The Determinants of Private Investment in Benin: A Panel Data Analysis

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Abstract

Investment is one of the mainsprings of economic growth. In order to analyse the factors explaining the weakness of investment by private firms in Benin, this paper used a capital demand function. This function was estimated using data from a panel of 123 firms in Benin and covering the 19972003 period. The findings showed that demand uncertainty and, more importantly, the fluctuations in the imports of manufactured goods from Nigeria have a negative effect on investment by private firms in Benin. The investment behaviour of these firms strongly hinges on the cost of capital utilization: When this cost is high, it weighs negatively on the purchase and installation of new production infrastructure. The magnitude of the effect of this cost of capital utilization and of the demand uncertainty which investment firms face depends on the nature of their activities.

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1. Introduction

Economic growth is the result of a combination of several factors among them an increase in investment (O'Connell and Ndulu, 2000; Veganzones, 2000). Investment has a double effect on economic growth. As a component of overall demand, investment has an effect on the level of demand and, especially, on the fluctuation of this demand. Investment is indeed the component of the overall demand that fluctuates the most, since the other components namely household consumption and public expenditure are relatively stable. A slowdown in investment is translated into a slowdown in growth.

Moreover, since investments consist of accumulating production capacity, they determine the productive capacity of the economy and the size of the labour utilized in making this capacity operational. Investments thus have an impact on economic activity. An increase in investments over several periods makes it possible to maintain growth cycles which come to an end as a result of decline or stagnation of these investments.

It is this relationship between growth and investment that makes it necessary to identify and analyse the determinants of investments. The first stage of poverty reduction is economic growth that leads to an increase in revenue. Maintaining investment well is a precondition for economic growth.

Since most developing countries implemented structural adjustment programmes (SAPs) and liberal economic policies, it is mainly the private sector that has funded investment. A slight increase was observed in the share of fixed capital in Benin's gross domestic product (GDP). This share rose from an annual average of 17.3% of GDP for the 19951999 period to an annual average of 18.8% of GDP for the 20002004 period. However, this increase in the share of investments in GDP came from the public sector whose gross formation of fixed capital rose from an annual average of 5.5% of GDP between 1995 and 1999 to an annual average of 7.0% of GDP between 2000 and 2004. At the time there was indeed stagnation in investment from the private sector; this sector's gross formation of fixed capital rose from an annual average of 11.7% of GDP (from 1995 to 1999) to 11.8% (from 2000 to 2004).[1] The question that arises is: What can explain the weakness and stagnation of private investment in Benin?

In 2005, an assessment of the investment climate (World Bank, 2005) found that the country was characterized by insufficient infrastructure, a high level of corruption and difficulties in obtaining bank loans.[2] Generally speaking, the business climate in Benin remains non-attractive: the 2007 Doing Business report ranks the country 137th out of a total of 175 countries.[3]

In addition to this unfavourable business environment, the literature identifies three main factors that can explain the low level of investment in countries like Benin: weak demand, the high costs of production factors and, most importantly, the different types of uncertainty (political, social, economic, etc.). However, there is a need to establish the magnitude of each of these possible causes in order to identify which incentives would be necessary to encourage private firms to invest.

Potential domestic demand is relatively low in Benin, since the buying power remains low. The real GDP (constant for 1995) has never reached US$500 per capita; it was estimated at US$442.76 in 2002 (see African Development Indicators, 2004). Moreover, the costs of production factors, except for fuel prices, are higher than those in the other countries of the subregion.[4]

Furthermore, the firms in Benin have to compete with products imported from Nigeria, Côte d'Ivoire, Ghana or even Europe and Asia. Benin shares a border with Nigeria and is only a little over 100km away from the other economic powers in the sub-region, namely Côte d'Ivoire and Ghana. It is thus easy to import products from these countries. Benin's shoreline in the south (where the Cotonou port is located) makes it easy to import products from Asia and Europe. These easily-available imported products on the Beninese market compete with those manufactured locally. Indeed, consumers in Benin almost always have a choice between imported products and locally manufactured ones. This reduces the market share of local firms and renders uncertain the residual demand addressed to them. The development of the informal sector makes this competition even worse (this takes even the form of unfair competition) since imported products are in most cases traded through the informal sector which escapes all forms of taxation. These imported products do not enter the Beninese market in a continuous flow and fluctuations in the external supply result in considerable and erratic variations in the residual demand addressed to local firms.

This demand uncertainty influences the investment decisions of private firms. The importance of taking uncertainty into account derives from the irreversible nature of most of the investment expenditure. For example, production equipment is specific to each industry and hence cannot be resold without incurring losses should the economic situation turn unfavourable.

What is the extent of the impact of these factors (low level of demand, high level of the cost of factors, and demand uncertainty) on the investment expenditure of private firms in Benin? This study is an attempt to answer this question using a microeconomic approach.

The aim of this study was thus to analyse the behaviour of investment by Beninese firms. The specific objectives were:

- to assess the impact of the instability of demand on the investment by Beninese firms;
- to analyse the effect of the cost of factors on the evolution of these firms' investment expenditure; and
- to study the influence of the type of activity on the behaviour of the Beninese firms' investment.

The remainder of the paper is structured as follows: Section II is the review of the literature; Section III presents the methodology, which specifies the study's model and presents the data for analysis; Section IV gives the analysis of empirical results; while Section V presents the conclusion followed by recommendations.

2. Literature review

This section first presents some theoretical analyses of irreversible investment decisions in an uncertain environment before discussing some empirical findings reported in the literature on the determinants of private investment.

Theoretical analysis of the determinants of irreversible investment in an uncertain situation

Arrow (1968) introduces the notion of irreversibility in the form of an inability to disinvest in an intertemporal production programme. He demonstrates that in such a case there exists a discrepancy between the cost of capital and its marginal contribution to profit. However, the impact of this finding is small probably because uncertainty is omitted. The results of the theory of decision making in uncertain situations and of financial theory have led to a surge of analytical theories on irreversible investments in a situation of uncertainty.

Henry (1974) explicitly analyses the effect of irreversibility on investment decisions in a situation of uncertainty. The author links irreversibility to an increase in information on the states of nature, which means that "we will know more tomorrow about the day after tomorrow than what we know today". As irreversibility leads to a reduction in the area of possible choices once the investment has been made, one would benefit by waiting to learn more in order to make a better decision. This waiting involves costs: one, the risk of seeing a competitor enter the market and, two, a surplus in cash flow (which one automatically forfeits by delaying the implementation of investment) which the investment would have led to. There is thus an analogy between undertaking to invest and taking a financial option: An investor must balance between the gains that would stem from an immediate investment and the cost of the loss of an opportunity to take decisions at a better time. This is the option value of the investment. By making an irreversible investment, a firm takes (or loses) this option. In other words, the firm gives up the possibility of waiting in order to get more information. This opportunity cost is additional to the cost of investment and the yield expected before undertaking to invest will be all the higher if the waiting is interesting.

