Exporter dynamics and investment under uncertainty

Nicolas Berman* Vincent Rebeyrol†

December 2011, preliminary and incomplete

Abstract

This paper studies the way in which the dynamics of exports affect investment at the firm-level. We first develop a simple model to study the investment behavior of firms when both domestic and export sales are uncertain. Two main testable predictions emerge: (i) if foreign markets are inherently more uncertain than the domestic market - due for instance to longer time-to-ship, exchange rate volatility or trade policy - investment should be less responsive to export sales than domestic sales; (ii) if experience in the export market reduces uncertainty about future sales, positive shocks affecting exports may trigger more investment some time after entry. These predictions are supported on a panel of French firms over the period 1986-2001. We also find that exporting experience and uncertainty interact with each other: experience matters more for the most volatile markets, and uncertainty matters more at low levels of experience. In general, these results can be interpreted as evidence supporting the presence of a strong uncertainty associated with entry into foreign markets that eventually vanishes as exporters gain experience on this market.

JEL classification:
Keywords: Export dynamics, uncertainty, investment, productivity

*Graduate Institute of International and Development Studies (IHEID). Address: Case Postale 136, CH - 1211, Geneva 21 - Switzerland. Tel: (0041) 22 908 5935. E-mail: nicolas.berman@graduateinstitute.ch.

†Toulouse School of Economics. Address: Manufacture des Tabacs, 21, Allée de Brienne, 31000 Toulouse France. E-mail: vincent.rebeyrol@tse-fr.eu

1 Introduction

New exporters start small and their exit rate is high in the first years.[1] This has been interpreted as reflecting the high uncertainty associated with entry into new markets. On the other hand, firms that manage to remain exporters grow quickly after entry and their exit rate decreases dramatically three to four years after entry (Eaton *et al.*, 2007). These dynamics of successful exporters suggest that uncertainty is progressively resolved as firms gain experience in the foreign market.

Since the early contribution of Arrow (1968), uncertainty is recognized to play an important role on the investment behavior of firms, as long as those investments are at least partly irreversible. Higher uncertainty should lead firms to delay investment because of the existence of a positive "option value of waiting" (McDonald and Siegel, 1986, Dixit and Pindyck, 1994). In addition, uncertainty makes investment behavior more cautious and less responsive to sales variations (Pindyck, 1988, Bloom *et al.*, 2007).

This paper links these two strands of the literature by studying the impact of domestic and foreign demand uncertainty on the investment behavior of new exporters. We first develop an illustrative model of irreversible investment under uncertainty, in line with the literature, to highlight how a possible different level of uncertainty in the domestic and in the export market affects the investment behavior of exporters. We derive two clear testable implications. First, if foreign markets are inherently more uncertain than the domestic one - due for instance to longer time-to-ship, exchange rate volatility or trade policy - investment should be less responsive to shocks affecting foreign sales than domestic sales. Second, if exporters accumulate information as they gain experience on the foreign markets, demand shocks affecting foreign sales should affect more investment some time after entry. In general, this implies that export dynamics influence firms' investment behavior in a different way than domestic sales do.

These predictions are tested using firm-level data on French firms over the period 1986-2001. Our dataset contains in particular balance-sheet information on both export and domestic sales, as well as capital stock and investment. For a significant share of the observations, investment is zero, which allows to test our theoretical predictions not only on the size, but also on the

[1]For instance, using Colombian data, Eaton *et al.* (2007) report an exit rate around larger than 60% after one year, but this number drops to 20-25% after two years or more. As shown later, similar patterns emerge in our French data, although the exit rate is lower the first year (around 50%). See also Albornoz-Crespo *et al.* (2010).

existence of investment. Our theory is supported by the data: (i) investment react significantly more to domestic than to foreign sales variations (ii) investment reacts more to export sales when uncertainty (as proxied by a sector-specific measure of export growth volatility) is low, and as the firm gains experience on the foreign markets. This is true both for the investment rate and the investment probability. Finally, export experience and uncertainty interact with each other: experience matters more for the more volatile markets, and uncertainty matters more at low levels of experience. In general, these results can be interpreted as evidence supporting the presence of a strong uncertainty associated with entry into foreign markets that eventually vanishes as exporters gain experience on this market. They also suggest an effect of the export dynamics on firm-behavior and characteristics.

Our paper first relates to the real options literature, which suggests that investment reacts less to demand shocks at higher levels of uncertainty, as firms place a greater value on the option of waiting. The main idea of these papers is to outline the additional value for the firm of being able to choose when to invest, rather than being in a "now-or-never" situation with respect to a possible investment. If a firm can wait for new information to arrive before deciding to pursue an irreversible investment, it can avoid potentially large losses by foregoing the investment when the outcome is unfavorable. Hence, a result from option-pricing applies to irreversible investments: the greater the uncertainty in an investment's expected future cash flows, the more valuable is the option to delay the investment. This literature both considers the timing and the size of investments (and so the evolution of the optimal capital stock) under uncertainty. [2] This issue is closely related to our paper as we study the reaction of the investment rate of new exporters to demand shocks at home and abroad.[3]

On the empirical side, the real option literature has also generated a lot of attention.[4] Our paper is methodologically close to Bloom *et al.* (2007), who investigate the firms' investment rate response to demand shocks for different level of uncertainty. Using a panel of U.K. publicly

[2]See Pindyck (1988), Abel and Eberly (1998) and Abel *et al.* (1996) for a simple finite-horizon framework.

[3]An important contribution is Pindyck (1988). He presents the firm's problem as a decision to invest in the marginal unit of capital which is valued as a real option. The firm's objective is to choose its optimal capital stock that maximizes firm value. It firm evaluates a succession of options to invest in each additional unit of capital. The firm exercises each investment option consecutively until it reaches its optimal capital stock. When uncertainty is greater, the value of the option to invest in the additional unit of capital increases, which leads to a lower optimal capital stock. Uncertainty therefore makes investment behavior more cautious and less responsive to sales variations. Our model follows this line of research and adapts a simplified version of Abel *et al.* (1996) to the case of new exporters.

[4]See for instance Guiso and Parigi (1999), Ghosal and Loungani (2000) or Boyle and Guthrie (2003).

traded manufacturing companies, they find that a moving from the bottom to the top quartile of uncertainty halves the sensitivity of investment to sales variations. Our results on uncertainty are in line with theirs.

Our paper is also related to the strand of international trade literature documenting the relationships between exporting activities, investment and TFP growth. Exporters have been shown to be larger and more productive than non-exporters, mainly because of a self-selection process, but also, to a lesser extent, to export-related productivity gains.[5] To explain this exporters' performance premium, the literature more recently focused on the complementarity between export market participation and investment. Recent theoretical contributions show that access to foreign markets provides incentives for firms to make productivity-enhancing investments.[6] Empirically, Lileeva and Trefler (2010) found evidence in favor of this hypothesis, especially for small firms, using data on Canadian plants.[7] Our paper complements this literature by showing that the way in which investment (and potentially TFP) reacts to entry into foreign markets may depend on the extent of success (how much exporters grow after entry) and on the length of export market participation.

Finally, our study also relates to a recent papers by Handley (2011) and Handley and Limao (2011), who show that uncertainty about trade policy may negatively affect investment and export participation. Their paper however mainly focuses on entry into export markets, while ours looks at investment decisions, and considers both general uncertainty and the role of exporting experience.

