term on the right-hand side of this equation has to be based on variables which are observed at period $t-3$. Strictly the $\mathbf{X}$ terms would become the sum over the previous 4 quarters but, for generality, we allow each quarter to have a different coefficient in equation 5.

The residual term, will now include a range of forecast errors, in addition to including $v_{i,t}$, specifically:

$$u_{i,t} = \beta\left(E_{i,t}\pi_{i,t+1} + E_{i,t-1}\pi_{i,t} + E_{i,t-2}\pi_{i,t-1}\right) - \beta\left(E_{i,t-3}\pi_{i,t+1} + E_{i,t-3}\pi_t + E_{i,t-3}\pi_{i,t-1}\right) + \sum_{k=0}^{3} v_{i,t-k} \tag{6}$$

To be as flexible as possible, and exploit the panel nature of our data, $\mathbf{X}_{i,t}$ includes a combination of continuous controls and fixed effects. For the continuous variables we include past wage growth, the current rate of operation and the number of employees. We then include fixed effects for time, time interacted with industry (the 2 digit SIC code), whether output is below capacity, whether there has been growth in new orders, unit costs and employment.

[14] Rotemberg pricing has the advantage that all firms make adjustments each period. As a result it is possible to derive a firm-specific Phillips Curve without imposing the symmetry assumptions required in the Calvo pricing model.

4.2 The Role of Expectations on Prices

Table 3 shows the results of estimating equation 5. To illustrate the robustness of results for β, we estimate two versions of the model. First, we consider the case where $\mathbf{X}$ includes only the current rate of operation and fixed effects of time and time interacted with industry (the 2 digit SIC code). The larger model includes all three continuous variables and the full set of fixed effects.

The key result is shown in the first row. This is the coefficient β, which reflects the influence of expected inflation on current price growth. Expected price growth influences actual price changes with a coefficient of between 0.5 and 0.6. This is robust across the two columns, despite all the additional controls and fixed effects. This suggest there is some degree of forward-looking behaviour in price setting and firms do take into account expectations when setting prices today. In the basic New Keynesian model, β would reflect the discount factor and be below 1. This model, however, features a range of additional control variables so we do not interpret this coefficient in such a strict way.

Our data do not contain a clear measure of marginal cost, but it is nonetheless interesting to inspect the coefficients on the three other continuous variables in the regression since one might expect wage growth and the current rate of operation to be correlated with marginal cost. In the first column, we only consider the rate of operation, although the coefficients are very similar in both columns. As expected, we generally find positive coefficients for the relationship between these proxies of cost and price growth. That said, the estimates are not statistically significant. This does not necessarily imply no role of marginal cost in the dynamics of inflation, but it is not possible to assess this fully without a cleaner measure of marginal cost at the firm level.

5 Are Expectations Rational?

In previous sections we have provided evidence that expectations are associated with fundamentals, and seem to matter for actual pricing outcomes today. But, are expectations rational? The rationality of expectations plays an important part of modern macroeconomic models and implies that firms' use all available information and do not systematically make mistakes. A strong degree of rationality and forward-looking behaviour then produces powerful effects of policies such as Forward Guidance in modern macro models (Del Negro et al. (2012)). Coibion et al. (2017) show, however, that growing micro evidence suggests departures from rationality. This is an issue we can now study with our micro data.[15] An implication of rational expectations is that forecast errors are zero in

[15] There is a controversial debate among economists whether or not it is possible to test for rational expectations using survey data, see Keane and Runkle (1999) for a summary. One argument against rationality tests based on survey data is that one can test only the implications of theories, rather than

