The Choice between Greenfield Investment and Cross-border Acquisition: A Real Option Approach

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Abstract

The purpose of this study is to formalize the choice of market entry strategy for an individual multinational enterprise (MNE) from a dynamic perspective. It is argued that incorporating a suitable treatment of irreversibility, uncertainty and flexibility related to a MNEs investment decision gives further insights to the choice of cross-border acquisitions to greenfield investment as the preferred entry mode. In most cases, the initial entry strategy serves as a platform allowing the firm to make subsequent investments to exploit host-country advantages and capabilities. We allow for this by taking a two-step expansion strategy explicitly into account. The evolutionary process of the value of the foreign direct investment includes two stochastic elements as well as the timing that triggers the transition from export to foreign direct investment. The results suggest that uncertainty and future investment opportunities play an important role when it comes to transit from export to the first phase of the foreign direct investment commitment as well as have an impact on the choice of entry strategy.

JEL classification: D92; F23; G31; O32

Keywords: Foreign direct investment; Multinational enterprise; Sequential investments; Entry mode; Greenfield investment; Cross-border acquisition

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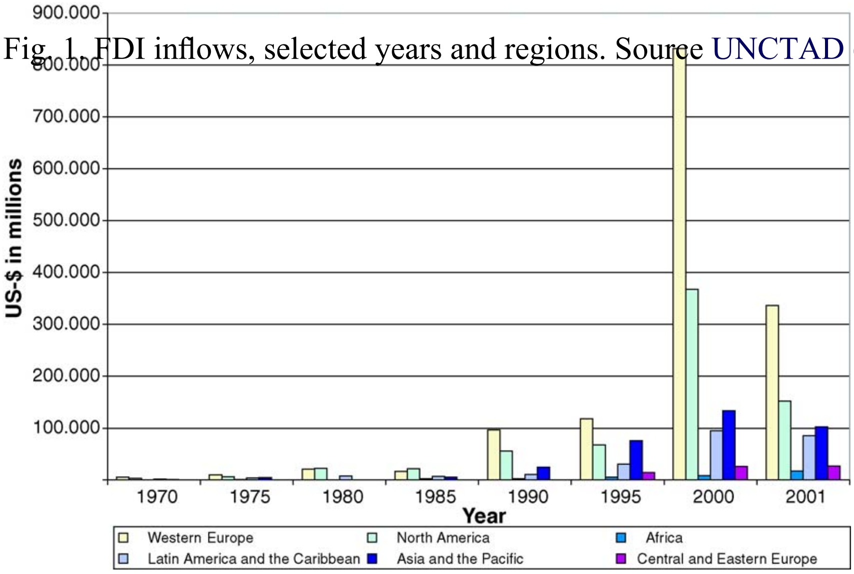
1. Introduction

In todays' fast moving rapidly changing business and technological environment, the form of market entry in new foreign markets has become a crucial decision to most MNEs. Firms initially establish themselves in a foreign market through exporting. Although this entry strategy represents a low risk entry mode, it offers little control mechanism if market conditions change. Furthermore, export is associated with limited profits. Leaving other entry strategies, for example joint-ventures, disregarded, a firm will be faced with the decision to increase its resource commitment in the future in order to exploit further growth. Focusing on possible equity modes to enter a foreign market, greenfield investment, i.e. setting up a new plant, as well as the acquisition of an established company in the foreign market represent favorable foreign direct investment alternatives.[2]

Fig. 1. FDI inflows, selected years and regions. Source UNCTAD (2001).



Besides all other market entry modes and a perceived decline in 2001, worldwide

[2] See Pan and Tse (2000) who distinguish entry modes based upon equity or non-equity modes.

foreign direct investment (FDI) continues to grow stressing the importance of equity based entry strategies (Fig. 1).

Furthermore, liberalization of foreign entry and ownership restrictions as well as the establishment of international accounting standards and shareholding systems have exponentially increased foreign investors' access to local markets and their ability to acquire assets within them. As a consequence, there exists a perceived worldwide trend of cross-border M&A as a preferred market entry strategy driving the upsurge in foreign direct investment. According to UNCTAD (2001), cross-border M&A accounted for 83% of worldwide FDI in 1999 especially driven by mega deals in telecommunication and media industries. Reasons for this are with no doubt advantages that arise from the resulting market power while reducing competition and from the possibility of speedy entry. The American internet auctioneer EBay for example used cross-border acquisitions in order to expand to thirteen countries within 100 days, leaving other possible entry strategies untouched. Besides this, foreign direct investment in form of greenfield investment becomes attractive for companies to expand in underdeveloped countries.

The homogeneous change in entry modes over time suggests that legislative changes in different countries do not explain the perceived trend, supporting the assumption that purely economic factors can explain the variation in entry modes across countries over time (see, e.g. Andersson & Svensson, 1996). So far, there exists a lack of in-depth research in the MNE literature with respect to the following questions. First, what triggers the switching of modes and second under which circumstances does the firm prefer greenfield investment over cross-border M&A?

2. Review of the literature

Several empirical studies have identified certain determinants that, with respect to greenfield investment and cross-border acquisition, affect the choice of entry strategy. In an early entry mode study, Dubin (1976) discovered that U.S. firms tend to favor greenfield investments if the firm size was large, targeting a developing country and had previously acquired foreign experience (cited in Kogut & Singh, 1988). Hennart and Park (1993) found that Japanese investors in the U.S. favor the use of acquisition rather then greenfield investment if the target market is characterized by high scale economies and high concentration levels. Caves and Mehra (1986) noted that entry mode is driven by the form of entrant's corporate organization and the characteristics of its product market. Focusing on firms entering the U.S. market, they disconfirmed the hypothesis that previous investments in a country have an impact on a firms choice to enter by greenfield over acquisition into the U.S. market. In addition, they indicated that acquired experience in these fields, e.g. knowledge of routinized processes in internationalization, will encourage a firm to choose acquisition rather than greenfield investment. In a similar fashion, Andersson and Svensson (1996) differentiate between technological and organizational skills of a firm and analyzed empirically their impact on entry mode choice. They come to the conclusion, that firms with strong organizational skills prefer takeovers, while firms with strong technological skills favor greenfield operations. Zejan (1990) noted that product line diversification encouraged, and industry growth discouraged crossborder acquisition. Furthermore he indicated that experience is insignificant and that takeovers become more common because of growing instability and uncertainty. Focussing on Japanese manufacturing companies entering the United States, ÓhUallacháin and Reid (1997) discovered that Japanese firms broadly disperse, both sectorially and geographically, their acquisition of American targets while their greenfield investments were mainly attracted by interregional distribution of domestic manufacturing. Thus, they conclude that agglomeration features tend to have an impact on the firms choice.

