Constraining Factors for Manufacturing Investments: An Empirical Study of the Norwegian Manufacturing Industry

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March 9, 2020

Abstract

Firms continuously analyze whether to stand by their planned investment projects or whether they need to adjust their investment plans. This paper applies panel data to assess the relative contribution of factors explaining changes in firms' investment plans. The analysis builds on data from a quarterly business tendency survey as well as national accounts statistics and register data. Conventional register data on investment decisions contain systematic measurement error due to time lag from when an investment decision is taken to it is effectuated. In contrast, survey data do not suffer from this problem and therefore are particularly well suited for studying investment behavior. I find that changes in the firms' expected demand and access to credit are the most important variables for explaining changes in investment plans. Firms; independent of size; are most likely to adjust their investment downwards when demand expectations are weak, and credit conditions are tight. Neither changes in capital

*I am grateful for the comments given by John Dagvik, Gunnar Bårdsen, Ådne Cappelen and Håvard Hungnes Funding: This work was partly financed by the Norwegian Ministry of Finance through its support to macroeconomic research in Statistics Norway

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costs nor the financing costs seem to play a significant role in the short-run investment dynamics.

Keywords: Real investments, Business survey, Panel data model

JEL Classification: E22, L20, D22

1 Introduction

Growth has been nearly absent in Europe and fairly weak in the Nordic countries through all the years after the Financial crisis in 2007/2008. Finally, most of the major economies are showing signs of recovery, and investments started rising in the mid 2010s, after nearly a decade without substantial growth. Banerjee et al. (2015) point to the fact that there is a 'Secular Stagnation' in Europe characterized by high income per capita and solid profit growth within firms, but still, real investments are not picking up after it plummeted the years after the financial crisis. Banerjee et al. (2015) highlight two possible explanations for this phenomenon: i) The first one is overcapacity due to the solid investment growth during the pre-Financial Crisis boom, and ii) The second one is low demand and hence low return on investments. Uncertainty and financial frictions are also factors viewed as important for explaining investment behavior. Uncertainty, both in price evolvement and expected demand, may reduce investment in a setting with imperfect markets, Bertola (1998) and Abel et al. (1996). Financial frictions dampen investment by causing external costs to rise due to agency problems, or it may induce liquidity constraints due to moral hazard, lack of competition, or high transaction costs. The purpose of this paper is to analyze the relative strength of the factors affecting real investments. For this purpose, I apply a panel data study on data from the Business tendency survey (BTS). There are several reasons for using data from the BTS. Firstly, these data do not suffer from bias due to the lag in delivery time of real capital. Remember that conventionally measured investment figures are notoriously difficult to interpret because of substantial delays from the time when the investment decision is taken until the changes in the capital stock is measured, either in official statistics or in the financial statements of the firms. The delivery times of real capital are also affected by the business cycles and depend on several factors such as the capacity utilization of the construction industry. In contrast, in the BTS, the answers provide direct information about changes in investment plans barely without any delay. Secondly, the BTS contains much more information about factors affecting real investments than regular register data do.

The BTS of Statistics Norway is a quarterly survey going back to 1990. The BTS is intended to provide information about the management of a representative share of the manufacturing industry in Norway, and it includes all large firms. Forecasters and government institutions use the survey regularly in its analysis. The BTS was revised in 2011. The old questionnaire contained questions about whether the firm had revised its investment plan – up, unchanged, or down. Upon request, I introduced an additional question into the survey. The added question intends to capture information about which factors that contribute to the firms' decision to revise down their investment.

The data set I use in this study is a panel data set that contains information from the questionnaire on whether or not changes in the investment plans had taken place for firms in the manufacturing industry as well as variables from the national account together with administrative data. Thus, this study uses both stated and revealed preference data. The revised version of the BTS Questionnaire questions the respondents about the motive behind their recent actions, and not only about their intentions.

The standard approach when studying real investments is to focus on a partial analysis of factors affecting investment decisions. In empirical studies of firm data, the identification strategy would, in many cases, not allow the researcher to study the effect of more than one or at most a couple of factors at a time. The contribution of this paper consists in establishing and estimating an empirical model for the probability of revising down investment plans, as a function of a set of several key explanatory variables.

In the empirical analysis, I find that the variable denoted "weak demand expectations" has the strongest effect on changes in the probability of a downward revision in firm investment. Limitations in firms' access to credit are also significant in explaining declining investment, but not as much as changes in demand expectations. In contrast to standard economic theory, changes neither in the price of capital nor in the cost of financing affect investments in the short run. This finding is in line with the results discussed in the first paper of this thesis, and one would expect that neither cost of capital, nor the price or cost expectations affect the level of real investments if firms to a lesser degree use formal methods for analyzing investment projects. The result of this analysis, which partly goes against the Investment Euler equation model (the benchmark model for analyzing aggregate investments, see, e.g. Smets and Wouters, 2007) is backed up by evidence obtained by the results in Paper 1.

2 Related literature

This section gives an overview of theoretical models and related empirical literature. I give a brief overview of theoretical investment models. Understanding those models are important for explaining how the questionnaire is designed. The last part of the section discusses relevant empirical studies.

2.1 Popular theoretical models

This subsection discusses some of the most popular models applied in the field of investment theory. The discussion serves as the basis for the selection of the possible response categories in the business tendency questionnaire discussed in section 3. I chose to highlight four popular investment theories; the Q-model, the Investment Euler equation model, The Jorgenson accelerator model, Real Options Theory, and the Financial accelerator theory. Investment models do often start with the Q-theory, Tobin (1969). The beauty of the Q-model lies in its microeconomic foundations and its logic result. The Q-theory expands the standard neoclassical production function with a representation of installation costs, such as in Abel (1981). The model states that the firm's value is given by today's dividend and the sum of all future dividends. Future dividends are the discounted sum of all future profits. If I maximize the value of the firm with respect to capital, subject to the law of motion of capital, I find the solution for the optimal investment level

$$I_s = \frac{q_s - pk_s}{\chi} K_s, \tag{1}$$

The relation in (1) is the Q-model, where I_t is investment at time t, q_t is the shadow price of capital, pk_t is the price of capital goods, χ is the installation cost parameter and K_t is the capital level. The Q-model implies that the firm invests if the shadow price (the ratio between the marginal return on capital and the cost of capital) is larger than the price of one unit of capital goods. The investment level depends on the cost parameter χ and the capital stock, K_s.

The Q-model has the same implication as the Net present value (NPV) model known from corporate finance. The conclusion from both models is that investments will increase as long as a rise in the real capital stock increases the net present value of the firm's dividend more than if the money was invested in an asset paying interests equal to $E[r]$. When forecasting investments, using the Tobin's Q-model, the interest rate plays an essential role as the nominal anchor.

The Investment Euler equation model differs from the Tobin's Q-model by being a period-to-period arbitrage condition for the firm's investment behavior Chirinko and Schaller (1996). Following Whited (1998) one may write the Investment Euler equation as:

$$(2) \quad E_{t-1}\beta_t[F_K(K_t,N_t) - \psi_K(I_t,K_t) + (1-\delta)(\psi_I(I_t,K_t) + pk_t)] = \psi_I(I_{t-1},K_{t-1}) + pk_{t-1},$$

where β_t is the discount factor, ψ_K is the cost function related to the capital level and ψ_I is the adjustment cost function related to the investment.

The Investment Euler equation model serves as a framework for understanding firms' timing of the investment project by highlighting the trade-off between investing today versus tomorrow.

As a response to the failure of neoclassical models to fit data and the ad hoc nature of the empirical analysis of its time, Jorgenson (1963) developed what is known as the accelerator model.

In the accelerator model, the firm sets its capital levels in order to maximize profit. I assume that for optimal production, Y_t^*, there exists an optimal capital stock, K_t^*. Investment is set so that the firms' capital stock adjusts towards the firm's optimal capital stock. Because adjustment to the optimal capital level has a certain lag (L) represented by the lag function $w(L)$, investments may be written as: $I_t = w(L)(K^*_{(t+1)} - K_t^*)$, where depreciation is assumed away. If I assume that at the optimal level of production the capital to output ratio is constant and equal to γ, then I can replace the capital level with the production times γ at time t, and time $t+1$. In addition, if I take into account that the optimal production level in the next period is unknown, I may replace the capital level with the expected production level. The resulting accelerator model therefore becomes

$$(3) \quad I_t = \alpha\gamma(E[Y_{t+1}] - Y_t)$$

Given the current production, investment is determined by the expected production, the adjustment parameter, α, and the optimal capital to output ratio, γ. This model gives a reasonable explanation of investment behavior if firms use expectations about future production as a proxy for determining its optimal capital stock at the beginning of the period $t+1$. The problem with the accelerator model is the strong assumption of a constant capital to output ratio. In the short run, this is a less strong assumption, and the model might be useful for explaining short-run movements in investments. However, if I relax this condition and only assume that it holds in the short run, the model might still be unrealistic in the sense that it might not be able to explain which economic and structural factors that cause a change in the capital to output ratio. A permanent change in the relative productivity of capital and labor or the relative costs of capital to labor will make it profitable to change the labor intensity in production, and hence the optimal capital to production ratio changes. Further, for this model to hold; inventories and the length of the order book must be fixed.

