HYSTERESIS IN ADJUSTING THE OWNERSHIP STRUCTURE
OF FOREIGN SUBSIDIARIES

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ABSTRACT

In this paper we study the insight that multinational corporations consider real exchange rate fluctuations as an important factor in their decision about the ownership structure of their foreign subsidiaries in supplying a foreign market. Based on company-level data, we empirically investigate the company and industry conditions that influence the hysteresis in adjusting this ownership structure. Exchange rate volatility and switching cost increases the degree of hysteresis in ownership adjustment decisions, while growth sales in the foreign market decreases it. Also, expectations of an appreciation of the home currency along with market concentration and growth in industry sales seem to favor higher ownership increases of foreign subsidiaries.
1 Introduction

In this study we present empirical evidence of the magnitude of hysteresis in the process Multinational Companies (MNCs) follow when they adjust the ownership of their foreign subsidiaries in response to changing macroeconomic and industry conditions. The study makes several contributions in the relevant literature. First, it focuses on foreign direct investment (FDI) that lead to subsequent adjustments of the ownership structure of foreign subsidiaries, going thus beyond the typical initial entry/exit discussion in the literature. Second, it presents empirical evidence for the impact a range of factors might have on the magnitude of the hysteretic phenomena in ownership adjustments. Finally, it employs company-level data that are appropriate in unveiling this type of phenomena.

Researchers have extensively studied the decision of MNCs to enter a foreign market. Several of them emphasize the impact of fluctuating and volatile exchange rates on this decision, while others identify some sluggishness (hysteresis) in MNC’s entry/exit decision in a foreign market in response to exchange rate fluctuations.¹ In particular, the former find that a depreciated and quite volatile home country exchange rate deters FDI outflows to foreign markets, while the latter show that sunk-cost investments along with some exchange rate uncertainty may cause a MNC to be reluctant for some period of time to leave a foreign market in case of an adverse shift in exchange rates (a hysteresis phenomenon), despite the fact that it forgoes operating profits. However, very little has been done in testing empirically the hysteresis phenomenon in FDI flows.²

Our study focuses on the company’s optimal choice and possible adjustments of the ownership structure of its foreign subsidiaries. We often refer to this as “production mode” choice where the company can choose among a vast array of alternatives such as a joint venture (JV) or a wholly owned subsidiary (WOS).³ Of course, there has been considerable scholarly
interest in studying the choice of production mode for supplying foreign markets. However, most researchers emphasize the initial selection of the production mode a MNC makes when entering a foreign market. Kouvelis et al. (2001) on the other hand contribute in the literature by studying theoretically subsequent adjustments in the production mode, and thus ownership structure of a foreign subsidiary a MNC pursues, discussing the hysteresis phenomenon during these adjustments. In the present study we extend the literature by first discussing the properties of this hysteresis through a simple model along the lines of Dixit and Pindyck (1994). Then, using company-level data from non-US MNCs we present empirical evidence for the factors that influence the magnitude of the hysteresis in adjusting the ownership structure of their US subsidiaries.

The structure of this paper is as follows. In section 2, we present our theoretical results, and summarize them in few testable hypotheses. Section 3 provides information on our data sources and transformations. Section 4 incorporates our empirical results. We conclude in section 5.

2 Theoretical Motivation

2.1 The Model

The main premises of our model are the following:

(i) The MNC has already decided to enter the foreign market;

(ii) The MNC chooses, at any point in time between three modes. Two of these modes correspond to specific ownership structures of their foreign subsidiary: a Joint Venture (JV) or a wholly owned subsidiary (WOS) located in the foreign country. The third mode is an export (EXP) based one where the firm supplies the foreign market by exporting from production facilities in the home country. Our analysis emphasizes mainly a
comparison between the two modes: JV vs. WOS, but always in the presence of an EXP alternative;

(iii) The firm can switch between production modes over time, but such switches usually incur switching cost that usually is sunk cost;*

(iv) Regardless of the choice of production mode the firm has adequate capacity to meet all foreign market demand;

(v) We assume that the ownership share translates in an equivalent share of control over production activities with such consideration reflected in the relevant production and transaction cost per unit sold in the foreign market;

(vi) The main element of macroeconomic uncertainty for the MNC is the volatility of real bilateral exchange rates between the home and the host country.

Let $e$ be the real exchange rate between home country and foreign currency defined as units of home currency – say a German mark (DM) - per unit of foreign country currency – say a US dollar. (“Home country” is the country of the parent MNC, and “foreign country” is the foreign market where the MNC’s subsidiary is located. We are using the US as the “foreign country” since this is consistent with our data that record FDI flows in the US). We also assume that the real exchange rate $e\left(\frac{DM}{S}\right)$ follows a geometric Brownian motion with a drift

$$de = \kappa e dt + \sigma e dz$$  \hspace{1cm} (1)

where $\kappa =$ drift parameter, $\sigma =$ variance parameter, and $dz =$ increments of a Wiener process.

