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Expectations and firm dynamics: Aggregate versus idiosyncratic shocks in emerging economies.

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Abstract

This paper assesses producer-expectation-driven fluctuations at the firm level in an emerging economy, disentangling three types of expectation shocks. Using unique microdata on expectations and firm decisions, it shows expectation shocks influence output, employment, and investment at the firm level like that usually associated with aggregate business cycles, indicating a widespread market reaction to this type of shock. It also shows that the intensity of those effects varies depending on the nature of the shock. While output and employment responses are larger to idiosyncratic expectation shocks, investment, on the other hand, is more sensitive to expectation shocks associated with the aggregate economy. Survey-based monitoring and policy interventions to anchor producers' expectations in environments plagued by great uncertainty should be aware of such heterogeneity.

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1. Introduction

Economic fluctuations are partially driven by expectation shocks regarding future economic opportunities. Nonetheless, micro-level evidence on how firms react when facing such shocks is still scarce. Does it resemble (on average) aggregate patterns on the relationship between producers' expectation shocks and aggregate business cycles? Would shocks in expectation concerning the aggregate economy or firms' future economic conditions have contemporary effects on firms' decisions and outcomes? Does the nature of the shock (idiosyncratic or aggregate) matters? This paper assesses those questions.[1]

Using unique producer-level data from a survey, this paper studies firms' dynamic responses to three different producers' expectation shocks (Aggregate Economy, Firm's Future, and Expected Demand) on a monthly basis. More specifically, we estimate Panel Vector Auto-Regressive (PVAR) models using microdata on firms' outcomes and expectations about future economic conditions. The goal is to obtain the dynamic responses to expectation shocks and to capture the channels by which they could affect firms' performance.

The main empirical results suggest that expectation shocks, in general, affect output at the firm level like that usually associated with aggregate business cycles, indicating a widespread market reaction to this type of shock. First, production, employment, investment intention, and capacity utilization increase in response to positive expectation shock concerning the aggregate economy, firms' production, and expected demand for their products. Second, inventories fall in response to positive expectation shocks about firms' conditions in the future, displaying a negative co-movement concerning production, employment, and capital utilization rate at the firm level; however, inventories increase in response to expected higher demand in the future. Third, the effects of producers' expectation shocks are highly persistent on investment intentions and employment (more than 12 months).

Nonetheless, the intensity of those effects varies for each channel depending on the nature of the shock. Idiosyncratic shocks affect output and employment in a few months, reaching their peak in the first three months, and effects are at least three times stronger than the reaction triggered by expectation shocks on the aggregate economy. Similarly, capacity utilization responses are larger to idiosyncratic shocks, but differences are negligible among shocks. On the other hand, investment is more sensitive to expectation shocks in the aggregate economy and to firms' own conditions.

The unique data used in the paper is collected through the Brazilian Industrial Survey and presents some advantages over other sources used in the literature. The survey assesses self-reported expectations and performance from a representative sample of the Brazilian industrial sector. It is collected monthly and composes an unbalanced panel with 136,085 observations of 6,415 formal firms between January 2010 and December 2015. Data on producers' expectations used by previous studies are pledged by shortcomings that compromise the assessment proposed by this paper. For instance, consider the Philadelphia FED's Business Outlook Survey (BOS) and the German IFO Business Climate Survey. In the latter, the survey unit is the product and most performance questions are asked every quarter, not matching the monthly expectations, while the former is composed of a few large manufacturing firms and is not representative of the manufacturing sector in the United States.[2] Those restrictions make

[1] By idiosyncratic shocks, we mean shocks expected to impact only the firm, while aggregate shocks refer to shocks expected to affect the whole economy from the producers' point of view.

[2] The BOS covers only manufacturers in the eastern two-thirds of Pennsylvania, southern New Jersey, and Delaware. The same problem of sampling biases seems to be present in other producer surveys in the United States, such as the New York FED's Empire State Manufacturing Survey.

it harder to assess widespread producer-expectation-driven fluctuations at the firm level on a monthly basis, which, in turn, is possible with our data.