The Modigliani-Miller proposition says that the firm's value is independent of its capital structure (Modigliani-Miller, 1958) . In real life, cash-flow and firm leverage have proved to be crucial for investment decisions and hence, for firms' prospects. Bernanke et al. (1999) proposed a medium scale macro model with financial frictions, known as the Financial accelerator model. In their macroeconomic model, the financial structure of entrepreneurs and consumers plays a crucial role in creating business cycle fluctuations – the reason why the financial structure matters are the presence of the external finance premium. Because of agency costs, lenders require a higher premium from the borrower when the debt-to-equity ratio is high. With a procyclical pattern in the price setting of net wealth, the risk premium would rise during downswings and fall in upswings. The procyclical behavior causes investments and consumption to expand further in good times and contract more in bad times.

Abel et al. (1996) propose an alternative to the controversial assumption of convexity of the installation cost function by using elements of real option value theory in the Q-model. By including the real option value theory Abel et al. (1996) introduce a model where firms take into account the future resale and purchasing price when optimizing their capital stock. The model treats the possibility of a future sale of the firms' acquired capital as a put option and the possibility of future investment in capital as a call option. The real options model shows how a change in the output price or an exogenous demand shock affects the value of the investments given different investment decision timing. A great benefit of this model is that it introduces a way to include uncertainty in the model.

2.2 Empirical studies of business surveys

There are several studies of business tendency surveys and investment planning. In this subsection I will here review a few of them.

Bachmann and Zorn (2013) discuss the effect of technology shocks on aggregate investments by using the results from the IFO investment survey. They find that aggregate demand shocks, such as substantial declines in private or public demand, explain most of the changes in aggregate investments, while financial conditions or technology shocks, are relatively unimportant. The strength of the study of Bachmann and Zorn (2013) is the linkage between the National account and the IFO survey. Together with two decades of historical data, firm-level investment behavior is studied over several business cycles. The IFO survey is designed such that it questions the firms on which factors that affected the investment activity in general. The consequence of this is that the precision of the estimates may be reduced because this introduces a possibility for misunderstanding the questionnaire when it is filled out. Bachmann et al. (2013) have also studied the German manufacturing industry. They study the result from the IFO business climate survey and discuss how to produce an uncertainty index using results from the survey. They show that the IFO survey correlates well with other measures, and show that the index for uncertainty explains changes in manufacturing production. Baker et al. (2013) establish a new measure for policy uncertainty and provide support to the finding in Bachmann et al. (2013), showing that firm investments are harmed by increases in uncertainty and that it increases the stock price volatility.

Vermeulen and Fuss (2008) also study how results from a business survey may be used to improve the investment model. Vermeulen and Fuss (2008) use forecast errors from the business survey to measure price and sales uncertainty and find significant effects of changes in the uncertainty of demand on both planned and realized investments. Österholm (2013) estimate a forecasting model for aggregate business investments using survey data from the Swedish Economic Tendency Survey. Österholm (2013) finds evidence that data on firms' responses to a business survey will improve investment forecasts significantly. It has a simple set-up and discusses forecast errors of several types of forecasting models against a standard autoregressive time-series model. My paper takes this strategy a step further. Instead of analyzing aggregate data, I use firm-level data. Firm data gives higher variation in the data and hence improves the identification strategy, and using firm data makes it possible to link the survey results with other survey data.

3 The business survey and data

The BTS of Statistics Norway is a quarterly survey going back to 1990. The purpose of the survey is to obtain information about business conditions and firms' investment behavior from managers in the manufacturing and mining industry in Norway. Statistics Norway conducts the survey electronically by sending a questionnaire to a sample of firms by email. Specifically, the survey questionnaire is addressed to the liaison at the firm, which is CFOs at large firms, financial managers in middle-sized firms and usually the manager at the smallest firms, because those firms are often without a designated financial manager. To classify the industries, the standard industry classification convention in Europe is used. The survey is voluntary, but still, the response rate is about 95 percent. The number of employees stratifies the population into four strata. From each stratum, a random sample of firms is selected and asked to participate in the survey. Each firm in the selected sample participates in the survey for six quarters before a new firm, which again is drawn randomly from the same stratum, replaces it. Thus, the survey has a rotating sample design. In the stratum containing the largest firms, all of the firms in the population are included in the sample, while firms with less than ten employees or a gross revenue less than 10 million Norwegian kroner (NOK) are excluded from the sample.

There was a substantial revision of the BTS in 2011. I were in a position to influence the revision of the questionnaire. The new version of the survey asks a specific question about why the firms' investment plans where cut. The questionnaire starts by asks whether the firm has revised its investment plan relative to last quarter. If the firm has revised it down, they are questioned about their reason for doing this revision. To avoid any misunderstanding from the respondents on what they actually was answer in to, it was decided only to include a question about which factors affect firms that are downsizing investments. This gives a more robust identification strategy at the cost of missing what causes firms upscale their investments. The BTS also question the firms about their expectations in general. To cross-validate that it is the factors that the firms' states to affect investments are the relevant ones, I also study how expectations, in general, affect their investment planning.

The questions from the questionnaire I study are:

Q1: "*Does your business consider undertaking a change in your approved plans for investment in real capital*: [down], [unchanged] or [up]?"[1]

Q2: "*Which of these factors – if any particular – contributes to limiting planned investments in real capital*: [Access to credit], [expected demand], [cost of capital], [financing costs], [public regulations], [public subsidies], [excess capacity], [other factors], [no specific factors]?"

Q3: "*What are your expectations for the development the next quarter relative to today for the following variables*: [production], [capacity], [employment], [home orders], [foreign orders], [total orders], [home prices], [input prices], [foreign prices]?"

The introduction of the second question in the BTS makes it possible to analyze which factors affect changes in manufacturing investments. The firms may answer why they revised down their investment plan. Of particular interest is whether there were any known factors, or no specific factors, which is a response category for the firms that are not able to pinpoint which factor that caused them to change their plan. The BTS also covers firms' expectations. In this question, the respondents answer if they expect the variables to decline, to be unchanged or increase. The third question gives us the possibility to study how the firms' expectation about the development of key variables affects the probability of revising down investments. Also, I may check if the firms answer consistently – meaning that I can find a relationship between the empirical models analyzing questions two and question three.

The results from the BTS are linked with Statistics Norway's Investment Survey, a survey of the firms' investments in the manufacturing industry. Matching those two surveys

[1]Translation from Norwegian to English done by the author.

Table 1: Descriptive data for the different response category to the question **Q2**: *Which factors contributes to limiting your firm's investments in real capital.* Conditional means, from the pooled sample

	Access to credit	Expected demand	Price of Capital	Cost of Finance	Official regulations	Public Subsidies	Excess capacity	Other reasons	No special reason	Unconditional mean
Small firms	.1972	.6944	.05	.0806	.0861	.0583	.1917	.0889	.0805	.481
Middle sized firms	.1959	.7331	.0709	.1115	.0676	.0709	.1858	.1385	.0743	.457
Large firms	.12	.88	.2	.12	.04	.04	.04	.04	.04	.062
All firms	.1938	.7180	.0646	.0954	.0764	.0631	.1836	.1087	.0764	.473
Employment, t	86.9	116	113	107	93.7	90.2	124	150	142	128
Investment, t	3066	3963	5611	3795	7212	3957	3210	4566	4929	4290
Decline in production, $t-1$	.194	.718	.0647	.0956	.0765	.0632	.184	.109	.0765	.303
Decline in production, $t+1$	.194	.72	.0648	.0957	.0766	.0633	.184	.115	.0705	.304

Note: The table shows the share firms relative to the full sample which responded yes for the respective categories. *Employment*: Mean employment figure conditional on the response category, at the current quarter t. *Investment*: Mean aggregate firm investment, conditional on response category, in thousand NOK, quarterly figures at time t. *Decline in production*: Share of firms reporting that production declined last quarter, $t-1$ and firms reporting that production is expected to decline a year ahead, $t+1$. The last column is figure for unconditional means

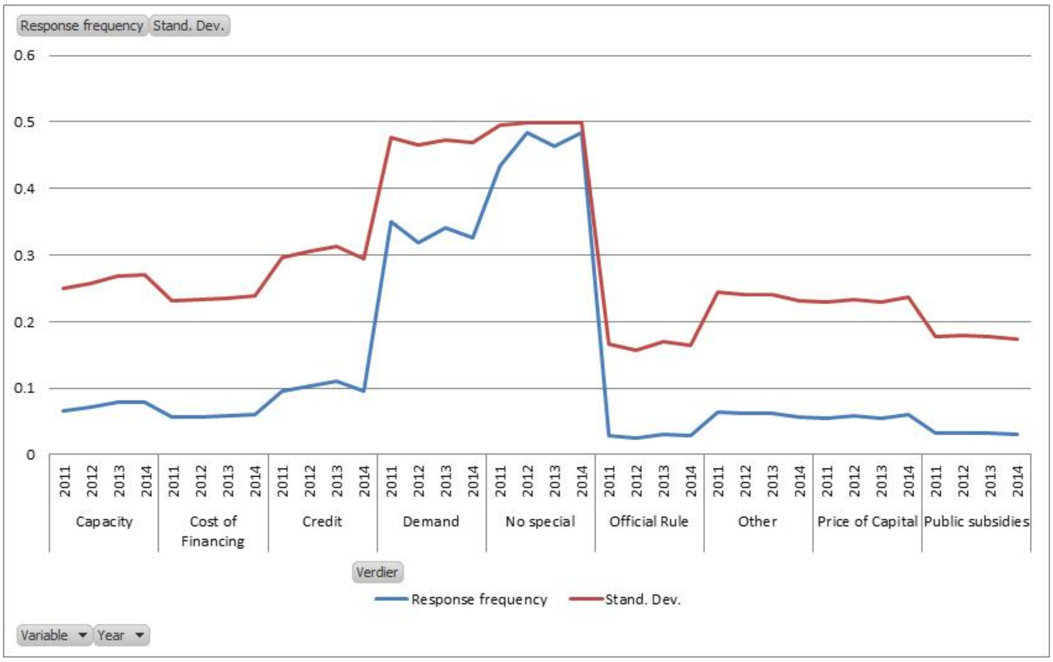

Figure 1: Factors explaining why the firms have revised down investments, average response and standard deviations. Quarterly responses are averaged over a year. In percent

allows me to control for both the size and type of investment the firms' have done.