We denote by $Q_o(e)$ the corresponding operating profit function when the MNC uses a JV with ownership share $\alpha$ ( $\alpha = 1$ in case of a WOS).
\[ Q_o(e) = e \left[ P^L - c_o \right] D \]  \hspace{1cm} (2a)

where \( D \) = foreign market demand, \( P^L \) = the price (in the foreign currency) the firm charges for its product when it produces it locally in the foreign market that is assumed to be the same for all local producers, and \( c_o \) = all production, and other relevant transaction costs per unit sold, when the firm produces all units in facilities in the foreign country, with the assumed level of ownership share. For the EXP mode, the corresponding operating profit function is

\[ Q_o(e) = \left[ P^E - c_o \right] D \]  \hspace{1cm} (our convention for EXP: \( \alpha = 0 \))  \hspace{1cm} (2b)

where \( P^E \) = the price (in home country currency) the firm charges for its exports to the foreign market, and \( c_o \) = the corresponding production and total transaction cost per unit for the EXP alternative. Also, it is assumed that the MNC follows a pricing strategy in the foreign market that allows it to respond to exchange rate movements, by appropriately adjusting its price of its exported goods, in a way that does not affect the targeted market share, and subsequently the forecasted demand in any period in that market. This pricing policy is captured by equation (3), \( ^{vi} \)

\[ P^E = \gamma \frac{1}{e} P^L + (1 - \gamma)c_o + k \]  \hspace{1cm} (3)

where, \( \gamma \) is the degree of market competition in the foreign market \((0 < \gamma \leq 1)\), with \( \gamma = 1 \) in case of pure competition and \( \gamma = 0 \) in case of a monopoly, and finally \( k \) is a price premium (assumed to be constant) commanded by the exporting firm due to factors such as brand name recognition, perceived quality based on country of origin, reputation etc.

We now proceed with the problem formulation. Let \( I \) be the index set of feasible production modes. We denote by \( V_i(e) \) the maximum profit the firm can earn over an infinite planning horizon, when it currently uses production mode \( i \in I \). The switching cost from mode
to \( i' \), where \( i, i' \in I \), is denoted by \( \lambda_{i'} \). It is assumed that \( \lambda_{i} = 0 \) for \( i \in I \). Then the Choice of Mode Problem (CMP) can be formulated as follows:

\[
V_i(e) = \max \left\{ Q_i(e) \Delta t + \frac{1}{1 + \rho \Delta t} EV_i(e'), -\lambda_{i'} + Q_i(e) \Delta t + \frac{1}{1 + \rho \Delta t} EV_i(e') \right\}
\]

(4)

for \( i, i' \in I, i \neq i' \)

where \( E \) is the expectation operator of the exchange rate distribution after \( \Delta t \) time units conditional on the realization of the current period exchange rate, and \( \rho \) is an appropriate discount rate.

Using standard results from Ito calculus, we can conclude that for a firm in mode \( i \), and for exchange rates for which it is optimal to continue operating in mode \( i \) (i.e., \( i' = i \)), it holds that,

\[
\frac{1}{2} \sigma^2 e^2 \nu''(e) + \kappa e \nu'(e) - \rho \nu(e) + Q_i(e) = 0 \quad \text{for} \quad i \in I
\]

(5)

where \( \nu'(...) \) and \( \nu''(...) \) denote first and second derivatives respectively.

Using standard arguments from contingent claims valuation literature, (Dixit and Pindyck (1994)) we obtain that the parameters \( \kappa \) and \( \rho \) should be estimated as \( \kappa = r - \delta \) and \( \rho = r \), where \( r \) is the riskless rate of return and \( \delta \) is the dividend or convenience yield on a financial asset perfectly correlated with the exchange rate \( e \). From now on we use these parameter values in (5). Therefore, for \( i = \alpha \) the differential equation becomes,

\[
\frac{1}{2} \sigma^2 e^2 \alpha''(e) + (r - \delta) e \alpha'(e) - r \alpha(e) + \alpha_{\alpha}(e) = 0
\]

(6)

Using methodological arguments as in Dixit (1989a), we can verify that there exist threshold values of the real exchange rate \( e \) and \( \bar{e} \) such that for \( e \geq \bar{e} \) (or for a relatively
depreciated home country currency) the dominant mode is JV (\( \alpha < 1 \)), and for \( e \leq \varepsilon \) (i.e. a relatively appreciated home country currency) the dominant mode is WOS (\( \alpha = 1 \)). In the range \( \varepsilon \leq e \leq \bar{e} \), also referred to as "hysteresis band", the company follows a "keep the current mode" policy. Thus, equation (6), for a prespecified \( \alpha < 1 \) is valid for all \( e \geq \varepsilon \), while for \( \alpha = 1 \) it is valid for all \( e \leq \bar{e} \). The boundary conditions for equation (6) are specified, through value matching and smooth pasting conditions at \( \varepsilon \) and \( \bar{e} \).

Equation (6) has the general solution (see Shimko (1992)):

\[
V_a(e) = Be^{-\varepsilon m} + \frac{(p^L - c_a)D}{e^\delta}
\]  
(7)

where \( m \) is the positive root of the equation \( \frac{1}{2} \sigma^2 m (m - 1) + (r - \delta) m - r = 0 \).

Equation (7), applied for prespecified values of \( \alpha < 1 \) and \( \alpha = 1 \), along with the boundary conditions previously mentioned, (i.e. value matching and smooth pasting) result in a system of four equations with four unknowns. The solution of this system provides values for \( \varepsilon \) and \( \bar{e} \). Sensitivity analysis on those parameters identifies the factors affecting \( \varepsilon \) and \( \bar{e} \), and thus the hysteretic behavior of firms in uncertain exchange rate environments.