Since Beaudry and Portier (2006) documented that fifty percent of business cycle fluctuations could be a result of expectation shifts triggered by news shocks, studies on business cycles once again have paid extra attention to the expectation shocks with unfolding economic consequences.[3] Several studies assess the impact of expectation changes on aggregate economic activity, but not at the firm level as proposed here. Mostly, they use stock market indexes (Beaudry and Portier, 2006; Kurmann and Otrok, 2013), consumer expectations (Souleles, 2004; Barsky and Sims, 2012), professional forecasters (Leduc and Sill, 2013) or idiosyncratic uncertainty (Bloom, 2009; Bachmann et al., 2013) to construct a quarterly series of aggregate expectation shocks (news or sentiments) and include them as a mechanism to explain aggregate business cycles. Our results contribute to the literature by providing evidence that firms' reaction to expectation shocks resembles aggregate patterns, but their channels and intensity depend particularly on the type of expectation shock they are dealing with.

The remainder of this paper is structured as follows. Section presents details about the data. Section presents the empirical strategic and the results of estimations. Finally, section provides some concluding remarks.

2. Data

We use the Brazilian Industrial Survey in our empirical analysis. This survey is a business opinion survey conducted by the Brazilian Confederation of Industry (CNI, the Portuguese acronym) and covers Brazilian industry as a whole. It contains information on economic activity and self-reported expectations at the firm level. This survey covers the manufacturing sector and the mining and quarrying sector (two-digit level) for different firms' sizes (small, 10-49 employees; medium, 50-249 employees; and large, 250-plus employees). Our sample covers the period ranging from January 2010 to December 2015. In summary, the unbalanced panel comprises 6,415 firms and 72 months, summing up to 136,085 observations.

The Brazilian Industrial Survey includes information that could be split into two sets of data. One covers monthly changes in industrial activity (backward-looking measures) on output, the number of (blue collar) employees, capacity utilization rate, inventory levels as well as investment intentions. While the other is composed of monthly series of producers' expectation measures (forward-looking) regarding the situation of the aggregate economy (Country and State) and the firm itself, besides firms' prospects over demand for their products domestically and internationally (through exports). Expectations measures refer to forecasts over the next six months and are collected on a monthly basis, allowing for the identification of switching prospect moments. In this survey, each respondent is the main manager.

The variables generated by the Brazilian Industrial Survey are discrete responses. We center all variables at zero such that positive coefficients (non-negative) represent an increase (non-increase) in indicators. We do this just to simplify the interpretation of the empirical results. We do not assume that the distance between categories of responses is the same. The categories of an ordinal variable thus are ranked, but the distances between the categories are considered unknown.

In Table 1 we show descriptive statistics of our data. They reveal that: (i) employment,

[3]For more on this topic see also Beaudry and Portier (2014). Further discussion on the relevant concerns and challenges in this area can be found on Beaudry and Portier (2004, 2007), Pesaran and Weale (2006), Barsky and Sims (2011, 2012), Schmitt-Grohe and Uribe (2012), Ng and Wright (2013), and Barsky et al. (2015).

investment intention, capacity utilization and expectation measures are procyclical; (ii) inventory is weakly countercyclical; and (iii) employment is less volatile than production, while investment intention is more volatile. Moreover, standard deviations of key variables are similar, which might be due to the discrete nature of the data or the short-run view of indicators. Given the absence of firms' price changes in the Brazilian Industrial Survey, we use a month-over-month price index at the sectorial level (IPP, at Portuguese acronym) elaborated by the Brazilian Institute of Geography and Statistics (IBGE, Portuguese acronym). Then, it also presents statistics on sectorial price: (i) sectorial price is weakly procyclical; (ii) sectorial price is more volatile than production. So, descriptive statistics at the firm level, in general, are in line with stylized facts for aggregate business cycles (Christiano et al., 2005).

