Does Demand and Price Uncertainty affect Belgian and Spanish Corporate Investment ?

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1 Introduction

Recent empirical research has shown that uncertainty plays a role in economics. Ramey and Ramey (1995), for instance, find a significant effect of economic growth uncertainty on average GDP-growth, where uncertainty is measured as the standard deviation of GDP-growth. In their cross-country sample the effect is negative. This implies that a country with a high growth volatility[1] tends to grow slowly. In a different strand of literature, in casu consumption models, uncertainty is also found to have a negative influence. Banks, Blundell and Brugiavini (1994) show that consumption growth is negatively affected by wealth volatility.

The aim of this paper is to investigate the impact of uncertainty on investment. A major complication is that many factors affect investment. Uncertainty might result from sources like profit, output or investment prices, marginal returns, wages, product demand, financial factors. A precise definition of the kind of uncertainty and – of course – a precise definition of its measurement are required first.

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[1] The terms 'uncertainty' and 'volatility' are used interchangeably in this study.

Recent empirical studies on US industrial sectors show strong evidence for a significant negative sign of demand uncertainty as well as output price uncertainty. Ghosal (1991) shows that demand uncertainty is important, though less important for large firms. It depresses the capital/labour ratio. Guiso and Parigi (1999) find a similar depressive effect on Italian corporate investment. In addition, Ghosal and Loungani (1996) show a depressive effect of output price uncertainty in competitive US industries[2].

These findings are very interesting because the explanation of investment behaviour has been quite unsatisfactory until now. Accounting for uncertainty effects could improve the often poor investment estimation results[3].

In this study we concentrate on corporate investment in Belgium and Spain. These two economies are dominated by small firms not quoted at the stock exchange. Empirical studies have already drawn the attention to these economies and shown the significance of financial distress. To the best of my knowledge, no empirical evidence exists on the possible impact of uncertainty. So a first question to be answered is whether uncertainty affects investment. For this purpose we use large data sets, namely 308 Belgian firms covering the period 1984-1992 and 1298 Spanish firms covering the period 1983-1993.

A firm's attitude towards uncertainty will in general not be independent of its characteristics. For instance, a small firm's attitude may differ from a large firm's one as it often has to rely on the sale of a less diversified product mix. Also, a firm with a high debt burden may be more or less uncertainty averse than a firm financed by mainly own funds. As there is no evidence on hand on this relation between uncertainty and firm characteristics, and we have only a few theoretical indications[4], this issue is further investigated.

The adopted methodology is the following. Uncertainty factors are calculated, incorporated in a neo-classical model, first order conditions are derived and estimated with the uncertainty factors as explanatory variables. The uncertainty of each variable is measured as a moving average of the standard deviation of the unpredictable part of the variable. By adopting this procedure and using a neo-classical framework, sales (as an indicator of demand), the nominal output price and the nominal investment price can be considered because they are not within influential reach of (most) Belgian and Spanish firms. Financial distress is taken into account explicitly. So the uncertainty factors are tested for, conditional on relevant factors affecting corporate investment.

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2 See also Ghosal (1995,1996,2000).

3 See Nickell (1978) who already pointed out the importance of uncertainty, or more recently, Caballero (1991), Dixit and Pindyck (1994).

4 See for instance Fries, Miller and Perraudin (1997).

The outline of the paper is as follows. Section 2 lays out the uncertainty measure. Section 3 describes the data, section 4 the econometric model and section 5 the GMM-results. Section 6 concludes.

2 An Empirical Measure of Uncertainty

Suppose a firm i is faced with variable $Z_{i,t}$. The uncertainty surrounding this variable is reflected in the unpredictable part. So this part is the center of our interest. We will assume that for each firm variable $Z_{i,t}$ follows a p-th order autoregressive process, ie.

$$Z_{i,t} = \alpha_{0i} + \sum_{j=1}^{p} \alpha_{ji} Z_{i,t-j} + \epsilon^Z_{i,t} \quad \text{where} \quad \epsilon^Z_{i,t} = \epsilon_t + \epsilon^I_{i,t} \quad \text{and} \quad \epsilon^I_{i,t} \sim N(0, \sigma_i^2) \quad (1)$$

The unpredictable part of $Z_{i,t}$, ie. $\epsilon^Z_{i,t}$, is decomposed in a pure time part (ϵ_t) and an idiosyncratic part ($\epsilon^I_{i,t}$). $\epsilon^Z_{i,t}$ is assumed to be i.i.d. Our main interest is the idiosyncratic part. We take its standard deviation σ_i as the measure of uncertainty around Z that firm i perceives. However, this measure is only firm specific and thus not suitable to use in the empirical analyses that is concerned with the time-dimension also. For this reason a k-th order moving average of the squared residuals will be taken, ie.

$$\hat{u}^1_{i,t} = \sqrt{\frac{1}{k+1} \sum_{j=-k}^{0} \hat{\epsilon}^2_{i,t+j}}, \quad (2)$$

where $\hat{\epsilon}_{i,t}$ is the residual[5]. As an alternative, the standard deviation could be weighted by the assets-to-equity ratio, denoted $\omega_{i,t}$. In this case the uncertainty measure is defined as

$$\hat{u}^2_{i,t} = \omega_{i,t} \hat{u}^1_{i,t} \quad (3)$$

Firms with higher debt levels, so a higher assets-to-equity ratio $\omega_{i,t}$, are assumed to be faced with more uncertainty than firms with lower debt levels[6].

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5 This measure was used by Klein (1977). Ghosal (1996) also uses this measure with long time series for many US industrial sectors and Bo (1998) for Dutch firm data having a small sample.

6 Leahy and Whited (1996) take the equity-to-debt ratio. They argue that their uncertainty measure, being the return at the stock exchange, increases with the leverage of the firm. Here, on the contrary, a high leverage is assumed to amplify uncertainty as this is more in line with expectations.

3 Data Description

Data come from the Belgian and Spanish Central Bank. They are annual and cover the period 1984-1992 for Belgium and 1983-1993 for Spain. Firms selected belong to the manufacturing industry where nineteen Belgium sectors and thirteen Spanish are distinguished. Firms selected are (i) public limited companies (corporate) (ii) with more than or with 20 employees (iii) with a net value added of 20.000 Belgian Francs or 1.000.000 Pesetas (iv) with a positive capital stock (v) with positive total assets (vi) with positive wages (vii) with positive dividends (viii) with positive equity and (ix) that do no change sector. In addition, firms are eliminated that have (i) a real capital stock growth of more than 300% or less than −0.90% (ii) a real assets growth of more than 500% or less than −0.90% (iii) a q of more than 25 or less than 0 (iv) a sales-to-capital ratio of more than 25 and (v) a value-added-to-capital ratio of more than 25. These selection criteria are according to the ones used in Barrán and Peeters (1998) and Estrada and Vallés (1995). Furthermore, firms are included when existing more than five consecutive years. So the two panels are unbalanced[7].