Table 3: The effect of firms' inflation expectations on price setting

	(1) Past inflation	(2) Past inflation
Exp. inflation (lag 3)	0.549**	0.518**
	(4.47)	(3.72)
Current Rate of Operation (lag 1)	0.019	0.021
	(0.72)	(0.61)
Current Rate of Operation (lag 2)	-0.014	-0.008
	(-0.65)	(-0.27)
Current Rate of Operation (lag 3)	0.022	0.016
	(0.75)	(0.45)
Current Rate of Operation (lag 4)	-0.017	-0.016
	(-0.54)	(-0.50)
Past Wage Growth (lag 1)		0.098
		(0.38)
Number of Employees (lag 1)		-5.425
		(-0.74)
Past Wage Growth (lag 2)		0.112
		(0.43)
Number of Employees (lag 2)		4.689
		(0.64)
Past Wage Growth (lag 3)		-0.133
		(-0.78)
Number of Employees (lag 3)		1.726
		(1.12)
Past Wage Growth (lag 4)		-0.019
		(-0.07)
Number of Employees (lag 4)		-0.824
		(-0.58)
Observations	643	622
BIC	1978.6	1855.1

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Notes: The Table reports parameter estimates from estimating the effect of a range of determinants on firms price growth expectations (equation (5)). The specification includes a range of continuous variables, reported in the Table as well as a range of fixed effects for time, time-industry, output below capacity, growth in sales volume, growth in unit costs, growth in employment. Robust t-statistics are reported in parenthesis.

expectation conditional on the information that was available to the forecaster (Rossi and Sekhposyan (2015)).[16] The tests we consider in this section build on these insights.

5.1 Wages and Prices

We first consider the rationality of the expected price and wage growth data. In a panel data setting, rationality can be tested by estimating the model

$$\widehat{e}^{\pi}_{f,t+4} = \alpha^{\pi}_{f} + \theta^{\pi}\hat{\pi}^{e4}_{t+4f} + \epsilon^{\pi}_{f,t+4} \tag{7}$$

where $\widehat{e}^{\pi}_{t+4} \equiv \pi^{4f}_{t+4} - \hat{\pi}^{e4}_{t+4f}$ is the 1-year ahead forecast error at time t defined as the difference between reported price increases over the last year, π^{4f}_{t+4}, and the forecast made a year earlier, $\hat{\pi}^{e4}_{t+4f}$.

If expectations are rational, we would expect both the constant and the coefficient on the forecast value in (7) to be equal to zero. The rationality test can therefore be formulated as a joint test of unbiasedness ($\alpha^{\pi}_{f} = 0$) and efficiency ($\theta^{\pi} = 0$).

The rationality of forecasts for wage growth can similarly be tested by estimating the regression equation, with $\widehat{e}^{w}_{t+4} \equiv w^{4f}_{t+4} - \hat{w}^{e4}_{t+4f}$

$$\widehat{e}^{w}_{f,t+4} = \alpha^{w}_{f} + \theta^{w}\hat{w}^{e4}_{t+4f} + \epsilon^{w}_{f,t+4}. \tag{8}$$

Earlier, we showed that there might be persistence in expectations which may lead to forecast errors that are correlated over time. As a result, the panel data model in equations 7 and 8 are estimated using standard errors that are robust to heteroskedasticity and autocorrelation.[17]

Table 4 reports the results from estimating the model in equations 7 and 8. The results in Table 4 show that null hypothesis of the rationality of price and wage growth expectations is firmly rejected. The constants and the coefficients are sizable, with large t-statistics. These results are interesting and possibly point to information frictions as discussed in e.g. Coibion and Gorodnichenko (2014). They also cast doubt on whether the strong assumptions in many macro models hold in reality.

the assumptions they are built upon (Prescott (1977)). Others disagree by pointing to an identification problem that arises when a theory is rejected because without testing for rational expectations, it is not possible to find out whether the equations of the model have been rejected or the assumptions about expectation formation (Keane and Runkle (1999)). Here, we adopt the later view.

[16] This is true only under covariance stationarity and a quadratic loss function.

[17] This setting implies that the estimation error is captured under the null hypothesis which means that we adopt the asymptotic framework of Giacomini and White (2006) to conduct inference.