In a qualitative manner, Buckley and Casson (1998b) focused explicitly on determinants influencing the choice between setting up an entirely new foreign facility (greenfield investment) or acquiring an existing company in the host country. They stressed the importance of certain additional costs that trigger the choice whether to enter via greenfield investment or acquisition. Görg (2000) implemented these findings in his analysis of duopolistic rivalry allowing for Cournot competition. However, both attempts do not account for the fact, that a firm's commitment to invest into a new market is associated with sunk costs which cannot be recovered once the project is initiated. Furthermore, foreign direct investment decisions are to a large portion investment decisions under uncertainty and are only but the first commitment of subsequent expansion. Thus with respect to the initial switching decision, i.e. whether to abandon export or not, one has additionally to consider the impetus of subsequent expansion.

In the last decade, researchers have highlighted the importance of a more dynamic perspective in foreign direct investment (FDI) theory. Buckley and Casson (1998a) stressed this need in order to overcome the static nature of past models and suggest real option methodology.[3]The methodology of real options allows for incorporating and modelling three important features, namely irreversibility, flexibility and uncertainty associated with foreign direct investments.[4] Irreversibility stresses the fact that the fixed costs of establishing subsidiaries, learning the market, hiring labor or training agents are already sunk, i.e. they cannot be sold on secondary markets. Uncertainty, and volatility respectively, is reflected in the amplitude and frequency of the profit stream and consequently influences the value of an investment project. While this volatility was low during the 1960s and 1970s, it has risen constantly due to international diffusion of modern production technology, international deregulation and convergence of different key technologies. Furthermore, uncertainty is

[3] A firm's investment decision rule has historically been based on the net present value rule (NPV). Focusing explicitly on foreign direct investment and the multinational firm, Hirsch (1976) and Buckley and Casson (1981) applied the net present value rule in order to model the timing as well as the switching of modes. However, in the early 1980s the NPV rule was modified to take account for the value of certain real options rights. In brief, real option theory suggests to view real investments as options buying the firm the rights such as to make investments later, the right to defer or alter scale or to initiate subsequent investments.

[4] A detailed introduction to real options is given by Dixit and Pindyck (1994) or Trigeorgis (1998).

important because it puts a premium on flexibility. It is this flexibility that Kogut (1983) sees as motivation for international firm activities. Thus, he suggests to view a MNE as a collection of valuable options which permits the transfer of resources and activities internationally.

Instances of real options for multinational enterprises stem from two sources of flexibility. First, there exists operational flexibility which is based on short-time planning horizons. This operational flexibility is directly associated and sometimes apparently available with an investment project. Entry and exit decisions, for example, contingent on exchange rate volatility have been analyzed with option valuation techniques by Dixit (1989) and Baldwin and Krugman (1989). The same source of uncertainty may justify the decision of a firm to produce one product in several locations around the globe, switching production between them as unprofitable situations unfold at certain locations. This type of operational flexibility was analyzed, for example, by Kogut and Kulatilaka (1994). In contrast to operational flexibility, strategic flexibility results from future investment opportunities initial new market equity commitments might generate. Buckley and Casson (1998a) have drawn the attention on this by arguing that the existing models do value FDI decisions only with respect to its immediate effects rather than in terms of possible new investment opportunities. Howells and Wood (1993) found that in most cases production serves as a platform in the expansion abroad of MNEs R&D units, this sort of flexibility, however, has still found little attention in modelling the multinational firm. Thus R&D tends to follow the establishment of a manufacturing site abroad with a certain time-lag. This assumption is strongly supported by the empirical findings of, e.g., Pearce and Singh (1992).

In a similar strain, Kogut and Chang (1996) examined empirically the effects of previous entry on subsequent expansion of Japanese firms in the United States. They come to the conclusion that the propensity to enter the foreign market is positively related to previous investments in that market, indicating that the initial investments carry a high option value due to possible new investment opportunities. The fact that foreign direct investment carries a high future option value is also stressed by Kogut (1991) who narrows the focus on international joint-ventures (JV). Possible project interdependencies within the JV allow for strategic flexibility calling for an interpretation of JVs as platform investments. Thus, although unprofitable from a stand-alone perspective, the value of a joint-venture can be much higher due to the flexibility to acquire later stakes of the venture in the future.

The goal of this paper is two-fold: To model a market entry situation of foreign direct investment under uncertainty given the observed fact of an evolutionary expansion sequence. And to differentiate between the two most important equity-based entry modes: greenfield investment and cross-border M&A. Thus, the rest of the paper is structured as followed. First we will present the model: a two-phase market entry situation where each phase is connected to some sort of sunk cost and the flexibility to decide whether to initiate the phase or not. The first phase represents the building phase, e.g. the establishment of a physical presence by either acquiring assets already in place or by building a production plant. This phase serves as a platform, i.e. an important prerequisite to further expand a MNEs presence in the new market. We link the second phase to the construction of a regional technology platform (RTP).[5] We will assume that the attributes of the foreign location are connected to the second phase by introducing a location specific variable Θ which is linked to MNEs profits. Finally, we will discuss our main findings.

