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FOREIGN DIRECT INVESTMENT AND INVESTMENT UNDER UNCERTAINTY

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Abstract. We show that in uncertain environments ownership and internalization advantages may be negatively rather than positively associated with FDI. This reversal from extant theory occurs because ownership advantages often serve to make FDI delayable, while internalization advantages often serve to make it less reversible. When FDI becomes either more delayable or less reversible, it is less likely to occur at a point in time. Our approach enriches the "who," "where" and "why" explanations offered by current FDI theory to incorporate the question of "when."

INTRODUCTION

When will a firm engage in foreign direct investment (FDI)? The eclectic paradigm [Dunning 1988a] and related theories based on market imperfections [Dunning and Rugman 1985] offer rich explanations of the "why," "where" and "who" of FDI. However, with few exceptions (e.g., Buckley and Casson [1981]; Casson [1994]), the FDI literature has left the question of timing, or the "when" of FDI, unexamined. The purpose of this paper is to integrate explicitly factors influencing the timing of FDI into the ownership-location-internalization (OLI) framework.

Our approach draws from recent work in the economics of uncertainty. We advance the counterintuitive proposition that in some cases OLI advantages will be negatively rather than positively associated with FDI. This proposition

derives from our treatment of uncertainty. Prior analyses of FDI timing (e.g., Casson [1994]) treat uncertainty as an endogenous problem to be resolved by investment (i.e., experiential learning). The initial investment is a platform for obtaining rights to future investment [Kogut and Kulatilaka 1994]. In contrast, we treat uncertainty as an exogenous problem resolvable only with the passage of time, irrespective of investment.

The eclectic paradigm implicitly states that FDI occurs when its expected net present value is both positive and greater than those of alternative modes of international production. However, this postulate is not compatible with recent advances in the field of investment under uncertainty. While FDI theory has been well-informed by research in industrial organization and transactions cost economics, it is less informed by recent research in the economics of uncertainty. High levels of some OLI advantages, while creating a rationale for FDI, can also make FDI more delayable or less reversible and therefore *less* likely to occur at a point in time. This is especially likely in uncertain environments. Recognition of these contradictory effects suggests a new path for FDI research that is grounded in both firm investment behavior and an enriched version of the OLI framework.

Such an approach is particularly germane for examining FDI decisions in emerging economies. A recent *Harvard Business Review* article asked several contributors about the advisability of investment in Russia.[1] Responses varied: Jean-Pierre van Rooy, president of Otis Elevator, said that Otis had "invested early, and moved as fast as possible" and agreed with Russian expert Vladimir Kvint that "now is the time to do business in Russia." The presidents and CEOs of Die Welt Development and Conoco were more wary, citing the numerous risks Western firms face in undertaking investment in this new environment. The crux of this debate was not *whether* to undertake investment in Russia – the participants were all optimistic about long-run prospects for the country and planned investments there. Nor did it center on the *form* of market participation. Instead, the debate was about *when* to invest. Should firms forge ahead, or should they "wait and see" what happens to the (choose one or more) depreciating ruble, Russian Mafia, infrastructure, commercial code, or IMF negotiations? Currently received FDI theory offers little in either advice or explanation regarding the timing of investment in uncertain environments such as Russia.

In the next section, we review recent research in economics related to firm investment decisions. We next introduce the concepts of delayability and reversibility, and then review FDI theory. Section three applies these concepts to the FDI decision, and examines the counterintuitive links between ownership and internalization advantages on the one hand, and delayability and reversibility on the other. Last, we offer suggestions for future research and discuss the implications for host country governments.

OPTION PRICING AND FIRM INVESTMENTS: A REVIEW

NPV Analysis and Investment Timing

The "textbook" decision rule for firm investments has historically been based on cost-benefit analysis: Invest in a project when the present value of inflows exceeds its costs; if alternatives are mutually exclusive, the firm should maximize NPV. In the late 1970s, however, this rule began to be modified with references to options theory. Often, an investment today buys options to invest later, and the analysis of such an investment must account for the value of these options. In brief, projects that have negative NPVs on a stand-alone basis may have positive NPVs once the value of options purchased are included [Myers 1977; Brennan and Schwartz 1985].