Our results have several implications. The general message of the literature dealing with the effect of uncertainty on investment is that firms are less responsive to monetary or fiscal policies in the presence of uncertainty, for instance in times of crisis. Similarly, our results imply that shocks affecting the export market - aggregate demand shocks, trade policies or exchange rate changes - may have a lower impact on investment than shocks affecting domestic sales. A second implication is that a positive effect of exporting on investment and ultimately on productivity may be observed, but with a lag: while an increase in market size is complementary

[5] A plethoric literature has tried to identify the effect of exporting on TFP - the so-called learning-by-exporting hypothesis-, with mixed results. See Wagner (2007) for a survey. Evidence in favor of learning by exporting effect has been found by Aw *et al.* (2003) for Korea and Taiwan, De Loecker (2007) or Van Biesebroeck (2005) for Sub-Saharan African countries.

[6] See Costantini and Melitz (2009), Atkeson and Burstein or Burstein and Melitz (2011).

[7] Similarly, Verhoogen (2008) found that firms entering foreign markets in Mexico simultaneously upgrade the quality of their products.

to (potentially cost-reducing) investment, this complementarity may be guaranteed for the firm only after some time, once uncertainty has sufficiently vanished. Finally, the effect of exporting on investment, and in turn productivity, may be higher in less volatile sectors, markets, or more during stable periods.

The next section presents a simple model of firm investment under uncertainty in the export market, and derive two testable predictions. Section 3 presents the empirical methodology and estimation issues, and section 4 describe the data used to test our main theoretical predictions. Finally, section 5 contains the empirical results and section 6 concludes.

2 Theoretical illustration: investment under uncertainty in domestic and export markets

We extend a very simple model of investment under uncertainty to highlight the role of an uneven uncertainty between the domestic and export markets. We only model the investment behavior of a firm conditional on its entry in the export market. We will assume that experience on the export market decreases firm-specific uncertainty. This may be the case for a number of reasons: the firm could learn about foreign demand, foreign consumers could learn about the firm's products, the firm could rationally pay more attention to foreign demand signals as it ages in these markets etc.[8] In line with our empirical analysis, we focus on the investment responses to demand shocks on domestic and export markets of firms facing different (exogenous) levels of uncertainty in each of these markets.

2.1 Assumptions

The firm faces an isoelastic demand in market i ($i = D, X$) at time t: $Q_{it} = A_{it}P_{it}^{-\varepsilon}$, where $\varepsilon > 1$ is the price elasticity of demand, assumed to be identical across markets.[9] A_{it} is a scale demand parameter. The production function is Cobb-Douglas: $Y_t = K_t^{\beta}L_t^{1-\beta}$, where L denotes labor, K capital and $1-\beta$ the labor share, with $\beta < 1$. The output is non storable. The firm can purchase capital at a constant price k but is unable to sell capital, i.e. the capital stock is

[8] Experienced exporters may also react more to change in exports because of their more diversified structure of exports (experienced exporters sell on average more products to more markets), which would limit the aggregate uncertainty they perceive on the export market. In our empirical analysis, we run some robustness checks controlling for firm export size to ensure our results are not driven by this effect.

[9] Introducing different elasticities doesn't add to the model, as long as price elasticities are constant.

irreversible. The capital stock does not depreciate and thus depends only on the firm purchases of capital. Labor is assumed to be a completely flexible factor of production with a price w. In each period, the firm observes demand at home (A_{Dt}) and abroad (A_{Xt}) and then decides its level of investment. We denote I_t the purchase of capital at time t: $K_t = K_{t-1} + I_t$. Using the fact that $Q_{Dt} + Q_{Xt} = Y_t = (A_{Dt} + A_{Xt}) P_t^{-\varepsilon}$, the profit function, where labor has been maximized out, is given by:[10]

$$\pi_t = a (A_{Dt} + A_{Xt})^{1-\alpha} (K_{t-1} + I_t)^{\alpha} - kI_t$$

where $\alpha = \frac{\beta(1-1/\varepsilon)}{1-B} < 1$, $a = \left(\frac{B}{w}\right)^{\frac{B}{1-B}} (1-B)$ and $B = (1-\beta)(1-1/\varepsilon)$. We label $A_t = A_{Dt} + A_{Xt}$.We further assume for simplicity that uncertainty in each period is reflected by only two possible states of demand: "good" with probability p or "bad" with probability $(1-p)$. If "good news" arrive, this will true for both markets.[11] Demand shocks in each market are proportional to demand. We get:

$$A_{t+1} = \begin{cases} A_{t+1}^{+} \equiv A_{Dt}(1+\theta+\frac{\lambda_D}{p}) + A_{Xt}(1+\theta+\frac{\lambda_X}{p}) & \text{with proba } p \\ A_{t+1}^{-} \equiv A_{Dt}(1+\theta-\frac{\lambda_D}{1-p}) + A_{Xt}(1+\theta-\frac{\lambda_X}{1-p}) & \text{with proba } (1-p) \end{cases},$$

where θ is the expected growth rate of total demand and $\lambda_i > 0$ is the uncertainty parameter for market i, $i = D, X$. The higher λ_i, the higher the uncertainty about future demand in that market: with our formulation, an increase in λ_i induces a mean preserving spread of A_{t+1}.

2.2 Firm investment behavior

Following Abel *et al.* (1996), we consider a 2 period framework. We think about the first period as the years around entry in the export market when uncertainty can be substantial, and the second as being some time after entry. In period t, the firm is endowed with a capital stock K_{t-1} and observes A_t. It then decides whether to purchase capital and how much, while facing uncertainty on the next period's demand. In period $t+1$, the second and final period, the firm

[10]It is worth to note that the optimal capital stock the firm chooses could be easily reinterpreted as a choice of a performance measure, would it be productivity or quality. Labeling $\varphi_t \equiv K_t^{1/\alpha}$, we would get: $\pi_t = a (A_D + A_X)^{1-\alpha} \varphi_t - k\left(\varphi_t^{1/\alpha} - \varphi_{t-1}^{1/\alpha}\right)$. Sales linearily increase with φ, the performance measure of the firm and the firm incurs convex adjustment costs ($\frac{1}{\alpha} > 1$) to increase φ.

[11]This assumption is made to ease exposition only, i.e. to avoid the description of four possible states of aggregate demand next period. The impact of domestic and export uncertainty would however be similar to what we present here.

does not face anymore uncertainty by construction. Hence in period $t+1$ we get:

$$\max_{I_{t+1}} \pi_{t+1} = aA_{t+1}^{1-\alpha} (K_t + I_{t+1})^{\alpha} - kI_{t+1}$$
$$\Rightarrow I_{t+1}^{*} = \left(\frac{\alpha a}{k}\right)^{\frac{1}{1-\alpha}} A_{t+1} - K_t \text{ if } I_{t+1} \geq 0$$

The firm chooses I_{t+1} to equalize the marginal revenue of capital with the user cost of capital. The firm therefore makes a positive investment only if the realization of A_{t+1} is large enough compared to the capital stock K_t.