3. The model

We consider an enterprise that has to decide whether to enter a new geographical market via greenfield investment or via an acquisition of a host country target while abandoning its current export serving strategy. It is assumed that the foreign investor is risk neutral and that market entry through foreign direct investment follows a two stage process and that each stage is connected to a profit flow from the products sold at each stage as well as

[5] We do not differentiate exactly between a regional technology platform and a R&D site in the host-country as for example Kuemmerle (1997). The only emphasis is on the fact that the firm generates value for the second phase by transforming knowledge into innovative products.

to some sort of sunk costs.[6]

The choice which entry strategy an enterprise chooses has no influence upon the profit rates of other enterprises in the foreign market. Uncertainty surrounding the foreign expansion is reflected in the changes of the company's profit flow. It is assumed that changes in the profit flow are exogenous and can be modelled by a random profit flow expressed by a geometric Brownian motion:[7]

$$d\pi(t) = \alpha\pi(t)\,dt + \sigma\pi(t)\,dz$$

where α is the rate of drift, σ represents the volatility and dz is an increment of the Wiener process. In this path, the profit flow π is known with certainty at time zero, but its rate of growth becomes increasingly uncertain over time. Given a continuously compounded rate of return *r*, the expected present value of the investment under the assumption of an infinitively lasting profit stream equals

$$v \equiv v(\pi) = E\left[\int_t^{\infty} \pi(s)\,e^{-r(s-t)}ds\right] = \frac{\pi}{r-\alpha}.$$

Since v is a multiple of π, the value of the investment project is also characterized by a geometric Brownian motion with drift α and volatility σ. In the theoretical considerations following the value of the investment v is used as the uncertain variable. Thus it is considered that the value of a chosen FDI mode at each stage is ex ante unknown and can be expressed by a stochastic process.

Foreign direct investment of the firm is considered to be a two phase evolutionary entry sequence. As Chang and Rosenzweig (2001) have depicted, a sequence structure like this is reasonable since firms in their sample, i.e. 812 Japanese and European companies,

[6] To simplify the analysis, we also assume that throughout the durations of each separate stage the option rights are exclusive and furthermore that there are no problems of forfeiture or expiration limits with regard to exercising the respective investment option.

[7] Pennings and Lint (2000) mention that a geometric Brownian motion seems to fit best the observed prices in rapidly changing, technology-based markets.

entered the U.S. market 2.5 times on average. The first phase represents the building phase, e.g. the establishment of a physical presence by either acquiring assets already in place or by building a production plant. While the firm invests in the first stage, it receives a project value of v the fluctuations of which are captured by dv(t) up to this point. This phase serves as a platform, i.e. an important prerequisite to further expand the presence in the new geographical market.

Whereas the first phase was primarily driven by the exploitation of the firms competitive advantage over local firms, competitive ability can only be promoted/secured on a global scale if the firm identifies geographically dispersed sources of competitive resources and then links them through its activities.[8] For the sake of simplicity, we assume that the distinctive feature of the second phase is to modify the already existing and mature product, i.e. to stay in the same line of business (LOB), however, with improved or adopted products.[9]

Thus the second phase is linked to the construction of a regional technology platform (RTP). The primary function is to make additional R&D activity and fulfill all corresponding supporting functions. While these functions do not generate profits on their own, we additionally consider its marketing and sale, thus a project value can be assigned to the stage. In order to capture a downstream feature like this, we split this stage into two substages, namely a substage where R&D and other non-profit functions are accomplished and a second substage where the company markets its new products. As Dixit and Pindyck have shown, one can superpose both substages, as long as the first substage does not generate any profit.[10]

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[8] Sometimes referred to as the globally linked approach. See Bartlett and Ghoshal (1989).

[9] This also corresponds to the empirically motivated article by Chang and Rosenzweig (2001) who found evidence regarding Japanese and European FDI in the United States over a 20 year time period, in which 65% of the observed subsequent foreign direct investment flows of an enterprise remained in the same line of business (LOB). Only 17% of the observed firms followed a diversification strategy and invested in alternative LOBs in the second stage of the investment process while the remaining 18% belong to firms who entered the foreign market only once.

[10] Dixit and Pindyck (1994, p. 321 ff.).

As a result of the perceived uncertainty, the project value V of the second stage obeys a stochastic evolution, too, which is represented by dV(t).[11]

The following equations summarize the formal assumptions:[12]

$$dv(t) = \alpha_i v(t)\,dt + \sigma_1 v(t)\,dz(t),$$
$$dV(t) = \alpha_3 V(t)\,dt + \sigma_2 V(t)\,d\xi(t),$$

with $\alpha_i = r - \delta_i$ and $\alpha_3 = r - \delta_3$ as the corresponding growth rates of the project values. The index *i* addresses the two possible equity modes (greenfield investment (i = 1) or cross-border M&A (i = 2)) in terms of the formation of a wholly owned subsidiary (WOS). $dz(t), d\xi(t)$ represent a Wiener process with zero mean and variance equal to dt. σ_1^2, σ_2^2 designate the variance of dv(t)/v(t) and dV(t)/V(t) respectively due to environmental risk. σ_1^2, σ_2^2 can be interpreted as the level of the investment project risk.

Since both products stem from the same line of business it is reasonable to assume that the firm has the necessary information to estimate the starting point of stochastic process *V*, i.e. V_0, whose evolution begins upon investing in the first phase.[13] One might think of the project as of the production of products that depend on the price of computer memory

[11] It is reasonable to ask, why the company does not form a joint-venture in the second stage. However, as Johanson and Vahle (1977), Gomez-Casseres (1989), and Agarwal and Ramaswami (1992) pointed out, firms that have already entered the market via foreign direct investment tend to follow such a strategy even in subsequent entry. See, e.g. Penner-Hahn (1998) for an empirical study on international R&D activity. In addition controlled research activities are in line with the arguments of the Internalization Theory stating the importance of protecting the value of knowledge for firms with high degrees of intangible knowledge. See, e.g. Penner-Hahn (1998), Buckley and Casson (1976), and Dunning (1980).

[12] There exists a traded commodity whose fluctuations are perfectly correlated with the values of each stage and their rate of drift αis smaller than that of *r*.

[13] Such an assumption is in line with the argumentation that the firm tend to stay in the same LOB.

modules, e.g. SDRAMs. This could be for example the production of notebooks in the first phase and tablet PCs in the second. Thus let $\alpha_i < \alpha_3$ and $\sigma_1 < \sigma_2$ indicating that the second project represents an enhancement of the first and thus being more innovative and uncertain than the first one. Furthermore, let $\delta_1 < \delta_2$. This assumption is worthwhile to explain more further. In general, δrepresent “dividends” the project pays and can be interpreted as opportunity costs for waiting. The reason why the opportunity costs for waiting are greater for cross-border acquisition than for greenfield investment results from the fact that once a target company has been identified, the decision whether to acquire or not additionally incurs the threat that another rival will acquire the target. While this threat increases the opportunity costs for the cross-border acquisition mode it is not present for a greenfield entry strategy.