Henry's (1974) publication led to direct application not in the area of investment, but in the theory of decision making in an uncertain situation (Galiègue, 1996). It was later, with research conducted by Bernanke (1983) and McDonald and Siegel (1986) that option value models incorporated the theory of irreversible investment in an uncertain situation. It should be recalled that Pindyck (1991) makes a simpler proposal illustrating with two periods and Serven (1996) formalizes and presents a version of this.

McDonald and Siegel (1986) demonstrate that the threshold of triggering an irreversible investment is higher than that of a reversible investment and that it is higher when uncertainty is high. In a situation of irreversibility, returns from an investment project must not only cover the cost of capital but also the cost related to the risk of finding oneself in a situation of over-capacity when the economic situation turns unfavourable. And yet option value models are based on the implementation of a single project, while investment decisions on the part of firms most often have to do with increasing the existing capital or not. The analysis, therefore, should be extended to more realistic models of accumulation of capital. Dixit and Pindyck (1994) and Galiègue (1996) make proposals related to option value models and irreversible investment under uncertainty.

Besides the option value models, the literature based on the Brownian movement to model uncertainty has put forward models without adjustment costs, but with a constraint on the impossibility of disinvestment outside the depreciation of capital (Bertola, 1998), and models incorporating adjustment costs that are proper to the underlying hypothesis of irreversibility (Abel and Eberly, 1997).

Bertola G. (1998) studies the case of a firm whose production technology corresponds to a Cobb-Douglas type function. The firm was confronted with a demand with constant elasticity but had market power. The author computes the operational profit (which depends on market conditions, namely demand and cost of labour) for the firm in question by deducting from its total receipts only the costs related to the work factor. Bertola then resolves the firm's programme which consists of maximizing its updated value (operational profit minus possible investment costs) on an infinite horizon. The firm could not disinvest in any other way than replacing equipment that had no cost value anymore. The market conditions were random (in relation to demand uncertainty, cost of labour and/or the cost of a unit of capital) and supposed to follow a Brownian movement. Bertola obtained a capital demand function whose explanatory factors are: demand, cost of labour, cost of capital utilization, and parameters representing demand uncertainty.

Abel and Eberly (1997) use the same analysis method but in their case the production function is that of constant returns to scale and the firm does not have market power. In the maximizing of its value the firm incorporated, in addition to the cost of acquiring capital equipment, an adjustment cost which is supposed to be convex. In the case of irreversible investments, Abel and Eberly (1997) find that a firm invests if the increase in its value resulting from the installation of an additional capital unit is higher than or equal to the cost of buying this unit, and that it does not invest in the opposite case.

Empirical studies on the determinants of private investment

Several empirical studies related to the determinants of private investment follow a macroeconomic approach. Serven and Solimano (1992) summarize empirical studies on the (macroeconomic) explanatory factors of private investment in developing countries that were undergoing structural adjustment. This study presents some research based on a microeconomic approach.

Samuel (1996) compares several models that explain the evolution of firms' investment expenditure. The estimations in his study use a panel of 331 American manufacturing firms for the 19721990 period. He finds that the principal determinant of investment is cash flow. He also finds that corporate managers pay greater attention to the availability of internal sources of funding and cost of capital than to the evolution of the share prices of their firm on the stock market. The fundamentals are thus found to be more important than the perception on the stock market.

Noting that the accelerator model had not been very relevant for the explanation of the evolution of investments in France since 1979, Legendre and Paretti (1997) developed, within a neoclassical framework and on the assumption of constant returns to scale and convex adjustment costs, a model that includes profitability as an argument for investment decision making. The model is not completely resolved, but already contributes to highlighting Euler's relationship.[5] This relationship is estimated (by the generalized method of moments) using annual data collected from 18 French industrial sectors from 1970 to 1987. The estimations make it possible to invalidate the model for five sectors, while for two other sectors the results obtained are unlikely. However, for the remaining 11 sectors the results do not question the relevance of the proposed model. The profitability is thus found to be one of the explanatory factors for the investment of French industrial firms during the period studied.

Zeufack (1997) studies the investment behaviour of manufacturing firms in Cameroon between 1988 and 1992. The findings reveal a negative influence of uncertainty on investment, a high adjustment speed and strong capital-profitability elasticity. Demand seems to have also played a key role in the accumulation of capital. By separating his sample of 68 firms into two sub-samples one comprising firms whose majority shareholders were Cameroonian (private, local) and another comprising firms whose majority shareholders were foreigners (private, foreign) Zeufack demonstrates that investment behaviour on the part of firms depends on whether they are local or foreign. Private local firms have a higher adjustment speed than private foreign ones (Zeufack, 1997). One of the most interesting findings from the comparison is a greater perception of uncertainty by private foreign firms. Zeufack (1997) explains this finding by the non-homogeneity of institutional constraints perceived and faced by the two categories of firms due to information asymmetries. One should therefore pay attention to this difference in reaction and explicitly take it into account while designing policies aimed at promoting private investment.

Pattilo (1998), using a model inspired by Bertola (1988) and a panel of 200 manufacturing firms in Ghana over two years (1994 and 1995), shows that due to demand uncertainty, firms wait for the marginal productivity of capital to go beyond a threshold specific to each firm before investing. The level of this threshold rises as uncertainty rises. Pattilo (1998) shows that uncertainty has a negative effect on the level of investment.

Sène (2000) studies a panel of 30 Senegalese firms over nine years (from 1988 to 1996) and finds that private investment is mostly influenced by the accelerator phenomenon: the decision by Senegalese firms to invest mostly depends on demand fluctuations. These firms also have a high adjustment speed. This means that the time necessary to adapt their production capacity is relatively short.

Gnansounou (2001), in a study of investment behaviour required of big firms in Benin, shows that these firms are influenced more by the relative cost of capital and demand fluctuations to which manufacturing firms are more sensitive than commercial ones. The researcher finds the average time for the adjustment of capital to be very short (less than seven months for manufacturing firms and eight months for commercial firms).

Herbet (2001), working on aggregated data from non-financial companies and individual French businessmen, finds that during the 1990s the accelerator and the profit rate are the only explanatory variables for the investment behaviour of French firms. The other variables (interest rate, Tobin's Q and the rate of utilization of production capacities) are irrelevant.

3. Methodology

The model

The objective of this study was to analyse the impact of demand fluctuations and costs of factors on the variation of the investment expenditure of French firms. Particular emphasis must be laid on the impact of demand uncertainty which firms are confronted with. For this reason, the study used a function of demand of capital which was obtained after resolving the optimizing system described below.

Production technology was represented by a Cobb-Douglas type function that took the following form:

$$Q_t = \left[K_t^{\alpha}\left(A_t L_t\right)^{1-\alpha}\right]^{\varphi} \quad 0 < \alpha < 1; \varphi > 0 \tag{1}$$

where Q_t is the quantity of output that was produced and sold; φ is the return to scale of the production;[6] K_t is the stock of capital; L_t represents labour that is assumed to be perfectly flexible and remunerated at the rate w_t, and A_t is an indicator of technological progress.