Overall, exchange rate volatility, the magnitude of the switching cost, and the growth of the foreign market demand decrease \( \varepsilon \) and increase \( \bar{e} \), strengthening thus the hysteresis in switching production mode and thus adjusting the ownership structure of a MNC's foreign subsidiary. On the other hand the degree of market competition in the foreign market has, at least theoretically, an undetermined impact on the size of the hysteresis, and therefore the degree of ownership switching hysteresis.
Intuitively, a volatile exchange rate increases the degree of economic uncertainty for a MNC that operates in a foreign market. In case of an adverse movement of exchange rates, and although the MNC's foreign subsidiary ends up operating with a sub-optimal ownership structure, the MNC might decide to wait before adjusting the ownership share of its subsidiary, not only due to the switching cost, but also because it is unable to predict the future level of a significantly volatile exchange rate. Thus, *ceteris paribus*, in the presence of volatile exchange rates, a MNC is willing to tolerate a larger appreciation of its home currency before it actually decides to increase the ownership share of its foreign subsidiary. *Hypothesis 1* captures this idea.

**Hypothesis 1** *The hysteresis in ownership adjustments becomes stronger (weaker) as the volatility of the exchange rate increases (decreases).*

The reason that a MNC might decide to postpone an adjustment of its ownership share of a foreign subsidiary is the existence of switching cost (usually a sunk cost) associated with this adjustment. In fact, if switching cost were absent, then a MNC would quickly adjust the ownership structure of its foreign subsidiary in response to a change in exchange rates. Thus, the interaction of switching cost and exchange rate uncertainty makes a MNC to tolerate larger appreciations (deprecations) of its home currency before it decides to increase (decrease) its ownership of a foreign subsidiary. *Hypothesis 2* incorporates this idea.

**Hypothesis 2** *The hysteresis in adjusting the ownership structure of a foreign subsidiary becomes stronger (weaker) in the presence of high (low) switching cost.*
A MNC also considers the growth prospects and profitability in the foreign market in its decision to adjust the ownership structure of its foreign subsidiary. Strong market demand growth implies large foregone profits for the company in case that its foreign subsidiary operates with a sub-optimal ownership structure. The MNC then has strong incentives to increase its ownership share of its subsidiary, since otherwise, it does not fully benefit from the high market demand. Consequently, *ceteris paribus*, the hysteresis in ownership adjustments is expected to be weaker in the presence of growing market demand, intuition that is captured in hypothesis 3:

**Hypothesis 3** The hysteresis in adjusting the ownership share of a foreign subsidiary becomes weaker (stronger) in the presence of high (low) demand in the foreign market.

Finally, Kouvelis et al. (2001) argue, within the confines of their modeling assumptions, that the degree of market competition and market structure of the industry in which the foreign subsidiary operates has an unclear impact on the hysteresis in adjusting the optimal ownership share of the subsidiary, since it affects $\varepsilon$ and $\bar{e}$ in the same direction.

### 3 Data

Although several researchers have already tested empirically the relation between exchange rates and FDI flows, very little has been done in testing for the factors that influence the hysteresis in FDI activity. Parsley and Wei (1993) makes an effort to present evidence for hysteresis in US trade flows with Canada and Japan, while Ansic and Pugh (1999) run laboratory experiments in studying the impact of sunk cost and exchange rate variability in hysteresis in
trade. Finally, Christophe (1997) presents indirect evidence of hysteretic behavior of U.S. MNCs in the 80s.

However, most researchers depend on industry-level data of FDI flows in their studies that most likely mask differences in firm-specific FDI decisions, leading Krugman (1989) to claim that “Such calculations are … no substitute for real evidence on what firms actually do …”. Moreover, possible hysteresis in adjusting the ownership structure of foreign subsidiaries is the outcome of a MNC’s strategic decision, and thus company level data should be more appropriate in testing for this type of phenomena.

Thus, in our study we use company-level data on US FDI inflows that come from the publication “Foreign Direct Investment in the United States”.

The data set reports the dollar value of FDI transactions in the United States of non-US MNCs that own at least ten percent of their US subsidiaries in which they invest. Every FDI transaction is classified according to the 4-digit SIC code and the US State that received the FDI inflow. In addition, these transactions are classified according to their type in six categories as Mergers and Acquisitions, Equity Increase, Joint Ventures, New Plants, Existing Plant Expansions, and Other.

The data set spans eighteen years (from 1977 to 1994), and we focus on the FDI transactions in all US manufacturing industries coming from the nine most important countries where US inflows are originated. In appendix A, we present a more detailed description of the sources of the data, along with a description for the appropriate data transformations for our empirical tests.

4 Empirical Results
Tables 1 and 2 include descriptive statistics and correlations among the most important variables in our estimations. In the remaining of this section we test formally the theoretical hypotheses described in section 2.