3.1. Export strategy

Export allows the firm to internationalize without making major investments. Thus, export represents a low resource commitment combined with a low risk profile. However, it is associated with a comparatively low profit return and provides insufficient control mechanism if market conditions change. It is taken for granted now, that an export strategy is the current preferred strategy for the firm to internationalize.

Let C^{ex} represent the current costs associated with an export strategy. Neglecting exchange rate effects and switching costs, an enterprise will abandon its current export service strategy if the value development for the foreign direct investment strategy hits a certain threshold value v*.[14]

[14] Pennings and Sleuwaegen (2000) provide a model for switching from current export to a one stage foreign direct investment project. Furthermore, they allow for alternative entry modes to be chosen, like, e.g. joint-ventures. For a discussion of exchange rate effects as well as switching costs see, e.g. Kogut and Chang (1996). An interpretation of export strategy as a real option itself available to a firm is given by, e.g. Broll and Eckwert (1999).

3.2. Foreign direct investment

During the first stage of setting up an operation physical presence costs of the order of $I_{1,i}^{FDI}$ emerge. With respect to Buckley and Casson (1998b) it is assumed that this up front cost incurs additional costs of market entry that differ with respect to the chosen entry strategy. The authors differentiate between:

- Marketing costs (C_m) that summarize the cost associated with gaining knowledge about the new market, in order to optimally select suppliers, distribution channels, and marketing activities.
- Adaptation costs (C_a) in order to modify production equipment.
- Costs of building trust (C_q) that come along with the internalization of the acquired facility.

While marketing costs C_m are present for a firm willing to conduct a greenfield investment one can neglect them for an acquisition strategy due to the internalization of information advantages the target company possesses about the new market. Adaptations costs C_a, however, can be neglected for the greenfield entry mode. They are unique only for the cross-border acquisition entry mode in order to adapt the production technology of the target to the firm's own production technology and quality standards. The same refers to the costs for building trust which result from efficient internalization process efforts.

Consequently we assume, that these costs combined with the costs for acquiring or building the production facility make up the set-up cost $I_{1,i}^{FDI}$. By introducing a binary variable φ, which is 1 in the case of a greenfield entry and 0 for a cross-border M&A entry one can formulate the set-up costs more explicitly:

$$I_{1,i}^{FDI} = I0 + (1 - \varphi)(C_a + C_q) + \varphi C_m.$$

Here, I0 represents the up-front investment costs for building or acquiring the production facility in the new market. With respect to Buckley and Casson we will assume that the cost at which a facility can be acquired is equivalent to the cost of new construction under a greenfield strategy. Counterbalancing these costs an enterprise obtains the project with value v given it exercises the investment possibility.

Exercising this option the initiated project serves as a platform for a second investment opportunity putting the firm in a position to accrue further potential growth. As noted earlier, we will refer to this project as a regional technology platform. Motivations for establishing a regional technology platform emerge from different sources like for example modification of product design, improvement in production technology, the support of local production activity, innovation spillovers or the support of regional production networks. Thus I^{RTP} represents the corresponding set-up cost designating the cost of exercising the second stage option. We will assume, that these costs are independent of the chosen entry mode in step one. By exercising the option the firm obtains a project with value ΘV, whereby $\Theta \in R$ is interpreted as a location specific parameter reflecting the attractiveness of the foreign market location. This is in accordance with the emerging view of FDI emphasizing that FDI is not only driven by firm-specific advantages of the investing firm, but may also be attracted towards centers of innovations located in recipient countries. As frequently observed, these technological advantages are heterogeneously distributed among countries (see, e.g. Kogut, 1990). Consequently, it is assumed that Θ is exogenously given and varies among countries.[15]

Formalizing the optimization problem in this manner is similar to the analytics of a financial compound option, whereby exercising the option in stage one generates a second option in stage two. The methodological foundations and solution of this optimization problem were first analyzed by Geske (1979) and McDonald and Siegel (1986). It may be demonstrated that for each stage there exists a threshold or trigger value at which it is optimal

[15] The variance of Θ founded upon the heterogeneity in technological resources and advantages is, for example, strictly evident in the biotechnology industry. A reasonable proxy for Θ could be, e.g. the amount of patents declared in a given country. See, e.g. Le Bas and Sierra (2002).

for an enterprise to exercise the investment option.[16]

The following section briefly summaries the trigger values v_i^* and V^* which illustrate when it is optimal for an enterprise to trigger the first and second stage.

4. Results of the two stage optimization problem

This section presents a summarization of a comparative-static analysis of the derived individual stage trigger points. The comparative-static results for the trigger value V^* are well-known from the standard literature (see Dixit & Pindyck, 1994). The threshold value V^* becomes larger, the higher the costs of production in the second stage are and the smaller β_1 is. Given that $\partial\beta_1/\partial\sigma_2 < 0$, it follows that an increase in involved investment uncertainty leads to an increase in V^*.

However, of special interest economically is the first trigger point. It permits inferences on the manner in which an enterprise enters a new market based upon the potential locational characteristics Θ and the market entry costs. Given the situation in which the second stage trigger value of V^* is greater than the first stage trigger value v^*, an enterprise will enter the market initially once the threshold value v^* is reached. Consequently, the second stage of investment will be postponed until the second trigger value V^* is reached. In the following, we will summarize our main findings resulting from the previous introduced assumptions.

Proposition 1 (Greenfield investment). *Given no alternative non-equity market entry modes, a firm will switch from export to greenfield investment, i.e. exercising the first stage, if* v *reaches an optimal trigger value* v_1^* *determined by*:

[16] The derivation of the trigger values are given in Appendix A.

$$v_1^* = e^{(r-\alpha_1)\tau} \frac{\gamma_1}{\gamma_1 - 1} [I_0 + C_m - F(V_0)],$$

with τ *as the corresponding construction time*.

Proof 1. See Appendix A.

The propensity to switch from export to cross-border acquisition is determined by the following proposition.

Proposition 2 (Cross-border M&A). *Given no alternative non-equity market entry modes*, *a firm will switch from export to cross-border M&A*, *i.e. exercising the first stage by acquiring a target in the host market*, *if* v_2^* *reaches an optimal trigger value* v_2 *determined by*:

$$v_2^* = \frac{\gamma_2}{\gamma_2 - 1}[I_0 + (C_a + C_q) - F(V_0)].$$

Proof 2. See Appendix A.