In Table 1, I present figures showing how firms that responded to Question 2. For each response category, the results show the proportion of firms that answer this was one of the reasons for my revise. To go deeper into the figures, I split the response frequencies by firm size and studying whether the investment level or the number of employees differ for the different categories. The survey shows that while 20 percent of small and middle-sized firms report that they revised down investment due to difficulties of accessing credit, only 12 percent of large firms did so. Changes in expected demand are reported by 72 percent of the firms to be one of the reasons for revising down investment. There is a slightly overweight of large firms reporting that this was the cause. It is also interesting to note that firms that report that official regulations are constraining investments have, on average 20 percent higher investments than firms report that other factors are causing them to reduce investment plans.

The descriptive statistics of the sample population used in this analysis are summarized in Table 1 and 2. The correlation matrix reported in Table 3 shows that the firms' choices

Table 2: **Summary statistics for the responses to question 3 – given that the firms are revising down their investments. In percent**

Variable	Better	Unchanged	Worse
Q3a: Expected production	13.1	41.0	46.0
Q3b: Expected capacity	13.5	45.3	41.2
Q3c: Expected employ	4.7	41.9	53.5
Q3d: Expected home orders	13.2	46.5	43.4
Q3e: Expected foreign orders	14.2	46.5	38.5
Q3f: Expected total orders	15.3	36.7	47.8
Q3g: Expected home prices	11.0	62.9	26.0
Q3h: Expected input prices	28.8	59.4	11.7
Q3i: Expected foreign prices	10.5	57.5	31.1
Q3j: Expected profitability	14.6	34.3	51.1

Note: Question 3(Q3i) have discrete response: 1, 2, 53 where. 1: conditions expected to worsen, 2 is no expected change and 3 is expected to improve

are somewhat correlated over time. A reason for this is that many firms chose not revise down their investments for long periods. That is as expected. I see that on average; nearly 8 percent of the firms are revising down their investments in any given quarter. Hence, it might be worth to take into account serial correlation when modeling the investment decisions. Figure 1 shows the mean response during the sample period. The average response for revising down investment plans, do not change much in this period.

The correlation matrix, shown in Tables 4 and 5, shows that the correlations between the independent variables are relatively small when it comes to factors explaining the investment plan revision. As one would expect, I find that firms' expectations about the key economic indicators are correlated with each other. Another way to interpret the correlation between the responses is sthat the expectations are consistent. Meaning that firms that expect production to rise also expect capacity to decline.

3.1 Benefits and disadvantages of studying a business survey

Investment equals the desired change in real capital, divided by delivery time. Thus, in order to analyze investment behavior empirically, one needs information about delivery

Table 3: **Correlation matrix for the decision variable measured at different lags. Quarterly figures**

	$s=t$	$s=t-1$	$s=t-2$	$s=t-3$
$s=t$	1			
$s=t-1$	0.368	1		
$s=t-2$	0.261	0.363	1	
$s=t-3$	0.253	0.267	0.382	1

Table 4: **Correlation matrix for the factors that is causing the firms to revise down its investments**

	Access to credit	Expected demand	Price of capital	Cost of financing	Official regulations	Public subsidies	Excess capacity	Other reasons	No special reasons
Access to credit	1								
Expected demand	-0.114	1							
Price of capital	0.113	0.045	1						
Cost of financing	0.271	-0.074	0.199	1					
Official regulations	0.013	0.008	0.172	0.132	1				
Public subsidies	0.193	0.069	0.3	0.265	0.198	1			
Excess capacity	-0.079	0.07	-0.017	0.04	0.064	0.002	1		
Other reasons	-0.04	-0.285	-0.034	-0.033	-0.047	0.006	-0.068	1	
No special reasons	-0.141	-0.459	-0.076	-0.093	-0.083	-0.075	-0.136	-0.1	1

Table 5: **Correlation matrix for the firms' expectation about factors affecting their business trends**

	Expected production	Expected capacity	Expected employ	Expected home orders	Expected foreign prices	Expected total orders	Expected home prices	Expected input prices	Expected input prices
Expected production	1								
Expected capacity	0.793	1							
Expected employ	0.499	0.526	1						
Expected home orders	0.606	0.57	0.444	1					
Expected foreign orders	0.509	0.441	0.362	0.534	1				
Expected total orders	0.619	0.555	0.485	0.759	0.698	1			
Expected home prices	0.29	0.281	0.202	0.247	0.255	0.268	1		
Expected input prices	0.133	0.154	0.176	0.151	0.296	0.24	0.663	1	
Expected foreign prices	0.064	0.074	0.039	0.06	0.078	0.071	0.219	0.218	1

times. It is not sufficient to know the desired change in real capital. Conventional data sources on investment figures, either aggregate or firm-level data, are by nature biased due to the delay from the time that the investment decision is taken to the investment is observed. The implementation delay makes survey data particularly interesting when studying investment behavior. Specifically, let K^* denote the optimal capital level and K the actual capital level, then the firm's desired change in real capital is given by $I^* = K^* - K$, and the corresponding investment is given by $I = I^*/D$, where D is the delivery time (Haavelmo, 1960). If I^* is used instead of I this yields a measurement error. Thus, if D is large, then the discrepancy between I and I^* increases. The delivery time is probably affected by the business tendency in a procyclical manner. This introduces a procyclical wedge, making it more difficult to assess which factors are affecting real investments during the different facets of the business cycle. The BTS measures both changes in investment plans and its causes at the same time, and consequently, this type of measurement error associated with delivery time vanishes. In other words, using survey data makes it possible to link decisions about real investments and the factors driving the decisions without the bias that results when data from registers or national account are used to analyze investment patterns.

Apart from the issue of delivery time bias, there are both strengths and weaknesses associated with using survey data to answer behavioral questions. The advantage with surveys is that they make it possible to obtain information about intentions to act. They enable us to measure expectations and not only past events. Most importantly, surveys allow the researcher to collect information about variables not always available in conventional data sources. On the downside, survey answers may not always correspond to what choices would be in real choice settings. To reduce the measurement error in the BTS, Statistics Norway carefully motivates the respondents to answer truthfully, and help is offered to fill out the survey questionnaire when needed. It is, of course, important that the questionnaire is actually filled out by those close to the decision-making process. That is why the questionnaire is sent electronically to the managing director or the financial manager for each firm.

4 Empirical method

In this section, I develop the empirical model. I assume that firms make their investment decisions based on maximizing some objective function (utility). For many firms, this utility function is the net present value of future profit, but not always. For example, in Paper 1 it is shown using business survey data, that for firms in the manufacturing industry 3/4 report that maximizing profit is only one of the motives for the owners. This evidence indicates that the assumption of firms being profit maximizers may be too restrictive. In my case, I do not observe profits and the empirical model will hold true whether or not a given firm maximizes the net present value of future profits or, alternatively, maximizes a more general utility function that allows the firm to account for other factors when making investment decisions. However, in the following, I shall discuss the model by referring to the net present value of future profits (NPV) as the firms' utility function, but it is understood that the arguments and model will hold for more general utility functions.

When investment decisions taken by the firm are carried out in order to increase the net present value of future profits (NPV), the firm's decision whether to revise the investment

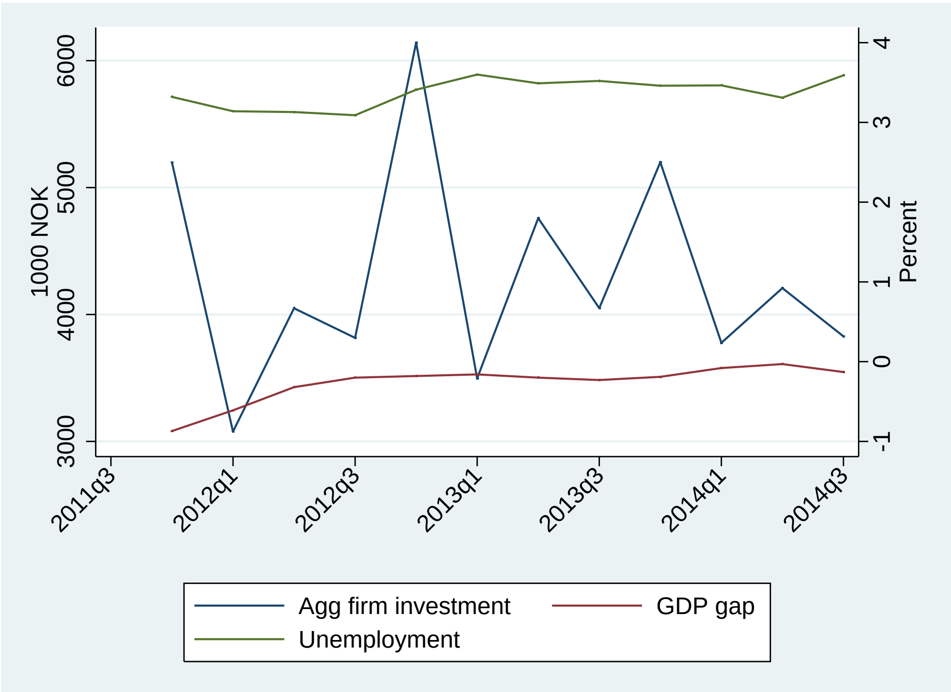

Figure 2: Macro economic data. Investments are aggregated firm investments from the Statistics Norway Investment statistics, in 1000 NOK. The unemployment rate is from the Labour force survey, in percent (right axis). The GDP gap estimated using National account figures in 2012-prices, with HP-filter of 20 000 on data including Statistics Norway's official forecasts for the 5 years following last observation (right axis).

plan or not depends fully on whether a change in the investment schedule increases the NPV of future profits. This implies that when firms revise down their investments, this is done in order to increase the NPV of future profits.