In period t, the firm chooses I_t to maximize its net present value at time t (NPV_t). This corresponds to the current profits, plus the uncertain profits in period $t+1$. The NPV has to take into account future expected profits flows, but also the option for the firm to make additional investments in the future if "good" news arrive. The NPV should therefore distinguish the impact of the current decision (I_t^*) on the future decision (I_{t+1}^*), for any possible realization of demand at time $t+1$.[12] If the firm makes a positive investment at time $t+1$ only when good news arrive, the firm has to maximize the following NPV:

$$\begin{aligned} \max_{I_t} NPV_t &= aA_t^{1-\alpha} (K_{t-1} + I_t)^{\alpha} - kI_t + p\left[aA_{t+1}^{+1-\alpha} \left(K_t + I_{t+1}^{*}\right)^{\alpha} - kI_{t+1}^{*}\right] + (1-p)\left[aA_{t+1}^{-1-\alpha} (K_{t-1} + I_t)^{\alpha}\right], \\ \text{if } I_{t+1}^{*} &\geq 0 \text{ when } A_{t+1} = A_{t+1}^{+} \end{aligned}$$

This yields the following first order condition:

$$\frac{\partial NPV_t}{\partial I_t} = 0 \Leftrightarrow \underbrace{a\alpha (K_{t-1} + I_t)^{\alpha-1} \left(A_t^{1-\alpha} + E[A_{t+1}^{1-\alpha}]\right)}_{\text{expected MRK}} = \underbrace{k}_{\text{user cost of K}} + \underbrace{p\left(a\alpha (K_{t-1} + I_t)^{\alpha-1} A_{t+1}^{+1-\alpha} - k\right)}_{\text{option value}} \quad (1)$$

where $E[A_{t+1}^{1-\alpha}] = pA_{t+1}^{+1-\alpha} + (1-p) A_{t+1}^{-1-\alpha}$. The firm chooses the level of investment that equalizes the expected marginal revenue of capital to the user cost of capital, *plus* the value of the option to invest in period $t+1$. It appears in a straightforward way that the option value increases with uncertainty (an increase in $A_{t+1}^{+1-\alpha}$ keeping $E[A_{t+1}^{1-\alpha}]$ constant). The option value also decreases with the capital stock $K_t = K_{t-1} + I_t$. This yields the optimal investment at

[12] Note that in this framework, where we have assumed no time discounting and a constant user cost of capital, investment cannot be positive at time $t+1$ with certainty. Any investment at $t+1$ that is certain should be done at t to also increase profits at t.

time t:

$$I_t^* = \left(\frac{A_t^{1-\alpha} + E[A_{t+1}^{1-\alpha}] - pA_{t+1}^{+1-\alpha}}{(1-p)} \right)^{\frac{1}{1-\alpha}} \left(\frac{a\alpha}{k} \right)^{\frac{1}{1-\alpha}} - K_{t-1} \tag{2}$$

We have assumed that the firm invests at $t+1$ only if "good news" arrive. This is the case only if $(1-p)\left(A_{t+1}^{+1-\alpha} - A_{t+1}^{-1-\alpha}\right) \geq A_t^{1-\alpha}$, i.e. if there is enough uncertainty compared to the current level of demand.[13]

2.3 Demand shocks on domestic and foreign markets

To highlight the role of uncertainty in each market on the firm's investment, note that the extensive expression for the optimal firm investment is:

$$I_t^* = \left(\frac{a\alpha}{(1-p)\,k} \right)^{\frac{1}{1-\alpha}} \left(A_t^{1-\alpha} + (1-p) \left(A_t\,(1+\theta) - \frac{\lambda_D}{1-p} A_{Dt} - \frac{\lambda_X}{1-p} A_{Xt} \right)^{1-\alpha} \right)^{\frac{1}{1-\alpha}} - K_{t-1}$$

First, this expression makes clear that investment will react differently to demand shocks on the domestic and export market if and only if $\lambda_D \neq \lambda_X$.

Second, recent empirical evidence shows that the exit rate of new exporters is very high in the first years and by far larger than the exit rate on the domestic market. This exit rate of the export market declines as firms gain experience in these markets. Moreover, export growth tends to be high in the first years and declines as surviving firms get more experience.[14] These stylized facts have been interpreted as evidence of (i) a higher uncertainty in the export market compared to the domestic market (i.e. $\lambda_X > \lambda_D$) and (ii) a decline of uncertainty

[13] This condition has a simple interpretation. Investment at $t+1$ will be positive with a high demand realization as long as the option value is positive. Note that the firm faces a trade off at the margin, for a given capital stock at time t. On the one hand, investing an extra unit of capital increases firm revenue at t with certainty. Waiting next period to invest this extra unit has therefore a cost: the cost of waiting. On the other hand, not investing this extra unit today allows to keep alive the option to invest it tomorrow in case of good news and to avoid "regrets" in case of bad news. This is the value of waiting. The optimal strategy of the firm is to invest as long as the cost of waiting is larger than the value of waiting. If $(1-p)\left(A_{t+1}^{+1-\alpha} - A_{t+1}^{-1-\alpha}\right) < A_t^{1-\alpha}$, the revenue from an additional unit of capital invested at t (proportional to $A_t^{1-\alpha}$), is always higher than the possible revenue loss if bad news arrive (proportional to $\left(A_{t+1}^{+1-\alpha} - A_{t+1}^{-1-\alpha}\right)$). It is easy to check that in that case, the value of the option of delaying investment is never positive.

[14] In our data, the exit rate is around 60% one year after entry, but goes down to 15% or less the following years. The export growth is 31% on average the first year, 20% the second year, and around 7% after four year or more.

in the export market for firms that survive (i.e. λ_X declines with firm's age in the export market). Following this empirical evidence, we incorporate these parameters characteristics into the above investment expression and obtain two testable predictions about the probability of a positive investment and its size:

Testable Prediction 1. *If $\lambda_X > \lambda_D$, the probability of a positive investment and the investment rate are less sensitive to demand shocks in foreign markets than in the domestic market.*

Testable Prediction 2. *If λ_X declines with exporters' experience, the probability of a positive investment and the investment rate are more sensitive to demand shocks in the foreign market for more experienced firms in those markets.*

These predictions have several implications. First, changes in foreign market conditions should have less impact on investment than those on the domestic market. It follows that policies aiming at increasing investment through boosting exports would be less effective than those targeting the domestic market. Second, changes in foreign market conditions may have a small impact on investment if aggregate uncertainty is substantial. This impact should also be different between firms: it will be more limited for the least experimented exporters. It follows that the age structure of firms in the export market should matter. One possible consequence is that the investment response to a trade liberalization/agreement will be delayed and increasing over time.

3 Empirical Methodology

3.1 An error correction specification

Our empirical methodology follows existing literature, in particular on Bloom *et al* 2007 (see also Bond et al. 2003). We estimate a reduced form error correction model (ECM) to test the impact of export experience on investment's reaction to demand shocks. The error-correction model was first introduced into the investment literature by Bean (1981). The idea of this specification is to allow for a flexible adjustment of the capital stock in the short-run while the capital stock converges towards its long-run equilibrium value. This suits particularly our hypothesis that uncertainty decreases with the firm export experience (and age): in the long run (second period in the model), the capital stock of the firm converges towards its optimal

value in a frictionless world (without uncertainty nor irreversibility). Moreover, Bloom (2000) shows that the actual capital stock series chosen by a firm under partial irreversibility has a long run growth rate equal to that of the hypothetical capital stock series that the same firm would choose under costless reversibility, because the gap between these two series is bounded.

The hypothetical optimal capital stock with no uncertainty nor irreversibility can be expressed in log as:[15]

$$k_{it}^{*} = y_{it} + \Psi_i + d_t \tag{3}$$

where k_{it}^{*} denotes the natural log of the desired capital stock for firm i in period t, y_{it} the log of total output, and Ψ_i and Υ_t represent firm and time specific fixed effects. These in particular are supposed to capture the variations in the user cost of capital across firms and over time, as well as an heterogeneity in their mark-ups. This formulation is consistent with a frictionless demand for capital for a firm with a Cobb-Douglas production function and facing an iso-elastic demand, as assumed in our model.