3.1 Whole Sample

Table 1a : *Means*

	Belgium	Spain
Investment-to-Capital ratio, $\frac{I}{K}$	0.28	0.16
Marginal product of capital, MPK	0.76	0.65
Value-Added-to-Capital ratio, $\frac{Y}{K}$	2.65	1.79
Sales-to-Capital ratio, $\frac{S}{K}$	7.15	5.89
Debt-to-Capital ratio, $\frac{B}{K}$	0.76	1.04
Real Investment Price, P^I	1.05	1.01
Modified User Cost of Capital, J	0.32	0.23
Number of Employees, N	442	264
Number of Firms	308	1298

Table 1a reports the averages of the main variables. A comparison shows that Belgian ratios are on average larger than the Spanish ones. An exception is the debt-to-capital ratio. This is on average lower in Belgium than in Spain, namely 0.76 to 1.04. This first observation is due to the fact that in the Belgian database – in terms of capital stock – more small than larger firms are represented. These turn out to have higher ratios than larger firms

[7] Detailed information on the data construction and statistics can be obtained upon request.

and, in addition, to have a higher variance on average than the Spanish firms (not shown here). The small firms are on average less leveraged than the large firms in Belgium, so not funded with bank loans but more with equity.

3.2 Sample Splits

In our analyses it is important to distinguish different types of firms. After all, certain groups of firms can react in a different way to uncertainty. The sample is splitted according to size and leverage at the mean values of the number of employees and debt, respectively. These sample splits are also often used in other studies, like those on financial distress.

Table 1b reports in a similar way as Table 1a the averages for the main variables. It follows that the small and large Belgian firms have on average 90 and 917 employees. In Spain small and large firms are smaller: they have 60 and 563 employees on average. As we saw before, the Spanish firms have more debt-to-capital than the Belgian ones but the difference between the low-debt and high-debt firms is less extreme than for Belgium (0.40 : 1.23 versus 0.07 : 1.03). Furthermore and quite interestingly, mainly large Belgian firms are highly leveraged[8]. In Spain, on the other hand, a direct relation between firm size and debt-to-capital is far less clear.

Table 1b : *Means subsamples*

	Belgium				Spain			
	Small	Large	Low-lev.	High-lev.	Small	Large	Low-lev.	High-lev.
$\frac{I}{K}$	0.27	0.29	0.29	0.27	0.17	0.16	0.15	0.17
MPK	0.78	0.75	0.98	0.68	0.68	0.60	0.62	0.66
$\frac{Y}{K}$	2.68	2.59	3.50	2.31	1.86	1.69	1.66	1.83
$\frac{S}{K}$	7.33	6.92	8.47	6.64	6.38	5.24	4.90	6.19
$\frac{B}{K}$	0.69	0.85	0.07	1.03	1.07	0.99	0.40	1.23
P^I	1.05	1.04	1.04	1.05	1.01	1.02	1.02	1.01
J	0.33	0.32	0.35	0.31	0.23	0.23	0.24	0.23
N	90	917	282	504	60	563	212	280
Number of firms	179	129	86	222	771	527	302	996

8 This is probably due to the fact that large Belgian firms have easily access to external funds due to the existence of cooperation centers (see Barrán and Peeters (1998)

4 An Empirical Investment Model

From the standard neo-classical model the dynamic investment model is derived, along the lines of Bond and Meghir (1994). The main focus is on the inclusion of the demand and price uncertainties. These factors are represented as marginal costs, denoted $\nu_{1i,t}$ and/or $\nu_{2i,t}$.

4.1 The Neo-Classical Model

Risk-neutral managers are assumed to maximize the present value of future profits of the firm. The profit stream of firm i at time t is specified as

$$E\left\{\sum_{t=0}^{\infty}\prod_{k=0}^{t-1}\left(\frac{1}{1+\tau_k}\right)[F(K_{i,t},N_{i,t})-G(I_{i,t},K_{i,t},P^I_{s,t},\nu_{1i,t},\nu_{2i,t})-W_{i,t}N_{i,t}]|\Omega_{i,t}\right\} \tag{4}$$

E is the rational expectations operator and the information set $\Omega_{i,t}$ contains the information until period t, τ_k is the real discount rate at the end of period k, $F(.)$ a production function and $G(.)$ an investment cost function. Further clarifications :

$K_{i,t}$ = the end-of-period real capital stock of firm i at t;
$I_{i,t}$ = real gross investment of firm i at time t;
$N_{i,t}$ = number of employees of firm i at t;
$W_{i,t}$ = real wage paid by firm i at t;
$P^I_{s,t}$ = the real investment price of sector s at time t;
$\nu_{1i,t}$ = exogenous shock to variable investment costs to firm i at time t;
$\nu_{2i,t}$ = exogenous shock to investment adjustment costs to firm i at time t.

Capital stock accumulates according the standard capital accumulation rule, i.e.

$$K_{i,t}=I_{i,t}+(1-\delta_{i,t})K_{i,t-1} \quad\Leftrightarrow\quad I_{i,t}=K_{i,t}-(1-\delta_{i,t})K_{i,t-1}, \tag{5}$$

where $\delta_{i,t}$ represents the economic depreciation rate of firm i at t. The investment cost function is specified quadratically as

$$G(I_{i,t},K_{i,t},\nu_{1i,t},\nu_{2i,t})=(\nu_{1i,t}+P^I_{s,t})I_{i,t}+\frac{b}{2}\left(\left[\frac{I}{K}\right]_{i,t}-\nu_{2i,t}\right)^2 K_{i,t} \tag{6}$$

The term $(\nu_{1i,t}+P^I_{s,t})I_{i,t}$ concerns the variable investment costs and the quadratic term represents adjustment costs[9]. $\nu_{1i,t}$ and $\nu_{2i,t}$ are stochastic shocks that affect the investment costs. $\nu_{1i,t}$ may be thought of as a shock