Let π_{it0} denote the NPV of firm i in year t given that investment is realized according to plans and similarly let π_{it1} be the NPV of firm i in year t given that investment is cut. Let $Y_{it} = 1$ if $\pi_{it1} - \pi_{it0} > 0$ and $Y_{it} = 0$ if $\pi_{it1} - \pi_{it0} < 0$. The values $\pi_{itj},\ j = 0,1$, are latent variables to the researcher, who only observes Y_{it}. Assume that

$$(4) \qquad \pi_{it1} - \pi_{it0} = V(\xi_{it} + \varepsilon_{it})$$

where $V(\cdot)$ is known apart from a set of unknown parameters (specified by the researcher), ξ_{it} is a vector of observed explanatory variables, and ε_{it} is an error term that represents the effect of unobserved variables. The term ε_{it} is supposed to capture the effect on $\pi_{it1} - \pi_{it0}$ from variables that are perfectly known to the firm as well as factors that are uncertain to the firm and vary over time in a manner that is unpredictable to the firm. Specifically, in the first paper it is shown that a large portion of firms in the manufacturing industry does not apply traditional investment decision methods. Instead, they rely heavily on intuition when making investment decisions. The factors affecting intuition are typically changing over time, such that a decision taken a quarter ago may be considered not optimal when the investment decision is up for revision. The model in (4) is not a full structural model because it does not include the possible effect of past realizations of investments on the current investment decision. The reason for this is that it is very hard to identify the effect of previous values of the dependent variable on the current realization (state dependence). In general, one cannot separate the effect of state dependence from unobserved heterogeneity without additional theoretical arguments which often may be ad hoc and therefore controversial. See Heckman (1981, 1991) for a discussion of this issue in particular cases. The model in (4) is, in this sense, a reduced form model.

The error term ε_{it} will also capture errors in the specification of the functional form of $V(\cdot)$. The variables that enter the vector ξ_{it} consists of choice variables such as access to credit and expected demand (x_{it}), firm-specific variables (z_{it}), such as number of employees, investment level and sales, and aggregated figures (y_t) such as employment conditions and aggregated demand. In order to obtain a model that one may estimate empirically, further assumptions are needed. The error term ε_{it} is perceived as a random variable that is assumed to be independent of the systematic term $V(\xi_{it})$. The error terms may be serially correlated. I formulate and estimate three model versions. The first two versions differ only with respect to the assumptions about the error term process (as a stochastic process in time), ε_{it}. In the first model (LogitFE) I assume a particular permanent-transitory error structure, namely

$$(5) \quad \varepsilon_{it} = \eta_i + u_{it}$$

where η_i is a fixed effect that captures the effect on investment of unobserved variables that are firm specific and do not change over time whereas u_{it} are serially uncorrelated random variables, with standard logistic c.d.f. that is independent of η_i. It represents the effect on investment of unobserved variables that vary over time. When the distribution of the fixed effects across the population is accounted for it follows that the unconditional autocorrelation function of the error term in the LogitFE model equals

$$(6) \quad Corr(\varepsilon_{it}, \varepsilon_{it-k}) = \frac{3Var(\eta_i)}{\pi^2 + 3Var(\eta_i)}$$

In the second model (LogitNRE) it is assumed that:

$$(7) \quad \varepsilon_{it} = \eta_i i + u_{it}$$

where η_i is a random effect that is assumed to be normally distributed across firms, whereas u_{it} have the same properties as above. The autocorrelation function in the Logit-NRE is thus the same as for the LogitFE given in (6). The third model is also a random effect Logit model but in contrast to the second model the random effects are distributed according to the following p.d.f.:

$$(8) \quad f_\alpha(z) = \frac{1}{\alpha\pi} \frac{\sin(\alpha\pi)}{e^{\alpha z} + e^{-\alpha z} + 2\cos(\alpha z)}$$

where α is a parameter, and $0 < \alpha \leq 1$, that has an interpretation as:

$$(9) \quad \alpha = \frac{1}{\sqrt{3Var(\eta_i)/\pi}}$$

The p.d.f. given in (8) is symmetric around zero but differs somewhat from the normal density in that it has heavier tails than the normal one. A great advantage with the distribution given in (8) is that it implies that:

$$(10) \quad E_{\eta_i}\left(\frac{1}{1+\exp(-V(\xi_{it}-\eta_i)}\right) = E_{\eta_i}\left(\frac{1}{1+\exp(-\alpha V(\xi_{it}}\right)$$

where the expectation is taken with respect to the random effect. The property in (10) is proved by Dagsvik et al. (2016). I shall call the first model the Fixed Effect Logit model (LogitFE), the second model the Normal Random Effect Logit model (LogitNRE) and the third model the Invariant Random Effect Logit model (LogitIRE). The relation in (10) implies that the unconditional Invariant LogitRE model also has the logit functional form at any given point in time. The LogitRE model is more restrictive than the LogitFE model because random effects are assumed to be distributed across firms according to specific distributions whereas there are no restrictions on the distribution of the fixed effects across firms in the LogitFE model. Another advantage with the logitFE is that the fixed effects are allowed to be correlated with the observed vector of covariates in contrast to the second model version where the random effects are assumed independent of ξ_{it}.

Let $F(\cdot)$ denote the logistic c.d.f. of $-u_{it}$. From the above assumptions it follows that in the LogitFE model

$$(11)\quad \Pr(\xi_{it}, \varepsilon it) = \Pr(Y_{it} = 1 | \xi_{it}, \varepsilon_{it}) = \Pr(V(\xi_{it}) + \eta_i + u_{it} > 0 | \xi_{it}, \eta_i) = F(V(\xi_{it} + \varepsilon_{it})$$

where the interpretation of $\Pr(\xi_{it}, \varepsilon it)$ is as the probability that firm i shall revise down the investment in year t, given $(\xi_{it}, \varepsilon it)$.

Unfortunately, the usual maximum likelihood method for the LogitFE yields inconsistent estimates. This is known as the incidental parameter problem, Neyman and Scott (1948). However, the conditional likelihood method can be applied to obtain consistent estimates of the parameters of (Chamberlain, 1980), but it is not straightforward finding the fixed effects using this method. An alternative method to obtain bias-corrected estimates of the fixed effects is using a maximum likelihood method proposed by Hahn and Newey (2004) that is known as the analytical bias correction. In order to estimate the fixed effect model, I use Stata with the logitfe package, Cruz-Gonzales et al. (2016) which utilize the analytical bias correction method for a two-way error component model.

Since the length of the panel is somewhat short, about eight quarters on average, it is common to compute standard errors of $\hat{\eta}_i$ by the bootstrap method. However, these bootstrap estimates might be biased since they rely on possible biased estimated standard errors of the fixed effect due to the short panel. Stamman et al. (2017) show that using the analytical bias correction the distortions of the estimated standard deviation for the estimated parameters is reduced and negligible when the number of time periods is eight or larger.

The corresponding conditional probability for LogitNRE and LogitIRE are similar to the model in (11), namely

$$(12) \quad \Pr(\xi_{it}, v_i) = F(V(\xi_{it}) + v_i)$$

The LogitNRE and the LogitIRE can be estimated by the maximum likelihood method. STATA contains a maximum likelihood package for the estimation of LogitNRE. The LogitIRE can be estimated by a version of simulated maximum likelihood procedure, as done by Dagsvik et al. (2016). But one can also apply the generalized estimating equations (GEE) estimation approach. In this paper, I have used the maximum likelihood method to estimate the LogitNRE model and the GEE approach to estimate the LogitIRE model. In order to use the GEE approach one needs to make convenient assumptions about the autocovariances

$$(13) \quad Cov(Y_{it}, Y_{is}) = \Pr(Y_{it} = 1, Y_{is} = 1|\xi_{it}, v_i) - \Pr(Y_{it} = 1|\xi_{it})\Pr(Y_{is} = 1|\xi_{it})$$

In the logitIRE it is assumed that

$$(14) \quad Cov(Y_{it}, Y_{is}) = \rho^{t-s}\sqrt{Var(Y_{it}, Y_{is})} = \rho^{t-s}\sqrt{P_{it}(1-P_{it})P_{is}(1-P_{is})}$$

where $P_{is} = \Pr(Y_{is} = 1)$. Which mean that

$$(15) \quad Corr(Y_{it}, Y_{is}) = \rho^{t-s},$$

where ρ is an unknown positive parameter that is less than one. The assumption in (15) is, however, not equal to the true autocorrelation function. Still, the GEE method still yields consistent estimates.