The general idea of the ECM formulation is to nest this long run specification into a model that allows to study short-run dynamics. Following a Bloom et al. (2007), we will use a basic error correction formulation derived from and autoregressive distributed lag (ADL(1,1)) model[16]:

$$\Delta k_{it} = k_{it} - k_{it-1} = \beta \Delta y_{it} + \theta(y_{i,t-1} - k_{i,t-1}) + \Psi_i + \Upsilon_t \tag{4}$$

Where θ is expected to be positive, reflecting the fact that firm with a below target capital stock are supposed to adjust upwards. Our main theoretical predictions relate to the sensibility of investment to shocks on the export market. To disentangle the impact of domestic and export sales growth, we use the fact that:

[15] in our theoretical example above, we would get the following demand for capital:

$$K_t^{*} = \beta\,(1 - 1/\varepsilon)\,(A_{Dt} + A_{Xt})^{1/\varepsilon}\, Y_t^{1-1/\varepsilon} k^{-1}$$

which would yield in log:

$$k_t = \ln \beta\,(1 - 1/\varepsilon) + 1/\varepsilon \ln\,(A_{Dt} + A_{Xt}) + (1 - 1/\varepsilon) \ln y_t - \ln k$$

[16] The main reason why we only include one lag in our specification is that we want to study the dynamics of investment following entry on the export market. Adding additional lags to the specification would be restrictive, as we would keep only the firms with more than two years of experience on the export market.

$$\Delta y_{it} \approx \frac{Y_{it} - Y_{it-1}}{Y_{it-1}} = \underbrace{\frac{Q^D_{it} - Q^D_{it-1}}{Q^D_{it-1}} \frac{Q^D_{it-1}}{Y_{it-1}}}_{\Delta q^D_{it}} + \underbrace{\frac{Q^X_{it} - Q^X_{it-1}}{Q^X_{it-1}} \frac{Q^X_{it-1}}{Y_{it-1}}}_{\Delta q^X_{it}} \tag{5}$$

where Q^X_{it} and Q^D_{it} represent export and domestic sales respectively. We also make standard approximation that $\Delta k_{it} \approx \frac{I_{it}}{K_{it-1}} - \delta_i$ where δ_i is the depreciation rate, potentially specific to the firm. To control for the possible role of financial constraints, we also introduce current and lagged cash flow (CF_{it}). Our basic specification takes the form:

$$\frac{I_{it}}{K_{it-1}} = \beta^D \Delta q^D_{it} + \beta^X \Delta q^X_{it} + \theta(y_{i,t-1} - k_{i,t-1}) + \pi_1 \frac{CF_{it}}{K_{it-1}} + \pi_2 \frac{CF_{it-1}}{K_{it-2}} + \Psi_i + \Upsilon_t + \varepsilon_{it} \tag{6}$$

To test the effect of uncertainty and experience on the way firms react to demand shocks on the export market, we will add to equation (6) interaction terms between Δq^X_{it} and firm-level experience on the export market (number of years since entry) or sector-specific measures of uncertainty. In the case of experience, our specification becomes:

$$\frac{I_{it}}{K_{it-1}} = \beta^D \Delta q^D_{it} + \beta^X \Delta q^X_{it} + \gamma \Delta q^X_{it} \times EXP + \eta EXP + \theta(y_{i,t-1} - k_{i,t-1}) + ... + \Psi_i + \Upsilon_t + \varepsilon_{it} \tag{7}$$

and we expect γ to be positive if export experience act negatively on the uncertainty perceived by the firm. One issue is worth mentioning here. Our experience variable is strongly correlated with a time trend, as mechanically more firms have a higher experience toward the end of our sample period. This correlation could bias our estimate if for some reason the reaction of investment to demand shocks is changing over time. To capture this, we introduce in specification (7) above an interaction term between Δq^X_{it} and the year variable. We demean the year variable, so that the coefficient on Δq^X_{it} can be interpreted as its effect for the average year of the sample.

Finally, our data also allows us to test the effect of the above interaction on the investment probability, as around 10% of the observations in our sample are zeros. In this case, our estimated equation takes the form:

$$\begin{cases} \Pr(I_{it} > 0) = 1 & \text{if} \quad \beta_p^D \Delta q_{it}^D + \beta_p^X \Delta q_{it}^X + \gamma_p \Delta q_{it}^X \times EXP + ... + \Upsilon_t + \mu_{it} > 0 \\ \Pr(I_{it} > 0) = 0 & \text{otherwise} \end{cases} \tag{8}$$

where "..." includes the same regressors as above.

3.2 Estimation issues

Specification (6) may suffer from a number of biases, principally due to the presence of unobserved firm effects Ψ_i and of the simultaneous determination of investment rate and output variables. While firm effects can be accounted for by using a within estimator, this does not solve the simultaneity bias. The common practice is to use GMM estimator - either "first difference GMM" or "system GMM" - where the right hand side variables are instrumented by their lagged values, and firm unobserved fixed effect wiped-out by first differencing. We follow the literature by using a system GMM estimator (Blundell and Bond, 1998[17]) close to the one used by Bloom et al. (2007) among others. We use the first and second order lags of the regressors as instruments in the first difference equation. Their exogeneity is assessed using a Sargan-Hansen test of overidentifying restrictions, and second-order serial correlation in the first-differenced residuals tested using an LM test (Arellano and Bond, 1991).

Finally, specification (8) will be estimated using a Probit estimator, or alternatively a FE-logit estimator that account for firm-specific unobserved characteristics.

4 Data

Our empirical analysis relies on French firm level data over the period 1986-2001. Our dataset contains balance sheet information from the BRN (Bénéfice Réels Normaux), which relies on fiscal declarations by domestic French firms. The BRN database is constructed from mandatory reports of French firms to the tax administration, which are in turn transmitted to INSEE (the French Statistical Institute). This dataset reports information including firms' total turnover and export turnover, employment, capital stock, investment, value added, the industry, year,

[17]The system GMM estimator, which combines a system of equations in first differences with equations in level, has be shown to be more efficient that the first difference estimator (Arellano and Bond, 1991) when the instruments are exogenous.

and other balance-sheet variables. It contains between 650,000 and 750,000 firms per year over the period - around 60% of the total number of French firms. Importantly, it is composed of both small and large firms, since no threshold applies. A more detailed description of the database is provided by Eaton *et al.* (2004).

As we are interested in the effect of foreign market experience on investment decisions, we keep in the sample only the firms that either export over the whole period or enter the export market at some point. An entrant is defined as a firm that did not export during the last year. We drop the firms that only serve the domestic market the entire period. We use two different measures of export experience. The first assumes that the firm keeps the experience accumulated in case of exit and re-entry. The second, on the contrary, assumes that experience starts again from zero each time the firm exits the markets during at least a year. As shown later, our results tend to support the first measure. Note that we exclude services from the analysis. This is in particular to exclude wholesalers. Finally, we clean the data from the top and bottom percentile of export and domestic sales growth, as well as cash flow and investment, by sector and year. Our final sample includes around 15,000 firms per year on average, and a total of around 50,000 firms. These firms export on average 20% of their total sales.

Table 1: Descriptive statistics

	Mean	S.D.	1st Quartile	Median	3rd Quartile
Number of employees	108.6	694.6	9.00	24.00	63.00
Export propensity	0.21	0.23	0.03	0.11	0.31
Δ ln Export sales	0.06	0.82	-0.24	0.05	0.36
Δ ln Domestic Sales	0.03	0.26	-0.08	0.03	0.15
Investment rate	0.14	0.23	0.03	0.07	0.17

Note: Source: authors' computation from BRN data. Number of observations is 220,425. Number of firms is 49,632. Export propensity corresponds to exports/total sales.