This view has been extended to work in corporate strategy [Bowman and Hurry 1993; Kogut and Kulatilaka 1994]. Investments are options that buy the firm rights such as the right to make later investments, the right to flexibility, or the right to enter new markets. An options-driven strategy assumes that an investment today may derive its value from the future choices it makes possible; it serves as a valuable "platform" for future investments.

There are two important (though usually implicit) assumptions in the literature that applies "options thinking" to firm investments. The first is that investment grants the firm certain choices, rather than eliminates choices. Thus, an investment in product development gives the firm the option to proceed with manufacturing. The second assumption is that the investment generates information that is used to help make a subsequent decision. For example, the investment in product development supplies information that is used to decide whether to begin manufacturing.

Both of these lines of thought have been integrated into the literature on international production. The ability of multinational firms to shift production in response to external shocks, or to arbitrage differences in tax rates, are examples of the first line, which emphasizes flexibility [Kogut 1983]. The second line, emphasizing experiential learning, is the focus of Casson [1994] and Chang [1995], each of whom posits an option value for sequential market entry strategies that permit the entering firm to apply information garnered from initial FDI to subsequent investments.[2]

Other research in the economics of uncertainty, however, has examined the effect of alternative assumptions. First, what happens when an investment eliminates future choices? For example, a decision to proceed with Product A may effectively preclude developing Product B. Also, a decision to invest means giving up the right to not invest; the right to not invest or to postpone the decision may be very valuable in some circumstances. The firm's right to reverse its decision or "change its mind" is also a valuable option. In addition, in certain cases, investment does not bring critical information because this

information will only be revealed with time. Exogenous information – the market price of steel, the fate of the ruble or Russian Mafia, changes in government ownership restrictions – will not be revealed because the firm invests; it will only be revealed with time. It may be better to forego investment today if the investment would reduce the options open to the firm at a later date, if waiting is likely to bring important information, or if the decision to invest is irreversible. In volatile environments in which new information is arriving, the best tactic may be to "keep options open" and await new inform-ation rather than to commit an investment today.

Thus, earlier applications of options theory were based on the choices "opened up" by an initial investment. A large volume of recent work has examined the case of choices "closed off" by an investment, and has shown that even if a project maximizes NPV at a point in time, it may be better to reject the project because of the future choices the firm would have to surrender. These ideas were introduced in the 1960s in seminal work on reversibility by Arrow [1968] and Jorgenson [1963]. Further analytical contributions related to reversibility of investment include Baldwin [1982], Dixit [1989], Pindyck [1991], Bertola and Caballero [1994], and Abel and Eberly [1995]. The option to wait for more information before proceeding has been treated in McDonald and Siegel [1986] and Pindyck [1991]. Dixit and Pindyck [1994] provide a complete review of these lines of research.

Although the mathematics in this research is highly complex, the effects of irreversibility and delayability can be easily seen using Pindyck's simple two-period example [1991, p. 1113]. Suppose a firm can invest $800 which will enable it to produce one widget per year, beginning immediately. Production costs are zero but the future price at which the firm will be able to sell widgets is uncertain. The price is now $100 but there is a 50% chance it will be $50 next year and a 50% probability that it will be $150. Once the price changes, it will stay at the new level forever, and the price is independent of the firm's invest-ment. The discount rate is 10%. The standard cost-benefit rule would accept the investment because the NPV is positive:

$$NPV = -800 + \sum_{t=0}^{\infty} \frac{100}{(1.1)^t} = \$300 \ . \qquad (1)$$

Suppose now that the investment has two characteristics. First, it is irreversible, or "sunk": once the investment has been made none of it can be recovered. Second, the investment decision can be delayed: the firm can post-pone the decision for a year to wait for information about the price of widgets. If the firm postpones the decision and the price of widgets falls, the firm will not invest because the NPV next year will be negative:

$$NPV = -800 + \sum_{t=0}^{\infty} \frac{50}{(1.1)^t} = -\$250 \ . \qquad (2)$$

The $50 price has a 50% probability, so there is a 50% chance that the firm will not invest if it waits. Waiting means that the firm keeps the option to not invest. Now calculate the NPV assuming that the firm waits one year, and invests only if the price goes up:

$$NPV = .5 \left[-\frac{800}{(1.1)} + \sum_{t=1}^{\infty} \frac{150}{(1.1)^t} \right] = \$386 . \qquad (3)$$