4.1 Average partial effects

In linear models the partial effects are simply the coefficients associated with the respective explanatory variables. In nonlinear models this is not so. Assume that $V(\xi_{it}) = x_{it}\beta + z_{it}\gamma + y_{it}\psi$ where x_{it}, z_{it} and y_{it} are the explanatory variables. It follows from (11) that the average partial effect for the LogitFE model with respect to x_{it} in year t is given by

$$(16) \quad \frac{1}{N}\sum_{i=0}^{N}\frac{\partial \Pr(\xi_{it})}{\partial x_{it}} = \frac{1}{N}\sum_{i=1}^{N}\beta F\left(x_{it}\beta + z_{it}\gamma + y_{it}\psi + \eta_i\right)\left(1 - F\left(x_{it}\beta + z_{it}\gamma + y_{it}\psi + \eta_i\right)\right)$$

Similarly for the average partial effect with respect to the other explanatory variables. Similarly, the corresponding aggregate partial effect (in year t) for the logit random effect models is given by

(17)

$$\frac{1}{N}\sum_{i=1}^{N}\frac{\partial \Pr(\xi_{it})}{\partial x_{it}} = \frac{1}{N}\sum_{i=1}^{N}\beta E\left[F\left(x_{it}\beta + z_{it}\gamma + y_{it}\psi + v_i\right)\left(1 - F\left(x_{it}\beta + z_{it}\gamma + y_{it}\psi + v_i\right)\right)\right]$$

where E is the expectation with respect to v_i.

5 Empirical findings

The approach taken by this paper has similarities to the approach of Österholm (2013), but I apply firm-level data instead of aggregate data. Firm data contain considerably more information than aggregate ones, and using firm data makes it possible to link the survey results with other survey data as well as register data. However, in contrast to Vermeulen and Fuss (2008) who also uses firm-level data, I analyze the impact of factors supposed to explain the firms' revision of investment plans.

Recall that the vector of firm-specific choice variables, x_{it}, consists of Access to credit, Expected demand, Price of capital, Cost of financing, Official regulations, Public subsidies, Expected capacity, Other reasons, No special reasons. The vector z_{it} contains firm-specific variables such as registered investments, firm size, industry and y_{it} is a vector of aggregate macro variables, such as the production gap and unemployment rate. To study whether there are any differences in factor composition and export intensities I divide the manufacturing industry into 5 sub-industries. The differences between industries were found to be small and did not affect the parameter estimates of the explanatory variables and because of that they are left out from the empirical model.

The benchmark models estimate the probability of revising down investment without taking into account any firm-specific information or macro variables. The estimated coefficients are shown in Table 6, with average partial effects found i Table 7. Note that Table 6 reports estimates of the coefficients of $V(\xi_{it})$ for the LogitFE and the LogitNRE, whereas for the logitIRE model the table reports estimates for $\alpha V(\xi_{it})$, where one recall that α might be less than one. Since I have not used a full information maximum likeli-

Table 6: Factors causing a downward revise of investment plans

	(1) LogitFE	(2) LogitNRE	(3) LogitIRE
Access to credit	0.546	0.531	0.635
	(0.217)	(0.179)	(0.172)
Expected demand	1.040	0.972	1.243
	(0.177)	(0.164)	(0.159)
Price of capital goods	0.103	-0.065	-0.068
	(0.266)	(0.229)	(0.219)
Financing costs	0.272	0.397	0.214
	(0.234)	(0.208)	(0.237)
Official regulations	0.260	0.330	0.550
	(0.312)	(0.249)	(0.264)
Public subsidies	-0.146	0.040	-0.134
	(0.299)	(0.296)	(0.276)
Excess capacity	0.522	0.533	0.643
	(0.188)	(0.191)	(0.177)
Other reasons	0.504	0.872	0.887
	(0.242)	(0.220)	(0.232)
No special reasons	-1.217	-1.294	-1.640
	(0.256)	(0.252)	(0.253)
Constant		-2.306	-3.123
		(0.231)	(0.301)
Time dummies	✓	✓	
Fixed effects	✓		
Firm size dummies	✓	✓	
Industry dummies	✓	✓	✓
AR(1) coefficient		0.33	
Log likelihood	-1072.4	.	-1697.0
No. firms	277	517	900
N	2609	4812	7960
Wald test ($\chi 2$)	755.6	159.3	437.1

a Dependent variable: *Did your firm revise down your investment plan this quarter?* .

b) Standard errors of the random effects model calculated using 200 bootstrap estimations.

c) The Hausman-test rejects the null [p-value = 0.00] that the coefficients of the fixed effect and the random effect are similar, hence I use FE in the rest of the paper.

d) The sample size varies because the LogitFE and the LogitIRE are no able to fully utilize the full sample because lack of variation in data within each firm. The appendix table 12 show results from a model using the same sample on all models. Significance levels: * $p < 0.1$, ** $p < 0.5$, *** $p < 0.01$

Table 7: Factors causing a downward revise of investment plans. Average partial effects

	(1) LogitFE	(2) LogitNRE	(3) LogitIRE
Access to credit	0.039	0.039	0.034
Expected demand	0.069	0.072	0.066
Price of capital	0.007	-0.005	-0.004
Cost of financing	0.019	0.029	0.011
Official regulations	0.018	0.024	0.029
Public subsidies	-0.009	0.003	-0.007
Excess capacity	0.037	0.039	0.034
Other reasons	0.036	0.064	0.047
No special reasons	-0.070	-0.095	-0.087

Note: Average marginal effects, evaluated using logitfe package for the FE model, and STATA's margins, dydx(*) for the LogitIRE model.

hood procedure, I cannot obtain estimates of α. However, the estimates of the variance of the random effects in LogitNRE and of the variance in the distribution of the fixed effects in LogitFE indicate that these variances are small compared to 1. Therefore the order of magnitude of the variance of random effects in LogitIRE is small compared to 1. The mean of the estimated fixed effects is -1.228, and the variance is 1.104, while the random effects model has a variance of 1.762. Hence, by using formula (9) I conclude that α is close to 1. In the Appendix, I also report results from the estimation of the linear probability model (LPM), see Appendix table 13. Regardless of which model that is chosen, the firms' demand expectation is found to be the most important factor in explaining why the investment plans are revised down. Specifically, the results using the LPM demonstrate the effect of ignoring the non-linear properties of the data, since the estimated parameters are nearly twice as large as for the non-linear model. It is further worth to note that the average partial effect is nearly identical for the three models, thus proving the robustness of the empirical results. To study how the fixed effect depends on the structural part of the model, I estimate a model for the fixed effects with the average response for each variable. The results, shown in Table 11 of the appendix, indicate that the fixed effects are nearly independent of the structural part of the model.

The firm's access to credit is found to be less important than changes in firms' demand

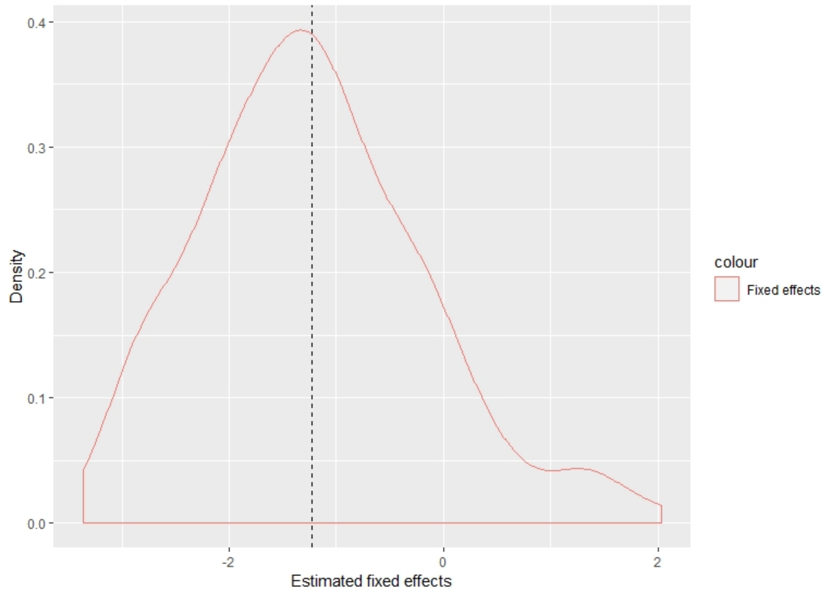

Figure 3: Density plot for the fixed effects of the LogitFE model

expectations. Still, firms' access to credit is crucial for understanding why investment plans are revised down. The average partial effects reported in Table 7, show that a change in the demand expectations changes the probability for firms revising down investments with 7 percentage points, while the marginal effects of a change in the credit conditions are about 4 percentage points. Less surprising is the positive effect of excess capacity, where the effect of changes in the firms' expectations about its capacity is of the same order as for credit conditions. Because capacity utilization and demand expectations might capture the same elements, I test for the presence of any interaction terms in the empirical specification. The interaction term is close to zero and insignificant and is not reported in the table. A reasonable explanation is that excess capacity is lagging demand expectations. Hence it is not necessary the same firm that reports that excess capacity and demand expectations are one of their reasons for revising down investments. This view is also supported by the results from the correlation matrix, Table 4. As shown, the expected capacity is barely correlated with demand expectations. It is indicating that weaker demand does not necessarily imply excess capacity.

Other reasons, unclear which, are also important for explaining the revision. As is "No special" reasons, which probably include increased general uncertainty or just a change in the manager's "gut feeling". I find it extremely interesting that firms are changing investment plans for no particular reason.