Table 1: Descriptive statistics

	Mean	Relative mean	Standard deviation	Relative standard deviation	Correlation with production
Production	-.124	1.000	.855	1.000	1.000
Employment	-.126	1.016	.611	.714	.410
Investment intention	.366	-2.956	.912	1.067	.223
Capacity utilization	-.313	2.529	.771	.901	.574
Inventory	.204	-1.652	.818	.956	-.060
Sectorial price	.437	-3.531	1.547	1.809	.000
Expectation on Aggregate economy	-.070	.562	.929	1.086	.203
Expectation on Firm's future	.332	-2.685	.889	1.040	.286
Expectation on Firm's demand	.193	-1.558	.829	.970	.300
Expectation on Export volumes	.037	-.303	.817	.956	.220

Note: First and second statistical moments of our panel data from the Brazilian Industrial Survey, in which we find a representative sample of manufacturing firm followed between January 2010 and December 2015. In case of real variables, mean figures below (above) zero indicate a month-over-month decrease (increase) in outcomes. In case of expectation measurements, mean figures below (above) zero indicate a pessimist (optimism) on the next six months. In case of Sectorial price, mean figures in month-over-month percentage change. The Sectorial price index used is the Brazilian producer price index (IPP, at Portuguese acronym) constructed by the Brazilian Institute of Geography and Statistics (IBGE, Portuguese acronym). Relative measures uses production as benchmark.

In Table 2, we present the correlation among our producers' expectation measures. According to this table: (i) producers' expectation measures are positively correlated; (ii) expectations for the aggregate economy and the firm are strongly correlated; (iii) expectations for the aggregate economy and export volume are weakly correlated. Lastly, figure 1 shows the dynamic of key variables. In the period between January 2010 and December 2015, the Brazilian economy floated from its peak to the trough and the Brazilian industry follow this slip down. The negative mean of outcomes measures described in Table 1 signalizes this fact. In the appendix, we present additional data details on Brazilian Industrial Survey.

3. Methodology and results

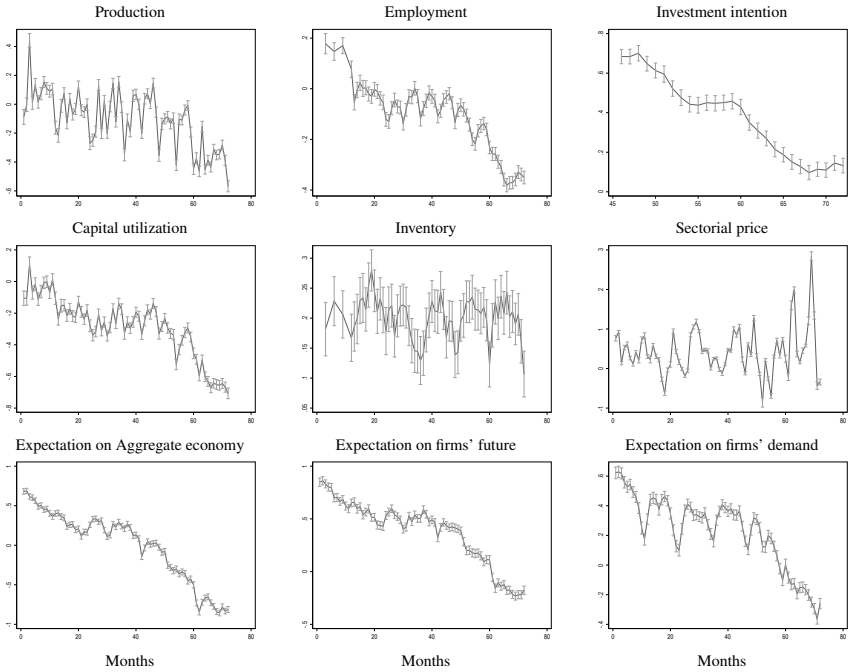
Using the previous data described, our empirical task is to estimate a Panel Vector Autoregressive (PVAR) model in the search for stylized facts usually associated with the aggregate business cycle. The goal is to assess the dynamic responses to expectation shocks at the firm level and to compare it to standard aggregate business cycle moments.