The demand is supposed to be that of constant elasticity and is described by the following equation:

$$p_t = D_t Q_t^{\mu - 1} \qquad 0 < \mu < 1; 0 \varphi \mu < 1 \tag{2}$$

where p_t is the price of output, D_t is the demand, and μ is the inverse of the firm's monopoly power. For $\mu = 1$, we get the case of a firm in a situation of perfect competition; μ tends to be 0 when the firm's monopoly power increases.

Taking into account the firm's market power made it possible to model the situation of imperfect competition which the industrial firms in Benin found themselves in. Indeed, except for activities like baking that require little industrial equipment, there are only a small number of firms by branch of activity.

For a given level of stock of capital K_t, the firm's operational profit was computed; it corresponded to the difference between the total receipts and the total wage costs:

$$\pi(K_t, Z_t) = \underset{L_t}{Max}(p_t Q_t - w_t L_t) = \frac{1}{1+\beta} K_t^{1+\beta} Z_t \tag{3}$$

with $\beta = \frac{\varphi\mu - 1}{1-(1-\alpha)\varphi\mu}$; Z_t, which represents the parameters of the economic circumstances, is an increasing function of the demand D_t and a decreasing function of the unit price of labour w_t.

The firm's goal is to maximize the mathematical expectation of the updated value of the expected cash flows:

$$\underset{X_t}{Max}\ E_t\left\{\int_t e^{-r(\tau-t)}[\pi(K_\tau Z_\tau)d\tau - c_\tau dX_\tau]\right\}$$

under the following constraints:

$$\frac{dD_t}{D_t} = \theta dt + \sigma dW \tag{4}$$

$$dK_\tau = -\delta K_\tau + dX_\tau ;\forall\tau \tag{5}$$

$$dX_\tau \geq 0 ;\forall\tau \tag{6}$$

where X_t represents the investment process; c_t the price of a unit of capital; δ the depreciation rate; and r the rate of updating. Equations 5 and 6 mean that the firm cannot disinvest: its stock of capital can only decrease by not replacing old equipment. Equation 4 means that demand D_t is uncertain and follows a Brownian movement of mean θ and standard deviation σ. In other words, the demand is permanently affected by shocks (positive or negative) around trend θ.

By resolving[7] this programme, we get the optimal demand for the firm's capital:

$$K_t^* = \left(\varnothing \frac{c_t(r+\delta-\delta\beta-\theta)}{Z_t} \right)^{1/\beta} \tag{7}$$

where ϕ is a function of the mean θ and the standard deviation σ of the equation representing the Brownian movement; and ϕ is a measure of demand uncertainty (*mid*).

c_t $(r + \delta - \beta\delta - \theta)$represents the cost of capital utilization (cuc_t). By considering the fact that Z_t depends on demand (D_t) and on the unit cost of labour (w_t), we get:

$$K_t^* = \left[mid(\theta_t, \sigma_t) \frac{cuc_t}{Z_t(Dt, w_t)} \right]^{\frac{1}{\beta}} \tag{8}$$

The optimal stock of capital depends on the level of the demand, the cost of capital utilization, the cost of labour, and demand uncertainty. By using the neperian logarithm, a linear function of capital demand is deduced that takes the form:

$$\ln K_t^* = \alpha_1 \ln cuc_t + \alpha_2 \ln D_t + \alpha_3 \ln w_t + \alpha 4 \ln mid_t + \alpha_0 \tag{9}$$

It is appropriate here to consider that the firm's effective stock of capital (k_t) generally adjusts to its optimal level only partially. Because of this, the study adopted a first-order autoregressive process using panel data. Thus, the first explicit form of the capital demand function to be estimated, in its autoregressive form, is:

$$\ln k_{it} = \lambda \ln k_{it-1} + \alpha_1 \ln cuc_{it} + \alpha_2 \ln D_{it} + \alpha_3 \ln w_{it} + \alpha_4 \ln mid_{it} + \alpha_0 + u_{it} \tag{10}$$

where $u_{it} = \eta_i + \varepsilon_{it}$.

In this formula, the presence of individual effects (fixed or random) is assumed. The Hausman (1978) test was used to know the exact nature of individual effects.

On an ad hoc basis, another explanatory variable was added to the model to make it possible to specifically study the effect of erratic fluctuations of imports from Nigeria on the investment by private firms in Benin.

Nigeria is one of the main sources of Benin's imports. However, these imports vary considerably in their structure and volume. This variation stems not only from the evolution of the exchange rate of the Nigerian currency, the Naira, and Nigeria's trading policies, but also from the relations between the authorities of the two countries. For example, deteriorating relations led to the closing of the borders between Nigeria and Benin at the end of 2003 and the beginning of 2004. It was thus necessary to study the influence of the uncertainty linked to such a situation on the investment of industrial firms in Benin. In this connection, the following equation was estimated:

$$lnk_{it} = \lambda\ lnk_{it-1} + \alpha_1 lncuc_{it} + \alpha_2 lnD_{it} + \alpha_3 lnw_{it} + \alpha_4 lnmid_{it} + \alpha_5 lnmiin_{it} + \alpha_0 + v_{it} \quad (11)$$

where *miin* is a measure of the uncertainty linked to the imports from Nigeria.

The measurement of variables, the expected signs and the data used

The capital (k_t) was measured by the tangible assets appearing in the firm's balance sheet; the demand (d_t) by the real turnover; and the cost of labour (w_t) by the average of staff costs. The cost of utilization of a unit of capital (cuc_t) is the total cost of capital utilization divided by the capital, with the total cost of capital utilization being the sum of the real cost of opportunity of capital and the depreciation allowance.

One can measure demand uncertainty from the monthly fluctuations of the real turnover for each firm. But only the annual values of the turnovers for the firms in our panel were available. Assuming that demand fluctuations are reflected in the variations in the level of prices, the demand uncertainty (mid_{it}) was measured using the ratio of the mean and the standard deviation of the 12 monthly indices of year t of consumer prices of the activity sector of firm i.

One can measure the uncertainty related to imports from Nigeria by a variable that reflects the fluctuations of the Naira. But this variable would have the same value for all the firms for a given year. Such a variable would not allow for variation between firms, and could thus be taken for a temporal effect. The $miin_{it}$ variable is the ratio between the changing mean and standard deviation over two years (t and t-1) of imports (from that country) of the products of the activity sector of firm i. The fluctuation of imports by type of product reflects not only the fluctuations of the exchange rate for the Naira, but also the Nigerian firms' productivity gains or losses. It also enables variation between groups of firms.

The increase in the cost of capital utilization should have a negative effect on the demand for capital; thus, α_1 should be negative. A positive sign is expected for the parameter linked to the demand (α_2). There is unanimity among authors about the positive nature of the accelerator effect (Jorgensen, 1971; Chirinko, 1993; Samuel, 1996).