Table 4: Rationality tests

	(1) $\widehat{e}$ (Price Growth)	(2) $\widehat{e}$ (Wage Growth)
Expected Price Growth	0.765**	
	(21.83)	
Expected Wage Growth		0.808**
		(29.10)
Constant	-0.420**	-1.402**
	(-10.65)	(-26.23)
Observations	3080	3038

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$

Notes: The Table reports parameter estimates for the rationality test regressions for firms' price growth expectations described in equations (7)-(8). Robust t-statistics are reported in parenthesis.

5.2 New Orders, Employment and Costs

Next, we consider the rationality of the new orders, employment and cost expectations. The challenge, as discussed above, is that these are discrete choice variables. Das et al. (1999) set out methods of testing for rationality when data are categorical. They make the assumption that with three categories a firm responds "Up" if it forecasts an outcome greater than some value a_1, "No change" if the firm forecasts an outcome in the interval $[a_2, a_1]$ and "Down" if it forecasts a value below a_2. The firm reports outcomes one quarter later using the same classification method. The cut points, a_1 and a_2 are assumed not to change between the forecast and the realisation, although they can differ between firms.

Without observing numerical outcomes (see Lui et al. (2011)) it is not possible to test whether a forecast of the mean is rational or not. It is possible, however, to test rationality making the assumption that the forecast is the mode or the median and we follow this approach.[18] If the forecast is a median forecast, the necessary requirement is that the median of the realisation should lie in the same category as the forecast. Thus, with three categories

$$\sum_{j=k+1}^{3} p_{jk} \leq 0.5 \ (k = 1, 2)$$
$$\sum_{j=1}^{k-1} p_{jk} \leq 0.5 \ (k = 2, 3).$$

[18] Results for those based on the mode are available on request.

The results of this exercise do not point to any departure from rational behaviour for any of the three variables we consider: we do not find that more than fifty per cent of the outcomes were for lower ranges than forecast or for higher ranges than forecast. Details of these tests are also available on request.

But, we can also explore this for respondents conditional on the category of their forecast. The test results conditional on the initial forecast do point to departures from rationality. For $k = 1$ or $k = 3$ we simply need to test whether the proportion $p_{kk} \geq 0.5$ is acceptable, contingent on the observed proportion $\hat{p}_{kk}$. This is done using the normal distribution with a one-sided test

$$\sqrt{n_k}\left(\frac{\hat{p}_{kk} - 0.5}{\sqrt{p_{kk}(1 - p_{kk}}}\right) \sim N(0, 1).$$

It is only meaningful to conduct these tests if the observed $\hat{p}_{kk} < 0.5$. If the observed value is greater than 0.5 the one-sided test will never reject the hypothesis that the true probability is at least 0.5. If $k = 2$, it is not possible for both $\hat{p}_{12}$ and $\hat{p}_{32}$ to be above 0.5. If neither value is above 0.5 there is, once again, no point in testing. But if one value is below 0.5, then the normal approximation can again be used to test whether the difference is significant.

In Figure 6A we show the proportions, p_{kk}, of those who (i) reported a fall conditional on having forecast such an outcome, and those who reported a rise conditional on having forecast such an outcome. When this proportion drops below 0.5, this is evidence of a departure from rationality. We also show upper 95% confidence interval for each proportion, calculated as

$$\hat{p}_{kk} + 1.65\sqrt{\frac{p_{kk}(1 - p_{kk})}{n_k}}.$$

Looking first at movements in new orders, Figures 6A and 6B show there are two cases where the probability of reporting " Down" conditional on having forecast it is significantly below 0.5. There are six cases where the probability of reporting " Up" conditional on it having been forecast is significantly below 0.5. With just over twenty observations, we should expect only one of each if firms are providing rational forecasts of their median outcomes. There is, therefore, some statistical evidence for over-optimism among firms expecting new orders to rise.