The propensity to switch from either greenfield investment or cross-border M&A to the realization of the regional technology platform is determined by the following proposition.

Proposition 3 (Regional technology platform). *A firm will initiate the second phase of its market entry sequence if V reaches an optimal trigger value* V^* *determined by*:

$$V^* = \frac{1}{\Theta} \frac{\beta_1}{\beta_1 - 1} I_2^{\mathrm{RTP}}.$$

Proof 3. See Appendix A.

First, let us consider the case where both FDI entry modes have the same initial up-front costs I^{FDI}. If not noted later on, we will assume the following values $C^{ex}_2 = 2$, $\Theta = 1$, $\delta_1 = 0.06$, $\delta_2 = 0.08$, $\delta_3 = 0.04$, $r = 0.05$. The firm will stick to exporting as long as v does not exceed the trigger value of either greenfield investment or cross-border M&A.

Allowing for a construction period of length one year, cross-border M&A is now always preferred due to the quicker market access. For low project uncertainty σ1 both thresholds are close to the costs of the investment opportunities. In such a case, the results of our model are consistent, although additionally implicitly dependent on time due to the dynamics of v, with the ones presented by Buckley and Casson (1998b) indicating that only the additional costs are important.

Both thresholds, however, increase as uncertainty increases, thus indicating that a switching of modes, i.e. from export to FDI, will further be postponed. The opposite can be observed for the trigger value of the second stage. Although low uncertainties result in a quicker switching of modes towards FDI, a firm will exercise the second investment opportunity much more later, than for high uncertainty. Furthermore, decreasing initial up-front costs I^{FDI} correspond with a firms propensity for FDI, thus indicating an earlier exercise of the first stage. Due to that fact that the initial investment carries a future option value, the switch from export to FDI depends additionally on the value of the subsequent investment opportunity. An increase in V0 thus, will decrease the trigger value for either greenfield investment or cross-border M&A. We will discuss the influence of F (·) later on in more detail. Fig. 2 below illustrates for similar FDI set-up costs I_1FDI = 2.4 and given a construction period of one year with respect to the greenfield entry mode the trigger values for the first stage (a) greenfield investment and (b) cross-border M&A. It also depicts the threshold for the second stage (c) regional technology platform.

4.1. Effects of additional costs on entry choice

So far, we have held the costs for the first stage constant, no matter which sort of entry strategy the firm chose. However, as was previously mentioned, both entry strategies differentiate with respect to the corresponding cost side. Allowing the cost to vary, we are now able to depict the influence of additional costs and uncertainty on the choice of entry. In order to capture the timing aspect of the foreign market entry, we will assume that the enterprise will prefer the strategy whose threshold value is first reached. For example, cross-border M&A is preferred by the foreign investor if the corresponding threshold value v_2^* is smaller than v_1^*.

Fig. 2. Thresholds determine the switching of modes from export to (a) greenfield investment, (b) cross-border M&A entry and (c) RTP.

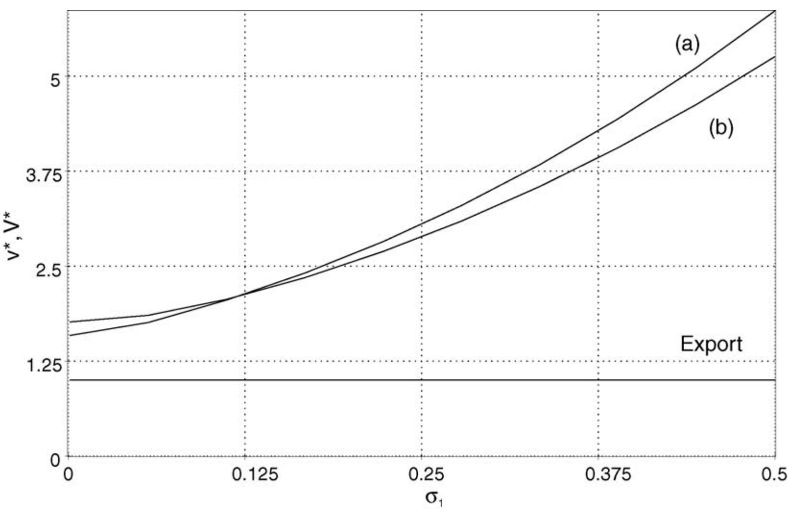
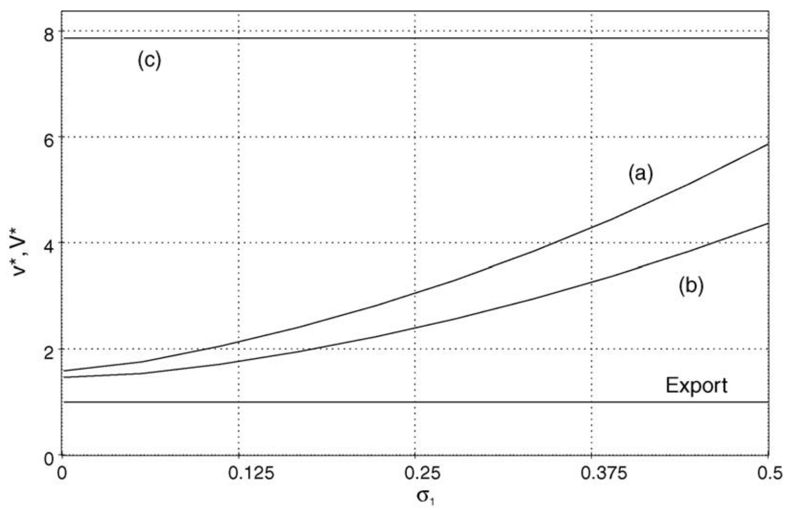


Fig. 3. Influence of M&A associated costs C_a, C_q on the choice between (a) greenfield investment and (b) cross-border M&A entry ($C_a + C_q = 2.7$).



Corresponding to the observed empirical literature, i.e. Hennart and Park (1993), an increase in the costs associated with M&A, $C_a + C_q$, implicates a tendency towards greenfield investments for areas of low project uncertainty. This effect corresponds with a decrease in marketing costs Cm. For high project uncertainty, however, cross-border M&A is still the preferred choice as illustrated in Fig. 3 above.