According to the model described above, α_3 should be negative. However, because of the measure of the cost of labour which does not take into account the (labour augmenting) technological progress that affects the productivity of labour $A_{t,}$ we find in the empirical literature a positive sign for the cost of labour measured by average staff costs or a negative sign for the relative cost of capital (which is the ratio of the cost of capital utilization to the cost of labour). This means a positive sign for the cost of labour, as there is a negative effect of the cost of capital utilization on the evolution of this capital (Zeufack, 1997; Crépon and Gianella, 2001). Thus, we expect α_3 to be positive.

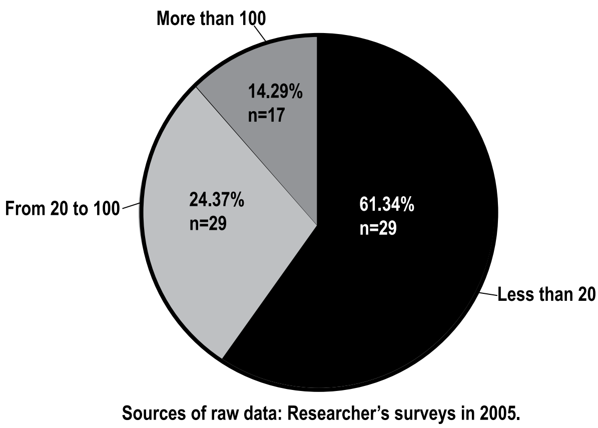
We expect a negative effect of demand uncertainty on investment. The signs reported in the empirical literature are not always negative, but Carruth et al. (1998), in their review of empirical literature, observe that most of the research (using macroeconomic or microeconomic data) finds a negative impact of uncertainty on investment.

This study used the monthly price index series published since January 1997 by the National Institute of Statistics and Economic Analysis (INSAE). The method of computation for this index is the same for all the West African Economic and Monetary Union (WAEMU) countries. The figures, by type of product, on imports from Nigeria were gathered from INSAE.

Corporate data were collected at the Tax Directorate from tax declarations. The data collected to provide this study with a sample comprised 123 private firms in the secondary sector (See Annex 3). These firms filed tax returns forms for the 19962003 period; they declared taxes on industrial and commercial profits.[8] Clearly, these are formally established firms whose accounting methods are in accordance with standard regulations.[9] Some firms started their activities after 1996 while others stopped their activities during the period under study.

The panel comprised small, medium and large firms. Graph 1 represents the structure of the sample by staff numbers in 2003 is given in Figure 1.

Figure 1: Distribution of the samples in the panel on the basis of staff numbers in 2003



Sources of raw data: Researcher's surveys in 2005.

In 2003, the firms in the panel that were still in business were 19. More than 61% of the firms in our sample had fewer than 20 employees in 2003. A total of 29 (24.37% of the sample) had staff whose numbers varied between 20 and 100. Seventeen firms (14.29% of the sample) had more than 100 employees. Despite this large proportion of small-sized firms, the very large ones were the source of the bulk of the value added produced by the sample (86.48%).

Annex 4 presents the descriptive statistics for the different variables in the model. Table 1 summarizes the firms in the panel according to their activity sector and their staff numbers in 2003.

Table 1: Activity sectors for the firms in the panel

Percentage	Frequency	
Food industries	22	17.9
Printing presses, factories for wood work and related products	20	16.3
Building and other public works materials	62	50.4
Chemical products factories and Other manufacturing industries	19	15.4
Total	123	100.0

Source: Researcher's surveys in 2006.

The sample had similar proportions of food industries (17.9%), printing presses and factories for wood work and related products (16.3), chemical industries and other manufacturing industries (15.4%). Industries that manufacture building and public works equipment represented 50.4% of the firms in the sample.

The panel was representative of all industrial firms in the formal sector in Benin because the total value added produced by the firms in the sample represented 38.16% of the value added created by the formal firms in the secondary sector.

4. Empirical results

Explanatory factors for the accumulation of capital by firms in Benin

The results of the estimation of Equation 10 using the usual estimation methods are summarized in Table 2. Column 1 of the table reports the results of the estimation of Equation 10 by the ordinary least squares method. With the data for this study being panel data, this equation was also estimated using the fixed effects method taking into account individual heterogeneities between firms (column 2). However, the presence of the delayed dependent variable results in endogeneity bias. The generalized method of moments (GMM) with instrumental variables makes it possible to solve this problem. Columns 3 and 4 present the results of the estimation of Equation 10 using GMM with first-difference variables (Arellano and Bond, 1991) and level variables (Blundell and Bond, 1998).

Table 2: Results of the estimation of the capital demand function for the entire panel

Explanatory variables	(1) OLS	(2) Fixed Effects	(3) GMM (Arellano-Bond)	(4) GMM System (Blundell-Bond)
Lagged capital (L1 lnkm)·	0.857***	0.744***	0.842***	0.715***
Cost of capital utilization (lncuc)	-0.509***	-0.517***	-0.856***”	-0.726***
Level of real demand (lndmr)·	0.078***	0.035*	0.031^{ns}”	0.108***
Cost of labour (lnwm)·	0.128***	0.071^{ns}	0.069^{ns}”	0.238**
Demand uncertainty (lnmid)	-0.025^{ns}	-0.049^{ns}	-0.007^{ns}”	-0.153**
Constant (_cons)	-0.412***	0.314^{ns}	0.0005^{ns}	0.236^{ns}
Number of observations	798	756	674	798
Number of firms	123	123	121	123

ns: non-significant; * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.
▪: first-difference variables.
Sargan test: Probability associated with (3): 0.000
Probability associated with column (4): 0.239
AR(2): Probability associated with (3): 0.167
Probability associated with column (4): 0.246

Source: Researcher’s estimations, 2006 (·expressed in CFAF million).

A discussion of the different specification problems and estimation methods is given in Appendix 5. The results of the Blundell-Bond (1998) method were deemed to be satisfactory at the econometric level. Therefore these results (column 4, Table 2) served as the basis for the analyses in this study.

The parameter linked to the lagged capital (l) is equal to 0.715. It represents the inertia of investment. The adjustment parameter (1-l) is 0.285. From this an average time of capital adjustment of two years, six months and three days is deduced, which reflects a very low speed of adjustment. Firms in Benin take two-and-a-half years to adjust their effective stock of capital to the desired level. This means that when economic activity increases, or when incentive measures are implemented, it takes time for investment to respond positively. Likewise, in bad economic circumstances, disinvestments take some time to occur. This result can be explained by the fact that potential investors first wait to see if the changes in the economic environment will be short-lived or if the incentive measures are well implemented and can be relied upon. This adjustment period can also be explained by the period of time that separates the decision to invest and the implementation of this investment. After deciding to invest, one has to look for and obtain funding (in case this investment is not self-funded), order equipment, and instal it. The long adjustment period could also mean that there are obstacles to implementing the investment after taking the decision to invest.