It is better to wait until the price uncertainty is resolved and then decide, rather than to invest today: the firm should wait for more information and retain the option to not invest. Though the NPV of investing today is positive, it is not as high as waiting for new information, and then investing only if the price goes up. By holding the option to invest for one year, rather than the investment itself, the firm eliminates the chance of a negative outcome while retaining most of the benefits of a positive outcome. The "wait and see" tactic is worth $86 more than the investment today. Investing today requires that the firm relinquish the right to change its mind. This right is especially valuable because of the price uncertainty, and the irreversibility of the investment. Therefore, holding the option to invest is more valuable than investing today.[3]

A critical assumption in the model is that investment does not resolve uncertainty, it is time that resolves uncertainty. Clearly, this assumption will not be valid for certain investments in which the firm gains the critical information *because* it has invested. For example, research and development investments will give the firm information about the likelihood of a product's success. Roberts and Weitzman [1981] present a model of sequential investment in which each investment gives the firm more information and the option of further investment. This is also the spirit of Kogut [1983], Casson [1994] and Chang [1995]. Pindyck [1991], however, focuses on information that arrives, rather than information that is acquired through investment. In practical terms, the earlier research explored endogenous uncertainty, while the later research deals with environmental uncertainty (e.g., the depreciating ruble or IMF negotiations) that may (or may not) be resolved with time but cannot be resolved by action on the part of the firm.

When this type of environmental uncertainty exists, what are the factors that make the option to wait relatively more valuable than the investment today, or vice-versa? There are three: The first is the degree to which the investment is reversible, the second is the degree to which it is delayable, and the third is the nature of uncertainty or risk. We address the first two of these factors below, and postpone our discussion of risk until a later section.

The Effects of Reversibility and Delayability

Suppose now that the investment is fully reversible: the investment may be fully recovered in one year should the price of widgets fall. The NPV is now:

$$NPV = -800 + .5\left(\frac{800}{1.1}\right) + .5\left(\sum_{t=1}^{\infty}\frac{150}{(1.1)^t}\right) + 100 = \$414. \qquad (4)$$
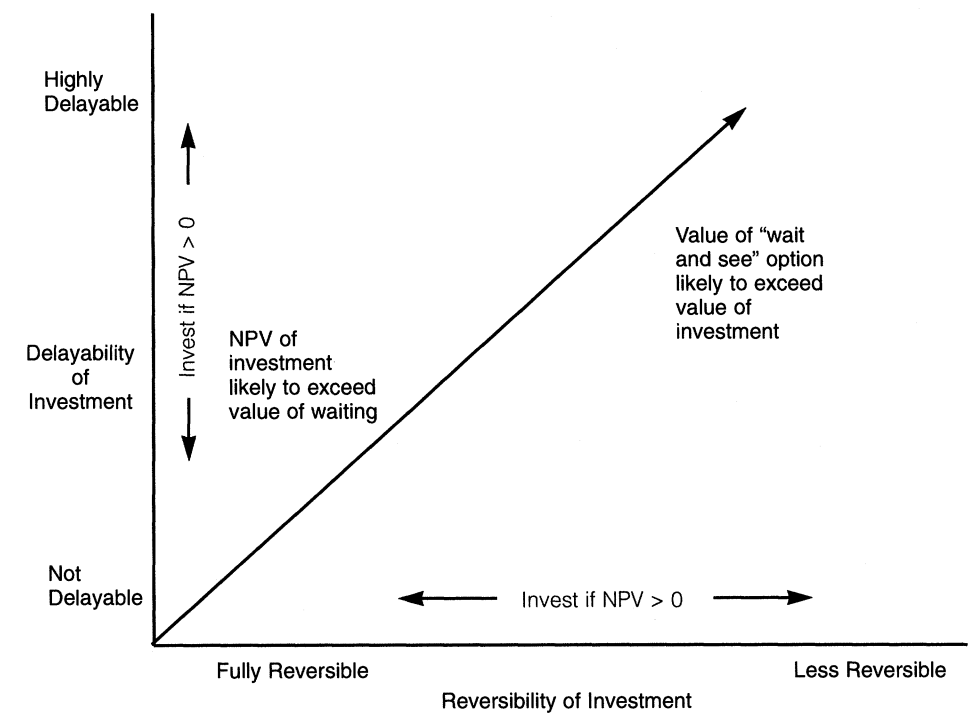
It is better to invest now: if the firm can change its mind at zero cost, there is little to be gained by delay and no reason to await new information. Alternatively, if the investment cannot, for whatever reason, be delayed, it is better to invest now: the "wait and see" option does not exist. If the investment is either (a) not delayable or (b) fully reversible, then the firm should invest now. However, if the investment is delayable and irreversible, the standard cost-benefit criterion should be changed to: invest today if the NPV is greater than the value of waiting for more information to make the investment decision.