[9] Strictly speaking, the term $\nu_{1i,t}I_{i,t}$ can be interpreted as either variable or adjustment costs (see Whited (1994)). We will however refer to it as variable costs here.

that is associated with each new acquirement of an investment good, increasing or decreasing the price of the good. $\nu_{2i,t}$ is a shock that affects the optimal level of investment adjustment, see Whited (1994). The derivatives with respect to the first and second argument are given by

$$G_{Ii,t} = \nu_{1i,t} + P^I_{s,t} + b\left(\left[\frac{I}{K}\right]_{i,t} - \nu_{2i,t}\right)$$

$$\text{and} \quad G_{Ki,t} = -\frac{b}{2}\left(\left[\frac{I}{K}\right]^2_{i,t} - \nu^2_{2i,t}\right) \tag{7}$$

4.2 The Dynamic Investment Model

The dynamic investment model can be derived by substituting gross investment, ie. (5), in (4) and taking derivatives with respect to $N_{i,t}$ and $K_{i,t}$. The Euler-equations are given by

$$F_{Ni,t} = W_{i,t} \tag{8}$$

$$F_{Ki,t} = G_{Ii,t} + G_{Ki,t} - \left(\frac{1-\delta_{i,t}}{1+\tau_t}\right) E\{G_{Ii,t+1}|\Omega_{i,t}\}, \tag{9}$$

where $F_{Ni,t}$ and $F_{Ki,t}$ is the marginal productivity of labour and capital at time t, respectively. The reduced form solution can then be derived, ie.

$$\begin{aligned} MPK_{i,t} - J_{i,t} = \gamma_1 &\left(\left[\frac{I}{K}\right]_{i,t} - \frac{1}{2}\left[\frac{I}{K}\right]^2_{i,t} - \psi_{i,t}\left[\frac{I}{K}\right]_{i,t+1}\right) \\ &+ \gamma_2\left[\frac{Y}{K}\right]_{i,t} - \gamma_3\left[\frac{B}{K}\right]^2_{i,t} \\ &+ \nu_{1i,t} - \psi_{i,t}\nu_{1i,t+1} - \gamma_4(\nu_{2i,t} - \frac{1}{2}\nu^2_{2i,t} - \psi_{i,t}\nu_{2i,t+1}) + \epsilon_{i,t} \end{aligned} \tag{10}$$

$$\text{where} \qquad \psi_{i,t} \equiv \frac{1-\delta_{i,t}}{1+\tau_t}$$

MPK is the marginal product of capital, Y/K is the value-added-to-capital-stock ratio that controls for non-constant-returns-to-scale, B/K is the debt-to-capital stock ratio and J is a modified user cost of capital[10]. In case of constant returns to scale, $\gamma_2 = 0$. In case where the firm is debt-constrained, γ_3 is significant. The sign of B/K is negative as a firm will invest more when it has more debt, as explained in Bond and Meghir (1994). $\epsilon_{i,t}$ is a disturbance term that represents the forecast errors arising from substituting the realized values for the unobserved variables[11]. All parameters are expected to be positive. For further derivation details and important differences with the Bond and Meghir-model, see appendix A.

[10] See also Chirinko, Fazzari and Meyer (1999) on the importance of the user cost of capital to business capital formation.

[11] Instrumental variables are used during estimation.

4.3 The Inclusion of the Uncertainty Factors

It will be assumed that only variable costs are affected by uncertainty. This is along the lines of Dixit and Pindyck (1994). Each time a capital good is bought, price P^I is paid and *in addition* a "price" for the uncertainty effects associated with it. There are more possibilities to include uncertainty effects, but in case of demand and price uncertainty, the inclusion as variable costs seems most logical. This is explained in detail in Appendix B.

We include the uncertainty term, $\kappa\hat{u}_{i,t}$, and fixed effects, time- and sector-dummies, denoted d_i, d_t and d_s, respectively. So,

$$\nu_{1i,t} = \kappa\hat{u}_{i,t} + d_i + d_t + d_s + \epsilon_{i,t}^{\nu_1} \qquad \text{and} \qquad \nu_{2i,t} = c + \epsilon_{i,t}^{\nu_2} \tag{11}$$

by which the equation to be estimated equals

$$\begin{aligned} MPK_{i,t} - J_{i,t} = {} & \gamma_1 \left(\left[\frac{I}{K}\right]_{i,t} - \frac{1}{2}\left[\frac{I}{K}\right]_{i,t}^2 - \psi_{i,t}\left[\frac{I}{K}\right]_{i,t+1} \right) \\ & + \gamma_2 \left[\frac{Y}{K}\right]_{i,t} - \gamma_3 \left[\frac{B}{K}\right]_{i,t}^2 \\ & + \gamma_4^* (\hat{u}_{i,t} - \psi_{i,t}\hat{u}_{i,t+1}) + d_i^* + d_t^* + d_s^* + \epsilon_{i,t}^* \end{aligned} \tag{12}$$

The starred variables and parameters are the re-defined old ones.

Ceteris paribus, uncertainty affects the gap $MPK - J$ positively if $\gamma_4^* > 0$ as future uncertainty does not exceed current uncertainty (ie. $\hat{u}_{i,t} - \psi_{i,t}\hat{u}_{i,t+1} > 0$ since $\psi < 1$). In this case uncertainty *depresses* investment because more returns are required on the new investment. On the contrary, if $\gamma_4^* < 0$ the gap $MPK - J$ decreases. In this case investment should be triggered as it is profitable[12].

5 Estimation Results

This section discusses the measurement of the uncertainty factors and some straightforward estimation results in first subsection, and the GMM-results of the neo-classical model (12) in the second subsection.

12 Notice that this is in the same vein as the option theory of Dixit and Pindyck (1994). They argue that the marginal costs of a project, say the investment price p, in addition to the standard deviation of returns, say σ, are the threshold value for inducing investment. If F_K indicates the marginal returns, investment will be triggered if

$$F_K > p + k\sigma \qquad \text{where} \qquad k > 0 \tag{13}$$

If there is no uncertainty, i.e. $\sigma = 0$, the standard neo-classical result holds where investment is triggered if marginal returns exceed marginal costs p. If there is uncertainty, i.e. $\sigma \neq 0$, investment is triggered if marginal returns exceed marginal costs p plus the uncertainty effect. In our empirical analyses we estimate the parameter k.