The estimated value of parameter a_1 is -0.726. This is the elasticity of the capital in relation to the (unit) cost of capital utilization. The high value of this elasticity reflects the firm's high sensitivity of investment to the cost of capital utilization. For example, a 10% fall in the cost of utilization of a unit of capital leads, everything else being equal, to a 7.26% increase in the firms' stock of capital. The cost of capital utilization is thus one of the key determinants of investment by firms in Benin.

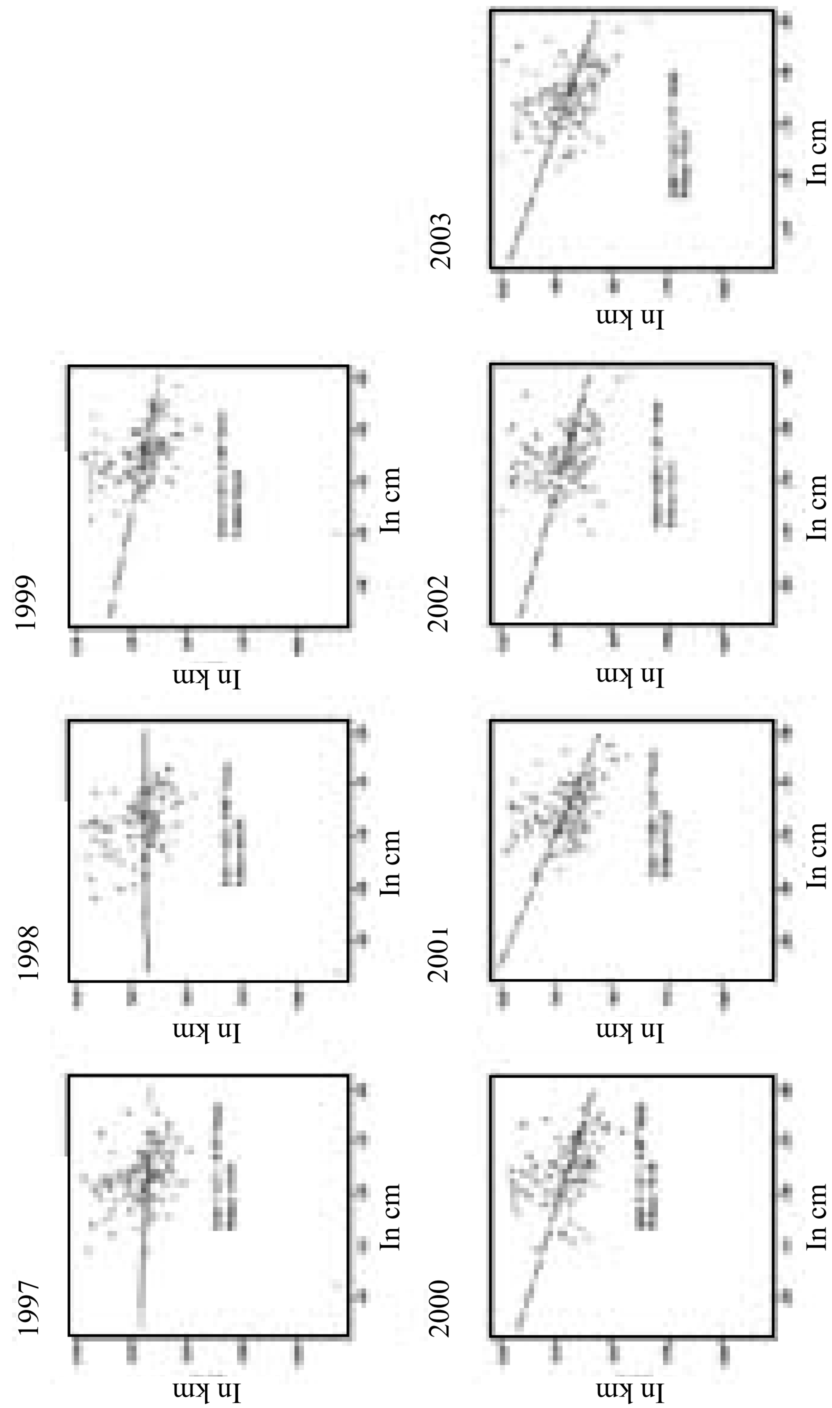
Private investment stagnated from 1999 due to an increase in the cost of capital utilization. Indeed, a look at the scatter of points on Figure 2 shows that from 1999 the absolute value of the slope of the adjustment straight line of the scatter of points becomes bigger and bigger. This increase in the slope of the adjustment straight line reflects an increase in the cost of capital utilization which has a depressive effect on investment.

However, with capital being irreversible, disinvestment is not always possible if an increase in the cost of capital utilization occurs. In this case the stock of capital is underused. In the absence of statistics on the rate of utilization of production equipment by Beninese firms, the cost of capital utilization was computed as if all the capital had been used. This can lead, in some cases, to an overvaluation of the cost of capital utilization. This can explain the relatively high value of the elasticity of the stock of capital in relation to its (unit) cost of utilization.

As for the other production factor (labour), the estimated value of the parameter that is associated with it is 0.238. A 10% increase in the unit cost of labour leads to an increase in the stock of capital of 2.38%. This is translated into a substitution of the labour factor by the capital factor.

The accelerator coefficient (α_2) was estimated at 0.108. This is the elasticity of the stock of capital in relation to demand. The low level of demand can also account for the stagnation of investment on the part of private firms in Benin.

Figure 2: Diagrams of the dispersion of capital in relation to the cost of its use



Source of raw data: Researcher's surveys, 2006.

One finding of this study is the identification of a significant negative effect of demand uncertainty on the Beninese firms' effective stock of capital. Indeed, the estimated value of the parameter linked to the measuring of demand uncertainty in this study is -0.153. The volatility of demand thus has a depressive effect on the Beninese firms' investment. This uncertainty deters private firms from investing. It can also be argued that, like demand uncertainty, all forms of uncertainty are detrimental to private investment.

The nature of activities and determinants of investment by firms

To identify possible differences in the magnitude of the effect of the determinants of investment by firms in Benin on the basis of the firms' activities, this study distinguished between firms that make building and public works equipment and other types of manufacturing industries. The results of the econometric estimations of Equation 10 are presented in Table 3.

Table 3: Results of the estimation of the capital demand function on the basis of the activities of the firms in the panel

Explanatory variables	(a) Firms making building and public works equipment	Other manufacturing firms	
		(b) Basic model	(c) Model based on trade uncertainty with Nigeria
Lagged capital (L1 lnkm)ï%	0.560***	0.640***	0.692***
Cost of capital utilization (lncuc)	-0.918***	-0.443**	-0.561***
Level of real demand (lndmr)ï%	0.097***	0.251**	0.197**
Cost of labour (lnwm)ï%	0.345***	0.238**	0.255*
Demand uncertainty (lnmid)	0.011ns	-0.161*	-0.148***
Uncertainty linked to imports from Nigeria (lnmiin)	—	—	-0.115*
Constant (_cons)	-0.195ns	0.379ns	-0.228ns
Number of observations	414 (7 ans)	384 (7 ans)	278 (5 ans)
Number of firms	62	61	61

ns: non-significant; * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level

: first-difference variables

Sargan test: Probability associated with column (a): 0.640
Probability associated with column (b): 0.543
Probability associated with column (c): 0.401

AR(2): Probability associated with column (a): 0.268
Probability associated with column (b): 0.422
Probability associated with column (c): 0.586

Source: Researcher's estimations, 2006 (expressed in CFAF million).