As discussed above the Q-model of Tobin (1969) argues that investments will increase when the value of an additional unit of capital is larger than the cost of installing the same unit of capital. The estimations result in Table 6 show that in contrast to the implications of the Q-model – there is no short-run effect of a decrease in the cost of capital on the investment plan. The investment Euler equation highlights that firms emphasize the relative gain of investing in period t relative to period $t+1$. To compare the gain between the two periods, the discount rate, which equals the financing costs plus the project-specific risk premium, plays a crucial role in the theoretical model. The empirical analysis shows that changes in the financing costs do not affect their decision of changing investment plans in the short run in the LogitFE and LogitNRE model, while the LogitIRE estimates a moderately positive effect on the probability of reducing investments. It might not be surprising that the effect of changes in the funding cost is uncertain, given that there are relatively rarely any unexpected changes in financing costs from one quarter to the other. However, this result is also consistent with the findings in Paper 1. Here, I find that an overwhelming share of firms that neither calculate the project risk nor consider it when doing investment budgeting. This also shows that it is access to external financing that is important, not the cost. If the funding cost is set accurately by the market, it should reflect the return and risk of the investment project. Hence it is already taken into account when calculating the return on investment. Changes in the price of capital are found not to affect the probability of revising down investments. This means that a change in the price of capital has zero effect on the firm's decision to revise down its investments. This might seem like a puzzling result, but is in line with what has been found in the empirical analysis based on time series data, Chirinko et al. (1999). An apparent reason for the lack of empirical evidence is that there are few episodes of sudden changes in the price of investment goods, hence making identification of any price effects difficult. Another reason is that the price of intermediate goods is priced according to the firms' willingness to pay for those goods.

The invariant random effect and the fixed effect model do not fully utilize the data compared to the normal random effect model. The fixed effect model uses only within variation and hence leaves out all individuals without such variation. One of the strengths of the NRE is that this model utilizes more data than the FE model. The invariant random effect model uses the between variation to calculate the parameters as the NRE, but in order to estimate the autoregressive correlation structure, the model needs at least three observations. This implies that the sample size differs between the three models unless the sample is reduced in size to match both the criteria from the FE and the IRE model. To test how the different models utilize the data, I estimate the NRE and the IRE on the same sample as for the FE model. Not surprising this reduces the difference of the estimated effects of access to credit and expected demand, for the NRE and the FE, while there is not much change in the estimates for the IRE model. To sum up: Some of the differences in the model results are driven by the fact that the NRE model exploits more data than the other models. Particularly, this includes data from firms whose observations are only present at the start or the end of the sample. Table A6 in the appendix summarizes the results.

Taking into consideration that macroeconomic conditions might affect the investment decision, I add macroeconomic controls such as the unemployment rate and the estimated GDP-gap. The estimated coefficients do not change significantly, when macro variables are added as explanatory variables. Table 8 shows the results of models with extended controls. Extending the model further with the inclusion of firm-specific data, matched by the help of accounting statistics, I find only a small effect of the size of the firms' investments. This is not surprising given that most firms have zero investments in a given quarter.

To see if the businesses with a different investment level are affected differently, I estimate the benchmark model including firm investment, both a model with aggregated firm investment, model (3), and a model with only machine investments, model (4), both models reported in Table 8. I find that both models give an estimated effect of production expectations are somewhat stronger while the estimated effect of liquidity constraints are moderated relative to models without controlling for firms' investment level.

To study whether firms with high investment rates report differently, I estimate the model, including only firms with above-average high investment levels, model (5) in Table 7. I calculate the average investment level for any given quarter and keep only observations with investments above average – this analysis results in two observations. First, the effect of expected capacity on firms' probability of revising down investments is nearly

Table 8: Factors causing a downward revise of investment plans

VARIABLES	(1) LogitFE	(2) LogitFE	(3) LogitFE	(4) LogitFE	(5) LogitFE
Access to credit	0.544	0.544	0.426	0.424	0.875
	0.216	0.216	0.247	0.247	0.396
Expected demand	1.039	1.039	1.133	1.132	0.759
	0.177	0.177	0.202	0.202	0.326
Price of capital	0.104	0.104	0.207	0.206	-0.249
	0.266	0.266	0.303	0.303	0.475
Cost of financing	0.272	0.272	0.529	0.529	-0.063
	0.234	0.234	0.268	0.268	0.455
Official regulations	0.26	0.26	0.143	0.141	0.591
	0.312	0.312	0.37	0.37	0.548
Public subsidies	-0.147	-0.147	-0.102	-0.1	-0.317
	0.299	0.299	0.328	0.328	0.608
Excess capacity	0.522	0.522	0.508	0.508	0.157
	0.188	0.188	0.209	0.209	0.376
Other reasons	0.504	0.504	0.458	0.456	0.17
	0.242	0.242	0.272	0.272	0.418
No special reasons	-1.217	-1.217	-1.352	-1.351	-1.387
	0.256	0.256	0.307	0.307	0.445
GDP gap		-0.515	-0.642	-0.645	
		0.362	0.41	0.409	
Firm agg. Investment			0.0000035		
			0.0000075		
Firm machine investment				0.0000028	
				0.0000084	
Time dummies	✓	✓	✓	✓	✓
Firms with investments > mean	.	.	.	.	Yes
Observations	2609	2609	2050	2050	833
No. firms	277	277	211	211	110
Log likelihood	-1072.4	-1072.4	-828.3	-828.3	-348.5

a Dependent variable: *Did your firm revise down your investment plan this quarter?* .

b) Standard errors of the random effects model calculated using 200 bootstrap estimations.

c) Modeled using a logit model with fixed effects (1)-(5).

d) In the model (5) only firms with reported investment above average is included. Significance levels: * $p < 0.1$, ** $p < 0.5$, *** $p < 0.01$

halved and insignificant, and I find that credit conditions have a stronger effect on investments relative to the effect of demand expectations. This indicates that firms with large investment projects are more vulnerable to changes in credit conditions than firms with smaller projects. If smaller projects are more often financed with internal funds, then this result is, as I would expect.

Macroeconomic events such as changes in exchange rates or aggregate demand affect firms differently, depending on several factors, such which industry the firm operates in. Export driven industries respond positively to reduce inland pressure and a depreciation of the exchange rate, while industries with their product-market at home benefit from higher consumer demand and increased public spending. For instance, do the capital intensive part of the food industry in Norway has a relatively smaller export share in comparison to the raw material industry, which exports most of its production. To tackle that the various industries respond differently to macroeconomic shock, I include interactions of the GDP gap with industry dummies for the random effect specification. Including this interaction, the term is found to affect the results and hence is not reported barely. This shows that macroeconomic shocks are not important for explaining differences between industries.

5.1 Using firms' expectations to forecast investments

The Business tendency survey includes a large set of complementary questions in addition to the questions about the dynamics of the investment analyzed above. The Business tendency survey asks firms how the firm expects important economic conditions to develop. The firms are asked about their expectations on how nine key variables are expected to evolve during the coming quarter relative to the situation today. They may answer: Better, Unchanged, Worse. To analyze whether firms answer consistently and if using different data will give new insight relative to studying what the firms' express are their reasons for revising the investment plan. I will, therefore, model the probability of revising down investments using the firms' expectations as explanatory variables. In contrast to the empirical models in the first part of the paper, I now have an ordinal response. There is no reason to assume that the effect of a change in expectations is linear in the explanatory variables. Because of this, I estimate a model where I have translated the variables to binary variables: One variable for expectations about better conditions and one for worse conditions, with no changes in expectations as a base. Of course, this increases the number of explanatory variables, but it also has the benefit of simplifying the interpretation. I employ the same empirical methods as above, namely a Fixed Effect Logit model, an Invariant Random Effect Logit model and the Normal Random Effect Logit model. The empirical results are shown in Table 9 and Table 10.

The empirical findings support the results from the benchmark model studied above. I find that an expectation of higher production still is one of the most important factors for explaining a decline in the investment plan. The average partial effect of an expected rise in production is estimated to be -0.022, while the effect of an expected worsening in the production is 0.036.

While excess capacity is reported to be important for firms revising down investments in the first analysis, I do not find an effect of the capacity variable on its probability of reducing its investment plan when studying firms' expectations. This may be due to the higher correlation between expected production and excess capacity, see Table 5. To investigate this further, I estimate a model where I include interaction effects. This changes the results slightly. There is still a positive effect of an expected decline in production, but there are no effects of an expected increase in production alone. However, if firms expect a decline in production and at the same time increasing capacity utilization; this has a strong effect on the probability of a downward revision in their investment plan for the coming quarter. I find an estimated average partial effect of 0.15.

Lower home prices both contribute to reduced profitability and hence not surprisingly, those factors raise the likelihood of the firm revising down investments. The finding that an implicit reduction of firms' expected profitability increases the probability of lowering investments is in line with standard investment models. The estimations also show that the expectations about the firms' changes in employment are essential for predicting short run investments. It is a strong predictor, and if the firm expects employment to decline. I find that the probability of a downward revise is high, with an estimated average partial effect of 0.08. This implies that the effect of reduced labor costs due to a shift towards higher capital spending is more than offset by the employment effect following a reduction in production. In other words, there is a procyclical co-movement of changes in labor and capital goods.

