

Multinational versus National Firms on Capital Adjustment Costs: A Structural Approach

Athanasios Lapatinas

Abstract

This paper provides an alternative perspective on the firm-level empirical analysis of the relation between foreign ownership and capital demand adjustment in host countries. The author estimates a dynamic structural model of investment on a sample of 4672 Belgian firms for the period 2003-2010, permitting him to distinguish the ‘ownership status’ of firms. He considers a dynamic discrete choice model of a general specification of adjustment costs including convex and non-convex components. The author uses the method of simulated moments in order to estimate the structural parameters. His results indicate that multinationals’ affiliates face lower capital adjustment costs than national firms.

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1 Introduction

The impact of the multinational firms (MNFs) on the world economy has been rapidly escalated over the last decades. Governments all over the world are concerned about Foreign Direct Investment (FDI) flows, especially in European countries where a substantial share of productive activities is under foreign control. Thus, there is a widespread fear in the European Union (EU) that foreigners are gaining too much economic control over the countries.

Capital markets have become increasingly global over the last 20 years and the impact of globalization on them is a central issue in the political economy and corporate finance literature. However, there are contradictory beliefs as global integration of markets can be seen as having two directly opposite effects on the cost of equity capital. On the one hand, the removal of barriers to foreign investment means that the risk premiums on securities are falling because the risk of these securities can be shared among more investors -and more efficient spreading of risks among investors with globally diversified portfolios means lower required returns and higher stock prices. On the other hand, the increasing integration of both capital markets and real business activity resulting from continued overseas expansion by multinationals, implies a greater degree of synchronization among various international capital markets - that is, a greater tendency for all markets to move together. Such greater correlation among national capital markets means reduced benefits to investors from global diversification; hence, a higher cost of capital.

In a recent debate on the effects of the growing international integration on the capital market, attention has been drawn to evaluate the impact of trade on investment and capital demand elasticity. However, there might be other paths through which globalization influences the capital market. Such a path may be the effect on capital adjustment costs, since higher adjustment costs trigger less-volatile responses of investment to any exogenous shock to capital demand.

There are good reasons to expect that MNFs are potentially more flexible in adjusting their capital. First, MNFs have the additional option of relocating output across subsidiaries and this might reduce adjustment costs. Second, MNFs are typically large and economies of scale in capital-investment management possibly decrease their adjustment costs compared to smaller NFs.

Although there is a growing literature on the role of multinational firms in global trade and international investment flows, very few studies have analyzed capital investment decisions of multinational firms (Desai et al. 2004, 2005a, 2005b; Belderbos et al. 2013).¹ To the best of our knowledge, this is the first work providing a comparison of the adjustment costs of capital in MNFs and NFs based on structural model estimation.

From an empirical point of view, models that ignore non-differentiable elements of capital adjustment costs or assume quadratic adjustment costs only, are unable to match the firm-level infrequent and lumpy dynamic pattern of investment activity found in most empirical studies. Moreover, they fail to provide direct estimates of adjustment costs, since structural parameters are impossible to be retrieved in the investment regressions.

The aim of this paper is to provide an alternative perspective to the firm-level analysis of the relation between foreign ownership and capital demand characteristics, through the estimation of a fully specified dynamic structural adjustment cost model at the micro level. The main target is to look at the dynamic nature of capital adjustment costs that firms face when they decide to invest and to address the following question: is there any difference in capital adjustment costs between MNFs and NFs?

Our data set is a balanced panel covering 4672 Belgian firms observed in the period 2003–2010. Belgium is a very interesting case since it has long been open to MNFs and currently has one of the most internationalized economies in the world. According to UNCTAD, Belgium has been among the top ten recipients of inward FDI flows for many years. At the end of 2009, it ranked fifth in terms of inward FDI stock, behind the United States, the United Kingdom, France and

¹ The behaviour of multinational firms and the consequences of multinational firm activity for the local economies of host and home countries have received considerable attention in economic research. Attention has focused on the firm and host country determinants of foreign direct investment (e.g. Wheeler and Mody 1992; Belderbos 1992; Blonigen et al. 2007; Baltagi et al. 2007; Aw and Lee 2008; Yeaple 2009; Chen and Moore 2010) the effects of FDI on trade (e.g. Lipsey and Weiss 1984; Blomström et al. 1997; Belderbos and Sleuwaegen 1998; Head and Ries 2001; Hanson et al. 2005), the consequences of multinational activity for domestic wages and employment (e.g. Feenstra and Hanson 1996; Slaughter 2000; Head and Ries 2002; Budd et al. 2005; Konings and Murphy 2006; Barba Navaretti et al. 2003), and (technology) spillovers from foreign direct investments (e.g. Aitken et al. 1997; Haskell et al. 2007).