5.1 The Uncertainty Effects and Some First Measures

The uncertainty factors are estimated as follows. For each variable under investigation an AR(1)-, an AR(2)- and an ARI(1,1)-equation are estimated, see (1). The equation with the lowest mean square error is assumed to fit the data best. The average of its residuals is then calculated for each year. These estimates, denoted by $\hat{\epsilon}_t$, are the estimates for ϵ_t. The estimates for $\epsilon^I_{i,t}$ are obtained from $\hat{\epsilon}^I_{i,t} \equiv \hat{\epsilon}^Z_{i,t} - \hat{\epsilon}_t$. Then a second-order moving average is calculated according to (2) or (3).

The variables under investigation are the sales-to-capital ratio, the nominal output price and the nominal investment price. For the sales-to-capital ratio the capital stock at the beginning of the sample is used, denoted by K_0. The exogeneity of the uncertainty measure in the econometric analyses is thus ensured. Further, output prices and investment prices are only sector-time specific. For Belgium uncertainty measures for investment prices are missing since these prices are not available per sector.

Table 2 reports the results of simple regressions of the marginal product of capital of firm i on the measured uncertainty factors. The uncertainty measures are *without* weighting, ie. $\hat{u}^1_{i,t}$, see (2), and *with* the weighting by the assets-to-equity ratio, ie. $\hat{u}^2_{i,t}$ see (3). The results show that correlations are (highly) significant. These results thus suggest that most uncertainty measures affect investment in Belgium and Spain indeed. Most important at this stage are the findings of strongly significant uncertainty measures, suggesting that uncertainty around these variables might matter for Belgian and Spanish manufacturing investment decisions in more complete analyses[13].

Table 2 : *Partial correlations marginal returns-uncertainty*

	Belgium		Spain	
	without weighting	with weighting	without weighting	with weighting
Sales-to-Capital, $\hat{u}\left(\frac{S}{K_0}\right)$	0.057**	0.024**	0.087**	0.053**
	(0.009)	(0.009)	(0.004)	(0.003)
Nominal Output Price, $\hat{u}(P)$	−0.043*	−0.101**	−0.014*	−0.022**
	(0.021)	(0.018)	(0.007)	(0.006)
Nominal Investment Price, $\hat{u}(P^{In})$	.	.	−7.337**	−1.718**
			(2.442)	(0.641)

The reported figure is the OLS-estimate for c_1 in the regression $MPK_{i,t} - J_{i,t} = c_0 + c_1\hat{u}_{i,t} + e_{i,t}$.

Standard deviations are given in brackets. K_0 is the capital stock at the beginning of the sample. Further explanations :

* = significant at 5%-level

** = significant at 1%-level

. = missing.

[13] We pay no attention to the sign of the effects here, as it is only a partial analysis.

5.2 The GMM-results

GMM-estimations are carried out with the DPD-program of Arellano and Bond (1988). Instruments used are two until four years lagged values of the explanatory variables for each year (in the "gmm"-command in the program), time-dummies and sector-dummies. For further details on the estimation results, see the notes of Tables 3-5.

The whole sample

Tables 3a and 3b report the results of model (12) for the full sample of 308 Belgian firms and 1298 Spanish firms. Column (1) gives the benchmark model, i.e. the model without uncertainty factors. In subsequent columns the uncertainty effects are included, one by one, and finally jointly.

For Belgium all models are accepted according to the Sargan-statistic, see "p-value Sargan". The "adjustment cost" parameter, which is actually the adjustment cost parameter b divided by the demand elasticity, is significant and equals about 0.09. So investment adjustment costs are important. Furthermore, the parameters associated with value-added-to-capital are significant. This indicates that constant returns to scale are rejected. The parameter of the financial variable debt-to-capital is about -0.03. It has the right sign because investment is stimulated by higher debt-to-capital levels. The estimate is significant, so firms face debt-constraints.

The results for Spain in Table 3b are slightly different. All models are accepted according to the Sargan-statistic, though, only at about the 2%-level. The "adjustment costs" parameter is *not* significant, a result which corroborates some previous Spanish findings[14]. Like for Belgium, constant returns to scale are rejected and the financial variable is (here highly) significant. The estimate for returns to scale is about 0.45 for Spain whereas it is 0.50 for Belgium, indicating that -on average- returns to scale are higher in Spain.

Most important to us are however the results concerning the uncertainty factors. Columns (2)-(4) show that sales uncertainty is not significant, whereas price uncertainty is highly significant. This positive sign indicates that investment is delayed by output price uncertainty. Neither for Spain is sales uncertainty significant, whereas price uncertainty is highly significant. The sign of the output price uncertainty is positive, implying that this type of uncertainty depresses investment. This is according to findings of Ghosal (1996) for US industrial sectors.

So these results suggest that output price uncertainty affects corporate investment, conditional on the important factors like adjustment costs (in Belgium), value-added-to-capital and debt-to-capital. The results of the highly significant partial correlation concerning demand uncertainty and investment price uncertainty, as presented in Table 2, are thus not confirmed in this more complete analyses.

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14 This does not imply that investment dynamics are negligible. A different adjustment cost specification might be needed to fit the data.

Table 3a : *Results dynamic model for Belgian firms*

	(1)	(2)	(3)	(4)
$\hat{u}\left(\frac{S}{K_0}\right)$		0.018		0.022
		(0.063)		(0.066)
$\hat{u}(P)$			13.79**	13.84**
			(5.99)	(6.04)
"adj.costs"	0.085**	0.086**	0.086**	0.088**
	(0.036)	(0.036)	(0.038)	(0.038)
$\left[\frac{Y}{K}\right]$	0.502**	0.504**	0.509**	0.511**
	(0.085)	(0.085)	(0.084)	(0.084)
$\left[\frac{B}{K}\right]^2$	−0.032*	−0.032*	−0.035*	−0.035*
	(0.020)	(0.020)	(0.021)	(0.021)
p-value Sargan	0.38	0.58	0.56	0.35
p-value m_1	0.10	0.12	0.08	0.09
p-value m_2	0.77	0.77	0.99	0.89
"p-value Wald" [2]				0.09