Reversibility and delayability are continuous rather than dichotomous concepts. Investments that are largely reversible include those that do not depreciate, those that have many uses, or those that are traded in efficient secondary markets. Alternatively, investment in highly specific assets with few uses will be less reversible, as will investment in assets that are traded in less developed secondary markets, or perhaps not traded at all. Similarly, some investments cannot be delayed, at least not for very long. Replacement investments fall into this category; the firm must replace an asset necessary for production (a conveyor belt or assembly robot) now. The firm also cannot wait in a "winner take all (or most)" competitive situation. It is the degree of delayability and reversibility that will determine whether it is preferable to invest now, or to postpone the decision.

Consider Figure 1. At the origin, the investment is fully reversible and cannot be delayed. Thus, the firm should invest now as long as the NPV is positive and greater than that of competing alternatives. In fact, this is true at any point along either the Y- or X- axis. Investments falling on the Y-axis are fully reversible and therefore *would* not be postponed. Investments falling on the X-axis are not delayable and therefore *could* not be postponed. On the interior of the graph, however, any movement to the north, east, or northeast makes it more likely that the firm should await more information before proceeding, even though the NPV of investing today is positive and greater than that of competing current alternatives.

Recall the case of Russia. Surely all of the firms faced great uncertainties, and all would have preferred more information, and new information about Russia becomes available daily. Why, then, the divergence in the timing decision? Or, consider China, where the level of approved FDI has soared but the amount actually utilized has lagged far behind [Spar 1994]. We suggest that the explanatory factors are the delayability and reversibility associated with these firms' investments. We return to these factors following the literature review.

FIGURE 1
The Value of the "Wait and See" Option

Highly
Delayable

Invest if NPV > 0

Delayability
of
Investment

NPV of
investment
likely to exceed
value of waiting

Value of "wait
and see" option
likely to exceed
value of
investment

Not
Delayable   ◄───── Invest if NPV > 0 ─────►

Fully Reversible   Less Reversible

Reversibility of Investment

FOREIGN DIRECT INVESTMENT THEORY: A REVIEW

General taxonomies of the theoretical literature on foreign direct investment and multinational enterprise can be found in Grosse and Behrman [1992] and Dunning [1993]. We focus on those classified as "Theories Based on Imperfect Markets" in Lizondo [1991], which correspond roughly to the traditions noted by Buckley [1990] and the four major strands identified in Cantwell's [1991] survey of theories of international production. We rely on Cantwell's terminology here: internalization, market power, macroeconomic development models, and competitive international industries.[4] Although these strands ask somewhat different questions, they share a common focus on FDI.

Internalization FDI theories center on transactional market imperfections and represent an extension internationally of transactions cost economics explanations of the boundaries of the firm.[5] (See Buckley and Casson [1976], Rugman [1981], Hennart [1982], and Teece [1985].) The variable of interest is the firm's choice to own the foreign assets directly rather than to use some other means of obtaining the rents from foreign production. This is explained as a function of the relative costs/efficiency of transferring assets or coordinating production internally via hierarchies versus markets. The logical necessity of ownership

advantages is often denied or treated as double counting [Buckley 1983; Casson 1987; Itaki 1991].

Market power FDI theories focus on structural market imperfections and emphasize FDI as the means by which firms extend their control [Hymer 1976; Caves 1971]. Firm-specific advantages of an industrial organization nature, such as product differentiation or economies of scale, serve as entry barriers to the industry at home and as a means of overcoming the obstacles of competing in a foreign market. However, they do not explain why the firm chooses to use FDI rather than some alternative mode of entry.