Table 1 contains some descriptive statistics. Our sample contains an important share of small and medium firms, as the first quartile of the number of employees is 9. Export sales growth is much higher that domestic sales growth on average, but also much more volatile. Finally, as mentioned in the previous section that while more than 99% of the firms invest at least once during the period, around 10% of the observations contain zero investment. Note that the presence of a relatively large number of observations with zero investment is a significant advantage of our data, as it allows us to test for the existence of a band of inaction in the

presence of uncertainty. As mentioned earlier, this is a prediction of our model, but also a general conclusion of the option values theories of investment that received little attention from the empirical literature so far (principally because most studies deals with larger or listed firms that never completely stop investing).

Table 2: Descriptive statistics by level of export experience

Experience	mean Δ ln exports	s.d. Δ ln exports	$\Pr(I_{it} > 0)$	# firms	$\Pr(Exit > 0)$
1	-		0.84	29,100	-
2	0.19	1.19	0.87	15,566	0.47
3	0.09	1.06	0.88	10,265	0.34
4	0.04	1.01	0.89	7,300	0.29
5+	0.04	0.87	0.91	5,367	0.26

Note: Source: authors' computation from BRN data. Experience: years since entry into export market. $\Pr(I_{it} > 0)$: share of observations with positive investment.

Table 2 contains more descriptive statistics, organized by level of export experience. These are largely consistent with the existing literature (e.g. Eaton *et al.*, 2007): exit rates rapidly decline with experience, and the firms that manage to stay serving the foreign markets grow quickly during the first years, before slowing down significantly. The variance of export growth across firms also decline with experience. One interpretation would be that uncertainty progressively decreases as firms gain experience, and therefore information, on the foreign markets. Finally, note that the proportion of firms with positive investment significantly increase with export experience: from 84% the year of entry to 91% after 5 years or more. This is also in line with the uncertainty assumption.

5 Results

5.1 Sensitivity of investment to sales variations: export vs foreign sales

The first prediction of our model is that investment should react more to variations in domestic demand than to changes in foreign conditions. This is a direct consequence of the higher uncertainty associated with foreign markets. To assess the relevance of this proposition, we estimate specification (6). Table 3 presents the results. Column (1) and (3) considers the

variations of total sales - therefore presenting the results of a specification very close to the one used by the literature -, while the rest of the estimations split total sales variations into their foreign and domestic components. Columns (3) and (6) add a lagged dependent variable to the regressors. We consider both the full sample (columns 1-3) and the sample restricted to the first that entered (possibly several times) the export market over the period, which will be the sample used in the rest of the paper. This amounts to dropping the firms that are always exporters.

Table 3: Investment sensitivity to export vs domestic sales variations

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:				I_{it}/K_{it-1}		
Sample		All firms			Entrants only	
Δ total sales$_{it}$	0.287^a			0.252^a		
	(0.024)			(0.035)		
Δ exports$_{it}$		0.204^a	0.186^a		0.180^a	0.171^a
		(0.026)	(0.026)		(0.032)	(0.032)
Δ dom. sales$_{it}$		0.240^a	0.222^a		0.230^a	0.222^a
		(0.021)	(0.022)		(0.028)	(0.028)
I_{it-1}/K_{it-2}			0.009^a			0.012^a
			(0.002)			(0.002)
$y_{t-1} - k_{t-1}$	0.289^a	0.284^a	0.267^a	0.268^a	0.279^a	0.274^a
	(0.021)	(0.022)	(0.023)	(0.033)	(0.032)	(0.033)
Difference in coef. (1)		-0.036^a	-0.036^a		-0.050^a	-0.051^a
Estimator				GMM-SYS		
Observations	219197	219197	219197	65374	65374	65374
Serial correlation (p-value)	0.00	0.00	0.00	0.15	0.14	0.38
Hansen (p-value)	0.00	0.00	0.00	0.10	0.13	0.44

Robust Standard errors in parentheses. ^{c} significant at 10%; ^{b} significant at 5%; ^{a} significant at 1%. All estimations include year dummies. Δ exports$_{it} = \frac{X_t - X_{t-1}}{X_{t-1}} \times \frac{X_{t-1}}{Y_{t-1}}$; Δ dom. sales$_{it} = \frac{D_t - D_{t-1}}{D_{t-1}} \times \frac{D_{t-1}}{Y_{t-1}}$. GMM-SYS: Blundell and Bond (1998) GMM estimator. Instruments used in these estimations are the first and second lags of all regressors. Coefficients on cash flow and its lag not reported. Instrument validity tested using a Sargan-Hansen test of the overidentifying restrictions. Second-order serial correlation in the first-differenced residuals tested using an LM test (Arellano and Bond, 1991). (1) Significance test of the difference in coefficients of Δ exports$_{it}$ $-$ Δ dom. sales$_{it}$

The results of the baseline estimations (1) and (3) are very close the typical estimates of the literature. All variables display the expected signs. Investment is found to react positively to an increase in total sales growth. The cash flow variables (not reported in the table for clarity) are also found to have a positive impact, suggesting that investment is to some extent affected by the existence of financial constraints. More importantly, the coefficient on the long-run term $(y_{t-1} - k_{t-1})$ is positive and significant as expected, suggesting that firms with a capital stock

below desired level invest more.

More interesting is the difference between the response of investment to domestic versus export sales variations, shown in columns (2), (3), (5) and (6). In all specifications, both variables have a positive effect on investment rate, but domestic sales are found to have a larger impact on investment. The difference in coefficients is significant at the 1% level in all specifications.[18] This is consistent with the idea that the foreign market is associated with higher uncertainty, making investment less reactive to changes in economic conditions. Moreover, this difference in particularly pronounced when we restrict the sample to entrants, which is also consistent with the idea that export experience dampens the higher uncertainty faced on foreign markets. In the next section, we study more specifically the role of export experience on investment.

5.2 Export experience and the sensibility of investment to demand shocks

Table 4 shows the results of the estimation of specification (7), where we explicitly look at the way in which the experience accumulated on the export market affect the investment response to demand shocks. Columns (1) to (4) considers only firms that enter only once over the period, while columns (5) and (6) include also the firms that enter and exit several times. The exogeneity of the instruments cannot be rejected in all columns, as shown by the Sargan-Hansen p-value which is between 0.19 and 0.68. Note also that we cannot detect significant evidence of second order serial correlation.

In columns (1) to (4), export experience is found to increase the response of investment to changes in exports. The coefficient on the interaction term is significant at the 1% including when the log of experience is considered instead of the level (column (4)). Assuming that the effect found in columns (1) to (3) is linear (which will be supported by additional estimations below), our results would suggest that the effect of variations in exports is no longer statistically different from the effect of domestic sales after 9 years of export experience. Note that the effect of domestic sales does not vary with export experience, as shown in column (2). This comforts

[18] The variables Δ exports$_{it}$ and Δ dom. sales$_{it}$ have different standard deviations. We have tried to standardized both variables by subtracting their mean and dividing by their standard deviations to make their coefficient more comparable. The results are qualitatively similar: a one standard deviation increase in Δ exports$_{it}$ always has a significantly lower effect that a one standard-deviation increase in Δ dom. sales$_{it}$. Results are available upon request.

