Economics
The Open-Access, Open-Assessment E-Journal

Discussion Paper
No. 2015-20 | March 20, 2015 | http://www.economics-ejournal.org/economics/discussionpapers/2015-20

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

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Abstract
This paper provides a different 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 observed between 2003 and 2010 that permits 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. He uses the method of simulated moments procedure to estimate the structural parameters. The results indicate that multinational's affiliates face lower capital adjustment costs than national firms.

(Published in Special Issue Micro-econometric Analyses of International Firm Activities)

JEL F23 D24 D92 G31
Keywords Multinational Firms, Investment, Capital Adjustment Costs

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Citation Athanasios Lapatinas (2015). Multinational versus National Firms on Capital Adjustment Costs: A Structural Approach. Economics Discussion Papers, No 2015-20, Kiel Institute for the World Economy. http://www.economics-ejournal.org/economics/discussionpapers/2015-20

Received March 11, 2015 **Accepted as Economics Discussion Paper** March 13, 2015 **Published** March 20, 2015
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I. INTRODUCTION

In the last decades, multinational firms (MNFs) have a growing impact on the world economy. Foreign Direct Investment flows have become matters of increased concern to governments, especially in European countries where a substantial share of productive activities is under foreign control and the fear that foreigners are gaining too much economic control over the country is spreading across EU.

Capital markets have become increasingly global over the last 20 years and the impact of globalization on capital markets is a central issue of the political economy and corporate finance literature. However, the beliefs are ambiguous and in fact, 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 in general 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 thus higher stock prices. At the same time, however, 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. And such greater correlation among national capital markets means reduced benefits to investors from global diversification and, hence, a higher cost of capital.

In the 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. One of these is 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. Third, -an idea which is more straightforward-, investments by local investors within their own economy are all sensitive to the business cycle and political accidents of that country. But, if something bad happens in one country and affects all firms in that country to some degree, something good might be happening in other parts of the world. A portfolio invested in many countries can therefore benefit from national economic cycles or events that are partly offsetting. This benefit of international diversification enables investors to reduce the risk of their portfolios substantially without reducing the return they expect on their wealth.

Although there is an expanding literature on the role of multinational firms in global trade and international investment flows, very few studies have analyzed multinational firms' capital investment decisions (Desai et al. 2004, 2005a, 2005b, Belderbos et al. 2013).[1] To the best of our knowledge this is the first work

[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 Wise, 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

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 (a) to match the firm-level infrequent and lumpy dynamic pattern of investment activity found in most empirical studies and (b) to provide direct estimates of adjustment costs since in the investment regressions it is impossible to retrieve the structural parameters.

The aim of this paper is to go beyond these studies by providing 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 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 dataset 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 foreign direct investment (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 China.[2] According to UNCTAD's transnationalization index, in 2005 Belgium ranked at the top of the list of the

al., 2005, Konings and Murphy, 2006, Barba Navaretti et al., 2010), and (technology) spillovers from foreign direct investments (e.g. Haskell et al., 2007, Aitken et al., 2007).

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

most “globalized” developed countries 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 that of most 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 and hence 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 supports the presence of both convex and non-convex components of adjustment costs, namely -based on the evidence of our dataset- 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 *et al.*, 2004, Cooper and Willis, 2001, Lapatinas, 2009, Lapatinas, 2012). 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 a 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]

[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.

We find that slow adjustment is generated -and can be explained- by costs associated with investment.[4] Adjustment costs are 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 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. Section 6 concludes.

II. DATA

The source of the data is the Amadeus database, a commercial database collected by Bureau Van Dijk. Our data 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.

For this paper, 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

[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.
[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.

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]

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

Real investment, I_t, is constructed as investment at current prices, $p_t I_t$, deflated by the investment price deflator (OECD Economic Outlook No.90). 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 purpose of 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, p. 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.*"

[7] This value is proposed by previous studies at micro-level, see for example Bond *et al.* (1999) and Bayraktar *et al.* (2005).