China.² According to UNCTAD's transnationalization index, Belgium ranked at the top of the list of the most "globalized" developed countries in 2005 and second after China in the combined list of developing and developed economies (UNCTAD 2008: Figure I.7). Belgium also has a strong FDI position in EU: it attracted between 5 percent and 20 percent of EU's inward FDI flows in the period 2002-2009, a higher share than most of the other similar-sized EU countries. It is the third most important inward FDI host country in EU, accounting for over 11 percent of cumulative EU inward FDI. The high share of Belgium's inward FDI is most probably related to country's central geographical location, resulting in its role in the distribution of goods and services across the European continent and to the importance of Brussels as the administrative capital of the EU.

We first monitor if the Belgian micro data set supports the presence of both convex and non-convex components of adjustment costs, namely -based on the evidence of our data set- we structurally estimate a dynamic discrete choice model with a general specification of adjustment costs including both convex and non-convex components (see Cooper and Haltiwanger 2006; Cooper and Willis 2001; Lapatinas 2009; Lapatinas 2012; Cooper et al. 2015). The model is not differentiable in investment and has to be solved numerically. This is done by implementing the Value Function Iteration method. In order to estimate the structural parameters of the model, we use the simulated moments procedure. The method of simulated moments essentially estimates the structural parameters of the model by matching the moments of the data with the moments of the model.³

We find that slow adjustment is generated—and can be explained—by costs associated with investment.⁴ Adjustment costs are found to be statistically significant; thus, firms change their demand for capital more slowly than the shocks to capital demand warrant, due to the interference of these costs. By

² UNCTAD's FDI/TNC database available at: <http://stats.unctad.org/fdi/>

³ The moments to be matched should capture the key features of the behaviour of investment adjustment at the firm level and identify the adjustment cost parameters. Details are given in a subsequent section.

⁴ Precisely speaking, we assume and verify that the reason for slow adjustment (once expectations about shocks are accounted for) is the costs associated with capital investment.

examining differences between MNFs and NFs, we find that multinational's affiliates face lower capital adjustment costs than national firms.

The remainder of the paper is organized as follows. In Section 2 we describe the dataset used in this study. Section 3 develops the dynamic discrete choice structural model of investment, whereas Section 4 describes the methodology and the estimation results for the entire sample. Section 5 discusses the differences between MNFs and NFs. Finally, Section 6 concludes our analysis.

2 Data

The source of the data is the *Amadeus database*, a commercial database collected by *Bureau Van Dijk*. Our data set consists of a balanced panel of 8516 Belgian firms over the period 2003–2010. These are the data we get after filtering all the firms that reported ownership status,⁵ depending on the availability of the profit and capital data. Firms are also dropped if they have a large outlier observation in the eight year period: a rate of investment more than 90% in a given year.⁶ This leads to our final balanced dataset of 4672 firms.

In this work, following Bayraktar et al. (2005), the book value of the capital stock, $p_t K_t$, counts the book value of the fixed assets of the firm (including building and structures, machinery and equipment, intangible fixed assets) excluding financial fixed assets (share ownership in other companies). Our investment measure, $p_t I_t$, is calculated by applying the perpetual inventory procedure with a depreciation of 8 percent per annum for all years:⁷

$$p_{t+1} K_{t+1} = p_t I_t + p_t K_t (1 - \delta) \Rightarrow p_t I_t = p_{t+1} K_{t+1} - p_t K_t (1 - \delta) \quad (1)$$

⁵ In the *Amadeus database*, a foreign firm is such when its “ultimate owner” (one that owns at least 50% of the company) is nonresident in the country analyzed.