Table 2: Correlation between the producers' expectation measurements

	Aggregate economy	Firm's future	Firm's demand	Export volumes
Aggregate economy	1.000			
Firm's future	.686	1.000		
Firm's demand	.437	.563	1.000	
Export volumes	.213	.338	.435	1.000

Note: The above statistics describe the correlation between the producers' expectation measurements in the Brazilian industry. Disaggregated data from the Brazilian Industrial Survey is used over the period between January 2010 and December 2015.

Figure 1: Dynamic of the cross-sectional average of key-variables



Note: The solid lines are the cross-sectional averages. The variables varies between -2 and 2. In case of real variables, values below (above) zero indicate a month-over-month decrease (increase) in outcomes. In case of expectation measurements, values below (above) zero represent a pessimism (optimism) on the next six months. In addition, the further below (above) zero, the greater and more widespread the pessimist (optimism). Disaggregated data from the Brazilian Industrial Survey cover the period between January 2010 and December 2015. The Sectorial price index used is the Brazilian producer price index (IPP, at Portuguese acronym) constructed by the Brazilian Institute of Geography and Statistics (IBGE, Portuguese acronym).

3.1 Econometric issues

Let Y_{it} be a vector of k endogenous variables for firm i at time t. In our formulation, Y_{it} comprises changes in production, employment, investment intentions, inventories, and capacity utilization. We employ three alternative measures of expectation: i) firms' expectations about future economic conditions of the aggregate economy; ii) firms' expectations about their future conditions; iii) firms' expectations about the future demand for their goods and services.

The reduced form dynamic relationship among the variables is represented by:

$$Y_{it} = A_{i0} + \delta_t + \sum_{j=1}^{11} \beta_j S_{jt} + A(\ell) Y_{it-\ell} + u_{it} \tag{1}$$

where A_{i0} is a $k \times 1$ vector of time-invariant firm-specific intercepts, δ_t represents unobservable time effects, S_{jt} represent monthly dummy variables (i.e seasonal dummies controls), $A(\ell)$ are $k \times k$ matrices of lagged coefficients, $A(\ell) \equiv \sum_{j=1}^{p} A_j \ell^{j-1}$. The element u_{it} is a $k \times 1$ vector of idiosyncratic disturbances, where $E(u_{it}) = 0$, $E(u_{it}u'_{it}) = \Sigma_u$ (being Σ_u a nonsingular matrix) and $E(u_{is}u'_{it}) = 0$ for $t \neq s$. We follow Arellano and Bover (1995) and rewrite equation 1 in terms of forwarding orthogonal deviations to eliminate individual fixed effects and proceed with the Generalized Method of Moments (GMM) estimation. That is, for every element $y_{it} \in Y_{it}$, we compute

$$y^*_{it} = (y_{it} - \bar{y}_{it}) \sqrt{\frac{T_{it}}{T_{it}+1}}, \tag{2}$$

where T_{it} is the number of available future observations for firm i at time t and $\bar{y}_{it}$ is its average.

To identify producers' expectation shocks, we impose two alternative orderings. In the first formulation, we order our expectation variable first, whereas, in the second, the expectation variable is ordered last. As we will show the results are qualitatively unchanged. We recover the Impulse-Response Functions (IRFs) from rewriting equation 1 as $B(\ell)Y_{it} = u_{it}$, where $B(\ell) = (I_k - A(\ell))$. If all eigenvalues of $A(\ell)$ have modulus less than 1, $B(\ell)$ satisfies the stability condition and is invertible. Therefore

$$B(\ell)^{-1} \equiv \Phi(\ell) = \sum_{j=0}^{\infty} \Phi_j \ell^j \tag{3}$$

will be the parameters of the moving average representation of our model. By imposing a Cholesky decomposition on $\Sigma_u = P'P$, where P is a lower-triangular matrix, it is possible to recover orthogonalized disturbances and hence we can obtain orthogonalized impulse responses.