4.1 Hysteresis in Adjusting the Ownership of a Foreign Subsidiary

Our primary goal is to test for the impact macroeconomic, industry and company conditions have on the hysteresis in adjusting the ownership structure of a foreign subsidiary that is partially owned by a MNC. Thus, we take a sub-sample of the ITA data set that includes only the FDI transactions in the US classified as Equity Increase (EI). These are FDI transactions by non-US MNCs that specifically finance an equity increase of their respective US subsidiaries leading thus to an ownership adjustment of these subsidiaries.

Naturally, the decision of a MNC to adjust its ownership of a foreign subsidiary is discrete in nature, since it can decide to either perform an EI investment or not in a given period of time. However, there might be some hysteresis in this decision-making due to the interaction of switching cost in an ownership adjustment and some economic uncertainty that makes the company hesitant in performing an EI investment. In fact, an EI investment project resembles a call-option, and the company can postpone its decision to exercise the option in the presence of some market uncertainty.

Obviously, the strength of the hysteresis affects the probability of pursuing an EI investment. Although the real exchange rate might favor it, strong hysteresis might make an EI investment less probable, and its postponement more likely. At the same time, industry and company factors influence the strength of the hysteresis in performing an EI investment with those conditions that strengthen (weaken) the hysteresis to make an EI investment less (more) probable to happen. Consequently, given the level of the real exchange rate, the statistical effects
of these factors on the probability of an EI investment in fact present evidence of their impact on the magnitude of the hysteresis in EI decision-making and thus ownership adjustments.

To proceed with this intuition, we select from the ITA data set of EI transactions only the cases of MNCs that made more than one EI investment to the same US subsidiary during the period of time that our data span (1977-1994). We thus focus on repeated decisions by MNCs to increase their ownership share of the same US subsidiaries, with the time interval between two consecutive EI transactions from a MNC to its US subsidiary indicating possible hysteresis between these ownership adjustment decisions. Overall, thirty non-US MNCs in the data are recorded as having made more than one EI investment to the same US subsidiary from 1977 to 1994.

Next, we construct a binary variable \( (BINARY) \) that takes the value of one (1) in the year during which a non-US MNC performed an EI transaction, and the value of zero (0) for each year until the next instance of an EI investment to the same US subsidiary. The outcome of Probit regressions of \( (BINARY) \) on various independent variables that theoretically affect the hysteresis in ownership adjustments, measures the influence these independent variables exercise on the probability of an EI to happen, and therefore the probability of a foreign multinational company to increase its ownership of its US subsidiary. If a given exogenous variable strengthens (weakens) the hysteresis in ownership adjustments, then this will be captured in our estimations by a negative (positive) impact of this variable on the probability of an EI investment to happen, since it makes an EI less (more) probable.

Theoretically, the volatility of the real exchange rate, the switching cost for an ownership adjustment, the degree of market competition of the industry in which the foreign subsidiary operates, and the market demand the foreign subsidiary faces are the factors that are expected to
influence the hysteresis in ownership increases. Hypotheses 1 through 3 capture these ideas and we test them by estimating reduced form equation (8):

\[ BINARY_i = f\left(EXG_i, EVOL_i, C8_i, SWCOST_i, PROFIT_i, DSALES_i \right) \] (8)

The dependent variable \( BINARY_i \) that captures the hysteresis in ownership adjustments is regressed on proxies for the various independent variables that theoretically are expected to have an impact on this hysteresis. Specifically, an index of the level of the real exchange rate \( EXG_i \) between the US dollar and the currency of the country where the FDI was originated is used in estimations.\textsuperscript{**} Notice that this variable controls for the incentives MNCs have to pursue or not an EI investment that are not related to the hysteresis phenomenon. Also, the volatility of the real exchange rate \( EVOL_i \), calculated as the annualized standard deviation of a moving average of \( EXG_i \) for the past thirty-six months, captures the exchange rate uncertainty in EI decisions.\textsuperscript{**} The switchover cost \( SWCOST_i \) is proxied either by the ratio of the real value of inventories to the real value of total assets of each US subsidiary receiving an EI investment \( SWCOST_1 \), or by the ratio between real inventory and real sales of the same subsidiary \( SWCOST_2 \). For the prospect of market demand growth and profitability two different sets of proxies are used. At a company level, the real value of profits as a percentage of both total assets \( PROFIT_1 \) and sales \( PROFIT_2 \) of the subsidiary receiving the EI investment are used to proxy the profitability of each subsidiary. Also, the growth rate of the subsidiary's real sales \( DSALES_1 \) proxy the growth of its market demand, while the growth rate of real sales of the
industry in which the subsidiary operates ($D_{SALES2}$) proxy the growth of the industry demand. The degree of market competition in the industry in which the subsidiary operates is measured by the 8-firm concentration ratio of the respective industry ($C_{8}$). Finally, to check the robustness of our empirical results, four different specifications of equation (8) are tested (Model 1 through Model 4; table 3) using the various proxies of our regressors.

As expected, in all specifications of equation (8) a depreciation of the home country real exchange rate ($EXG_{t}$) makes an EI transaction less probable, indicating thus a weaker desire of MNCs for EI adjustments. However, these results are statistically significant only in one specification. On the other hand, the estimated coefficient for the volatility of the real exchange rate is negative and statistically significant in all specifications. This indicates that as real exchange rates become more volatile, an EI investment becomes less probable to happen and therefore the hysteresis in ownership adjustments becomes stronger. Overall, the data support hypotheses 1 and the argument that exchange rate volatility strengthens the hysteresis in ownership expansions.