Macroeconomic development models highlight the relationship of FDI with trade and location factors, particularly relative costs and demand-induced innovation [Kojima 1978; Vernon 1971].[6] These models share the view of FDI as a response to shifts in national comparative advantage. Product cycle models go beyond locational cost concerns to introduce more micro elements; FDI is treated as a response by the firm to product and/or technological maturity as well as to growing demand in foreign markets, which stimulates the entry of local firms into the business.

Theories in the final group, competitive international industries, in effect blend two of the other major strands. In the oligopolistic reaction, follower firms in the home country industry match FDI undertaken by a leader [Yu and Ito 1988]. The exchange of hostages deals with cross-penetration of markets; FDI by a firm from one country prompts industry rivals from the host country to respond by investing in the home country of the initial investor [Graham 1978]. These rivalistic perspectives draw upon notions of imperfect competition and country-specific elements characteristic of the trade/locational perspective. In the technological accumulation approach, each firm develops a bundle of technological capabilities and assets that places it on a trajectory [Pavitt 1988; Cantwell 1989]. This bundle evolves in response to preexisting capabilities within the firm as well as local conditions.

Dunning's [1988a, 1988b] eclectic paradigm integrates elements from these strands into a framework for examining international production in general and FDI in particular. Its synthesis of ownership, location and internalization (OLI) advantages (from the market power, macroeconomic development and internalization models, respectively) organizes a range of variables likely to influence to influence the "who," "where" and "why" of FDI activity.

A related stream of research also relevant to this paper examines firm choices among alternative market-servicing modes, such as exporting, licensing, or joint ventures in addition to full ownership. While the OLI framework is most commonly associated with FDI, it actually is a more general paradigm that also can be applied to entry mode questions [Agarwal and Ramaswami 1992; Hill et al. 1990; Kim and Hwang 1992].

Dunning [1993, p. 76] maintains that the eclectic paradigm is not a theory of MNE or FDI per se, but rather an organizational framework for examining the activities of firms engaged in cross-border activities: it "prescribes a conceptual framework for 'what is' rather than 'what should be'". Nonetheless, the OLI framework implicitly gives rise to a normative decision rule: when ownership and location advantages make foreign productive activities profitable, and internalization advantages make hierarchical exchanges the best way to exploit the opportunity, then a firm should engage in FDI. In the next section we demonstrate why this implicit decision rule can lead to poor decisions. We then introduce two variables – the delayability and reversibility of investment – that offer counterintuitive implications about the impact of high ownership and internalization advantages on FDI timing.

REVERSIBILITY, DELAYABILITY, OLI ADVANTAGES, AND FDI TIMING

The basis of currently received FDI theory implicitly is a special case of cost-benefit analysis that explains why profitable FDI opportunities occur, but is less helpful in clarifying the decision to move forward or to wait for more information. Insights from the theory of investment under uncertainty illuminate this choice by examining the effects of delayability and reversibility, which are often present. While an FDI project may have a positive expected NPV (including the opportunity costs of foregoing alternative modes) arising from OLI advantages, it may reduce the firm's choices in the future if it is irreversible. Further, it may be advantageous to postpone a delayable decision in volatile environments. These intuitively appealing insights can enrich theory by clarifying issues concerning the "when" of FDI.

The issue of FDI timing has received relatively little attention. Buckley and Casson [1981] show that the switch from one mode of market servicing to another (e.g., from licensing to FDI) should not necessarily be made as soon as its NPV is positive–NPV may be maximized by deferring the switch. Unlike recent theory, which is derived from option values and uncertainty, their model is driven by the relationship among different costs and market growth. Others examine the value of FDI as a platform for later investment [Casson 1994; Chang 1995] or for switching activities among locations [Kogut and Kulatilaka 1994]. Casson [1994] links option values and FDI timing: the option to apply useful information learned in one country to a second is retained in a sequential FDI strategy but given up if the firm enters both countries simultaneously. Information and uncertainty in this model are endogenous: the former can be gained and the latter resolved only by the act of investing.

These approaches generally treat FDI as irreversible. Those that are driven by costs are deterministic; uncertainty plays no role. Those that deal with option values and uncertainty require that initial FDI be undertaken; without the investment, there are no options. Our approach differs in three aspects. First,

information and uncertainty are exogenous; the former arrives (or does not) and the latter is resolved whether or not the firm invests. This drives the second difference: the valuable option in our model is the one to forego FDI entirely if the information is unfavorable. FDI does not create an option, in the sense of serving as a platform for later investment. Instead, FDI requires surrendering the (possibly valuable) option to not invest. Third, we relax the requirement that FDI be irreversible.