3.2 Main empirical results

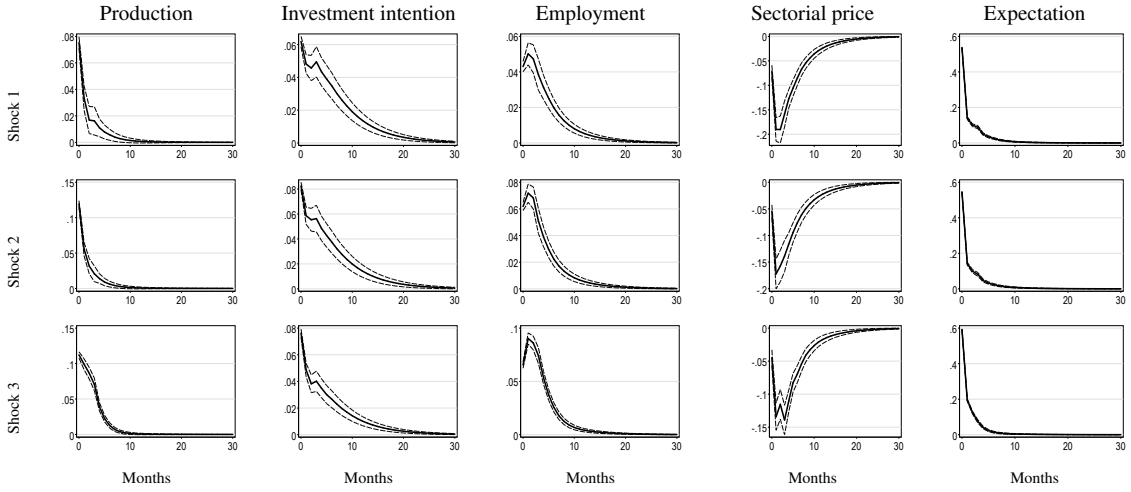
Our main interest lies in the dynamic responses to unanticipated producers' expectation shocks. The PVAR models are estimated over the sample period using monthly data from January 2010 to December 2015 (72 months) using the Brazilian Industrial Survey. The investment intentions variable only starts in November 2013, which restricts our sample time length. A well-known result of macroeconomic literature is that investment is an essential variable in the business cycle account (Christiano et al., 2005). For these reasons, we estimate models with investment intentions in the sample (27 months).

We use two specifications: Small Var composed of production, investment intention, employment, sectorial price, and each expectation measurement; Large VAR composed of production, investment intention, employment, capacity utilization, inventory, sectorial price, and each expectation measure. Using three expectations variables and two identification strategies for the two specifications, we thus estimate a total of twelve PVAR models. In all models, we use the Akaike information criterion, Schwarz information criterion, and Hannan-Quinn information criterion to select the lag length. Our choice was to select the

lag length based on two or more criteria.[4]

Figures 2 and 3 display our endogenous variables dynamic responses to a one-standard-deviation expectation shock. In Figure 2 the expectation variable is ordered first, while in Figure 3 it is ordered last, while each column shows a different producers' expectation measure. Each panel presents the response of each variable (in terms of deviation from its sample average) to an expectation shock. Figure 2 shows that after a positive expectation shock (all measures) production, investment intention, and employment increase at impact and remain above their long-run level for 12 to 24 months. Meanwhile, sectorial prices fall and remain below the long-run level for 24 months after the shock. Figure 3 displays similar results, except for the null response at impact as the expectation variables are ordered last. By construction, production, investment intention, employment, and sectorial price do not respond contemporaneously at impact.

Figure 2: Producer expectations (ordered first) and economic activity: Small VAR



Note: Impulse-Response Functions (IRFs) from the PVAR model when the expectation variables are ordered first. Expectation shock 1 refers to a one standard deviation shock to the producer's expectation about the aggregate economy. Expectation shock 2 represents a one standard deviation shock to the producer's expectation about its future condition. Expectation shock 3 refers to a one standard deviation shock to the producer's expectation about its future demand. Solid lines represent the response of each variable to an expectation shock when the expectation variable is ordered last in the PVAR model. The dashed lines represent the 68% confidence interval using a Monte Carlo procedure with five hundred replications.