For manufacturing industries other than those making building and public works equipment, the uncertainty-related coefficient is significant at the 10% level. The other coefficients are, apart from the constant, significant at an error risk of 5%. The Wald test carried out from the results of the econometric estimations from the two sub-samples showed that with the exception of the coefficient related to the cost of capital utilization, the coefficients obtained did not differ form one sub-sample to another. The firms manufacturing building and public works equipment were found to be highly sensitive to the cost of capital utilization. The elasticity of the effective stock of capital in relation to its (unit) cost of utilization was found to be -0.443 for this sub-sample of firms, and -0.918 for the other sub-sample.

It is the high depreciation rate that explains the strong sensitivity of the firms manufacturing building and public works equipment to fluctuations in the cost of capital utilization. In this context, the cost of utilization of a unit of capital is the sum of the depreciation rate and the real interest rate that represents the real cost of the timeliness of this unit of capital. Since the real interest rate is the same for all the firms, the high level of the depreciation rate remains the only explanation for the strong sensitivity of the firms manufacturing building and public works equipment to the fluctuations of the (unit) cost of capital. For example, the average depreciation rate for the equipment of these firms was 28.0% in 2003. This was 9% higher than that of the other firms, whose depreciation rate for their equipment was only 19.02% during the same year. A high depreciation rate in the building and public works sector is an indication that the production equipment in the sector, compared with that of the other manufacturing firms, comprises tangible assets whose authorized depreciation rate is higher.[10]

With regard to the effect of the level of demand, the investment expenditure of the firms manufacturing building and public works equipment depends little on the current level of demand, but much on the order book. This can be explained by the specific way in which the public works sector functions. The residual demand addressed to each firm in this sector depends upon the invitations to tender that it has "won". Moreover, there is a relatively long time between when the decision is taken to have a firm carry out work and when the work is effectively started.

But the situation is the opposite for the other types of firms: they determine their investment according to their expectations of the residual demand that will be addressed to them, and they produce and count on the distribution network to sell their manufactured products without knowing their customers. For their part, the firms manufacturing building and public works equipment know, over a certain period, their residual demand and their customers. This special mode of functioning of the firms in the public works sector accounts for their low sensitivity to the current level of demand and, especially, the fact that they are not subject to demand uncertainty.

However, these firms undergo other forms of uncertainty which have not been modelled in this study. For example, more than any other firms, they suffer the effects of political uncertainty, as their activities entirely or partially have to do with public works. For example, the delay by the National Assembly to vote the national budget has a direct impact on their activities: a lack or a late disbursement of funds is likely to cause a slowdown in the work underway or a delay in beginning work planned for the following year.

The effect of the uncertainty related to the trade with Nigeria

In order to analyse the effect of the uncertainty related to the variations in the trade relations with Nigeria, a variable was introduced, in an ad hoc fashion, to measure this effect (see Equation 11). Regression analysis was carried out on the basic model that was modified accordingly only using the data on the sub-sample of manufacturing firms. This can be explained by the fact that the firms in the public works sector are not directly subject to the competition arising from the import of products from Nigeria. These products are made up in part of manufactured products that take a share of the Beninese market away from the local manufacturing firms. The results[11] of the estimation of Equation 11 with data from manufacturing firms are summarized in column (c) of Table 4.

Thanks to the Wald test carried out on each of the estimated parameters, we see that the inclusion of this variable did not lead to a significant difference between the values taken by the different parameters. The parameter associated with the variable measuring the uncertainty related to the trade relations with Nigeria was found to be negative and significant (at the 10% level).

The manufacturing firms in Benin are subject to uncertainty about the effective demand addressed to them. This uncertainty is due not only to the fluctuations in the domestic demand but also to the variations in the share of this demand that is met by imported products, especially from Nigeria. The variations in the imports from Nigeria depend on the Naira exchange rate, the Nigerian firms' needs in foreign currency, and the political relations between the two governments. These two types of uncertainty (variations in demand and imports of manufactured products) had a negative effect on the investment by the firms in Benin.

5. Conclusion and recommendations

The results of the econometric estimations carried out in this study have made it possible to identify the determinants of the accumulation of capital by private firms in Benin and to assess their respective role in explaining the investment behaviour of those firms. The costs of factors, notably the cost of capital, are, in terms of sensitivity, the primary explanatory factors of the investment of private firms in Benin. The increase in demand also explains the increase in investment expenditure. However, its erratic fluctuations have a negative effect on the accumulation of productive capital. Differentiating firms in the building and public works sector from other manufacturing firms enabled this study to realize that firms in the building and public works sector have a greater sensitivity to fluctuations in the cost of capital utilization. These firms do not seem to be affected by demand uncertainty, while the other manufacturing firms are. The fluctuations in the imports of manufactured products from Nigeria increase the demand uncertainty addressed to the manufacturing firms set up in Benin and have a negative impact on the investment by these firms.

On the basis of its findings, this study recommends:

- Reducing the long-term interest rates in order to facilitate investment in manufacturing industries;
- Reducing, or exempting from, duties and taxes levied on machines, equipment and tools destined for manufacturing production in order to reduce the cost price of production equipment;
- Setting up conditions for accelerating economic growth that is likely to lead to an increase in demand that is necessary for increasing private investment in Benin;
- Giving assistance to the firms that are set up in Benin to enable them to gain market shares in the other WAEMU countries; and
- Reducing the tax rate on industrial and commercial gains by having a specific rate for production firms separate from that for business firms.

Because of the importance of the quality of the business climate in making investment decisions, it would be useful to carry out a deeper study of it. However, from an analysis of the 2007 Doing Business indicators for Benin and the assessment of the investment climate in Benin that was carried out by the World Bank (World Bank, 2005), the following recommendations can still be made:

- Improving the availability and the quality of utilities such as electricity, water, and telecommunications, as well as reducing their prices;
- Setting up a commercial court in Benin to settle disputes between business people or between these and other corporate partners, notably banks;
- Finalizing the land legislation, since plots of land are largely used as security for obtaining bank loans; and
- Strengthening strategies to fight corruption.

Notes

1. Source: The National Institute of Statistics and Economic Analysis.

2. Appendix 1 summarizes the results of that survey for Benin. For full details on the investment climate in Benin, see Banque Mondiale (World Bank, 2005).

3. Appendix 2 presents the indicators of "Doing Business" in Benin.

4. For example, the guaranteed minimum wage (i.e. the salaire minimum interprofessionnel garanti, SMIG) is CFAF27,500 in Benin, while it is CFAF18,898 in Niger, CFAF21,694 in Togo, and CFAF24,118 in Mali.