⁶ Following Bayraktar et al. (2005), we assume that investment rates higher than 90 percent are measuring a merger or acquisition.

⁷ This value is proposed by previous studies at micro-level, see for example Bond et al. (2005) and Bayraktar et al. (2005). We have also experimented with different values finding similar results.

Real investment, I_t , is constructed as investment at current prices, $p_t I_t$, deflated by the investment price deflator.⁸ Real capital stock, K_t , is constructed in the same way. The investment rate is then defined as the ratio of real investment to the real capital stock, $\frac{I_t}{K_t}$.

Summary Statistics

For the purposes of our analysis, the firms are split into MNFs and NFs according to their “ultimate owner” status: In the *Amadeus database*, a foreign firm is such when its “ultimate owner” (a company, a public authority, a state, a mutual fund, a nominee, a trust or a trustee that owns at least 50 percent of the company) is nonresident in the country analyzed. As Barba Navaretti et al. (2003: 711) comment “*this information on the ownership status is not as accurate as we would have liked. First, it is time-invariant, as the data base does not report this information by year.[...]Second, information on the outward activities of firms is often missing, so that it is not possible to distinguish between national firms with or without foreign subsidiaries. Third, there is no information on firms’ closure.*”

In order to motivate the theoretical model in Section 3, we start looking at some features of the data. Table 1 shows summary statistics of the real capital stock and the yearly investment rate for the sample of all firms and for MNFs and NFs partially. Figure 1 depicts the distributions of the investment rates for the period 2003–2010, while Table 2 shows some features of these distributions for the set of firms and for each of the MNFs and NFs respectively. It should be noted that statistics in this paper are calculated as across firms’ averages (i.e. first statistics are calculated for each individual firm over the period 2003–2010 after which the average across firms of these statistics is calculated).

⁸ We construct the investment price deflator by dividing aggregate industry investment data by prices of 2010.

Table 1: Summary statistics

	Sample	Mean	Median	Std. dev
I_{it}/K_{it}	All firms	0.039	0.007	0.195
	MNFs	0.018	-0.011	0.194
	NFs	0.051	0.016	0.195
K_{it}	All firms	14.6	13.6	4.2
	MNFs	20.4	19.8	4.8
	NFs	11.7	10.5	3.9

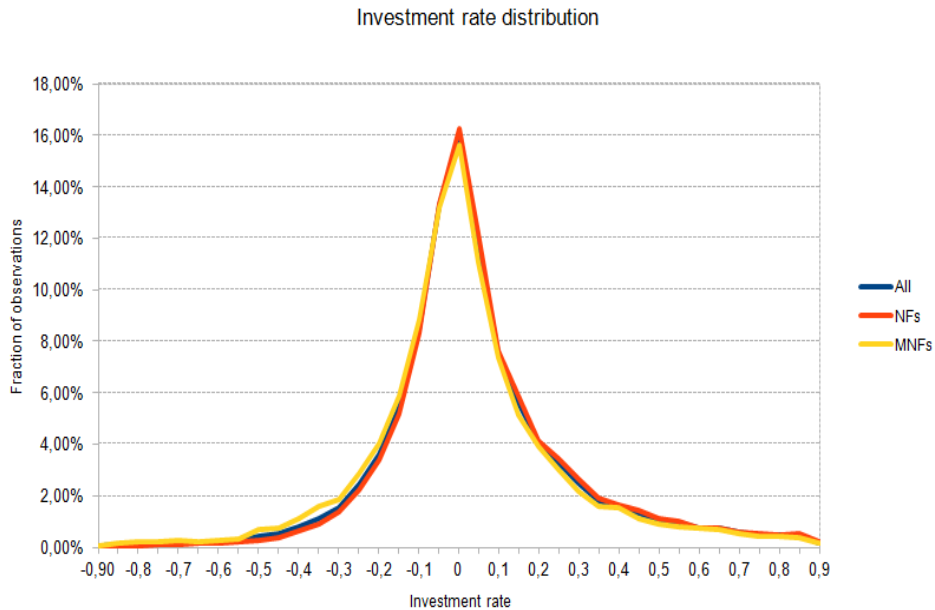
Notes: Statistics on 4672 Belgian firms: 3090 national firms (NFs) and 1582 multinationals (MNFs). Capital stock is in million euros.