Hypothesis 2 expresses the notion that high switching cost makes companies to be slower in adjusting their ownership share of a foreign subsidiary. In testing this hypothesis, four specifications of equation (8) are estimated (Model 1 through Model 4; table 3), using respectively ($SWCOST_{1}$) and ($SWCOST_{2}$) to proxy the switching cost. In all specifications, the estimated coefficient for the switching cost is negative, and it is statistically significant in three out of four specifications. High switching cost appears to depress the probability of an EI investment, thus presenting evidence of stronger hysteresis in ownership share adjustments consistent with hypothesis 2.
Market demand growth and profitability are also expected to have an impact on the hysteresis in ownership adjustments. Strong growth of market demand and high profitability presents incentives for a quicker increase in the ownership share of a foreign subsidiary in order to capture a larger share of the business opportunities. Hypothesis 3 states this idea that is tested by estimating four different specifications of equation (8) (table 3). In the first two specifications, proxies for the subsidiary’s profits are used to capture its profitability (PROFIT, and PROFIT2,) while in the next two specifications proxies for the subsidiary and industry sales are used (D SALES1, and D SALES2,).

The estimated coefficients indicate that only the growth rate of industry sales has a statistically significant impact on the probability of an EI investment and this is robust for all the estimated specifications of equation (8). In addition, the positive sign of the estimated coefficient reveals that strong industry demand growth strengthens the probability of an EI investment presenting thus evidence of reduced hysteresis in an ownership adjustment (consistent with hypothesis 3). Overall, it appears that industry demand considerations are more important in influencing the hysteresis in ownership adjustments than individual company sales or profits. In other words, the industry outlook appears as a stronger incentive in expediting an EI investment than the outlook of the individual companies that receive this investment.

Finally, the degree of market competition in the industry in which the foreign subsidiary operates might also have an impact on the strength of the hysteresis in ownership adjustments. Industries that are closer to pure competition are characterized by stronger market competition while the ones with significant market concentration are usually less competitive. However, theoretically we were unable to determine the specific effects of market competition on the size of the hysteresis in ownership adjustments. Our empirical results are also inconclusive in this
matter, since the estimated coefficient of \((C8)\) is negative but statistically insignificant. Perhaps these inconclusive results might be the outcome of an imperfect proxy for market concentration in use (i.e. the 8-firms concentration ratio), or the unpredictability of investment decisions in oligopolistic industries with strong strategic interaction among companies.

4.2 Switching Cost and Hysteresis in Ownership Adjustments

The magnitude of the hysteresis in ownership adjustments of foreign subsidiaries is influenced by the interaction of industry and company conditions with the switching cost associated with such adjustments. In fact, the switching cost is a necessary condition for this phenomenon in a MNC’s decision making. Overall, the interaction of switching cost with exchange rate volatility is expected to further strengthen the hysteresis, while its interaction with market demand growth to weaken it.

This intuition is tested by estimating equation (9), where interaction variables between the exogenous variables in consideration and the switching cost are included (e.g. \(SWCOST_1 \times EVOL_1 = SEVOL_1\)).

\[
BINARY_i = f(SWCOST_1, SEVOL_1, SC8, SDSALES1, SDSALES2)
\]

The results are reported in table 3 (Model 5). The estimated coefficient of \((SEVOL_1)\) is negative and statistically significant indicating that exchange rate uncertainty strengthens the impact of switching cost on the hysteresis in ownership adjustments by decreasing the probability of an EI investment to happen. At the same time, industry sales weaken this impact (positive estimated coefficient of \(SDSALES2\)) while growth of company sales have a statistically insignificant influence on switching cost’s impact on the hysteresis in ownership adjustments.
4.3 The Magnitude of Ownership Adjustments

The analysis so far presents evidence for the impact various economic, industry and company variables might have on the hysteresis in ownership adjustments of foreign subsidiaries. In the present section we further extend the analysis by also exploring the factors that determine the magnitude of the pursued ownership increase of a foreign subsidiary given the company’s decision to increase its equity of its foreign subsidiary.

Our data set includes as before the thirty non-US MNCs that performed more than one EI transaction to the same of their US subsidiaries for the period between 1977 and 1994. In our estimations now, the dependent variable \( \alpha_i \) is the real value of each EI transaction as a share of the real value of the total assets of the US subsidiary receiving the investment. In fact, \( \alpha_i \) measures the size of the ownership increase of its US subsidiary a MNC achieves through an EI investment as it is given by the increase in its equity share of this subsidiary. On the other hand, the independent variables are the same as before capturing the volatility of the exchange rate \( EVOL_i \), market concentration \( C8_i \), switchover cost \( SWCOST1_i \) and \( SWCOST2_i \), profits of the subsidiary receiving the EI investment \( PROFIT1_i \) and \( PROFIT2_i \), the growth rate of the subsidiary’s sales \( DSALES1_i \), the growth rate of industry sales \( DSALES2_i \), along with exchange rate expectations \( ETREND_i \) calculated as the moving average of the monthly change of \( EXG_i \) for the past thirty six months. The results from estimating the reduced form equation (10), using the Random Effects Model, are reported in table 4.

\[
\alpha_i = f(ETREND_i, EVOL_i, C8_i, SWCOST_i, PROFIT_i, DSALES_i)
\]  

(10)
The estimated coefficients indicate that an expected depreciation of the home currency with respect to the US dollar ($ETREND_i$) reduces the size of the ownership increase of the US subsidiary. Also, these results are robust in all the specifications in estimating equation (10). MNCs tend to reduce the magnitude of an ownership increase of their US subsidiaries in case they expect a depreciation of their home currency.