We argue in the following sections that the presence of particular OLI advantages can make FDI less reversible or more delayable. OLI advantages confer valuable options upon the firm, which are often surrendered when FDI occurs. Paradoxically, in some cases a higher level of these advantages makes investment today less, not more, likely.

Ownership Advantages and Delayability

Dunning [1991, p. 123] defines ownership advantages as "any kind of income-generating assets which make it possible for firms to engage in foreign production." These advantages are a source of positive NPVs, and the OLI framework implies that, other factors equal, the greater these advantages, the more likely the firm is to engage in FDI.

Consider, however, the relationship between the delayability of FDI and ownership advantages. Where ownership advantages are more unique – in the sense of having a longer life or being more difficult or costly for competitors to duplicate – they create a temporary monopoly and quasi-rents for the firm, but one that decays over time as competitors catch up [Hirsch 1976; Magee 1977]. A firm with unique ownership advantages has greater leeway to delay its FDI decision, as these advantages preserve at least temporarily its gateway to entry [Yip 1982]. Given uncertainty, it can wait for information to arrive before committing itself; if the information is favorable, it can use its unique advantages to start FDI. A firm with fewer unique advantages has less leeway; if it waits, its advantages may erode to the point where they no longer suffice to overcome the difficulties of foreign entry. At the theoretical extreme, an ownership asset so unique that it could never be duplicated confers a very high degree of delayability – the valuable option to "wait and see" indefinitely in uncertain environments. Thus, to understand the FDI behavior of firms, we must evaluate ownership advantages on an additional dimension – the delayability they confer upon the FDI decision.

Consider an example. Suppose that in 1994 a firm had ownership advantages in the form of ten-year pharmaceutical patents in Russia and South Africa. The firm believes that demand for its product will be high in these markets, and that proximity to the market is important. Quality control factors and the desire to prevent knowledge dissemination dictate that the firm internalize rather than sell the patent. This convergence of OLI advantages suggests a positive NPV for FDI and that investment should be undertaken.

However, because of the nature of the ownership advantage, FDI is delayable. The patent grants the ability to invest profitably now, but its ten-year duration also grants the option to defer FDI. In 1994 key uncertainties were unresolved, such as the possibility of a reversion to state control of industry in Russia or to apartheid in South Africa. The probability of these negative outcomes was small, which partially accounted for the positive NPV of investment today, but the firm would suffer large losses if it invested and any of the negative outcomes occurred. These uncertainties were likely to be resolved over the coming year. Notwithstanding the positive value of investing today, holding the option to invest for one year to "wait and see" may create more value. The value-maximizing tactic may be to forego one year's sales and invest in each country only if the negative outcomes do not materialize.

It is the uniqueness of the ownership advantage (in this case the patent) that confers a degree of delayability to the FDI decision. If these advantages were less unique, investment today would be more, not less, likely. If, for example, the firm had patent protection for only five years – a less valuable ownership advantage – one year's lost sales would figure more importantly in the comparison of the two alternatives: investment today would be more likely to dominate the "wait and see" option. Paradoxically, the greater ownership advantage gives the firm the ability to wait to make sure that the negative outcomes do not occur, and makes investment today less likely to dominate the option to invest in the future.

The uniqueness of ownership advantages, and the degree of delayability they confer, will depend in part upon the structure of the markets in which the firm competes and its competitive position vis-à-vis industry rivals. FDI will be less delayable in industries where speed matters or product life cycles are short, if competitive positions across countries are interdependent, or if investment is likely to yield critical information that can be applied elsewhere. Advantage is by definition a relative term, and the distinction between monopolistic and non-monopolistic ownership advantages is critical [Casson 1987]. With a monopolistic advantage, the firm may have a strong edge over both foreign and host country rivals, thereby lessening the impact of the factors noted above. With a non-monopolistic advantage, it may have an edge over indigenous firms only, and these factors become more important. Thus, a monopolistic advantage will confer greater delayability.