Table 2: Features of the investment rate distribution for all firms and for each ‘ownership status’ group

	Fraction of observations (%) in each sample		
	All firms	MNFs	NFs
$ I_{it}/K_{it} < 0.02$ (inaction region)	12.9	12.4	13.1
$I_{it}/K_{it} < 0$	47.2	50.6	45.4
$I_{it}/K_{it} > 0.2$ (positive investment spike)	18.0	16.2	18.9
$I_{it}/K_{it} < -0.2$ (negative investment spike)	9.7	12.4	8.2
correlation: $(I_{it}/K_{it}, I_{it-1}/K_{it-1})$	-0.008	0.041	-0.033
$(I_{it}/K_{it}, I_{it-2}/K_{it-2})$	-0.021	-0.106	-0.129

Notes: Statistics on 4672 Belgian firms: 3090 national firms (NFs) and 1582 multinationals (MNFs).

Figure 1: Investment rate distributions for multinationals (MNFs) and national firms (NFs)



In the period 2003–2010, the median firm had a real capital stock of 13.6 million euros and an investment rate at 0.007. Regarding the ‘ownership status’ groups, the correspondingly moduli are also depicted in Table 1. The average value of the capital stock is 14.6 million euros (11.7 for the NFs and 20.4 for the MNFs) and the average value of the investment rate is 0.039 (0.051 for the NFs and 0.018 for the MNFs). The average standard deviation across firms of the investment rate is 0.195.

When looking Figure 1 and Table 2, the distribution of investment rate indicates some very interesting stylized facts. The remarkable feature of the investment rate distribution in Belgian micro-economy is the infrequent nature of capital adjustment: there are many periods in which capital remains fixed from one year to another. The frequency of non-adjustment is 12.9 percent for the set of firms in the dataset (12.4 for MNFs and 13.1 for NFs). This may be suggestive of the fact that changing the capital stock even by a small amount may imply sizeable adjustment costs that deter firms from investing. This would be the case, for instance, in the presence of a fixed component in the adjustment cost function.

Hence, the first stylized fact is that the frequency of no adjustment is high for all firms (large mass point around zero in investment rate distribution), especially high for NFs and slightly declines for MNFs. One possible explanation might be that capital adjustment costs are relatively more important for NFs.

Following the relevant literature, an investment positive (negative) spike is defined as more than 20 percent investment (disinvestment) rate. The fraction of observations in this region is 18 (9.7) percent for the set of firms, 16.2 (12.4) percent for the MNFs and 18.9 (8.2) percent for the NFs. Therefore, the distributions of investment rates have fat tails which imply the second stylized fact that there are sporadic periods of large capital adjustments.

Table 2 also depicts the autocorrelations of investment rates at lags one and two. These autocorrelations have a negative sign, indicating the third stylized fact: high capital adjustment episodes are followed by low adjustment episodes.

Recapitulating, the empirical evidence reported in this section stresses three important stylized facts: (a) there are periods in which firms decide not to change their capital input (infrequent nature of capital adjustment), (b) there are periods of large investment episodes (lumpy nature of capital adjustment) and (c) the commonality is investment spikes to be followed by smooth and low investment rate periods.⁹

The above three stylized facts can back up the adoption of a capital adjustment model incorporating both convex and non-convex costs of capital adjustment to account the infrequent and lumpy adjustment activity. Taking these facts into consideration we develop a relevant model below.

3 Theoretical Model

We assume a large and fixed number of firms. Firm i begins in period t with the inherited real capital stock, K_{it} , which has been adjusted in the previous period. Before making any adjustment decision, the firm observes the current period

⁹ Table 2 also indicates that Belgian firms disinvest as often as they invest. This motivates the adoption of a symmetric adjustment cost function which allows (dis)investment to respond similarly to positive and negative shocks.

profitability shock, A_{it} . Given state variables, the firm makes its investment decision depending on the capital adjustment costs.