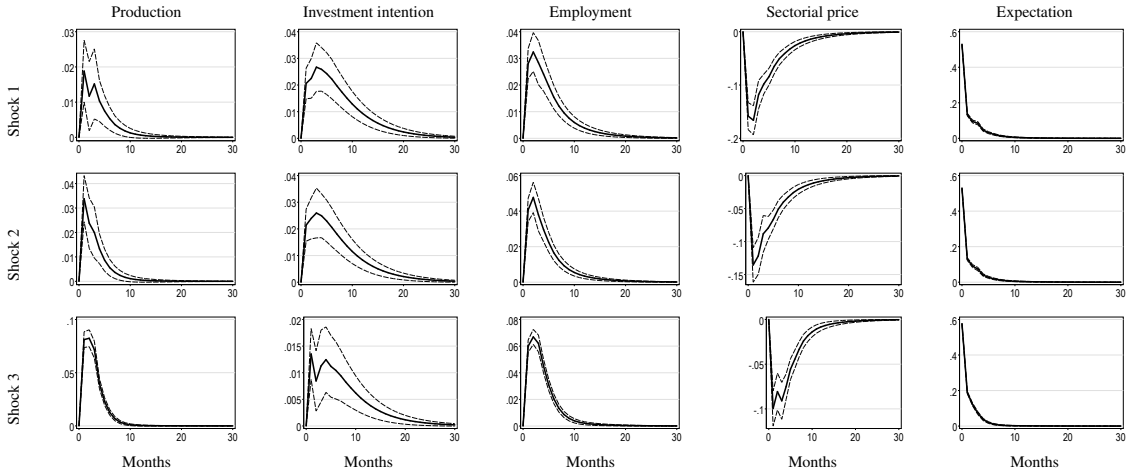
Nonetheless, the effect is heterogeneous and depends on the nature of the shock. When the shock comes from expected demand, production and employment respond much stronger than when the source of shock is over the firms' future activity or aggregate economic activity. In the small-VAR model, investment is slightly more sensitive and persistent when the shock is over the expected aggregate economic activity.

The results for the Large-VAR model, which adds capacity utilization and inventory as the endogenous variables, point to similar reactions.[5] Regarding production, investment intention, employment, and sectorial price changes, the results are virtually the same as in the Small-VAR model. When producers become more optimistic about the future (all expectation measures), capital utilization increase at impact and remain above their long-run level for 12 months. Meanwhile, inventories fall and remain below the long-run level for 12 months after the shock when the expectation shock is on the aggregate economy or firms' future but increases when

[4]The model with the largest lag length was a PVAR with four lags and eleven seasonal dummies.

[5]In the online appendix, we present the IRFs for the Large-VAR model.

Figure 3: Producer expectations (ordered last) and economic activity: Small VAR



Note: Impulse-Response Functions (IRFs) from the PVAR model when the expectation variables are ordered last. Expectation shock 1 refers to a one standard deviation shock to the producer's expectation about the aggregate economy. Expectation shock 2 represents a one standard deviation shock to the producer's expectation about its future condition. Expectation shock 3 refers to a one standard deviation shock to the producer's expectation about its future demand. Solid lines represent the response of each variable to an expectation shock when the expectation variable is ordered first in the PVAR model. The dashed lines represent the 68% confidence interval using a Monte Carlo procedure with five hundred replications.

the expectation is on firms' demand. This latter result might be a consequence of firms' optimal behavior in the presence of investment adjustment costs or labor market frictions. In such cases, it is optimal to anticipate higher future demand by increasing output (and inventories) today. Similar results are found, except for the null response at impact, as the expectation variables appear last in the VAR.

Even in the Large-VAR model, effects are still heterogeneous regarding the nature of the shock. The novelty in this model is the heterogeneous response of capacity utilization and inventory. When expectations variables appear last in the VAR, capacity utilization responses to expectation shocks on the aggregate aggregate economy are smaller compared to those to idiosyncratic shocks. Inventory barely reacts to expectation shocks, but it falls when expectation shocks are over the firm's future, while it increases when the shock is on expected demand.

From both the estimated PVAR models, Small and Large-VARs, we have computed the Forecast Error Variance Decomposition (FEVD) due to expectation shocks. The tables in the online appendix present the decomposition exercises. Overall the FEVD indicators are relatively greater when expectation shocks are ordered last. At an 8-48 months horizon, the FEVD results show that expectation shocks explain a maximum of 7% of the variance of production, 11% of employment, and 6.5% of investment intention. Moreover, expectation shock explains little capacity utilization, less than 3% of the variance, and nothing of inventory, less than 0.1%.