5. $ø_t = 1/b\hat{o}_t + u_t$ where $ø_t$ represents the variation of the firm's stock of capital and $\hat{o}_t$ the profitability of the investment that takes into account adjustment costs, with b being the parameter to be estimated.

6. For j = 1 we obtain a constant-return-to-scale production function.

7. The resolution of the programme is presented in Bertola (1998).

8. It became necessary for this study not to consider the data from before 1997 because no monthly price index was available for those years.

9. Much as one would have wished to include informal sector enterprises in our sample, it was not possible to obtain the data required for this study over a period of eight years, as most of these enterprises do not do any book-keeping.

10. This is most likely due to the possession of a high percentage of transport equipment whose depreciation rate is 20%. Except for the startup costs and other fixed expenses whose authorized depreciation rate is 33%, the other tangible assets (with the exception of transport equipment) are depreciated at a rate of 10%.

11. Because the statistics related to the imports by type of products from Nigeria were not available until 1999, the estimation of Equation 11 covered the 19992003 period.

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Appendixes

Appendix 1: Summary of the findings of the survey on the assessment of the investment climate in Benin

Bureaucracy	Benin	Region	All countries
Senior management time spent dealing with requirements of regulations (%)	6.46	9.29	6.4
Consistency of officials' interpretations of regulations	36.6	53.42	49.31
Corruption	**Benin**	**Region**	**All countries**
Unofficial payments for firms to get things done (% of sales)	4.57	1.72	1.33
Firms expected to give gifts in meetings with tax inspectors (%)	21.21	15.89	31.85
Value of gift expected to secure government contract (% of contract)	8.24	3.59	2.29
Courts	**Benin**	**Region**	**All countries**
Confidence in the judicial system (%)	34.72	59.35	58.96
Dispute resolution time (weeks)	10.48	11.02	12.46
No resolutions in courts for overdue payments (%)	92.97	84.51	69.02
Crime	**Benin**	**Region**	**All countries**
Security costs (% of sales)	0.82	1.19	1.39
Losses due to crime (% of sales)	0.34	1.11	0.82
Finance	**Benin**	**Region**	**All countries**
Internal finance for investment (%)	77.14	66.54	61.87
Bank finance for investment (%)	13.65	19.77	17.4
Informal finance for investment (%)	2.67	2.5	4.38
Supplier credit financing (%)	5.71	6.72	7.3
Collateral needed for a loan (% of loan)	118.68	142.11	141.66
Loans requiring collateral (%)	90.57	82.73	80.86
Informality	**Benin**	**Region**	**All countries**
Sales amount reported by a typical firm for tax purposes (%)	88.17	79.43	84.08
Infrastructure	**Benin**	**Region**	**All countries**
Delay in obtaining an electrical connection (days)	55.62	49.95	25.13
Electrical outages (days)	77.33	49.3	20.75
Value lost to electrical outages (% of sales)	6.45	4.51	3.42
Water supply failures (days)	19.21	30.84	10.19
Delay in obtaining a telephone connection (days)	130.97	69.68	34.49

Continued next page

Appendix 1: Continued

Infrastructure	Benin	Region	All countries
Firms using the Web to interact with clients/suppliers (%)	24.87	29.77	46.7
Jobs	**Benin**	**Region**	**All countries**
Firms offering formal training (%)	35.33	38.89	41.2
Permanent skilled workers receiving training (%)	...	22.23	26.96
Employment growth over the last 3 years (%)	28.92	16.24	14.92
Tax	**Benin**	**Region**	**All countries**
Time spent in meetings with tax officials (days)	4.7	5.01	3.4
Trade	**Benin**	**Region**	**All countries**
Average time to clear direct exports through customs (days)	6.31	4.4	3.95
Longest time to clear direct exports through customs (days)	9.4	8.43	7.19
Average time to claim imports from customs (days)	10.09	8.22	6.21
Longest time to claim imports from customs (days)	21.95	16.46	12.25
Firms that export directly (%)	23.16	31.32	27.55

Appendix 2: Doing Business Indicators

for Benin

Setting up a firm (2006)

Indicator	*Benin*	*Region*	*OECD*
Procedures (number of)	7	11.1	6.2
Time taken (days)	31	61.8	16.6
Cost (% of per capita income)	173.3	162.8	5.3
Minimum capital (%) of per capita income)	379.1	209.9	36.1

Managing administrative licences (2006)

Indicator	*Benin*	*Region*	*OECD*
Procedures (number of)	16	17.7	14.0
Time taken (days	333	230.2	149.5
Cost (% of per capita income)	338.9	1,024.5	72.0

Hiring (2006)

Indicator	*Benin*	*Region*	*OECD*
Hiring difficulty index	39	44.3	27.0
Timetable strictness index	60	52.0	45.2
Laying off difficulty index	40	44.9	27.4
Employment strictness index	46	47.1	33.3
Cost of hiring (% of salary)	29.0	12.7	21.4
Cost of laying off (weekly wage)	35.8	71.2	31.3

Registering a property (2006)

Indicator	*Benin*	*Region*	*OECD*
Procedures (number of)	3	7.0	4.7
Time taken (days)	50	109.9	31.8
Cost (% of the value of the property)	15.1	11.6	4.3

Access to credit (2006)

Indicator	*Benin*	*Region*	*OECD*
Legal rights index	4	4.2	6.3
Credit information disclosure index	1	1.3	5.0
Coverage by public registers (% of adults)	10.3	1.5	8.4
Coverage by private offices (% of adults)	0.0	3.8	60.8

Continued next page

Appendix 2: Continued

Protecting investors (2006)

Indicator	*Benin*	*Region*	*OECD*
Disclosure index	5	4.4	6.3
Director's accountability index	8	4.5	5.0
Shareholder power index	4	5.2	6.6
Investor protection index	5.7	4.7	6.0

Paying taxes (2006)

Indicator	*Benin*	*Region*	*OECD*
Payment (number)	72	40.9	15.3
Time taken (hours)	270	336.4	202.9
Total imposition rate (in % of profits)	68.5	71.2	47.8

International trade (2006)

Indicator	*Benin*	*Region*	*OECD*
Export documents (number)	8	8.2	4.8
Time taken to export (days)	35	40.0	10.5
Cost for importing (in US$ per container)	980	1,561	811
Import documents (number)	11	12.2	5.9
Time taken to import (days)	48	51.5	12.2
Cost for exporting (in US$ per container)	1,452	1,947	883

Execution of contracts (2006)

Indicator	*Benin*	*Region*	*OECD*
Procedures (number)	49	38.1	22.2
Time taken (days)	720	581.1	351.2
Costs (% of debt)	29.7	42.2	11.2

Bankruptcy (2006)

Indicator	*Benin*	*Region*	*OECD*
Time taken (years)	4.0	2.6	1.4
Cost (% of the property)	14.5	16.0	7.1
Recovery rate (cents per dollar)	23.7	17.7	74.0

Aggregate classification of Benin

Facility of ...	*2006 classsification*	*2005 classification*	*Variation in the classification*
Doing Business	137	139	+2
Setting up a firm	126	115	-11
Managing administrative licences	133	131	-2
Hiring	121	123	+2
Registering a property	85	84	-1
Access to credit	117	117	0
Protecting the investors	46	43	-3
Paying taxes	162	163	+1
International trade	130	126	-4
Execution of contracts	162	161	-1
Bankruptcy	98	133	+35

Note: The 2005 classification was recalculated to reflect the methodological changes effected in 2006 as well as the inclusion of 20 new countries.