Table 9: How expectations affects firms' probability of revising down it investments

VARIABLES	Logit FE	Logit IRE	Logit NRE
Increase in production	-0.344	-0.254	-0.496
	-0.274	-0.236	-0.261
Decrease in production	0.489	0.539	0.534
	-0.237	-0.212	-0.224
Increase in capacity utilization	0.121	0.215	0.323
	-0.266	-0.211	-0.253
Decrease in expected utilization	-0.18	-0.439	-0.109
	-0.241	-0.199	-0.247
Increase in employment	-0.617	-0.599	-0.566
	-0.266	-0.242	-0.274
Decrease in employment	1.03	0.957	1.302
	-0.154	-0.154	-0.147
Increase in home orders	-0.005	0.045	-0.148
	-0.251	-0.241	-0.207
Decrease in home orders	-0.031	-0.107	0.006
	-0.211	-0.216	-0.227
Increase in foreign orders	-0.145	0.079	0.096
	-0.243	-0.225	-0.218
Decrease in foreign orders	-0.094	0.392	0.137
	-0.203	-0.192	-0.201
Increase in total orders	0.201	0.089	0.144
	-0.268	-0.261	-0.255
Decrease in total orders	0.049	0.022	0.062
	-0.221	-0.204	-0.205
Increase in home prices	-0.195	-0.324	-0.539
	-0.222	-0.213	-0.202
Decrease in home prices	0.412	0.434	0.511
	-0.205	-0.212	-0.227
Increase in input prices	-0.127	0.07	0.082
	-0.256	-0.3	-0.26
Decrease in input prices	0.027	0.243	0.298
	-0.206	-0.183	-0.192
Increase in foreign prices	0.089	0.243	0.268
	(0.153	-0.145	-0.139
Decrease in foreign prices	0.408	0.318	0.561
	-0.244	-0.209	-0.242
Observations	2609	4812	7690
Industry dummies	.	.	.
Time dummies	✓	✓	✓
Firm size dummies	.	Yes	Yes
Fixed effect	Yes	.	.
AR(1) coefficient	.	0.33	.
Log likelihood	-1117.7	.	-1759.5
Regressors	29	31	31
Wald test ($\chi 2$)	179	159.3	363.2
Number of firms/groups	277	517	900

a Dependent variable: *Did your firm revise down your investment plan this quarter?*

b) Estimated using a random effect panel data model. Robust standard errors, clustered at firm level.

c) Modeled using a logit model

d) Significance levels: * $p < 0.1$, ** $p < 0.5$, *** $p < 0.01$

Table 10: How expectations affects firms' probability of revising down it investments, Average partial effects

VARIABLES	Logit FE	LogitIRE	LogitNRE
Increase in expected production	-0.022447	-0.019196	-0.027571
Decrease in expected production	0.0358016	0.0407126	0.0296527
Increase in expected capacity	0.0083328	0.0162256	0.0179137
Decrease in expected capacity	-0.01182	-0.033184	-0.006048
Increase in expected employment	-0.037201	-0.045279	-0.031438
Decrease in expected employment	0.0812915	0.0723123	0.0723169
Increase in expected home orders	-0.00036	0.0033979	-0.008193
Decrease in expected home orders	-0.002096	-0.008051	0.0003482
Increase in expected foreign orders	-0.009611	0.0059534	0.0053265
Decrease in expected foreign orders	-0.00625	0.0296367	0.0076191
Increase in expected total orders	0.0138992	0.0067263	0.0079993
Decrease in expected total orders	0.0033651	0.0016819	0.0034274
Increase in expected home prices	-0.012829	-0.024518	-0.029923
Decrease in expected home prices	0.0303774	0.0328251	0.0283568
Increase in expected input prices	-0.008408	0.0052684	0.0045469
Decrease in expected input prices	0.0018497	0.0183985	0.0165747
Increase in expected foreign prices	0.0060827	0.0183661	0.0149029
Decrease in expected foreign prices	0.0301253	0.0240097	0.0311626

Controlling for the business cycle effects by introducing the unemployment rate or the GDP gap does not affect the size of the estimated coefficients. Hence I do not report those results. Indicating that the factors affecting investments do not change in my sample when the labor or product market changes. A relevant critique is that small variation in both markets during the sample period weakens the possibility of identifying this effect.

6 Summary

This paper has identified which factors affect investment behavior in the short run and the relative strength of those factors. By applying data from a business tendency survey, I have shown that firms' investment plans are being postponed or lowered due to a reduction of demand or further liquidity constraints. Traditional investment models discussed in this paper highlight the user cost of capital as an important factor, but this paper does not find empirical evidence in favor of this.

The main finding is that a demand shock increases the probability of a reduction in firm-level investment by 7 percentage points, whereas a shock in credit constraints increases the probability of a reduction in the firm investment by 4 percentage points. The effect of changes in the capacity has about the same effect as changes in credit constraints. This result is backed up by analyzing the effect of the firms' expectations and their probability of revising down investments. Furthermore, the study shows that firms' expectation on its employment level is also a strong predictor for reduced investment level.

I do not find significant effects of other explanatory variables on the firms' probability of revising down its investments. Neither a change in the price of capital goods, the level of interest rate nor public subsidies have a significant impact on the probability of firms revising down its investment level in the coming quarter.

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A Appendix

In order to study whereas the fixed effects are dependent of the structural part of the model I estimate the relationship between the mean of the explanatory variables and the fixed effect:

$$\eta_i = \alpha + \beta \bar{X_i} + \varepsilon_i, \quad (18)$$

where $X_i = \frac{1}{T}\sum_{t=1}^{T} X_{i,t}$ and ε_i is an IID error term. The empirical model is estimated with ordinary least squares (OLS) using R. The results are reported in table 11.

The random effect and the fixed effect model utilizes the variation in data to identify the effects of changes in the explanatory variables differently. When there are missing values in the data sample this have consequences for which observations that are included in the estimation of the models. The fixed effect model (logitFE) will leave out all firms which have no variation in the endogenous variable, while the random effect model with autocorrolated errors (LogitIRE), will leave out all firms with less than three observations. To study how the differences in data sample affects the estimated models I create a test sample where I include only observations where there are variation in the endogenous

Table 11: Effects of the explanatory variables on the estimated fixed effect

VARIABLES	OLS
Access to credit	0.087
	(0.324)
Expected demand	-0.452
	(0.355)
Price of capital	-1.411
	(0.548)
Cost of financing	-0.556
	(0.523)
Official regulations	-0.026
	(0.545)
Public subsidies	0.729
	(0.574)
Expected capacity	0.633
	(0.379)
Other reasons	-0.084
	(0.460)
No special reasons	0.727
	(0.426)
Constant	-1.211
	(0.344)
Observations	274
Adjusted R^2	0.101
F-test, p-value (df 9)	0.000

Table 12: Factors causing a downward revise of investment plans. Estimated coefficients of the benchmark models, 2011q3-2014q3. Sample sized reduced when modeling the LogitIRE and LogitNRE to compere the regression when differences in the sample is reduced

VARIABLES	LogitFE	LogitIRE	LogitNRE
Access to credit	0.546	0.467	0.511
	(-0.217)	(0.174)	(0.146)
Expected demand	1.04	0.947	0.994
	(-0.177)	(0.174)	(0.146)
Price of capital goods	0.103	0.175	-0.157
	(-0.266)	(0.269)	(0.223)
Financing costs	0.272	0.566	0.148
	(-0.234)	(0.236)	(0.197)
Official regulations	0.26	0.038	0.262
	(-0.312)	(0.312)	(0.248)
Public subsidies	-0.146	-0.192	-0.070
	(-0.299)	(0.283)	(0.243)
Expected capacity	0.522	0.453	0.634
	(-0.188)	(0.174)	(0.154)
Other reasons	0.504	0.711	0.545
	(-0.242)	(0.229)	(0.195)
No special reasons	-1.217	-1.121	-1.205
	(-0.256)	(0.262)	(0.214)
Constant		-1.082	-1.180
	(0.275)	(0.231)	
$\text{Chi}^2(22)$	755.6	162.6	239.1

Table 13: Effects of the explanatory variables on the estimated fixed effect estimated with a linear probability model (LPM)

VARIABLES	LPM, FE
Access to credit	0.0617
	(0.0188)
Expected demand	0.1107
	(0.0144)
Price of capital	0.0042
	(0.0187)
Financing costs	0.0271
	(0.0206)
Official regulations	0.0332
	(0.0321)
Public subsidies	-0.0135
	(0.0299)
Expected capacity	0.0629
	(0.0186)
Other reasons	0.0748
	(0.0250)
No special reasons	-0.0120
	(0.0126)
Observations	7,690
Time dummies	✓
Firm size dummies	.
Fixed effect	✓
Log likelihood	0.0963
Degrees of freedom	22
Chi^2	183.8
Number of firms	900

variable and the firm is observed at least in three time periods (without gaps). Table 12 summarizes the results.

To investigate whether the dynamics of a panel data contribute to identification of the investment decision I apply several models. Table 14 show results for both the standard linear specification, a logit model and the GMM approaches as discussed in section 4 . The first column shows the result of the linear probability model (GLS) specified without the lagged dependent variable and serve as the baseline case. The baseline GLS specification shows as the logit specification that 'expected demand' and 'excess capacity' together with 'access to credit' and 'other reasons' explain why firms revise down its investments. Adding the lagged dependent variable to the GLS and logit specification does increase the estimated coefficients for 'access to credit' and 'excess capacity' with nearly 50 percent. While the effect of 'expected demand' is unchanged.

Dynamic models are by nature subject to autocorrelation in the error terms. As suggested in section 4 applying the Arellano-Bond or the Blundell-Bover estimator may help us solve problem with autocorrelation that the GLS does not help us with. Further the GMM estimator allows for using instruments to tackle the endogeneity of the lagged dependent variable. Specifying the difference GMM estimator and the system GMM estimator using the similar specification as for the GLS shows that the estimated size of the lagged dependent variable is more than halved. More interesting is it that the effect of 'access to credit' and 'expected demand' are now equally important for explaining the probability that the firm would revise down its investments. In other words the conventional GLS strategy underestimates the effect of 'access to credit' and overestimate the effect of changes in 'expected demand'. The estimated coefficient of 'expected demand' is slightly reduced, but still significant at 1 percent level. Changes in 'excess capacity' are still important for explaining the revisions, but the estimated effect is somewhat lower for both the coefficient on 'access to credit' and 'expected demand'. Measures affecting the firms' investment decisions that are not explicitly covered by this survey are called 'other reason'. As shown by the estimation results a significant share of the changes in investments are caused by those factors and the effect is barely affected by the choice of model specification.