The FEVD indicators also reveal the heterogeneous reaction to different types of shocks. They demonstrate how important idiosyncratic shocks are in explaining the variations of the firms' production and employment in the model. In the Small-VAR model, the effect might be at least three times stronger for idiosyncratic shocks. Investment intention and sectorial price variations are more sensitive to shocks in the aggregate expectation shocks, mainly in the Large-VAR model.

Therefore, our results suggest that shocks to producers' expectations have non-negligible

effects on output, investment, employment and prices at the firm level that resembles the effects found by other studies on non-fundamental shocks over the aggregate economy. Nonetheless, they reveal heterogeneous responses depending on the type of shock producers´ are facing.

3.3 Robustness exercises

We report here how our main results are sensitive to empirical assumptions. We present the majority of these robustness exercises in the appendix. First, we test for the importance of including investment in the estimation.

Although our producer-level data contains 72 months, we only use 27 months in the main results due to the shorter length of our series on investment intentions. Therefore to check our main results, we re-estimate the previous models without investment and hence we use all the months available. In general, production and employment still increase in response to positive expectation shocks, regardless if it is about the aggregate economy, the firm itself, or its expected demand.[6] Similarly to our baseline results, sectorial prices fall in response to expectation shocks. Moreover, the FEVD results show that excluding investment series in the estimation does not change the fact the expectation shocks explain a small fraction of the variance of the key variables.

Second, we test for a different inventory measure. As suggested by Auernheimer and Trupkin (2014), there are two types of inventory measures: i) the effective level of inventory, used in the baseline model; and ii) the variation of unplanned inventory, which is a monotonous function of the ratio of sales-inventories. We re-estimated our models using unplanned inventory and did not change the main results.

Third, we examine how results change by considering direct shocks on expected exports. Although, there is a positive correlation between expectation measures (see table 2), expectation on export volumes enables us to address explicitly an important dimension of producers' expectation - future foreign demand - which could have different unfolding consequences.[7] Overall, production and employment are still procyclical, although the effects of exports' expectation shock are less persistent on employment.

Finally, we also estimate the models considering firms' size, without sectorial price, and with the sector-specific trend. For the former, we are interested in testing for heterogeneous responses by different firm sizes. Results, however, do not change substantially. Patterns seem similar regardless of the firm size. The same is true for the estimation without the sectorial price and with the sector-specific trend, co-movements remain the same, although marginal differences can be seen in the confidence intervals and FEVD, which get marginally larger.

4. Final remarks

Expectations play a non-negligible role in economic fluctuations, there is considerable documentation of its importance for aggregate business cycles, but empirical evidence on the dynamics at the firm level remains somewhat limited. In this paper, we study how different types of producers' expectation shocks relate to their decisions and outcomes, in a setup of high granularity and frequency.

[6] Figures in the appendix present the results of the robustness exercises.

[7] Some sample restrictions are imposed, since around 30% of firms in the Brazilian Industrial Survey are self-reported as exporters.

Our results provide micro evidence of positive and persistent co-movement among production, employment, investment intention, and capital utilization rate in response to expectation shocks at the firm level, but highlight important differences regarding the intensity and speed of the responses depending on the type of expectation shock. Unexpected changes in the expectation over the aggregate economy are more likely to trigger caution on investment decisions and affect sectorial prices while idiosyncratic shifts in firms' expected demand are more likely to persistently reduce production and employment in a process that starts a few months after the shock. Overall, the main findings are robust to both ordering and variable choices in the baseline model.

We contribute to the literature by revealing the patterns of expectation-driven business dynamics at the firm level and the importance of distinguishing the nature of shocks. It represents a step forward in the investigation of producers' expectation-driven cycles and their unfolding consequences but leaves open questions related to the expectation formation itself, its timing, and the particular importance of each firm for the aggregate fluctuations. These questions are important avenues for future research.

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