Appendix 3: Data collection table

The firm's number: ……………..   The firm's activity sector: ……………………………………………

YEAR	Tangible assets	Depreciation allowances	Staff costs	Wage bill	Workforce	Turnover	Value-added	Gross operating surplus	Pre-tax profit	Long-term debt
1996										
1997										
1998										
1999										
2000										
2001										
2002										
2003										

Appendix 4: Descriptive statistics of the model's variables

Variable	Mean	Std.	Dev.	Min	Max	Observations	
lnkm	overall	3.850826	2.518408	-13.81551	9.860667	N =	922
	between		2.356319	-5.701636	8.907508	n =	123
	within		1.001559	-4.263049	12.08457	T-bar =	7.49593
lncuc	overall	-1.546802	.5574056	-4.6016	.0407874	N =	811
	between		.4051507	-2.787681	-.4703767	n =	123
	within		.3836967	-3.364915	-.1513521	T-bar =	6.5935
lndmr	overall	4.951773	2.369381	-14.18454	10.70846	N =	810
	between		1.966191	-1.504322	9.895597	n =	123
	within		1.362316	-10.51935	11.36733	T-bar =	6.58537
lnwm	overall	-.302643	.6928311	-3.038306	2.072884	N =	811
	between		.5757396	-1.594701	1.557957	n =	123
	within		.3855048	-2.568081	2.062811	T-bar =	6.5935
lnmid	overall	4.34595	1.036295	2.969067	7.45594	N =	861
	between		.6140321	3.494473	5.525323	n =	123
	within		.8363632	2.766457	6.582187	T =	7

Appendix 5: Specification of the model and methods of estimation

The method of obtaining the best estimators of the different parameters of linear models using panel data depends on the panel's degree of homogeneity. This degree of homogeneity is observed after the different specification tests. Moreover, the autoregressive process allows the convergence of capital towards its optimal level only if the various variables of the model (notably the dependent variable, namely, capital) are stationary. In the opposite case, the error correction model must be used.

The stationarity tests designed by Levin and Lin (1992), Maddala and Wu (1999) and Im et al. (2002) were used for each variable of the model. The results show that all the observation series in this study were stationary in level. This finding is not surprising since the time dimension of the panel data is very low: seven for the explanatory variables and eight for the explained variable. The autoregressive specification of the adjustment of capital to its desirable level was thus acceptable. Our model thus took the form of a dynamic autoregressive panel data model. We now have to check the homogeneity level for our panel of firms.

Fisher's test enabled us to check the presence of some homogeneity in the behaviour of the firms in the panel. The test discriminates between the specification related to total homogeneity and that related to (partial) heterogeneity through individual constants. It was used on the simple (non-autoregressive) form of the model. The results of this test led to non-rejection of the hypothesis of the presence of individual heterogeneity. This is a predictable finding to the extent that it would be difficult to hypothesize that there is total homogeneity in the behaviour of investment firms in Benin. After all, productivity differences bring about differences in the levels of investment.

But one also has to verify whether these individual effects are fixed or random. The Hausman test enables this kind of verification. Carried out on the simple (non-autoregressive) model, this test did not lead to the rejection of the hypothesis of the presence of individual fixed effects. The study also carried out the Hausman test on the autoregressive form of the model. The Arellano-Bond method was used to estimate the autoregressive model with a presence of random effects while the Blundell-Bond method was used to estimate the autoregressive model with a presence of fixed effects. The Hausman test confirmed the presence of fixed effects.

This finding leads to the conclusion that each firm has its own specific ways of determining the optimal level of the stock of capital that it needs to achieve its production plan. These specificities can come from differences in productivity (of labour, capital or both) and from how market conditions are perceived (political or social uncertainty, for example) or from institutional constraints (exposure to corruption, shareholding structure, types of partnership etc.). Such specificities justify the differences in the behaviour of firms although these specificities have the same sensitivity (or elasticity) in relation to structural factors, namely the level of demand, the capital utilization and the cost of labour.

We thus have to estimate an autoregressive model using panel data with a presence of fixed effects and of measurement errors for certain variables, notably the cost of capital utilization. It is difficult to obtain good estimates of an autoregressive model with fixed effects (Sevestre, 2000). That is why it is useful to specify the estimation method used in this study.

The usual methods (i.e. the Least Square Dummy Variable or LSDV and General Least Square or GLS) of estimating linear models using panel data do not enable one to obtain convergent estimators for autoregressive models using panel data due to the presence of a delayed endogenous variable as an explanatory variable. That is why this study had to use the GMM with instrumental variables. Two types of methods are usually used in the empirical literature: the Arellano-Bond (1991) method and the Blundell-Bond (1998) method.

The Arellano-Bond (1991) method did produce satisfactory results: the coefficients of important explanatory variables such as the level of demand and the cost of labour were not significant. The Sargan-Hansen instrument over-identification test does not enable one to accept the validity of the instruments used. This ineffectiveness of the Arellano-Bond (1991) method is not uncommon while estimating the functions of investment or demand of capital for a small sample (Zeufack, 1996). It stems (in part) from the fact that the first difference of the neperian logarithm of variables transforms these into growth rates. The first-order difference equation is a relationship among growth rates of different variables, which reduces the significance of the estimated coefficients. Moreover, this method reduces the panel's time dimension by one or several years because of the first difference and the use of delayed variables as instrumental variables. The reduction in the number of observations and in the resulting number of instruments leads to a weak significance for the estimated coefficients, especially in this study where panel data had a low time dimension.

The Blundell-Bond (1998) method enabled this study to have acceptable results. Because of the colinearity between the endogenous variable and its lagged value, the study used the lagged first difference of the second (or higher) order of the endogenous variable as an instrument of the lagged endogenous variable. Because of the errors linked to the measurement of the cost of capital utilization, the study used its first difference and their lagged values as instruments, following Sevestre (2000). The lagged first difference of the second (or higher) order of the measurement of demand uncertainty served as instruments because of the measurement errors and the non-exogenous nature of uncertainty in investment decisions. The level values of the real demand and cost of labour were also used as instruments. The results of the Sargan-Hansen test enabled the study to validate these instruments. From the results of the Arellano-Bond test for autocorrelation, a lack of errors autocorrelation in the result of the model estimation with level data is observed.

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