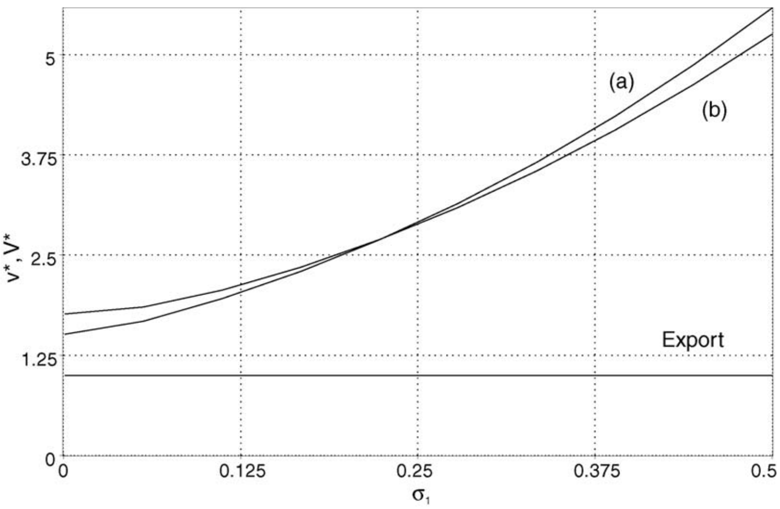
The propensity to favor greenfield investment against its alternative entry mode will further depend on the length of the construction period τ. While deregulation, for example, may improve the legislative environment it may result in shorter bureaucratic actions and consequently decreases a firms construction time. As Fig. 4 indicates, this further broadens the spectrum for favored greenfield investment towards higher project uncertainties.

4.2. Effects of growth option on entry choice

So far, we were able to depict the influence of the cost factors. In addition, the length of the construction period τ is responsible for the influences affecting the growth option and thus the mode of entry. The cross-border M&A growth option can be accessed quicker than for the greenfield investment, which corresponds to the assertion made by Buckley and Tse (1996, p. 309).

However, the growth option itself influences the first threshold, too. The results indicate that, although the first project might be unprofitable on a stand-alone basis, the high initial option value F(V0) with respect to the second stage may justify the investment in the whole project. Furthermore, allowing a sufficiently high option value F(V0), the firm might not even find it attractive to export its goods to the new market from the start. Consequently, it would do better of penetrating the new market via foreign direct investment. Such expansion phenomena of MNEs have been observed in the past and the literature refers to it as “born-globals”.

Fig. 4. Influence of construction time τ on the thresholds for (a) greenfield investment and (b) cross-border M&A entry (τ= 0.75).



Two important factors affect the size of F(V) and F(V0), respectively . First, location characteristics have been neglected so far, by assuming a Θ of one. It has been observed, however, that foreign direct investment is not only "pushed" by the firm-specific advantages of the firm, but may also be "pulled" towards centers of innovation located in recipient countries (see, e.g. Shan & Song, 1997). Thus, given a positive economically rational interval of Θ we will at first allow Θ to vary.[17] From the equations presented above, an influence from Θ on the choice of entry mode is evident. Locations characterized by a higher Θ enhance the temporal speed of switching from exports to FDI. This is because the corresponding option value F(V) of the second stage is positively correlated with Θ. Consequently, the higher the value of the growth option the lower the trigger value v_1* and v_2*, respectively. Furthermore, an increase in Θ also decreases the threshold of the second stage, making investment

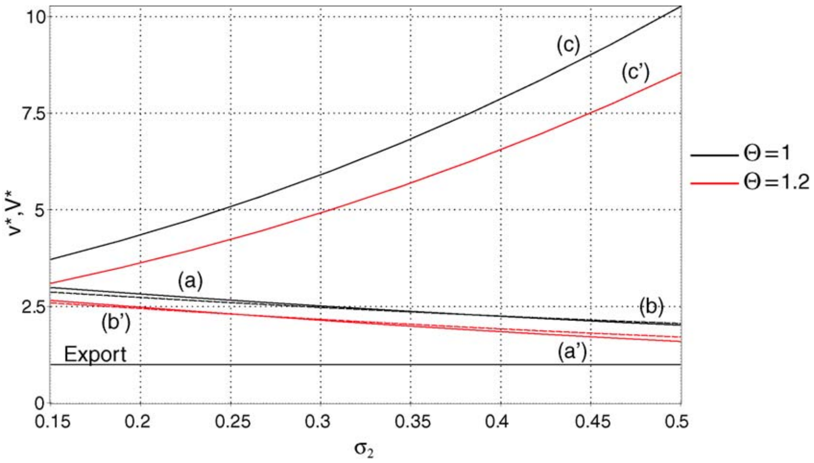
[17] The location specific parameter Θ could, for example, be zero for the case of a political event such as expropriation. On the other hand, technologically advanced countries can stimulate agglomeration economies, i.e. Θ>1, that would have a positive exogenous effect on the value of the investment.

commitment in the second stage much more likely.

Second, the timing of the first stage is also affected by the uncertainty of the second stage. Greater uncertainty corresponds with a decrease in the thresholds of the first stages v_1* and v_2*. Consequently, the first stages will be initiated earlier. The economic rationality is based upon the asymmetric structure of option rights. Greater fluctuations in the corresponding cash flows result in higher profit potentials while the associated losses remain unaffected. However, participation from this is only possible if the investor commits himself quicker to the first stage. The following Fig. 5 summarizes the findings graphically.

In addition it is interesting to note as exemplified in Fig. 5 above that uncertainty of the second stage has a different effect on the foreign direct investment flow than the location parameter. The location parameter influences both thresholds v_i* and $V*$ in the same direction. From sensitivity analysis, however, one can observe little changes with respect to the spread between investment in the first stage and investment in the second stage. On the contrary, an increase in σ2 increases the relative spread, i.e. the time span between investing in the first stage and investment in the second stage. Although there is a trend towards early commitment in cases of high instability and uncertainty, investment in the innovative second phase of the sequence will take place much later. Countries offering such an economic environment will not instantaneously benefit from the whole value of the foreign direct investment, because only commitment to a stage will add value to the host country.