For employment, the evidence for non-rational behaviour is weaker. Figures 6C and 6D show that there are two occasions when the modal test is significantly breached, in both cases by firms which had forecast falling employment (in 2014Q2 and 2015Q1). The median test shows three breaches in 2011Q2, 2014Q2 and 2015Q1 by firms which had forecast falling employment. There are no breaches by the firms which forecast stable or

rising employment.

On the other hand, forecasts of movements in unit costs clearly fail the tests for rationality. For the firms that forecast falls in unit costs, the median test was failed significantly on ten occasions. For those forecasting rises, the median test was failed on eight occasions (see Figures 6E and 6F). Of these, there were five occasions (2014Q3, 2015Q2, 2015Q4 and 2016Q1) when the tests were failed both by the firms which forecast falls in costs and by those which forecast rises. This, of course, might indicate that firms tended to take views which were too extreme, both on the upside and on the downside.

We noted earlier that the test is based on the premise that firms' forecasting errors are independent of each other. If there is a single macro-economic influence that leads to outturns higher than had been forecast, for example, then it is not obvious that this is a failure of efficient forecasting. On the other hand, repeated test failures — of the kind observed for unit cost expectations — may be indicative of forecasting failure rather than macroeconomic shocks. It is hard to see that a common macroeconomic shock could, on four occasions out of twenty-three, lead to significantly below half of the firms who forecast a fall in costs actually experiencing this while, at the same time, significantly fewer than half of the firms who forecast a rise actually experienced this.

5.3 Summary

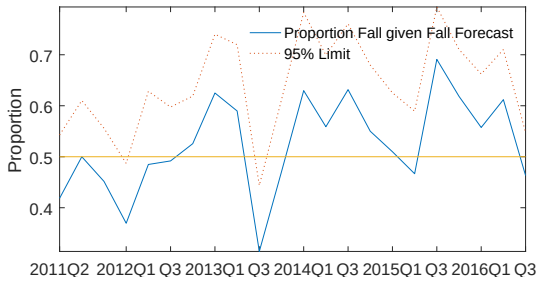
Our findings suggest different degrees of rationality for different expectations. One interpretation of our results is that firms may have rational expectations of quantity variables — new orders and employment — but not of price variables — wages and unit costs. That might be the case if, at least in the short term, quantity variables are much more important to firms than price variables.[19] Of course, all these factors are still related. For example, employment decisions also affect unit costs. But, while employment expectations appear more rational, there may still be departures from rationality for unit costs: firms may not assess rationally the prospects for the other influences on costs.

6 Conclusions

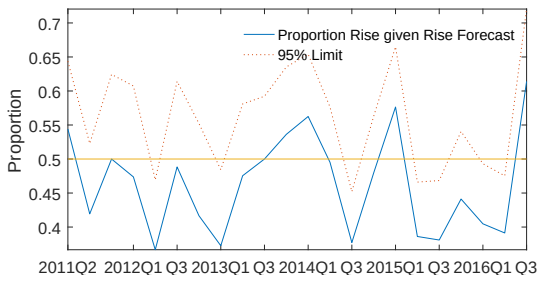
Modern macroeconomic models make a number of assumptions about the common information, forward-looking behvaiour and rationality of firms. These assumptions play an important role in determining the predictions of these models for aggregate outcomes. Insights for these models have also influenced central banking where the management of inflation expectations is considered to be important in order to achieve low and stable

[19] These findings are also consistent with the results for New Zealand in Coibion et al. (2017) who find that many more firms track GDP compared to inflation.