The firm's dynamic programming problem is given by:¹⁰

$$V(A_{it}, K_{it}) = \max \{V^A(A_{it}, K_{it}), V^{NA}(A_{it}, K_{it})\} \quad (2)$$

The manager needs to choose optimally between adjusting capital, with value $V^A(\cdot)$, and not adjusting capital at all, with value $V^{NA}(\cdot)$. These two alternative options have a value given by:

$$V^A(A_{it}, K_{it}) = \max_{\{I_{it}\}} \Pi(A_{it}, K_{it}) - C(I_{it}, K_{it}) + \beta E_{A_{it+1}/A_{it}} V(A_{it+1}, K_{it+1}) \quad \text{if } I_{it} \neq 0 \quad (2a)$$

subject to the constraint $I_{it} = K_{it+1} - K_{it}(1 - \delta)$

$$V^{NA}(A_{it}, K_{it}) = \Pi(A_{it}, K_{it}) + \beta E_{A_{it+1}/A_{it}} V(A_{it+1}, (1 - \delta)K_{it}) \quad \text{if } I_{it} = 0 \quad (2b)$$

The profit function is parameterized in the following way:

$$\Pi(A_{it}, K_{it}) = A_{it} K_{it}^\theta \quad (3)$$

where $0 < \theta < 1$ is the curvature of the profit function. A_{it} is the current period profitability shock that contains both an idiosyncratic component, as well as an aggregate one. The discount factor, β , is fixed and equals $(1 + r)^{-1}$, where r is the risk-free market interest rate. It is assumed that capital is the only quasi-fixed factor of production and all variable factors have already been maximized out of the problem. The forms of the $C(I_{it}, K_{it})$ function that have been suggested in the literature are fixed, linear, concave and concave-convex.¹¹ In its most general form, we assume:

¹⁰ The model is relatively similar to the ones used by Cooper and Haltiwanger (2006), Lapatinas (2009), Lapatinas (2012).

¹¹ For an extensive review see Hamermesh and Pfann (1996).

$$C(I_{it}, K_{it-1}) = \frac{\xi}{2} \left(\frac{I_{it}}{K_{it-1}} \right)^2 K_{it-1} + FK_{it-1} + pI_{it} \quad (4)$$

which includes symmetric convex and non-convex (fixed and linear) components.¹²

In this framework, there will be periods of inaction, when fundamentals are not favorable and periods of bursts of adjustment when fundamentals are high or low enough. The firm (dis)invests when its capital stock is (more)less than its optimal level, otherwise it prefers to avoid adjustment costs and remains inactive.

Since non-adjustment is an option due to the presence of non strictly-convex adjustment costs, there is the possibility of corner solutions in the demand for capital. In this case, the standard marginal conditions for optimality given by the Euler equation fail to hold. In the model presented above, we explicitly take into account the existence of corner solutions by considering a discrete-time-discrete-choice dynamic structural model. Previous studies adopting continuous time-state-space framework have not provided direct estimators of the structural parameters due to difficulty in obtaining closed-form solutions.

Furthermore, due to the discontinuity in the investment process, the model cannot be solved analytically. Thus, we solve the model using a numerical method known as the Value Function Iteration method. This method can be summarized as follows. Let V be the value function. The value function iteration starts with some initial value V_0 and then evaluates $V_{j+1} = T(V_j)$ for $j = 0, 1, 2, \dots$ (where T is a mapping operator solving the dynamic programming problem given by equation 2). The desired value function is obtained when the difference between V_{j+1} and V_j is less than some predetermined threshold value.¹³

The set of the structural parameters $\{\beta, \delta, \theta, \xi, F\}$ combined with the transition matrix for the profitability shocks, determine the behavior of the model.

¹² Following Bayraktar et al. (2005), the parameter p of linear adjustment costs is fixed *a priori* to one in the subsequent analysis.

¹³ See Rust (1987a, 1987b) for details.

4 Estimation

4.1 Methodology

Our main target is to estimate the adjustment costs of capital. To do so, we assume a profit functional form and estimate/calibrate a number of parameters directly from the data.¹⁴ This enables us to calculate the profitability shocks assuming that they contain both an aggregate and an idiosyncratic component. Following Cooper and Haltiwanger (2006), we represent the aggregate shock process as a two-state Markov process and assume that the idiosyncratic profitability shocks follow an AR(1) process. We approximate the AR(1) process by a discrete Markov process using the method outlined in Tauchen (1986). We solve the dynamic programming problem via the Value Function Iteration method and create simulated data. This simulated data set is used to estimate the structural parameters determining the magnitude of convex and non-convex adjustment costs using the method of simulated moments. The estimated parameters are those that reproduce the moments obtained by the actual data. The above methodology is described in more details in the subsequent sections.