\# firms : 308, # obs. : 1773, Period : 1986-1992

Table 3b : *Results dynamic model for Spanish firms*

	(1)	(2)	(3)	(4)	(5)
$\hat{u}\left(\frac{S}{K_0}\right)$		−0.108			−0.110
		(0.102)			(0.107)
$\hat{u}(P)$			9.816**		11.45**
			(4.050)		(4.079)
$\hat{u}(P^{In})$				−7.211	−13.46
				(7.300)	(7.409)
"adj.costs"	0.006	−0.015	0.001	−0.001	−0.015
	(0.043)	(0.051)	(0.026)	(0.047)	(0.053)
$\left[\frac{Y}{K}\right]$	0.462**	0.438**	0.468**	0.462**	0.450**
	(0.036)	(0.046)	(0.038)	(0.038)	(0.048)
$\left[\frac{B}{K}\right]^2$	−0.024**	−0.024**	−0.026**	−0.026**	−0.027**
	(0.009)	(0.010)	(0.010)	(0.011)	(0.011)
p-value Sargan	0.05	0.02	0.05	0.02	0.04
p-value m_1	0	0	0	0	0
p-value m_2	0.11	0.13	0.19	0.06	0.48
"p-value Wald" [3]					0.02

\# firms : 1298, # obs. : 7207, Period : 1985-1993

Table 4a : *Results dynamic model for small and large Belgian firms*

	Small firms			Large firms		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{u}\left(\frac{S}{K_0}\right)$	−0.106		−0.101	0.124		0.133
	(0.080)		(0.080)	(0.093)		(0.088)
$\hat{u}(P)_{s,t}$		9.679	9.291		8.909	9.532
		(7.276)	(6.965)		(5.681)	(5.945)
"adj.costs"	0.163**	0.177**	0.167**	0.010	−0.001	0.007
	(0.052)	(0.050)	(0.050)	(0.564)	(0.063)	(0.018)
$\left[\frac{Y}{K}\right]$	0.575**	0.585**	0.577**	0.396**	0.392**	0.403**
	(0.109)	(0.107)	(0.108)	(0.076)	(0.081)	(0.078)
$\left[\frac{B}{K}\right]^2$	−0.012	−0.011	−0.012	−0.007	−0.011*	−0.009
	(0.013)	(0.013)	(0.013)	(0.008)	(0.009)	(0.008)
p-value Sargan	0.70	0.84	0.82	0.31	0.45	0.53
p-value m_1	0.01	0.01	.01	0.54	0.81	0.71
p-value m_2	0.86	0.69	0.78	0.01	0.01	0.02
"p-value Wald" [2]			0.27			0.04

small firms : 179, # obs. : 1013; # large firms : 129, # obs. : 760

Table 4b : *Results dynamic model for small and large Spanish firms*

	Small firms				Large firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{u}\left(\frac{S}{K_0}\right)$	−0.052			0.047	0.060			0.060
	(0.090)			(0.092)	(0.136)			(0.129)
$\hat{u}(P)$		2.781		5.647		6.635*		6.786*
		(3.71)		(3.982)		(4.059)		(4.065)
$\hat{u}(P^{In})$			−8.585	−13.21*			−3.796	−3.688
			(7.720)	(7.776)			(8.251)	(7.434)
"adj.costs"	0.062	0.068	0.071	0.064	−0.105*	−0.109*	−0.113*	−0.104*
	(0.056)	(0.053)	(0.055)	(0.058)	(0.059)	(0.067)	(0.068)	(0.060)
$\left[\frac{Y}{K}\right]$	0.505**	0.517**	0.520**	0.510**	0.353**	0.351**	0.344**	0.378**
	(0.054)	(0.049)	(0.049)	(0.056)	(0.058)	(0.049)	(0.049)	(0.056)
$\left[\frac{B}{K}\right]^2$	−0.016	−0.016*	−0.018*	−0.018	−0.022*	−0.020*	−0.022*	−0.020*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.012)	(0.012)	(0.012)	(0.011)
p-value Sargan	0.01	0.01	0.01	0.02	0.41	0.64	0.47	0.59
p-value m_1	0	0	0	0	0	0	0	0
p-value m_2	0.14	0.12	0.10	0.16	0.59	0.93	0.62	0.87
"p-value Wald" [3]				0.22				0.39

small firms : 771, # obs. : 4034; # large firms : 527, # obs. : 3173

Table 5a : *Results dynamic model for low- and high-leverage Belgian firms*

	Low-leverage firms			High-leverage firms		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{u}\left(\frac{S}{K_0}\right)$	−0.014		−0.011	0.074		0.075
	(0.082)		(0.082)	(0.085)		(0.084)
$\hat{u}(P)$		3.506	3.432		2.978	3.133
		(4.547)	(4.528)		(5.248)	(5.237)
"adj.costs"	0.344**	0.354*	0.348**	0.102**	0.097**	0.102**
	(0.151)	(0.153)	(0.149)	(0.042)	(0.042)	(0.043)
$\left[\frac{Y}{K}\right]$	0.455**	0.456**	0.455**	0.520**	0.514**	0.520**
	(0.093)	(0.095)	(0.093)	(0.097)	(0.097)	(0.097)
$\left[\frac{B}{K}\right]^2$	−1.99**	−1.952**	−1.956**	−0.022*	−0.021	−0.022
	(0.679)	(0.679)	(0.674)	(0.016)	(0.015)	(0.016)
p-value Sargan	0.43	0.38	0.37	0.41	0.38	0.42
p-value m_1	0.10	0.10	0.10	0.11	0.12	0.13
p-value m_2	0.21	0.18	0.18	0.30	0.21	0.24
"p-value Wald" [2]			0.74			0.43

low-lev. firms : 86, # obs. : 498; # high-lev. firms : 222, # obs. : 1275

Table 5b : *Results dynamic model for low- and high-leverage Spanish firms*

	Low-leverage firms				High-leverage firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{u}\left(\frac{S}{K_0}\right)$	0.017			0.010	−0.131			−0.142
	(0.151)			(0.162)	(0.106)			(0.110)
$\hat{u}(P)$		4.010		3.599		7.503**		9.875
		(5.492)		(5.751)		(3.820)		(3.950)
$\hat{u}(P^{In})$			18.71	17.939			−9.45	−16.31
			(14.29)	(14.86)			(5.57)	(7.624)
"adj.costs"	−0.022	−0.021	−0.025	−0.022	−0.012	0.007	0.005	−0.014
	(0.045)	(0.045)	(0.046)	(0.046)	(0.053)	(0.048)	(0.049)	(0.056)
$\left[\frac{Y}{K}\right]$	0.456**	0.456**	0.455**	0.457**	0.423**	0.459**	0.453**	0.434**
	(0.051)	(0.049)	(0.048)	(0.051)	(0.052)	(0.044)	(0.043)	(0.054)
$\left[\frac{B}{K}\right]^2$	−0.010	−0.012	−0.010	−0.011	−0.020**	−0.022**	−0.023**	−0.023**
	(0.023)	(0.023)	(0.022)	(0.024)	(0.009)	(0.009)	(0.010)	(0.010)
p-value Sargan	0.17	0.22	0.23	0.23	0.10	0.14	0.11	0.10
p-value m_1	0.02	0.03	0.02	0.02	0	0	0	0.0
p-value m_2	0.39	0.51	0.40	0.45	0.21	0.11	0.09	0.48
"p-value Wald" [3]				0.62				0.02

low-lev. firms : 302, # obs. : 1665; # high-lev. firms : 996, # obs. : 5542

Notes Tables 3-8 :