Also, market concentration ($C8_i$) seems to favor the magnitude of EI investments by a MNC. Multinational companies increase the ownership of their subsidiaries in concentrated industries in anticipation of higher profits stemming from the market power of the companies in highly concentrated industries. Finally, the growth rate of industry sales ($DSALES2_i$) pushes for high EI transactions, while the growth rate of company sales lead to smaller EI transactions.

5 Discussion and Conclusions

Multinational companies usually serve foreign markets by either exporting or operating a production facility in these markets. Exchange rates are important in the company's strategic decision of how to serve a foreign market, but irrespective of the pursued strategy, the company makes investments that are frequently irreversible. On the other hand, exchange rate uncertainty (and for that matter any other economic uncertainty associated with the foreign market) along with the irreversibility of investments lead MNCs to hesitate (hysteresis) before they take the decision to pursue and adjustment of the ownership of their foreign facilities.

In the present paper we test empirically for the factors that influence this hysteresis in the presence of changing market and macroeconomic conditions. Based on company-level data, it appears that the hysteresis associated with ownership adjustments of a foreign subsidiary becomes stronger with high exchange rate volatility, and in the presence of high switching cost,
while it is weakened in case of strong industry demand growth. Moreover, expectations for an appreciation of the home currency along with market concentration and growth in industry sales seem to favor higher ownership increases of a foreign subsidiary.

Apparently, MNCs increase their ownership involvement in foreign markets as their home exchange rate appreciates, but follow a “wait and see” strategy in adjusting their involvement in the foreign market in the presence of exchange rate uncertainty and high switching cost. These findings are consistent with Kogut and Chang (1996) who find MNC to use joint ventures for some period of time as a platform before getting more involved in the foreign market. This is also consistent with the case where MNCs “mothball” their foreign subsidiaries for some period of time before abandoning altogether the foreign market. Moreover, our findings support Amuendo-Dorandes and Pozo’s (2001) findings of a long term relation between exchange rates and Foreign Direct Investment flows.

Obviously, hysteretic phenomena might characterize the strategic decisions of MNCs in pursuing investment on existing plant expansions, new plants or finally Mergers and Acquisitions. This analysis is part of our future research.
Appendix A

Data Sources and Transformations

Countries in the sample: Belgium, Canada, France, Germany, Italy, Japan, Sweden, Switzerland, and United Kingdom.

Bilateral Real Exchange Rate: We follow the same derivations as in Goldberg and Kolstad (1995). Specifically, we multiply the nominal exchange rate, defined as the price of a US dollar in terms of the currency of the home country, and multiplied by the price deflator of the home country and divided by the respective one of US. Then we index it with respect to its 12/1994 value (Source: IMF International Financial Statistics).

Volatility of the real exchange rate: We follow the calculations suggested by Campa and Goldberg (1995), and Goldberg and Kolstad (1995). Specifically, we calculate the standard deviation of a moving average of the real exchange rate for the past 36 months.

Consumer Price Index: We use the “Consumer Price Index” for Belgium, Canada, France, Germany, Italy, Japan, Switzerland, UK and the US, and the “Consumer Price” for Sweden. (Source: Datastream International).

Equity Increase (EI): An FDI that raises the percentage of securities of US subsidiaries held by a non-US investor. (Source: ITA Transaction Database, US Department of Commerce).

Company Data: We use the dollar value of inventory, profit, total assets and sales of the US subsidiaries in our sample. (Source: Compustat; in millions of US dollars)
Appendix B

Table 1.
Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Stand. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>$EVOL_i$</td>
<td>12.227</td>
<td>5.888</td>
<td>1.481</td>
<td>32.295</td>
</tr>
<tr>
<td>$C8_i$</td>
<td>63.333</td>
<td>21.064</td>
<td>13.200</td>
<td>97.000</td>
</tr>
<tr>
<td>$ASSETS_i$</td>
<td>627.304</td>
<td>1235.706</td>
<td>7.925</td>
<td>2723.154</td>
</tr>
<tr>
<td>$SALES_i$</td>
<td>1044.478</td>
<td>1950.329</td>
<td>12.552</td>
<td>3870.474</td>
</tr>
<tr>
<td>$INVENTORY_i$</td>
<td>107.689</td>
<td>790.727</td>
<td>0.00</td>
<td>530.007</td>
</tr>
<tr>
<td>$PROFITS_i$</td>
<td>39.184</td>
<td>836.106</td>
<td>-228.213</td>
<td>480.501</td>
</tr>
</tbody>
</table>

Notes: "ASSETS_i", "SALES_i", "INVENTORY_i", and "PROFITS_i" come from the respective financials of the US subsidiaries in our sample that received Equity Increase investment from non-US multinationals (in millions of US dollars).