The Sargan test for overidentifying restrictions fail for the benchmark model using

Table 14: Dynamic panel data model: Factors causing a downward revise in investment plans.

	GLS		Conditional logit		Difference GMM		System GMM	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L1. dependent var		0.0866***		0.399***	0.167***	0.162***	0.160***	0.153***
		(0.0233)		(0.129)	(0.0319)	(0.0340)	(0.0315)	(0.0321)
Access to credit	0.0513***	0.0555***	0.563***	0.652***	0.0892***	0.103***	0.0871***	0.0998***
	(0.0162)	(0.0173)	(0.197)	(0.186)	(0.0230)	(0.0246)	(0.0229)	(0.0244)
Expected demand	0.0992***	0.0902***	1.108***	1.061***	0.0782***	0.0826***	0.0779***	0.0819***
	(0.0130)	(0.0137	(0.150)	(0.170)	(0.0167)	(0.0176)	(0.0166)	(0.0175)
Price of capital	-0.0142	0.00794	-0.147	0.146	0.0126	0.0140	0.0131	0.0126
	(0.0142)	(0.0159	(0.267)	(0.260)	(0.0230)	(0.0244)	(0.0231)	(0.0243)
Cost of financing	0.0158	0.0150	0.152	0.117	0.00138	-0.00138	0.00211	-0.00222
	(0.0179)	(0.0183)	(0.233)	(0.188)	(0.0213)	(0.0227)	(0.0212)	(0.0224)
Official regulations	0.0240	0.00251	0.241	0.0489	-0.00254	-0.0112	-0.00432	-0.0134
	(0.0249)	(0.026	(0.277)	(0.387)	(0.0292)	(0.0315)	(0.0292)	(0.0312)
Public subsidies	-0.0139	-0.0124	-0.172	-0.169	-0.0136	-0.00439	-0.0141	-0.00405
	(0.0230)	(0.0265	(0.226)	(0.308)	(0.0361)	(0.0368)	(0.0364)	(0.0370)
Expected capacity	0.0567***	0.0586***	0.539***	0.568***	0.0689***	0.0619***	0.0688***	0.0609***
	(0.0178)	(0.0185)	(0.176)	(0.188)	(0.0226)	(0.0230)	(0.0224)	(0.0229)
Other reasons	0.0558***	0.0501**	0.548***	0.503*	0.0611**	0.0641**	0.0612**	0.0646**
	(0.0210)	(0.0212)	(0.209)	(0.268)	(0.0242)	(0.0263)	(0.0243)	(0.0264)
No special reasons	-0.0127	-0.00986	-1.269***	-1.253***	-0.00769	-0.00347	-0.00847	-0.00539
	(0.0111)	(0.0120)	(0.254)	(0.268)	(0.0151)	(0.0161)	(0.0151)	(0.0160)
Production last quarter						0.0194***		0.0196***
						(0.00552)		(0.00551)
Employment last quarter						0.0151**		0.0141*
						(0.00783)		(0.00787)
L1.Unemployment rate						-0.0654***		-0.0688***
						(0.0245)		(0.0235)
L2.Unemployment rate						0.0826***		0.0736***
						(0.0223)		(0.0204)
Observations	8,541	7,633	2,835	2,355	6,489	5,764	7,451	6,732
Number of firms	908	876	278	247	833	818	869	856
Fixed effects	✓	✓	✓	✓				
Model df	8	9	9	10	10	14	10	14
F-test	16.11	14.26	.	.	.	.	.	.
Wald (chi2)	.	.	192.6	153.2	122.5	142.7	121.3	146.2
Sargan test (p-value)	.	.	.	.	0.0006	0.0136	0.0004	0.0617
AR(2) test (p-value)	.	.	.	.	0.5183	0.7691	0.4458	0.6069

a Linear specification in (1) and(2), using xtreg. Non-linear model in (3) and (4), using clogit. Linear specification with instruments in (5) and (6) GMM using the Arellano-Bond estimator. Linear specification with instruments in (7) and (8) GMM using the Blundell-Bond estimator. Production last quarter, employment last quarter together with the unemployment rate are assumed to be predetermined and used as instruments.

c Godness of fit measure: F-test for linear models and Wald test (χ^2) non-linear probability models.

d AR(2) test: Arellano-Bond test for zero autocorrelation in first-differentiated errors. It is the P-value for a test of autocorrelation of order 2 that is reported. All p-values are close to zero for the test of AR(1).

e Sargan test: Test for overidentifying restrictions, H_0: overidentifying restrictions are valid

Robust standard errors in parentheses, using bootstrapping, Significance levels: *** p$<$0.01, ** p$<$0.05, * p$<$0.1

Table 15: Dynamic panel data model: Factors causing a downward revise in investment plans. Firms expectations as explanatory variables. Linear specification, panel data

	GLS	Con. logit	Difference GMM		System GMM	
	(1)	(2)	(3)	(4)	(5)	
L1.Dependent var	0.0579	0.249	0.124**	0.121**	0.140***	0.136**
	(1.92)	(1.46)	(3.02)	(2.85)	(3.38)	(3.22)
Expected production	0.0277*	0.643**	0.0220	0.0260	0.0228	0.0257
	(2.42)	(2.78)	(1.57)	(1.75)	(1.58)	(1.72)
Expected capacity	0.00570	-0.0912	0.00960	0.00643	0.0109	0.00909
	(0.46)	(-0.41)	(0.61)	(0.42)	(0.68)	(0.58)
Expected employ	0.0567***	0.988***	0.0329**	0.0303**	0.0338**	0.0295*
	(5.92)	(6.06)	(2.84)	(2.59)	(2.89)	(2.49)
Expected home orders	-0.00806	0.0888	-0.0118	-0.0124	-0.0133	-0.0117
	(-1.05)	(0.48)	(-1.08)	(-1.16)	(-1.18)	(-1.07)
Expected foreign prices	0.00131	0.0341	0.00397	0.00686	0.00398	0.00620
	(0.14)	(0.20)	(0.34)	(0.59)	(0.34)	(0.54)
Expected total orders	-0.00485	-0.276	-0.00808	-0.00605	-0.00880	-0.00502
	(-0.52)	(-1.41)	(-0.63)	(-0.49)	(-0.68)	(-0.40)
Expected home prices	0.0350*	0.504	0.0366	0.0404*	0.0347	0.0370
	(2.51)	(1.88)	(1.92)	(1.99)	(1.79)	(1.82)
Expected foreign prices	-0.000465	-0.0233	-0.0136	-0.0166	-0.00954	-0.00840
	(-0.04)	(-0.10)	(-0.85)	(-1.04)	(-0.59)	(-0.52)
Expected input prices	-0.0225*	-0.332*	-0.0297*	-0.0311*	-0.0311*	-0.0338*
	(-2.00)	(-1.97)	(-2.37)	(-2.28)	(-2.44)	(-2.40)
GDP gap	-0.0479	-0.962				-0.123
	(-1.72)	(-1.80)				(-1.68)
Production last quarter				0.0249***		0.0227***
				(3.87)		(3.43)
L2.Unemployment rate				0.0540*		0.0275
				(2.10)		(1.34)
L1.GDP gap						0.0343
						(0.84)
Constant	-0.117***		-0.0181	-0.253**	-0.0228	-0.184*
	(-3.58)		(-0.46)	(-2.73)	(-0.56)	(-2.32)
Observations	4253	1271	3371	3001	4222	3803
Number of orgnr	593	145	505	488	584	567
Fixed effect	✓	✓				
Model df	10	11	10	12	10	14
F	7.789	.	.	.	.	.
Wald test (chi2)	.	122.5	66.00	83.19	103.2	140.1
Sargan-test (p-value)			0.017	0.39	0.000	0.065
AR(2)-test (p-value)	.	.	0.48	0.98	0.57	0.84

a Model (1) linear specification using GLS. Model (2) non-linear specification using conditional logit. Model (3) and (4) GMM using the Blundell-Bond estimator. Model (5) and (6) GMM using the Arellano-Bond estimator. Production last quarter, employment last quarter together with the unemployment rate and the GPD gap are assumed to be predetermined and used as instruments in the system GMM and GDP gap is excluded from the instruments in the difference GMM.

b Estimated standard errors using clustering at firm level. Significance levels:

c AR(2) test: Arellano-Bond test for zero autocorrelation in first-differentiated errors. It is the P-value for a test of autocorrelation of order 2 that is reported. All p-values are close to zero for the test of AR(1).

d Sargan test: Test of overidentifying restrictions, H_0: overidentifying restrictions are valid both difference and system GMM. I introduce predetermined variables, such as the firms' response to the question 'how strong was the firm's production' and 'how high was the firm's employment' last quarter, together with the lagged unemployment rate, from the Labour force survey. Using these variables as additional instruments secures a significantly high p-value for the Sargan test using the system GMM estimator. The AR(2) test rejects autocorrelation in all cases.

Applying the similar dynamic structure as the first strategy, shows that adding dynamics changes the estimated coefficient. The estimate for the lagged dependent variable is nearly zero and insignificant in the standard linear specification, a bias towards zero if the GMM models gives the right estimate. The estimated coefficient for the lagged dependent variable is barely affected by the choice of GMM model specification, a finding that also holds for the other variables. The benchmark model reject the Sargan test for overidentifying restrictions, to solve this predetermined variables are included. As shown in Table 15 adding predetermined variables barely have effect on the estimated coefficients.