Table 4: Investment and export experience

Dep. Var.:	(1)	(2)	(3) I_{it}/K_{it-1}	(4)	(5)	(6) I_{it}/K_{it-1}
Sample	Single entries				Single+multiple entries	
Experience type (a)					I	II
Δ exports$_{it}$	0.138^a	0.139^a	0.138^a	0.114^a	0.135^a	0.146^a
	(0.034)	(0.034)	(0.034)	(0.037)	(0.031)	(0.030)
Δ exports$_{it}$ $\times$ experience	0.010^a	0.010^a	0.011^a		0.008^b	0.006
	(0.004)	(0.004)	(0.004)		(0.004)	(0.004)
Δ exports$_{it}$ $\times$ ln experience				0.053^a		
				(0.020)		
Δ dom. sales$_{it}$	0.242^a	0.246^a	0.244^a	0.241^a	0.223^a	0.224^a
	(0.023)	(0.027)	(0.023)	(0.023)	(0.024)	(0.024)
Δ dom. sales$_{it}$ $\times$ experience		-0.001			-0.001	-0.001
		(0.003)			(0.003)	(0.002)
Experience	-0.002	-0.002	-0.001		-0.003^a	-0.003^a
	(0.002)	(0.002)	(0.002)		(0.001)	(0.001)
ln experience				-0.012^c		
				(0.007)		
I_{it-1}/K_{it-2}			0.013^b			
			(0.005)			
$y_{t-1} - k_{t-1}$	0.278^a	0.280^a	0.284^a	0.279^a	0.247^a	0.246^a
	(0.033)	(0.033)	(0.033)	(0.032)	(0.028)	(0.028)
Estimator	GMM-SYS				GMM-SYS	
Observations	43851	43851	43851	43851	65333	65333
Serial correlation (p-value)	0.32	0.31	0.67	0.31	0.18	0.18
Hansen (p-value)	0.33	0.68	0.42	0.44	0.19	0.21

Robust Standard errors in parentheses. ^{c} significant at 10%; ^{b} significant at 5%; ^{a} significant at 1%. All estimations include year dummies and an interaction term between Δ exports$_{it}$ and year (year is demeaned). Δ exports$_{it} = \frac{X_t - X_{t-1}}{X_{t-1}} \times \frac{X_{t-1}}{Y_{t-1}}$; Δ dom. sales$_{it} = \frac{D_t - D_{t-1}}{D_{t-1}} \times \frac{D_{t-1}}{Y_{t-1}}$. Experience: number of years since entry on export market. GM-SYS: Blundell and Bond (1998) GMM estimator. Instruments used in these estimations are the first and second lags of all regressors. Coefficients on cash flow and its lag not reported. Instrument validity tested using a Sargan-Hansen test of the overidentifying restrictions. Second-order serial correlation in the first-differenced residuals tested using an LM test (Arellano and Bond, 1991). (a) Experience type I: Export experience is kept in case of exit and re-entry. Experience type II: experience is lost in case of exit and re-entry.

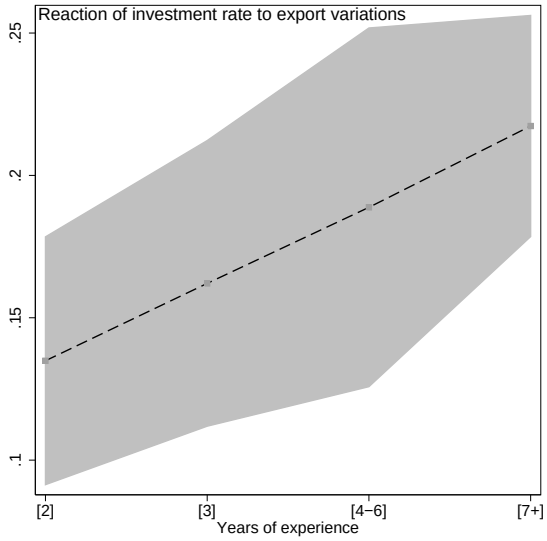
us in the fact that we are not capturing changes in firms' age (experience in general), but indeed experience related to the foreign markets.

In columns (5) and (6) we include in the sample the firms that enter several times the export market. This raises issues about of the computation of the export experience. As mentioned previously, we consider two alternative definitions. In column (5), we assume that each times a firm enters the market, it starts with the level of experience which prevailed the last time it exited. In column (6) we assume that experience is lost each time the firm exits: it starts to

zero again at each entry.

Two results emerge from these estimations. First, only the interaction between exports and the first type of experience is significant in column (5). This suggests that firms keep to some extent the experience accumulated before exiting. Second, even in column (5), the size and significance of the interaction term is lower than when considering only unique entries. This suggests that some (but not all) information accumulated through experience is lost in the process of exiting and re-entering the market.

Figure 1: Effect of export growth on investment rate, by experience level



In figure 1 we estimate the effect of experience using a less parametric specification. More precisely, we split the export experience variable into four bins corresponding to the four quartiles of its distribution, and replace the above interaction with a set of interaction terms between export growth and these bins of experience. Figure 1 show the coefficients for a specification with four interaction terms, together with 90% confidence bands. The figure exhibits a clear positive trend. The first coefficient on export growth is found to be around 0.13 for the first group of firms, and goes up to 0.21 for the most experimented firms. The shape of the curve in figure 1 also confirms that the linearity assumption made previously is likely to be satisfied.

5.3 Robustness

Table 5 contains a number of robustness exercises. The effect of experience that we emphasized in the previous section can be due to an increase of uncertainty, as we argue, or to other firm-specific elements that may be correlated with export experience.

First, the more experienced exported may be on average firms that export more, or that have more diversified exports. This may affect the uncertainty they face - or their risk aversion - and make them more responsive to changes in demand, but in this case there would be no role of experience on the uncertainty face on market served by the firms. Columns (1) to (4) include in our estimations variables that capture the size of the firm's exports, either at the time of entry (columns (1) and (2)) or later on (columns (3) and (4)). The value of initial exports has no significant effect on investment or on the way investment reacts to changes in exports (columns (1) and (2)). On the other hand, the investment rate of firms with a higher lagged value of exports reacts more to changes in exports (column (3)), but the coefficient on this interaction term becomes insignificant when we introduce the interaction between changes in exports and experience. This suggest that alternative mechanisms such as export diversification do not explain our findings.

Another possibility is that firm learn about the foreign markets and make their investment decisions after observing how well they perform compared to their competitors, not only their export growth. In column (5) we introduce the changes in the domestic and foreign market shares of the firm[19]. Only the domestic market share has a positive and significant sign. The interaction term between export growth and experience remains positive and significant (column (6)).

5.4 Investment probability

.

Table 6 contains the results of probabilistic estimations of specification (8). We use alternatively a probit specification (columns (1), (2), (4) and (5)) or a FE-logit (columns (4) and (6)). Marginal effects, computed at means, are reported for the probit specifications.

Our previous results are also observed for the probability to invest. In column (1), we show

[19]The domestic market share is computed as the share of the firm's sales in the total sales of French firms of the same 3-digit sector during year t. The export market share is the share of the firm's sales in the total foreign sales of French firms of the same 3-digit sector during year t.

Table 5: Investment and export experience: robustness

Dep. Var.:	(1)	(2)	(3)	(4)	(5)	(6)
			I_{it}/K_{it-1}			
Δ dom. sales$_{it}$	0.269^a	0.238^a	0.261^a	0.248^a		0.223^a
	(0.023)	(0.023)	(0.020)	(0.022)		(0.027)
Δ exports$_{it}$	0.217^a	0.157^a	0.052	0.043		0.123^a
	(0.047)	(0.046)	(0.071)	(0.054)		(0.034)
Δ exports$_{it}$ $\times$ Experience		0.010^b		0.007^c		0.010^b
		(0.004)		(0.004)		(0.004)
ln init. exports$_{it}$	-0.012	-0.005				
	(0.017)	(0.013)				
Δ exports$_{it}$ $\times$ ln init. exports$_{it}$	-0.002	-0.003				
	(0.005)	(0.005)				
ln exports$_{i,t-1}$			-0.015^b	-0.015^a		
			(0.007)	(0.005)		
Δ exports$_{it}$ $\times$ ln exports$_{i,t-1}$			0.016^b	0.011		
			(0.008)	(0.007)		
Δ Export Market share$_{it}$					0.600	2.877^c
					(0.563)	(1.694)
Δ Export Market share$_{it}$ $\times$ Experience						-0.387^c
						(0.210)
Δ Dom. Market share$_{it}$					1.336^c	0.377
					(0.747)	(0.385)
Export experience		-0.002		-0.001		-0.002^c
		(0.002)		(0.002)		(0.001)
$y_{t-1} - k_{t-1}$	0.321^a	0.274^a	0.312^a	0.292^a	0.142^a	0.254^a
	(0.032)	(0.033)	(0.028)	(0.032)	(0.037)	(0.034)
Observations	43851	43851	43851	43851	43851	43851
Estimator			GMM-SYS			
Serial correlation (p-value)	0.27	0.32	0.24	0.27	0.18	0.30
Hansen (p-value)	0.12	0.26	0.20	0.40	0.03	0.26