- Estimation results are given for model (12) in first differences.
- All results presented are the DPD one-step GMM estimators, with standard errors robust to heteroskedasticity. Time-dummies and sector-dummies are included in each model and highly significant. In Table 3b interrelated time- and sector-dummies are used since the model is not accepted according to the Sargan-statistic elsewise.
- Instruments used in Tables 3-8 : $(I/K)_{i,t-2}...(I/K)_{i,t-4}, (I/K)^2_{i,t-2}...(I/K)^2_{i,t-4}, (Y/K)^2_{i,t-2}...(Y/K)^2_{i,t-4}$, time-dummies and sector-dummies (19 for Belgium and 13 for Spain).
- Figures in brackets are standard errors.
- "adj.costs" represents $\left(\left[\frac{I}{K}\right]_{i,t} - \frac{1}{2}\left[\frac{I}{K}\right]^2_{i,t} - \psi_{i,t}\left[\frac{I}{K}\right]_{i,t+1}\right)$, i.e. the variable associated with adjustment costs.
- $\hat{u}(\frac{S}{K_0})$, $\hat{u}(P)$ and $\hat{u}(P^{In})$ represent the sales uncertainty, the output price uncertainty and the investment price uncertainty. In Tables 3-8 they are measured as $\hat{u}(\frac{S}{K_0})_{i,t}$, $\hat{u}(P)_{s,t} - \psi_{i,t}\hat{u}(P)_{s,t+1}$ and $\hat{u}(P^{In})_{i,t} - \psi_{i,t}\hat{u}(P^{In})_{s,t+1}$. See appendix B.
- "p-value Sargan", m_1 and m_2 are the p-values of the statistics for overidentifying restrictions, and the first and second order autocorrelation, respectively. "p-value Wald" is the p-value of the joint test statistic on the uncertainty effects. The figure in square brackets is the number of degrees of freedoms.
- * Significant at 10%-level
  ** Significant at 5%-level

Sample splits

Tables 4a and 5a report the results for Belgium, similar to Table 3a, albeit for small and large, and low- and high-leverage firms separately. Three important points catch the eye. First, adjustment costs are not significant for large firms. Second, more interpretable economicly, returns-to-scale are higher for large than for small firms; for small firms they are 0.58 (on average) and for large firms 0.39 (on average). A scale effect also exists between the two leverage groups as the low-leverage group has higher returns-to-scale. Third, low-leverage firms are evidently debt-constrained, whereas small firms seem not. This might be explained by the fact that small firms would hardly increase investment in case where they had more access to debt. Furthermore, debt-to-capital influence investment by low-leverage firms more negatively and more significantly than for high-leverage firms.

Most surprising are the findings concerning the price uncertainty effects. Price uncertainty was found to be significant for the whole sample of firms, but is no longer for the sample splits of small/large and low-/high-leverage firms. Neither -but less surprising- is the fact that sales uncertainty is not significant. To investigate whether the findings for the whole sample might be an artefect, we come back to this issue in the next section.

In Tables 4b and 5b the results for Spain are presented. Returns-to-scale clearly differ between the two samples, being 0.51 for the small firms and 0.35 for the large firms. The results for the low- and high-leverage firms on the other hand show no differences in size effects as the value-added-to-capital ratio is about 0.45. Debt constraints have a higher impact on large than small firms and high high- than low-leverage firms. Here, however, results should be interpreted with care since the Sargan statistic indicates that the model is rejected at the 1%-level for the small firms. It is difficult to trace the cause of the bad fit of the model for this group of firms.

Interesting is the finding of a significant output price uncertainty for the group of large firms and the group of high-leverage firms, but not for the small and low-leverage firms. So for Spain, there is a significant difference between both groups of firms here.

A discussion on the robustness of the results

As explained before, the point estimates presented in Tables 3-5 are the one-step GMM estimates. Usually these estimates instead of the two-step GMM-estimates are presented, as the latter are known to have a standard deviation that is downward biased in small samples (Arellano and Bond (1991)).

In order to investigate the robustness of the results some more results are reported in Table 6 : (i) the two-step GMM-results (ii) the one-step GMM-results where we measure uncertainty by using the weighting factor of assets-to-equity (see (3)), and (iii) the one-step GMM-results where the set of instruments is only one period lagged. As said before, the two-step GMM-estimator shows more significant results than in Tables 3-5. Weighting the uncertainty measuure can show us how results depend on small changes and, as some might argue, a better uncertainty measure. Finally, using instruments that are less deeply lagged, can increase the standard errors.

The results show that large firms in both Belgium and Spain react negatively to output price uncertainty. So these results are robust over the experiments. The same holds for high-leverage Spanish firms. It is further interesting that sales and investment price uncertainty seems to matter in some of the measured cases, but the evidence is less clear.