4.2 Estimation of the Profit Function

We define $a_{it} = \ln(A_{it})$. We assume that the exogenous profitability shock consists of two components: an aggregate shock, b_t and an idiosyncratic shock, ε_{it} :

$$a_{it} = b_t + \varepsilon_{it} \quad (5)$$

Furthermore, we assume $\varepsilon_{it} = \rho_\varepsilon \varepsilon_{it-1} + \eta_{it}$, where η_{it} is i.i.d.¹⁵ Taking logs of (3) yields:

¹⁴ In principal, all structural parameters could be estimated in our model but this substantially increases computational time. More computational efficiency is necessary; hence we only consider the structural estimation of capital adjustment cost parameters.

¹⁵ It is very common to the firm-level literature to assume first order process for the underlying shocks. See e.g. Olley and Pakes (1996) and Levinsohn and Petrin (2003). Our specification of the relatively simple AR(1) process for the idiosyncratic shocks is motivated by the need to keep the state space relatively parsimonious and thus more informative for the downstream numerical analysis and estimation.

$$\pi_{it} = \theta k_{it} + b_t + \varepsilon_{it} \quad (6)$$

We estimate equation (6) via Least Squares (pooled OLS) using a complete set of 0.54, with a standard error of 0.013. The corresponding estimates for MNFs and time dummies to capture the aggregate shocks.¹⁶ From our data, θ is estimated as NFs are 0.49 (0.017) and 0.53 (0.018), respectively.¹⁷ Once we have estimates of the parameters entering the profit function, we can construct the profitability shocks, which will be used as an observable state variable in the estimation of the rest of the structural parameters. Table 3 presents some features of the idiosyncratic profitability shocks for all firms and for each group of MNFs and NFs. It should be noted that the key moments of the shock processes are critical for understanding the nature of adjustment costs, since they reflect the persistence and the variability of profitability shocks. Moreover, they provide the necessary information for the solution of the firm-level optimization problem, requiring the calculation of a conditional expectation on future profitability.

4.3 Simulations

We fix the discount factor β at 0.97. We have also estimated the model with different values of β obtaining similar results.

The AR(1) process of the idiosyncratic shocks is approximated by a discrete Markov process using the method outlined in Tauchen (1986). The method proposed by Tauchen (1986) is used to create a discrete state space representation of the stochastic AR(1) process for the firm specific shocks. The transition matrix for the idiosyncratic shocks is computed from the empirical transitions observed at the firm-level and reproduces statistics from the idiosyncratic profitability shock series (Table 3).

We solve the dynamic programming problem via the Value Function Iteration method and we create simulated data. The remaining structural parameters $\Theta \equiv (\xi, F)$ are estimated using the Method of Simulated Moments.

¹⁶ The R^2 of the regression was 0.28 (0.33 for MNFs and 0.24 for NFs).

¹⁷ All parameters are significant at the 99% level.

Table 3: Features of the idiosyncratic profitability shocks, for (i) all firms in the sample, (ii) multinationals (MNFs) and (iii) national firms (NFs)

	All firms	MNFs	NFs
Mean	−0.15	−0.18	−0.14
Median	−0.05	−0.09	−0.03
Minimum	−14.00	−14.61	−8.15
Maximum	8.26	8.51	7.36
Std. Dev	0.83	0.80	0.85

Notes: All statistics are calculated as across firms' averages for the period 2003–2010.

4.4 Estimation Method: Method of Simulated Moments

The method of simulated moments estimates the structural parameters by matching the implications of the structural model with key features of the data and works as follows.