Table 2.
Correlations: Company Data

<table>
<thead>
<tr>
<th></th>
<th>$EI_i$</th>
<th>$EVOL_i$</th>
<th>$C8_i$</th>
<th>$ASSETS_i$</th>
<th>$SALES_i$</th>
<th>$INVENTORY_i$</th>
<th>$PROFITS_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$EI_i$</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$EVOL_i$</td>
<td>0.238</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C8_i$</td>
<td>-0.164</td>
<td>0.297</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$ASSETS_i$</td>
<td>0.341</td>
<td>-0.371</td>
<td>-0.253</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$SALES_i$</td>
<td>0.235</td>
<td>-0.373</td>
<td>-0.224</td>
<td>0.962</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$INVENTORY_i$</td>
<td>0.283</td>
<td>-0.047</td>
<td>0.032</td>
<td>0.705</td>
<td>0.784</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>$PROFITS_i$</td>
<td>0.593</td>
<td>-0.260</td>
<td>-0.382</td>
<td>0.796</td>
<td>0.712</td>
<td>0.338</td>
<td>1.00</td>
</tr>
</tbody>
</table>

22
Table 3.
Hysteresis in Ownership Adjustments of US Subsidiaries

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.583*</td>
<td>2.169*</td>
<td>2.562*</td>
<td>2.334*</td>
<td>1.387*</td>
</tr>
<tr>
<td></td>
<td>(3.780)</td>
<td>(3.488)</td>
<td>(3.782)</td>
<td>(3.599)</td>
<td>(2.318)</td>
</tr>
<tr>
<td><strong>CONSTANT</strong></td>
<td>-0.0027</td>
<td>-0.0029</td>
<td>-0.0028</td>
<td>-0.0035**</td>
<td>-0.0039</td>
</tr>
<tr>
<td></td>
<td>(-1.249)</td>
<td>(-1.309)</td>
<td>(-1.347)</td>
<td>(-1.683)</td>
<td>(-1.602)</td>
</tr>
<tr>
<td><strong>EVOL</strong></td>
<td>-0.0192*</td>
<td>-0.0193*</td>
<td>-0.0196*</td>
<td>-0.0212*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.083)</td>
<td>(-2.129)</td>
<td>(-2.148)</td>
<td>(-2.336)</td>
<td></td>
</tr>
<tr>
<td><strong>C8</strong></td>
<td>-0.181</td>
<td>-0.177</td>
<td>-0.165</td>
<td>-0.144</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.615)</td>
<td>(-1.509)</td>
<td>(-1.482)</td>
<td>(-1.289)</td>
<td></td>
</tr>
<tr>
<td><strong>SWCOST1</strong></td>
<td>-1.431**</td>
<td>-1.457**</td>
<td>-1.154**</td>
<td></td>
<td>0.158</td>
</tr>
<tr>
<td></td>
<td>(-1.902)</td>
<td>(-1.940)</td>
<td>(-1.700)</td>
<td></td>
<td>(0.155)</td>
</tr>
<tr>
<td><strong>SWCOST2</strong></td>
<td>-0.889</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.325)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PROFIT1</strong></td>
<td>-1.373</td>
<td>-1.353</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.443)</td>
<td>(-1.545)</td>
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</tr>
<tr>
<td><strong>PROFIT2</strong></td>
<td>-1.201</td>
<td></td>
<td></td>
<td>-0.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.386)</td>
<td></td>
<td></td>
<td>(-0.051)</td>
<td></td>
</tr>
<tr>
<td><strong>DSEAS1</strong></td>
<td>0.261*</td>
<td>0.265*</td>
<td>0.264*</td>
<td>0.253*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.867)</td>
<td>(2.894)</td>
<td>(2.887)</td>
<td>(2.711)</td>
<td></td>
</tr>
<tr>
<td><strong>SEVOL</strong></td>
<td></td>
<td></td>
<td></td>
<td>-0.0288*</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-2.372)</td>
<td></td>
</tr>
<tr>
<td><strong>SC8</strong></td>
<td></td>
<td></td>
<td></td>
<td>-0.209</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-1.340)</td>
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</tr>
<tr>
<td><strong>SDSEAS1</strong></td>
<td></td>
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<td></td>
<td>-0.235E-05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-0.001)</td>
<td></td>
</tr>
<tr>
<td><strong>SDSEAS2</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.324*</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2.653)</td>
<td></td>
</tr>
<tr>
<td><strong>Log Likelihood</strong></td>
<td>-50.824</td>
<td>-51.815</td>
<td>-50.953</td>
<td>-52.652</td>
<td>-52.589</td>
</tr>
<tr>
<td><strong>Pseudo R²</strong></td>
<td>0.172</td>
<td>0.156</td>
<td>0.169</td>
<td>0.146</td>
<td>0.149</td>
</tr>
<tr>
<td><strong>Sample</strong></td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>98</td>
<td>98</td>
</tr>
</tbody>
</table>

Notes: A (*) next to a coefficient indicates its significance at 0.01 level, and a (**) its significance at 0.05 level. The reported t-statistics in parentheses are corrected for heteroscedasticity.
Table 4.
Size of Ownership Change of US Subsidiaries