Fig. 5. Influence of second stage uncertainty σ2 and location characteristics Θ on the sequential market entry (τ = 0.75,Θ= 1,σ1 = 0.15): (a) greenfield investment, (b) cross-border M&A entry, and (c) RTP: $(a^1–c^1)$ denote the corresponding strategies for Θ = 1.2.



4.3. Economic implications

The choice of market entry varies among different industries. In order to depict this one must find a proxy that captures the uncertainty of projects on average in an industry.[18] Thus, we choose the volatility of the Morgan Stanley Capital International (MSCI) World index as of year 2001, especially its sector-specific subcategories as summarized in Table 1. In order to focus explicitly on R&D intensive industries, we excluded less R&D intensive sectors like, e.g. the food and beverage sector or the textile industry. What we see is, e.g. a significantly higher annual volatility for the Information Technology industry in the year 2001 than for example for the pharmaceutical industry.[19]

[18] On the decomposition of total uncertainty and the importance of industry uncertainty in a real option context, refer to, e.g. Bulan (2001).

[19] The following statements are based on the assumption that the cross-border M&A strategy corresponds with

Compared with the results of the model, we would expect to see more cross-border M&A in such industries which is in accordance with the observed trend depicted by, e.g. OECD (2002) and UNCTAD (2001). For industries with less volatility, like for example the sector World Industrial, including machinery and transportation, we would expect to observe much more greenfield investments.

Table 1
MSCI World index for different industries (2001)

Index	Volatility 250 days
MSCI World Energy	0.25
MSCI World Industrials	0.22
MSCI World Information Technology	0.38
MSCI World Pharmaceutical	0.23
MSCI World Telecommunication Serv.	0.30

Source: Bloomberg.

Two significant results are evident from the above analysis. First, the effect of uncertainty dominates the influence of additional cost elements with regard to the decision thresholds; industries exhibiting high levels of uncertainty tend to be characterized by cross-border M&A activity. Second, given that location specific attractiveness is high, the transition from a pure export strategy to foreign direct investment will be accelerated. Situations may thus arise, in which the growth options contributes immensely to value-added. Consequently, foreign direct investment may emerge as the initially preferred strategy given low levels of uncertainty.

5. Conclusion

In this paper, we briefly review the recent evidence of the growth in M&A activities in the global entry market process of multinational firms as well as the empirical driven literature concentrating on the choice of equity entry modes. The model introduced here is a

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higher additional costs (see Fig. 3).

first attempt to stress the sequential nature of foreign direct investment and to depict the importance of subsequent options on the initial entry decision. In line with the demand towards a new agenda for modelling the multinational firm, we present a real options model approach based on a two-phase market entry situation, stressing the need to consider sunk costs and uncertainty as opposed to static models. Although we did not explicitly model the time dependence, implicit results can be drawn due to the fact, that the evolution of the project value depend on time. We obtain a threshold that is determined by the associated entry costs, uncertainty and the location characteristics. Of course, the performance of the model depends on the accuracy of the parameter estimates.

The results show the new complementary insight, that the choice of entry mode not only depends on the associated additional costs but also on the uncertainty surrounding the project. Furthermore, our results are consistent with the perceived dominant trend observed today for companies to speed up international expansion via foreign direct investment if high levels of location-specific attractiveness are present. In such a case, a high growth option value may justify the transition to more riskier modes. In cases of high instability and uncertainty, however, investment in the innovative second phase of the sequence will take place much later outperforming the effect of early commitment. Countries offering such an economic environment are disadvantaged and will not instantaneously benefit from the whole value of the foreign direct investment, because only a firms' commitment to a stage will add value to the host country.

However, further restrictions have to be made in order to differentiate for example between home-based augmenting and home-based exploiting motives surrounding the establishment of regional technology platforms. In addition, real option rights, and especially growth option rights are to a large extent not exclusive. Competition may cause an erosion of the option value, e.g. due to first-mover advantage. In such a case, it is worthwhile to extend the assumption that the evolution of a foreign direct investment follows a geometric Brownian motion and to implement Poisson-Jump arguments.

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Appendix A

We use the dynamic programming method to determine the option values for both stages *f* and *F*. Thus the values of the investment possibilities $f_i(v)$ and $F(V)$, as well as the optimal trigger points v_i^* and V^* (representing the actual timing of the respective investment) may now be solved for recursively. First the values of the second stage investment possibility F(V), along with the corresponding trigger point V^* are derived. Then the values of the first stage investment possibilities $f_i^*(v)$ along with the corresponding trigger point v_i^* are derived. In contrast to the second stage these values differ with respect to the chosen entry strategy *i*.

A.1. Threshold value of the second stage

The Bellman-equation of the second phase builds the initial point of analytical departure. Assuming that the world economy is risk neutral and that the risk free interest rate is constant at *r* we get:[20]

$$rF\mathrm{d}t = \mathcal{E}(\mathrm{d}F),$$

whereby *F* denotes the option value of V (t) and E(···) represents the expectations operator. With the aid of Itô's Lemma one obtains for the differential of F(V):

$$\mathrm{d}F = \frac{\partial F}{\partial V}\mathrm{d}V(t) + \frac{1}{2}\frac{\partial^2 F}{\partial V^2}(\mathrm{d}V(t))^2.$$

[20] Given the long-term nature of foreign direct investment, problems may occur due to the assumption of a constant risk free interest rate over the life of the investment. However, as Merton (1973), for example, has shown this problem in combination with the pricing of options can be overcome by using the zero coupon bond yield corresponding to the maturity of the option. In our case, we refer to Clark (1997) who used the 30 year U.S. government Separately Traded Registered Interest and Principal Security (STRIPS) for estimating the risk free interest rate for infinitively lived foreign direct investments (r = 5.38%).