With an arbitrary set of parameter values and by using the Value Function Iteration method we solve the firm's dynamic programming problem. After the model is solved for given Θ values, a simulated panel data set of 2000 firms and 60 periods is obtained using the created policy functions.¹⁸ This simulated data set is used to calculate the model analogues of the moments we obtained using actual data. Following the relevant literature (Cooper and Haltiwanger 2006; Bayraktar 2002; Bayraktar et al. 2005; Lapatinas 2009; Lapatinas 2012) the three key moments of the firm level adjustment dynamics that we seek to match are the serial correlation in investment rate, the frequency of positive investment spike observations (more than 20 percent investment) and the frequency of negative investment observations. These moments are chosen partly due to their prominence in the literature and partly due to their informativeness of the underlying structural parameters, which we estimate. The serial correlation in investment rate is sensitive to the structure of adjustment costs, as pointed for

¹⁸ As a robustness check we have also experimented with other combinations of simulated data finding similar results.

example by Caballero and Engel (2003) and Cooper et al. (2015) and reveals the dynamics of capital adjustment across time. The other two moments capture key features of the investment rate distribution. Each of these three moments captures significant features of investment behavior at the firm-level. Denoting as Ψ^d the vector of moments from the actual data and as $\Psi^s(\Theta)$ the vector of moments from the simulated data for given values of Θ , the simulated moments routine searches for the structural parameter estimates that minimize the distance between the two vectors of moments.¹⁹ More formally, the statistic we try to minimize with respect to Θ in order to find the structural parameter values is the following quadratic function:

$$J(\Theta) = (\Psi^d - \Psi^s(\Theta))'W(\Psi^d - \Psi^s(\Theta)) \quad (7)$$

where W is the 3×3 identity matrix. The vector of true moments is $\Psi^d = \left[\frac{I_{it}}{K_{it}} > 0.2, \frac{I_{it}}{K_{it}} < 0, \text{corr}\left(\frac{I_{it}}{K_{it}}, \frac{I_{it-1}}{K_{it-1}}\right) \right] = [0.18, 0.47, -0.008]$. Given the discontinuities in the model and the discretization of the state space, as it is the case in related studies, we use the method of simulated annealing in order to minimize $J(\Theta)$ with respect to Θ . As Bayraktar et al. (2005) notice, simulated annealing is the ideal algorithm for dealing with complex functions, first because it explores the function's entire surface and can escape from local optima by moving uphill and downhill and second, because the assumptions required with respect to functional forms are quite relaxed.²⁰

4.5 Estimation Results

We estimate the structural parameters of the model by employing the method of simulated moments. Table 4 gives the estimated values of the quadratic and fixed

¹⁹ As pointed by Gourieroux and Monfort (1996), minimizing the distance between the simulated data moments and the actual data moments will emerge consistent estimates of the structural parameters.

²⁰ We implement the SIMANN algorithm, described in Goffe (1996).

cost parameters as well as the standard errors.²¹ Moreover, Table 5 focuses on the comparison of the simulated data results with the actual data results and provides the three moments of actual and simulated data.

Overall, the structural parameters are precisely estimated: the precision of the estimates, as measured through the asymptotic variance of the asymptotically normal indirect estimator $\hat{\Theta}$, is related to the sensitivity of the auxiliary parameters to movements in the structural parameters. If the sensitivity is low, the

Table 4: Estimated structural parameters

Structural parameters	Estimated values
ξ	0.3181 (0.0012)
F	0.4360 (0.0068)

Notes: standard errors are reported in parentheses.

Table 5: Moments of actual data versus moments of simulated data

Actual Moments		
$corr(\frac{I_{it}}{K_{it}}, \frac{I_{it-1}}{K_{it-1}})$	$\frac{I_{it}}{K_{it}} > 0.2$	$\frac{I_{it}}{K_{it}} < 0$
-0.008	0.18	0.47
Simulated Moments		
-0.0827	0.10	0.50

Notes: $\frac{I_{it}}{K_{it}}$ is the investment rate.

²¹ The standard errors of the parameters are computed as the square root of the main diagonal elements of the outer product of gradients estimator obtained by numerical differentiation of $J(\Theta)$ around the optimal parameters values. For more details see Greene (2003: 481).

numerical derivative of $J(\Theta)$ around the optimal parameter values will be near zero, indicating a high variance for the structural estimates. The small standard errors provide us with information about the curvature of the quadratic function $J(\Theta)$ at the point estimates and the potential errors in achieving a global minimum.