Robust Standard errors, in parentheses. ^{c} significant at 10%; ^{b} significant at 5%; ^{a} significant at 1%. All estimations include year dummies and estimations (4) and (5) include an interaction term between Δ exports$_{it}$ and year (year is demeaned). Δ exports$_{it} = \frac{X_t - X_{t-1}}{X_{t-1}} \times \frac{X_{t-1}}{Y_{t-1}}$; Δ dom. sales$_{it} = \frac{D_t - D_{t-1}}{D_{t-1}} \times \frac{D_{t-1}}{Y_{t-1}}$. Experience: number of years since entry on export market. GM-SYS: Blundell and Bond (1998) GMM estimator. Instruments used in these estimations are the first and second lags of all regressors. Coefficients on cash flow and its lag not reported. Instrument validity tested using a Sargan-Hansen test of the overidentifying restrictions. Second-order serial correlation in the first-differenced residuals tested using an LM test (Arellano and Bond, 1991).

that this probability is much less sensitive to exports than to domestic sales variations. The marginal effect for export is only half of the domestic sales one. In the rest of the columns, we find that experience significantly increases the response to export growth. The effect is quantitatively similar as the one found previously. Finally, as it was the case for the investment

rate, this result is more robust for the first type of experience.

Table 6: Export experience and the probability to invest

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	$\Pr(I_{it}/K_{it-1}>0)$		$\Pr(I_{it}/K_{it-1}>0)$			
Sample	Single entries		Single+multiple entries			
Experience type (a)			I		II	
Δ exports$_{it}$	0.081^a	0.029	0.027	0.141	0.036	0.596
	(0.021)	(0.035)	(0.031)	(0.405)	(0.030)	(0.384)
Δ dom. sales$_{it}$	0.152^a	0.100^a	0.102^a	0.449^b	0.101^a	0.476^b
	(0.009)	(0.015)	(0.013)	(0.211)	(0.013)	(0.211)
Δ exports$_{it}$ $\times$ Experience		0.013^b	0.013^b	0.124^c	0.012^b	0.043
		(0.006)	(0.006)	(0.006)	(0.006)	(0.069)
Experience		0.004^a	0.004^a	-0.028	0.004^a	-0.016
		(0.000)	(0.000)	(0.037)	(0.000)	(0.016)
Δ dom. sales$_{it}$ $\times$ Experience		0.009^a	0.008^a	0.156^a	0.008^a	0.150^a
		(0.003)	(0.003)	(0.036)	(0.002)	(0.036)
$y_{t-1}-k_{t-1}$	-0.020^a	-0.019^a	-0.019^a	0.575^a	-0.019^a	0.576^a
	(0.002)	(0.002)	(0.001)	(0.073)	(0.001)	(0.073)
Difference in coef. (1)	-0.071^a					
Estimator	Probit		Probit	FE-Logit	Probit	FE-Logit
Observations	44452	43851	65333	13306	65333	13306

Robust Standard errors in parentheses. ^{c} significant at 10%; ^{b} significant at 5%; ^{a} significant at 1%. Marginal effect computed at means reported for probit estimations. All estimations include include year dummies. Estimations (2) to (6) also include an interaction term between Δ exports$_{it}$ and year (year is demeaned). Δ exports$_{it} = \frac{X_t - X_{t-1}}{X_{t-1}} \times \frac{X_{t-1}}{Y_{t-1}}$; Δ dom. sales$_{it} = \frac{D_t - D_{t-1}}{D_{t-1}} \times \frac{D_{t-1}}{Y_{t-1}}$. Experience: number of years since entry on export market. Coefficients on cash flow and its lag not reported. (a) Experience type I: Export experience is kept in case of exit and re-entry. Experience type II: experience is lost in case of exit and re-entry.

5.5 Investment, uncertainty and export experience

Is the effect of export experience due to a decrease in uncertainty? Experience could affect the sensibility of investment to export sales through various channels. One could be the relaxation of financial constraints. However, this seems unlikely to explain our results as we control for the firm's cash flow in our estimation. In this section we further investigate the role of uncertainty on investment sensitivity to sales shocks.

In Table 7 we first study how uncertainty directly affect investment through export sales. We focus on the sample of first which enter the export market once during the period. We add to our baseline specification an interaction term between a sector-specific measure of uncertainty and export sales. Our measure of uncertainty is the variance of average the growth rate of

Table 7: Investment, uncertainty, and export experience

Dep. Var.:	(1)	(2)	(3) I_{it}/K_{it-1}	(4)	(5)
Sample	All	Experience Low	Experience High	Uncertainty High	Uncertainty Low
Δ exports$_{it}$	0.198^a	0.237^a	0.187^a	0.123^a	0.160^b
	(0.041)	(0.038)	(0.050)	(0.046)	(0.067)
Δ exports$_{it}$ $\times$ Uncertainty	-0.510^b	-0.867^a	0.254		
	(0.207)	(0.189)	(0.292)		
Δ exports$_{it}$ $\times$ Experience				0.016^a	-0.004
				(0.006)	(0.007)
Δ dom. sales$_{it}$	0.258^a	0.280^a	0.250^a	0.260^a	0.207^a
	(0.032)	(0.033)	(0.033)	(0.035)	(0.032)
Experience				-0.004^c	-0.002
				(0.002)	(0.002)
$y_{t-1} - k_{t-1}$	0.296^a	0.347^a	0.284^a	0.293^a	0.224^a
	(0.040)	(0.046)	(0.044)	(0.051)	(0.045)
Observations	36532	22018	14514	18758	18759
Estimator			GMM-SYS		
Serial correlation (p-value)	0.79	-	0.02	0.95	0.51
Hansen (p-value)	0.10	0.33	0.01	0.24	0.20

Robust Standard errors, in parentheses. ^{c} significant at 10%; ^{b} significant at 5%; ^{a} significant at 1%. All estimations include year dummies and estimations (4) and (5) include an interaction term between Δ exports$_{it}$ and year (year is demeaned). Δ exports$_{it} = \frac{X_t - X_{t-1}}{X_{t-1}} \times \frac{X_{t-1}}{Y_{t-1}}$; Δ dom. sales$_{it} = \frac{D_t - D_{t-1}}{D_{t-1}} \times \frac{D_{t-1}}{Y_{t-1}}$. Experience: number of years since entry on export market. GM-SYS: Blundell and Bond (1998) GMM estimator. Instruments used in these estimations are the first and second lags of all regressors. Coefficients on cash flow and its lag not reported. Instrument validity tested using a Sargan-Hansen test of the overidentifying restrictions. Second-order serial correlation in the first-differenced residuals tested using an LM test (Arellano and Bond, 1991). High and low for above or below the median of the considered variable. These estimations include only the firms that stay in the same 2-digit sectors over the entire period.

export sales in the 3-digit (NES 114) sector to which the firm belongs, computed over the period 1993-2001 from our balance-sheet data.[20]

Columns (1) shows that uncertainty indeed [21] reduces significantly the sensitivity of investment to export sales variations. This result has already been found by a number of papers (see in particular Bloom *et al.*, 2007) in the case of total sales.