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

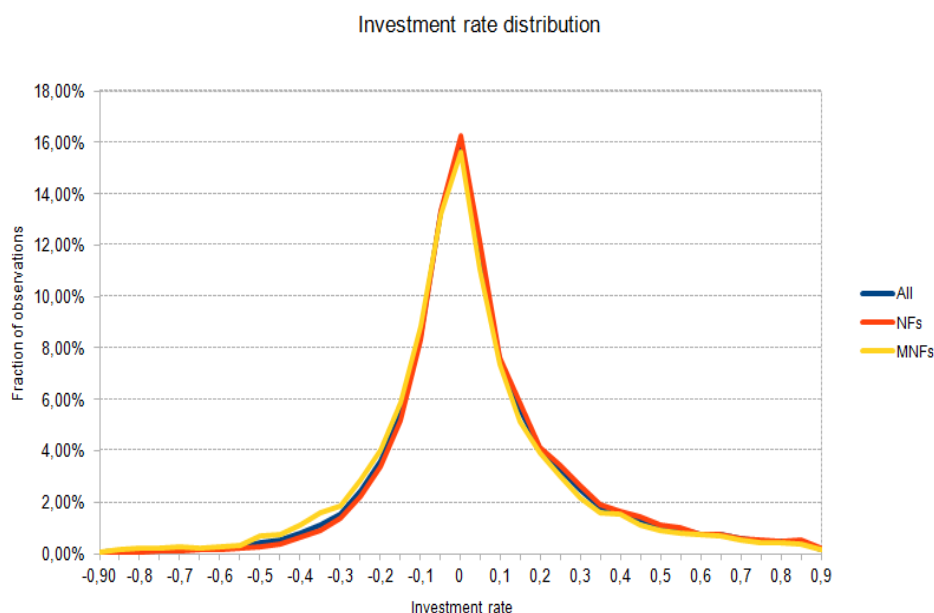
Notes: Statistics on 4672 Belgian firms: 3090 national firms (NFs) and 1582 multinationals (MNFs). Capital stock is in million euros.

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
$\left\|I_{it}/K_{it}\right\| < 0.02$ (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).

Fig. 1. Investment rate distributions of all firms, multinationals (MNFs) and national firms (NFs)



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 and Table 2 shows some features of these distributions for the set of firms and for each of the MNFs and NFs. 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).

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. With regard to '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 stays 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.

So 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.

The above three stylized facts clearly back up the adoption of a capital adjustment model which incorporates both convex and non-convex costs of capital adjustment to account the infrequent and lumpy adjustment activity. We develop a relevant model below.

III. THEORETICAL MODEL

We assume a large and fixed number of firms. Firm i begins to 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 profitability shock. Given state variables, the firm makes its investment decision depending on the capital adjustment costs.

The firm's dynamic programming problem is given by:[8]

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

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

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

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

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

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

The profit function is parameterized in the following way:

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

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.[9] In its most general form, we assume:

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

which includes symmetric convex and non-convex (fixed and linear) components.[10]

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 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 which have adopted 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. The model is solved 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

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[9] For an extensive review see Hamermesh and Pfann (1996).

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

some initial value V_0 and then evaluates $V_{j+1} = T(V_j)$ for $j = 0,1,2.....$ (where T is a mapping operator which solves 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.[11]

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

IV. ESTIMATION

Methodology

Our goal is to estimate the adjustment costs for capital. To do so, we assume a profit functional form and estimate/calibrate a number of parameters directly from the data.[12] 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.

[11] See Rust (1987a, b) for details.
[12] 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.

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}:

$$a_{it} = b_t + \varepsilon_{it} \tag{5}$$

We assume $\varepsilon_{it} = \rho_{\varepsilon}\varepsilon_{it-1} + \eta_{it}$, where η_{it} is i.i.d.[13] Taking logs of (3) yields:

$$\pi_{it} = \theta k_{it} + b_t + \varepsilon_{it} \tag{6}$$

We estimate equation (6) via Least Squares (pooled OLS) using a complete set of time dummies to capture the aggregate shocks.[14] From our data θ is estimated as 0.54, with a standard error of 0.013. The corresponding estimates for MNFs are 0.49 (0.017) and for NFs, 0.53 (0.018).[15] 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 shows 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

[13] 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 (2000). 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.