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.042</td>
<td>-0.020</td>
<td>-0.065</td>
<td>-0.263</td>
</tr>
<tr>
<td></td>
<td>(0.117)</td>
<td>(-0.058)</td>
<td>(-0.181)</td>
<td>(-0.076)</td>
</tr>
<tr>
<td>ETREND$_i$</td>
<td>-37.400*</td>
<td>-37.279*</td>
<td>-37.929*</td>
<td>-34.885*</td>
</tr>
<tr>
<td></td>
<td>(-3.359)</td>
<td>(-3.407)</td>
<td>(-3.437)</td>
<td>(-3.489)</td>
</tr>
<tr>
<td>EVOL$_i$</td>
<td>0.0097</td>
<td>0.010</td>
<td>0.101</td>
<td>0.0069</td>
</tr>
<tr>
<td></td>
<td>(1.415)</td>
<td>(0.129)</td>
<td>(1.475)</td>
<td>(1.103)</td>
</tr>
<tr>
<td>CS$_i$</td>
<td>0.152**</td>
<td>0.159</td>
<td>0.156**</td>
<td>0.127</td>
</tr>
<tr>
<td></td>
<td>(1.828)</td>
<td>(0.054)</td>
<td>(1.886)</td>
<td>(1.610)</td>
</tr>
<tr>
<td>SWCOST1$_i$</td>
<td>-0.134</td>
<td>-0.127</td>
<td>0.019</td>
<td></td>
</tr>
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<td></td>
<td>(-0.648)</td>
<td>(-0.635)</td>
<td>(0.101)</td>
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<tr>
<td>SWCOST2$_i$</td>
<td>-0.211</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>(-1.038)</td>
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<td>PROFIT1$_i$</td>
<td>0.352</td>
<td>0.387</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(1.165)</td>
<td>(0.196)</td>
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</tr>
<tr>
<td>PROFIT2$_i$</td>
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<td>(1.428)</td>
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<tr>
<td>DSALES1$_i$</td>
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<td>-0.0023**</td>
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</tr>
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<td></td>
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<td>(-1.915)</td>
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</tr>
<tr>
<td>DSALES2$_i$</td>
<td>0.084</td>
<td>0.082</td>
<td>0.078</td>
<td>0.105**</td>
</tr>
<tr>
<td></td>
<td>(1.429)</td>
<td>(1.414)</td>
<td>(1.332)</td>
<td>(1.857)</td>
</tr>
</tbody>
</table>

Notes: The OLS and the Fixed Effects regressions are not reported since they have been rejected in favor of the Random Effects Model. A (*) next to a coefficient indicates its significance at 0.01 level, and a (**) its significance at 0.05 level. The reported t-statistics in parentheses are corrected for heteroscedasticity.
REFERENCES
Austin, J.E. (1990), Managing in Developing Countries: Strategic Analysis and Operating Techniques, Free Press, New York.


1 Corresponding author: Democritus University of Thrace, Dept. of Economic Relations and Development, Greece; e-mail: axarlog@otenet.gr

2 I thank Bill Casey, Panos Kouvelis and Simon Johnson for constructive discussions and criticism. I also gratefully acknowledge financial support from the Glavin Center, Babson College, U.S.A.


4 Parsley and Wei (1993), using industry data, find little evidence for hysteresis in US trade flows with Canada and Japan, while Ansic and Pugh (1999) use laboratory data to test their hypotheses.

5 A joint venture mode (JV) is an equity-based cooperative venture, where the firm entering the foreign market shares the ownership, and the required investment, of a production facility in the foreign market with a local partner, while a wholly owned subsidiary (WOS) is a wholly owned and completely controlled production facility in the host country.


7 Obviously, the switching costs vary according to the switch between specific production modes the firm intends to do. For instance, if the firm decides to switch from a WOS to a JV, the switching cost might involve for example all transaction costs in establishing a contractual relationship with a local partner and organizing the joint production activities. Similarly, if the firm plans to switch from a JV to a WOS the switching cost might consist of the acquisition costs of the local partner’s share or the termination cost of the JV and the development costs of new production facilities in the foreign market, etc.

8 It follows the economic intuition presented in Hooper and Mann (1989).

9 For more on this issue see Kouvelis et al. (2001).


11 These data were maintained by the International Trade Administration (ITA), the US Department of Commerce, and were discontinued after 1994.

4 See appendix A for more on the description of these types of FDI inflows.

5 The nine countries in the sample are the source of approximately 87% of all FDI inflows in the US manufacturing the ITA data set records.
Of course, a MNC might decide not to pursue an EI investment in a certain year for other reasons besides a hesitation due to hysteresis. To control for these motives, we include in the regressions to follow a proxy for the level of bilateral real exchange rates that in the literature appear very important in influencing FDI flows.

Summary statistics and correlations of key financials from the thirty US subsidiaries that received the EI inflows in the sub-sample are reported in tables 1 and 2.

For instance, the real exchange rate between the US dollar and the German DM is defined as

\[ exg = \frac{DM \times CPI_{Germany}}{\$ \times CPI_{US}} \]

where \( CPI_{US} \) and \( CPI_{Germany} \) are the Consumer Price Indices in the US and Germany respectively. An increase in \( \left( EXG \right) \) implies a depreciation of the DM with respect to the US dollar.