There is a perpetual nature of foreign direct investment due to the fact that legislation in most countries is such that no specific life span for a company is specified.[21] Thus standard dynamic programming arguments show that *F* satisfies:

$$\frac{1}{2}\sigma_2^2 V(t)^2 \frac{\partial^2 F}{\partial V^2} + \alpha_3 V(t) \frac{\partial F}{\partial V} - rF = 0,$$

with $\alpha_3 = r - \delta_3$. The general solution to the above stated differential equation has the form:[22]

$$F(V) = A_1 V(t)^{\beta_1} + A_2 V(t)^{\beta_2},$$

with

$$\beta_1 = \frac{1}{2} - \frac{\alpha_3}{\sigma_2^2} + \sqrt{\left[\frac{\alpha_3}{\sigma_2^2} - \frac{1}{2}\right]^2 + \frac{2r}{\sigma_2^2}} > 0,$$

$$\beta_2 = \frac{1}{2} - \frac{\alpha_3}{\sigma_2^2} - \sqrt{\left[\frac{\alpha_3}{\sigma_2^2} - \frac{1}{2}\right]^2 + \frac{2r}{\sigma_2^2}} < 0.$$

The associated boundary conditions for this phase are as follows:

$$F(0) = 0,$$

$$F(V^*) = \Theta V^* - I_2^{\mathrm{RTP}},$$

$$\left.\frac{\partial F(V)}{\partial V}\right|_{V=V^*} = \Theta.$$

While F (0) = 0 results in $A_2 = 0$ due to continuity arguments, the two other boundary conditions are used to determine the value of the investment possibility F (V(t)) as well as the corresponding trigger value, yielding:

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[21] See Clark (1997, p. 480). Consequently, the value of the real option right does not depend on time which results in $\partial F/\partial t = 0$. In cases, however, where a specified contractual life span exists, the value of the foreign direct investment is a function of time. Thus the value of the real option additionally depend on the time left until the real option right matures.

[22] Compare Dixit and Pindyck (1994, p. 143 ff.).

$$F(V) = \begin{cases} A_1 V(t)^{\beta_1} & \text{if } V(t) < V(t)^* \\ \Theta V(t) - I_2^{\text{RTP}} & \text{if } V(t) \geq V(t)^* \end{cases}$$

with

$$V^* = \frac{1}{\Theta} \frac{\beta_1}{\beta_1 - 1} I_2^{\text{RTP}},$$

and

$$A_1 = \Theta \frac{1}{\beta_1} \left[\frac{1}{\Theta} \frac{\beta_1}{\beta_1 - 1} I_2^{\text{RTP}} \right]^{(1-\beta_1)}.$$

A.2. Threshold value of the first stage

The derivation of the stage one trigger point is analogous to Section A.1. Consequently, the Bellman Equation for the first stage results in:

$$r f \mathrm{d}t = \mathcal{E}(\mathrm{d} f),$$

Applying Itô's Lemma gives the differential equation for the first stage:

$$\frac{1}{2}\sigma_1^2 v^2 \frac{\partial^2 f_i}{\partial v^2} + \alpha_i v \frac{\partial f_i}{\partial v} - r f_i = 0,$$

with $\alpha_i = r - \delta_i$ and i indicating whether the market entry is done by greenfield investment ($i = 1$) or cross-border M&A ($i = 2$). This ODE has the following regular solution:

$$f_i(v) = B_1 v^{\gamma_i},$$

with

$$\gamma_i = \frac{1}{2} - \frac{\alpha_i}{\sigma_1^2} + \sqrt{\left[\frac{\alpha_i}{\sigma_1^2} - \frac{1}{2}\right]^2 + \frac{2r}{\sigma_1^2}} > 0.$$

Given following assumption about the entry costs $I_{1,i}^{\text{FDI}}$, the binary variable ϕ

$$I_{1,i}^{\text{FDI}} = I_0 + (1 - \phi)(C_a + C_q) + \phi C_m,$$

$$\phi = \begin{cases} 1 & \text{if } i = 1 \\ 0 & \text{if } i = 2, \end{cases}$$

as well as the boundary conditions:

$$f_i(0) = 0,$$

$$f_i(v_i^*) = \left(1 - \phi + \phi\, \mathrm{e}^{-(r-\alpha_1)\tau}\right) v_i^* - \left[I_{1,i}^{\mathrm{FDI}} - F(V_0)\right],$$

$$\left.\frac{\partial f_i(v)}{\partial v}\right|_{v=v_i^*} = \left(1 - \phi + \phi\, \mathrm{e}^{-(r-\alpha_1)\tau}\right) + \underbrace{\left.\frac{\partial F(V_0)}{\partial v}\right|_{v=v_i^*}}_{=0}.$$

It is worthwhile to note here that a greenfield entry takes time to build of length τ. Thus, one has to consider the future value of the investment project $v_i^*\, \mathrm{e}^{-(r-\alpha_1)\tau}$ the firm receives after making the initial investment outlay (see Friedl, 2002). Based upon this the value of the first phase $f_i(v)$ and the corresponding trigger value v_i^* that initiate foreign direct investment can be determined:

$$f_i(v, V) = \begin{cases} B_1 v^{\gamma_i} & \text{if } v < v_i^* \\ (1 - \phi + \phi\, \mathrm{e}^{-(r-\alpha_1)\tau})v - \left[I_{1,i}^{\mathrm{FDI}} - F(V_0)\right] & \text{if } v \geq v_i^*, \end{cases}$$

$$v_i^* = (1 - \phi + \phi\, \mathrm{e}^{-(r-\alpha_1)\tau})^{-1} \frac{\gamma_i}{\gamma_i - 1}[I_{1,i}^{\mathrm{FDI}} - F(V_0)],$$

with

$$B_1 = (1 - \phi + \phi\, \mathrm{e}^{-(r-\alpha_1)\tau})^{(1-\gamma_i)} \frac{1}{\gamma_i} \left[\frac{\gamma_i}{\gamma_i - 1}\left[I_{1,i}^{\mathrm{FDI}} - F(V_0)\right]\right]^{(1-\gamma_i)}.$$

However, since we are interested in a sequential market entry, one has to make sure that $v_i^* < V^*$ holds. Thus, comparing Eqs. (A.11) and (A.23) results in the additional restriction:

$$I_{1,i}^{\mathrm{FDI}} - F(V_0) < \epsilon_i I_2^{\mathrm{RTP}},$$

with

$$\epsilon_i = \frac{1}{\Theta} \frac{\beta_1}{\gamma_i} \frac{\gamma_i - 1}{\beta_1 - 1} \left(1 - \phi + \phi\, \mathrm{e}^{-(r-\alpha_1)\tau}\right).$$

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