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

[15] All parameters are significant at the 99% level.

and the variability of profitability shocks and moreover they provide the necessary information for the solution of the firm-level optimization problem, which requires the calculation of a conditional expectation on future profitability.

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.

Simulations

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

We approximate the AR(1) process of the idiosyncratic shocks 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. We estimate the remaining structural parameters $\Theta \equiv (\xi, F)$ using the Method of Simulated Moments.

Estimation Method: Method of simulated moments

The approach is to estimate 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 2000 firms and 60 periods simulated panel data are obtained using the created policy functions.[16] 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 about the underlying structural parameters, which we estimate. The serial correlation in investment rate is sensitive to the structure of adjustment costs, as pointed for example by Caballero and Engel (2003) and Cooper, Haltiwanger and Power (1999) 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 data simulated given Θ, the simulated moments

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

routine looks for the structural parameter estimates that minimize the distance between the two vectors of moments.[17] 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:

$$J(\Theta) = (\Psi^d - \Psi^s(\Theta))' W (\Psi^d - \Psi^s(\Theta)) \tag{7}$$

where W is the 3×3 identity matrix. The vector of true moments is $\Psi^d = \left[\frac{I_{it}}{K_{it}} > 0.2,\ \frac{I_{it}}{K_{it}} < 0,\ corr(\frac{I_{it}}{K_{it}}, \frac{I_{it-1}}{K_{it-1}}) \right] = [0.18,\ 0.47,\ -0.008]$. 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.[18]

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Estimation results

Using the method of simulated moments, the structural parameters of the model are estimated. Table 4 gives the estimated values of the quadratic and fixed cost

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[17] 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.
[18] We implement the SIMANN algorithm, described in Goffe (1996).

parameters as well as the standard errors.[19] Table 5 focuses on the comparison of the simulated data results with the actual data results and gives the three moments of actual and simulated data.

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.

Overall, the structural parameters are precisely estimated: the precision of the estimates, 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 numerical derivative of $J(\Theta)$ around the optimal parameter values will be

[19] 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, p. 481).

near zero, indicating a high variance for the structural estimates. The small standard errors give 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 from 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.[20] 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.[21]

Now we focus on the comparison of the simulated data results with the actual data results. In Table 5 we compare the three moments of actual data vs. simulated data. The dynamics of the simulated data seem to be very much alike 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.[22]

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[20] Cooper and Haltiwanger (2006) estimate ξ as 0.455, Bayraktar (2002) finds an estimated ξ at 0.311 and Bayraktar *et al.* (2005) estimate ξ as 0.532.

[21] Cooper and Haltiwanger (2006), Bayraktar (2002), Bayraktar *et al.* (2005) estimate F at 0.069, 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.

[22] 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.

V. MULTINATIONAL VERSUS NATIONAL FIRMS

In this section, we examine differences between MNFs and NFs. Table 6 indicates again that fixed and convex costs are substantially present. High adjustment costs deteriorate investment in NFs since fixed and convex capital adjustment costs are greater for NFs.

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.

Three 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. Third, investments by local investors within their own economy are all sensitive to the business cycle and political accidents of that country. But, if something bad happens in one country and affects all firms in that country to some degree, something good might be happening in other parts of the world. A portfolio invested in many countries can therefore benefit from national economic cycles or events that are partly offsetting. This benefit of international diversification

enables investors to reduce the risk of their portfolios substantially without reducing the return they expect on their wealth.

VI. 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 and hence to reduce the risk premiums they require to hold stocks. But 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 and, 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 MNFs 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 MNFs and NFs, we found that multinational's affiliates face lower capital adjustment costs than national firms.

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