Table 6a : *Robustness uncertainty effects Belgium*

	(1)	(2)	(3)	(1)	(2)	(3)
	Small firms			Large firms		
$\hat{u}\left(\frac{S}{K_0}\right)$	−0.037	−0.043	−0.104	0.074*	0.076	0.121**
	(0.042)	(0.06)	(0.070)	(0.038)	(0.061)	(0.063)
$\hat{u}(P)$	5.330	7.34	−11.03*	4.820**	10.55**	12.99*
	(1.649)	(6.37)	(6.496)	(2.414)	(4.757)	(7.679)
	Low-leverage firms			High-leverage firms		
$\hat{u}\left(\frac{S}{K_0}\right)$	−0.035	−0.011	−0.061	0.046	0.078	0.099
	(0.024)	(0.081)	(0.076)	(0.035)	(0.056)	(0.081)
$\hat{u}(P)$	3.245*	3.569	3.863	2.430	3.390	2.795
	(1.790)	(4.495)	(6.812)	(2.407)	(4.469)	(7.394)

Table 6b : *Robustness uncertainty effects Spain*

	(1)	(2)	(3)	(1)	(2)	(3)
	Small firms			Large firms		
$\hat{u}\left(\frac{S}{K_0}\right)$	−0.054	−0.008	0.206**	0.092**	0.045	0.548**
	(0.037)	(0.330)	(0.068)	(0.039)	(0.045)	(0.136)
$\hat{u}(P)$	2.140	3.092	3.667	6.226**	7.764**	5.897**
	(1.651)	(1.405)	(3.951)	(1.138)	(3.049)	(2.720)
$\hat{u}(P^{In})$	−4.506	4.675	4.026	2.253	10.50	12.88*
	(4.088)	(5.082)	(6.625)	(4.183)	8.117	(6.849)
	Low-leverage firms			High-leverage firms		
$\hat{u}\left(\frac{S}{K_0}\right)$	0.014	0.083	0.196**	−0.094	−0.061	0.310**
	(0.043)	(0.098)	(0.101)	(0.060)	(0.044)	(0.076)
$\hat{u}(P)$	4.649**	3.989	0.304	4.526**	5.852**	8.608**
	(1.637)	(4.499)	(4.737)	(1.800)	(2.667)	(3.215)
$\hat{u}(P^{In})$	14.83**	32.75*	2.394	−6.164	5.124	11.52*
	(6.331)	(17.09)	(1.238)	(3.942)	(5.938)	(6.707)

Columns :

(1) Two-step GMM-estimates of model without weighting (see also also Tables 3-5)

(2) One-step GMM-estimates of model with weighting

(3) One-step GMM-estimates of model without weighting, with instruments 1-3 periods lagged

Further :

* Significant at 10%-level

** Significant at 5%-level

6 Summary and Conclusions

Firm specific uncertainty measures have been calculated for sales and prices for both Belgium and Spain. First, their relation with investment is analyzed in a direct way. The results show that both demand and price uncertainty correlate significantly with corporate investment, giving us an indication that these types of uncertainty might influence investment. Next, these uncertainty effects are included in dynamic investment equations, taking into account price levels, average capital productivities and debt-to-capital ratios.

GMM-results show that output price uncertainty depresses investment in Belgium and Spain, a result exactly in line with US results for competitive firms described by Ghosal (1996). Split samples show that the link between uncertainty and investment behaviour seems strongest for the group of large and the group of high-leveraged firms in Spain, a bit weaker for Belgian large firms. Interesting is further that evidence for an effect of sales uncertainty on investment behaviour is far less clear. So for Belgium and Spain we do not corroborate the findings in Ghosal for the US and Guiso and Parigi for Italy. Investment price uncertainty does not seem to matter at all.

A possible explanation for the results is hard to give at this stage. A high probability of bad outcomes, so low output prices, and hence low revenues, seems to refrain owners and/or managers of firms in Belgium and Spain from investing or gives them an incentive to delay investment. Interesting future avenues could be the effect of uncertainty in conjecture with entry and exit, the age of the firm or competitivity (as among others Ghosal and Loungani consider). Of course the issue of measuring uncertainty should remain a main point of attention. Probably data on expectations of future developments obtained by questionnares, like used by Guiso and Parigi, would be a good alternative approach to constructing a measurement from the balance sheet data.

To conclude, these analyses corroborate the findings in other studies that uncertainty factors are not negligible and tend to depress investment for certain groups of firms. Even after strongly filtering the data over a considerable period of 9 to 11 years, taking into account price levels, scale effects and financial restrictions that are faced by Belgian and Spanish investors, significant effects are found from price volatility. Firm-specific aspects have been shown to be decisive to analyze firms' reactions towards uncertainty. As uncertainty seems to matter and therefore could improve our understanding of investment behaviour, it should deserve more attention in future research.

A Appendix : Derivation Dynamic Model

Under the assumption of linear homogeneity of the production function it holds that

$$F(K_{i,t}, N_{i,t}) = F_{Ki,t}K_{i,t} + F_{Ni,t}N_{i,t} \qquad \Leftrightarrow \qquad F_{Ki,t} = MPK_{i,t} \tag{14}$$

where $MPK_{i,t} \equiv \frac{F(K_{i,t},N_{i,t}-W_{i,t}N_{i,t}}{K}$ is the marginal product of capital and (8) has been substituted.

Substituting (14) and (7) in (9) it follows that

$$\begin{aligned}
MPK_{i,t} &= b\left(\left[\frac{I}{K}\right]_{i,t} - \nu_{2i,t}\right) - \frac{b}{2}\left(\left[\frac{I}{K}\right]^2_{i,t} - \nu^2_{2i,t}\right) - b\left(\frac{1-\delta_{i,t}}{1+r_t}\right)E\{\left[\frac{I}{K}\right]_{i,t+1} - \nu_{2i,t+1}|i,t\} \\
&\quad + \nu_{1i,t} + P^I_{s,t} - \left(\frac{1-\delta_{i,t}}{1+r_t}\right)E\{\nu_{1i,t+1} + P^I_{s,t+1}|i,t\} \qquad \Leftrightarrow \\
MPK_{i,t} - J_{i,t} &= b\left(\left[\frac{I}{K}\right]_{i,t} - \frac{1}{2}\left[\frac{I}{K}\right]^2_{i,t} - \psi_{i,t}\left[\frac{I}{K}\right]_{i,t+1}\right) \\
&\quad + \nu_{1i,t} - \psi_{i,t}\nu_{1i,t+1} - b(\nu_{2i,t} - \frac{1}{2}\nu^2_{2i,t} - \psi_{i,t}\nu_{2i,t+1}) + \epsilon_{i,t}
\end{aligned} \tag{15}$$

where

$$J_{i,t} \equiv P^I_{s,t} - \psi_{i,t}P^I_{s,t+1}$$

$$\psi_{i,t} \equiv \frac{1-\delta_{i,t}}{1+r_t}$$

The unobserved terms have been substituted by their realisations. Therefore an error term, $\epsilon_{i,t}$, with mean zero and uncorrelated with the information set available to the firm at time t, is added to the equation. In case of non-constant-returns-to-scale the term Y/K appears. It is further possible to include credit constraints, in the sense that the interest rate depends on the debt-to-capital ratio (see Bond and Meghir (1994) or for a full derivation Barrán and Peeters (1998)), by which a debt-to-capital ratio (squared) appears in the equation. The final reduced form solution is given by (10).