More interesting is the interaction between export experience and uncertainty. We find that experience on the export market dampens the negative effect of uncertainty on investment. Above the median level of experience (four years), uncertainty has no effect anymore (column (3)). On the contrary, The interaction term between uncertainty and export growth is negative

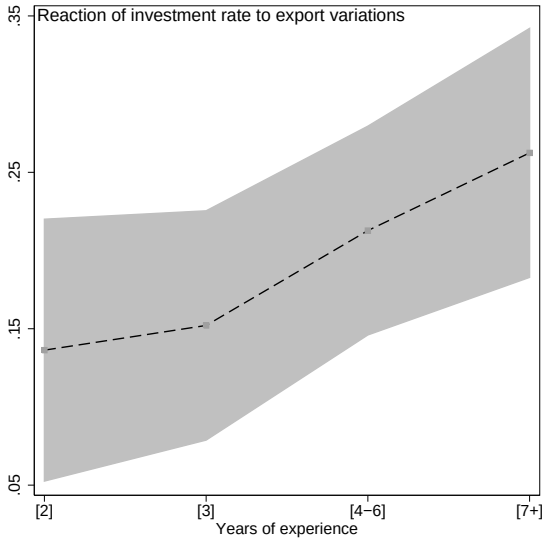
[20]Note that the number of observations is slightly lower than in Table 4. This is due to the fact that we drop the firm for which the sector changes over time.

[21]Similar results are obtained using the probability to invest.

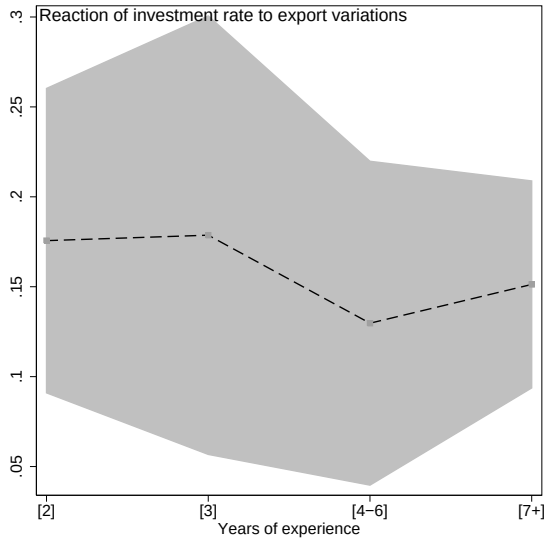
and significant at the 1% level for the least experimented firms (column (2)).

Figure 2: Effect of export variations on investment rate, by experience level

(a) High uncertainty



(b) Low uncertainty



Similarly, export experience matters more in more volatile sectors, as shown in columns (4) and (5). For sectors below the median in terms of uncertainty, effect of experience is close to zero and statistically insignificant. This clearly suggests that experience plays a role in diminishing uncertainty in the most volatile sectors. This can be seen in Figure 2, where we replicate Figure 1(a) for these two groups of firms, above and below the median in terms of uncertainty. While the investment rate is increasingly reactive to export sales in the first case, no clear pattern emerges in the second one.

6 Conclusion

(to be completed)

References

Abel, A. B. and Eberly, J. C. (1998), "An Exact Soultion for the Investment and Market Value of a Firm Facing Uncertainty, Adjustment Costs, and Irreversibility", NBER Working Papers 4412.

Abel, A. B., Dixit, A., Eberly, J. C. and Pindyck, R. S. (1996), "Options, the Value of Capital, and Investment", *The Quarterly Journal of Economics*, vol. 111 nº 3: pp. 753–77.

Albornoz-Crespo, F., Calvo Pardo, H. F., Corcos, G. and Ornelas, E. (2010), "Sequential Exporting", CEPR Discussion Papers 8103.

Atkeson, A. and Burstein, A. (), "Innovation, Firm dynamics, and International Trade", *Journal of Political Economy*.

Aw, B. Y., Chung, S. and Roberts, M. (2003), "Productivity, output, and failure: a comparison of taiwanese and korean manufacturers", *Economic Journal*, vol. 113 nº 491: pp. 485–510.

Bean, C. R. (1981), "An Econometric Model of Manufacturing Investment in the UK", *Economic Journal*, vol. 91 nº 361: pp. 106–21.

Bloom, N., Bond, S. and Reenen, J. V. (2007), "Uncertainty and Investment Dynamics", *Review of Economic Studies*, vol. 74 nº 2: pp. 391–415.

Boyle, G. W. and Guthrie, G. A. (2003), "Investment, Uncertainty, and Liquidity", *Journal of Finance*, vol. 58 nº 5: pp. 2143–2166.

Burstein, A. and Melitz, M. (2011), "Trade Liberalization and Firm Dynamics", *mimeo*.

Costantini, J. and Melitz, M. (2009), "The dynamic effects of real options and irreversibility on investment and labour demand", in the organization of firms in a global economy. ed. e. helpman, d. marin & t. verdier. harvard university press.

De Loecker, J. (2007), "Do exports generate higher productivity? Evidence from Slovenia", *Journal of International Economics*, vol. 73 nº 1: pp. 69–98.

Dixit, A. and Pindyck, R. (1994), *Irreversible Investment*, Princeton: Princeton University Press.

Eaton, J., Kortum, S. and Kramarz, F. (2004), "Dissecting Trade: Firms, Industries, and Export Destinations", *American Economic Review Papers and Proceedings*, vol. 94 nº 2: pp. 150–154.

Eaton, J., Eslava, M., Kugler, M. and Tybout, J. (2007), "Export Dynamics in Colombia: Firm-Level Evidence", NBER Working Papers 13531.

Ghosal, V. and Loungani, P. (2000), "The Differential Impact of Uncertainty on Investment in Small and Large Businesses", *The Review of Economics and Statistics*, vol. 82 nº 2: pp. 338–343.

Guiso, L. and Parigi, G. (1999), "Investment And Demand Uncertainty", *The Quarterly Journal of Economics*, vol. 114 nº 1: pp. 185–227.

Handley, K. (2011), "Exporting under trade policy uncertainty: Theory and evidence", mimeo.

Handley, K. and Limao, N. (2011), "Trade and Investment under Policy Uncertainty: Theory and Firm Evidence", mimeo.

Lileeva, A. and Trefler, D. (2010), "Improved Access to Foreign Markets Raises Plant-Level Productivity... for Some Plants", *The Quarterly Journal of Economics*, vol. 125 nº 3: pp. 1051–1099.

McDonald, R. and Siegel, D. (1986), "The Value of Waiting to Invest", *The Quarterly Journal of Economics*, vol. 101 nº 4: pp. 707–27.

Pindyck, R. (1988), "Irreversible Investment, Capacity Choice, and the Value of the Firm", *American Economic Review*, vol. 78 nº 5: pp. 969–85.

Van Biesebroeck, J. (2005), "Exporting raises productivity in sub-Saharan African manufacturing firms", *Journal of International Economics*, vol. 67 nº 2: pp. 373–391.

Verhoogen, E. A. (2008), "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector", *The Quarterly Journal of Economics*, vol. 123 nº 2: pp. 489–530.

Wagner, J. (2007), "Exports and Productivity: A Survey of the Evidence from Firm-level Data", *The World Economy*, vol. 30 nº 1: pp. 60–82.