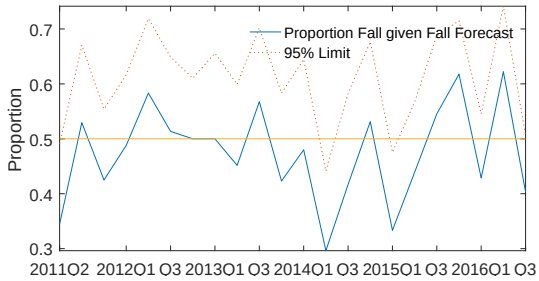
Figure 6: Rationality tests for new orders, employment and cost expectations



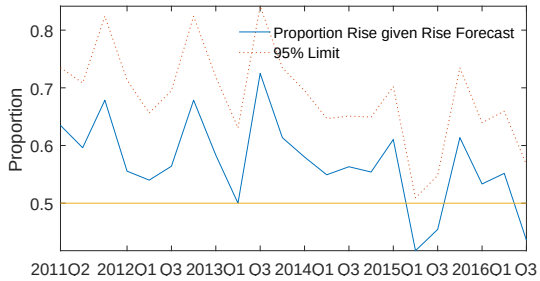
(A) New orders (Fall)



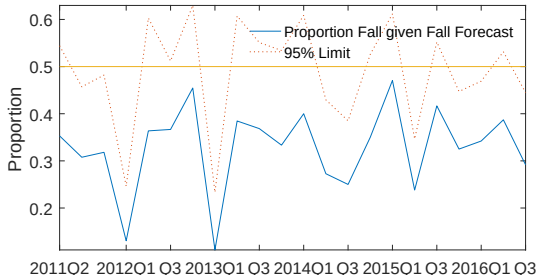
(B) New orders (Rise)



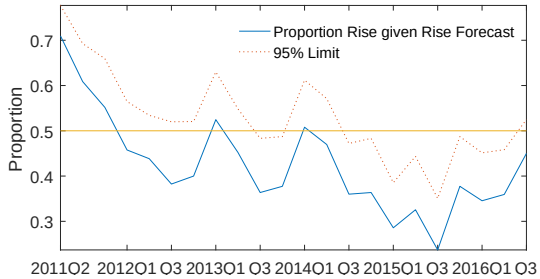
(C) Employment (Fall)



(D) Employment (Rise)



(E) Cost (Fall)



(F) Cost (Rise)

inflation rates (Bernanke (2004)).

We shed new light on how firms' expectations are formed, and whether they matter, using a novel panel dataset on firms' expectations from the UK's Confederation of British Industry. We focused our analysis around three issues: (i) the information on which firms' form expectations and the associated heterogeneity and dispersion this might produce (ii) whether firms' are forward-looking in their price setting and whether expectations affect pricing outcomes today (iii) whether firms' expectations are rational. All three of these components are central to modern macro models.

We have shown that firms' expectations of price and wage growth are influenced by a combination of aggregate and firm level indicators, although price expectations seem more related to aggregate inflationary pressures and cost indicators, while wage expectations reflect expected aggregate GDP growth and firm-specific output and employment variables. Expected growth in new orders seems to reflect more aggregate influences, while employment and cost expectations seem to reflect firm specific factors. This suggests that firm-specific influences play an important role, and that firms are selective about the indicators that they use when forming expectations for particular variables. As in other recent papers, we also find evidence of considerable dispersion of firms' price and wage growth expectations.

Firms' wage and price growth expectations also seem to matter for price setting behaviour. Price increases depend on expected future price increases with a coefficient which is around 0.5. Although this is evidence that firms' expectations are important in pricing decisions, we also show that these expectations are not fully rational. Expectations channels (e.g. in the transmission of monetary policy) therefore still seem potentially important, but actual outcomes will depend on how precisely expectations are formed. The statistical evidence in Section 3 speaks to this, but understanding the expectations formation process more deeply is an interesting avenue for future work.

Taken together, our results suggest heterogeneity in the use of information, rational inattention or bounded rationality and some degree of forward-looking behaviour may be important empirical regularities in firms' expectations. This suggests that the transmission mechanisms may be more complex than many models typically assume. Whether this changes the predictions of our models is then, ultimately, a theoretical issue, but our results provide new empirical insights to motivate this line of work.

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