The dynamic model (10) is equivalent to the one by Bond and Meghir (1994) iff $\nu_{1i,t-i} = 0$ for i=0,1, and $\nu_{2i,t}$ equals a constant. Bond and Meghir estimate it without the price variable J. Further, time-, sector- and individual effects are included and said to cover the price effect. To eliminate the fixed effects the model is estimated in first differences.

The model estimated by Bond and Meghir is re-arranged in such a way that the term $(I/K)_{i,t+1}$ is on the left side of the equality sign, instead of $MPK-J$. We have two strong reasons for not following this approach. First, by explaining I/K instead of $MPK - J$ the adjustment cost specification (6) is very strongly relied upon[15]. By explaining $MPK - J$, on the other hand, it can be tested whether adjustment costs are significant. This is the case if γ_1 is significant since γ_1 equals b divided by the elasticity of demand, see above. Secondly, the form of (13) is kept, in that the gap between marginal returns and user costs are explained by the adjustment costs, liquidity constraints, and uncertainty effects that are to be

[15] In this case the terms $(I/K)_{i,t}$ and $(I/K)^2_{i,t}$ on the right hand side should theoretically have a coefficient that is larger than one and a coefficient smaller than zero, respectively. In this case all coefficients are divided by the adjustment cost parameter b. So, it is not possible to test for the non-significance b. Many empirical studies show very different parameter estimates, probably due to the adjustment cost specification.

included in the ν's. So the effect of uncertainty on the gap between the marginal product of capital and the user costs is analyzed, and its effect on investment is thus only derived indirectly.

In our further analyses and in contrast with most other studies, price variable J is included. This is according to the model, and moreover, including it is different from replacing it by time-, sector-dummies and fixed effects because only *one* parameter is estimated for a variable that is sector-time dependent instead of S + T (= the number of sector + the number of years). Moreover, the interest rate and depreciation rate are observed. A final reason is that the uncertainty effect of these variables is measured, that might interfere with the level effect.

B Appendix : Justification Inclusion Uncertainty Effects

The first order conditions of the profit maximizing model (4) are given as

$$\tilde{F}_{Ki,t} = \frac{\tilde{p}^{In}_{i,t}}{\tilde{p}_{i,t}} - \psi_{i,t}\frac{\tilde{p}^{In}_{i,t+1}}{\tilde{p}_{i,t+1}}, \tag{16}$$

where $\tilde{F}_{Ki,t}$ represents the marginal capital productivity, $\tilde{p}_{i,t}$ the nominal output price, $\tilde{p}^{In}_{i,t}$ the nominal input price and $\psi_{i,t}$ is as defined in (15). For the sake of simplicity, perfect foresight is assumed and adjustment costs are assumed to be zero here, i.e. $b = 0$ in (6). So (9) has boiled down to (16).

We consider demand uncertainty, that affects the marginal productivity, and price uncertainties, being output and investment prices. So it can be assumed that

$$\tilde{F}_{Ki,t} \equiv F_{Ki,t} + \kappa_1\sigma^s_{i,t}, \qquad \tilde{p}^{In}_{i,t} \equiv p^{In}_t + \kappa_2\sigma^I_{i,t}, \qquad \tilde{p}_{i,t} \equiv p_{i,t} + \kappa_3\sigma^p_{i,t}, \tag{17}$$

where $\sigma^s_{i,t}, \sigma^I_{i,t}, \sigma^p_{i,t}$ are the standard deviations of sales, output prices and investment prices (possibly dependent on time t), and all κ's are in between (about) -2 and 2. In case of no demand and price uncertainty, that is the standard case, all σ's are zero. In the case of uncertainty, the marginal productivity and prices can vary between the average value and $\pm 2\sigma_{i,t}$.

From substituting (17) in (16) it follows that

$$F_{Ki,t} = \frac{p^{In}_{i,t}}{p_{i,t}} - \psi_{i,t}\frac{p^{In}_{i,t+1}}{p_{i,t+1}} + \nu_{i,t} - \psi_{i,t}\nu_{i,t+1} \quad \text{where} \tag{18}$$

$$\nu_{i,t} - \psi_{i,t}\nu_{i,t+1} \equiv -\kappa_1\sigma^s_{i,t} + \frac{\kappa_2\sigma^I_{i,t}}{p_{i,t} + \kappa_3\sigma^p_{i,t}} - \frac{\kappa_3\sigma^I_{i,t}p^I_{i,t}}{p^2_{i,t} + \kappa_3\sigma^p_{i,t}p_{i,t}} - \psi_{i,t}\left[\frac{\kappa_2\sigma^I_{i,t+1}}{p_{i,t+1} + \kappa_3\sigma^p_{i,t+1}} + \frac{\kappa_3\sigma^I_{i,t+1}p^I_{i,t+1}}{p^2_{i,t+1} + \kappa_3\sigma^p_{i,t+1}p_{i,t+1}} - \right]$$

$$\approx -\kappa_1\sigma^s_{i,t} + \kappa_2\left[\frac{\sigma^I_{i,t}}{p_{i,t}} - \psi_{i,t}\frac{\sigma^I_{i,t+1}}{p_{i,t+1}}\right] - \kappa_3\left[\sigma^p_{i,t}\frac{p^I_{i,t}}{p^2_{i,t}} - \psi_{i,t}\sigma^p_{i,t+1}\frac{p^I_{i,t+1}}{p^2_{i,t+1}}\right]$$

In this last step, all small terms have been omitted.

This expression equals (10) where $\gamma_1 = \gamma_2 = \gamma_3 = 0$ and labour is neglected. If we call the right hand side of (18) the "marginal costs", it follows that *current* sales uncertainty, and *current* as well as *future* nominal output price and nominal investment price uncertainty affect these costs. The current uncertainty effects are estimated to be as in (2) or (3), whereas the future uncertainty effects are predicted. The effect they actually have, depends on the κ's that reflect the "risk" attitude of the investors. In case where $\kappa_1 > 0$, sales uncertainty depresses the marginal costs, which is logical as an increase in the expected sales improves the revenues. The higher uncertainty is in this case, the sooner investment is triggered. The same holds for the output price uncertainty (in general, since $\psi_{i,t} < 1$) if $\kappa_3 > 0$. Investment price uncertainty, on the other hand, increases the marginal costs if $\kappa_2 > 0$. In this case there is a tendency to delay investment.

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