The structural parameters ξ and F are significantly different than zero indicating the importance of convex and fixed adjustment costs. The estimated value of the coefficient determining the magnitude of the convex adjustment cost, ξ , is 0.3181.²² The estimated value of the coefficient determining the magnitude of the fixed adjustment cost, F , is 0.4360. This implies that a firm that undertakes an investment project faces a fixed adjustment cost of 43.6 percent of installed capital. The estimated value of the coefficient F is high compared to the estimates found by relevant studies.²³

Table 5 compares the three moments of actual data vs. simulated data. The dynamics of the simulated data seem almost identical to the dynamics of the actual data. The actual value of the autocorrelation of the investment rate is -0.008 and it is estimated as -0.08 by the model. Furthermore, compared to the actual data, the simulated data display roughly the same fraction of positive investment spikes and disinvestment rates.²⁴

5 Multinational versus National Firms

In this section, we examine differences between MNFs and NFs. Table 6 indicates once more the presence of fixed and convex costs.

²² Cooper and Haltiwanger (2006) estimate ξ as 0.049, Bayraktar (2002) finds an estimated ξ at 0.311 and Bayraktar *et al.* (2005) estimate ξ as 0.532.

²³ Cooper and Haltiwanger (2006), Bayraktar (2002), Bayraktar *et al.* (2005) estimate F at 0.039, 0.029 and 0.031 respectively. It is essential to bring to reader's notice that the estimation results are affected by the fact that we are only exploiting the binary choice between no adjustment and adjustment. In this sense, our results are not directly comparable with the above results.

²⁴ This is very important since, as Khan and Thomas (2008: Section 3.3) discuss, it is a common difficulty in the quantitative models of lumpy investment the matching of positive and negative spikes empirical observations.

High adjustment costs deteriorate investment in NFs since fixed and convex capital adjustment costs are greater for NFs. Two main arguments are summarized in the literature, which may explain this result. First, MNFs may experience lower capital adjustment costs than NFs since the former are more likely to have management-planning departments for handling investments. Second, MNFs have the additional option of relocating output across subsidiaries and this might reduce capital adjustment costs.

Table 6: Estimated structural parameters for each ‘ownership status’ group

‘Ownership status’	Structural parameters				
	θ	ρ	σ_ε	ξ	F
MNFs	0.49	0.28	0.80	0.0944 (0.0009)	0.4003 (0.0194)
NFs	0.53	0.25	0.85	0.5317 (0.0018)	0.5858 (0.0016)

Notes: θ is the curvature of the profit function. ρ and σ_ε are the serial autocorrelation and the standard deviation of the idiosyncratic shocks respectively. Standard errors in parentheses. MNFs = multinationals, NFs = national firms.

6 Concluding Remarks

The progressive integration of international financial markets over the past 20 years has led to a significant reduction in the cost of capital of corporations around the world. Global diversification of their portfolios has enabled world investors to spread risks more effectively, reducing the risk premiums they require to hold stocks. However, the effect of globalization on cost of capital is not a straightforward one. At the same time, the increasing synchronization of both real international business activity and world financial markets is partly offsetting the benefits of global diversification. The increased sensitivity of corporate stock prices to events occurring all over the world, holding all else constant, means greater risk for local investors and hence higher risk premiums. For this reason,

small local economies are no longer insulated from worldwide shocks to the extent they once were; hence, both corporations and investors face increased exposure to such events.

This paper provides a different perspective on the firm-level empirical analysis of the relation between foreign ownership and capital adjustment costs in host countries and sheds light on the general belief that MNEs face lower capital adjustment costs than NFs. Through the estimation of a fully specified dynamic structural discrete choice adjustment cost model at the micro level for 4672 Belgian firms observed in the period 2003–2010, we found that slow adjustment is generated -and can be explained- by costs associated with investment. Both convex and non-convex adjustment costs were found to be statistically important; thus, firms change their demand for capital more slowly than the shocks to capital demand warrant, due to the interference of these costs. By examining differences between MNEs and NFs, we found that multinationals' affiliates face lower capital adjustment costs than national firms.

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