Conditions in the host country also may make FDI easier or harder to postpone, depending upon the firm's motives for investment. In the case of market-seeking FDI, market size may be small relative to minimum efficient scale, early movers may be able to close distribution channels to followers, or local firms may be developing the skills necessary to enter the business. In the case of efficiency-seeking FDI, cost advantages of local production may be vital for exports to other markets. Local resources may be unique or scarce,

giving an edge to early investors with natural resource-seeking motivations. For knowledge or strategic-asset seeking FDI, potential local partners or allies may be few and the capabilities that the firm hopes to gain may have important implications for competition elsewhere.

The ability to delay FDI is contingent on both the strength of a firm's ownership advantages and the extent of locational early mover advantages. The interaction of these factors is depicted in Figure 2. Suppose that the host country is characterized by important uncertainties that can only be resolved with time, and that the FDI entails significant non-recoverable costs. We relax the latter assumption in the next section where we examine the relationship between reversibility and internalization advantages.

In quadrant I, the decision is easy. Early mover advantages are low and the firm has a monopolistic advantage: it can postpone FDI and wait for information. If the information is favorable, the firm can enter with little problem as its monopolistic advantages will serve as a gateway to entry. Thus, strong ownership advantages lead to FDI *not* being undertaken. In quadrant IV, the effects of both factors also are consistent, although given high uncertainty the decision is not easy. Because early mover benefits are high, and the firm has no monopolistic advantage to fall back on (or sell), delay is less viable: it must invest now or perhaps give up the chance for good. It is the relative *weakness* of the firm's ownership advantages that leads to FDI today.

In quadrants II and III, the effects of the two factors are not mutually reinforcing. In quadrant III, the firm lacks a monopolistic advantage but the early mover advantages are low. This is likely a region where the FDI decision

FIGURE 2
Delay under Uncertainty

Nature of Ownership Advantage		I Easy to delay: wait for information to arrive	II Get toes wet or investigate alternative mode
	Monopolistic		
	Non-monopolistic	III Wait for competitors' moves and follow if they invest	IV Cannot delay: invest now
		LOW	HIGH

Importance of Country
Early-mover Advantages

is especially influenced by competitive interaction. It may defer FDI until one of its rivals makes a move, and then copy it. This scenario is consistent with empirical studies of the oligopolistic reaction implying that firms with very strong ownership advantages were less likely to match rivals' FDI moves [Knickerbocker 1973; Flowers 1976; Chang 1995].

In quadrant II oligopolistic reaction is less likely than in quadrant III. Given low uncertainty, firms in quadrant II would exploit their strong ownership advantages and the high early mover benefits by investing today. But given high uncertainty, they may seek alternatives. In the case of market-seeking FDI motives, if the firm's monopolistic advantages can easily be packaged and sold, it might turn to licensing to develop a position quickly in the foreign market [Contractor 1981]. For efficiency and resource-seeking motives, the firm might try to reduce its exposure by a "get your toes wet" small initial investment or by seeking a partner to put up some of the initial capital and assume some of the risk.

We conclude that the argument that greater ownership advantages increase the likelihood of FDI today is an oversimplification. Ownership advantages may be necessary for profitable FDI, but they are not sufficient for investment to occur even in the presence of both internalization and location advantages. Some forms of ownership advantages will bear a negative relationship with the likelihood of investment at a point in time. To the extent that the advantage is easily imitated or substituted for, FDI is less delayable: the firm is more likely to surrender the option of waiting and invest now. FDI decisions will be more delayable, however, to the extent that they are based on ownership advantages that are not (easily) duplicatable, and to the extent that critical information will arrive exogenously. In some cases, the form of the ownership advantage means that the option will be more valuable than the investment; this explains "wait and see" behavior and reflects the characteristic of delayability. In other cases the ownership advantages may have a rapid "decay" factor, and require that firms act quickly – hence the observed rush to invest in some circumstances.

Internalization Advantages and Reversibility

The value of FDI today versus holding the option to do so in the future also depends upon the extent to which the investment is reversible. Irreversibility is an exit barrier, and the prospect of sinking non-recoverable investments is an entry barrier. Thus, irreversibility is a deterrent to FDI. We define full reversibility as the ability to recover the full investment whenever the firm chooses. If FDI is fully reversible, there is no economic rationale for post-poning a positive NPV project. If, on the other hand, the investment will be only partly recoverable, or if transaction costs are high, the FDI is not fully reversible. The less reversible the FDI, the greater the rationale for postponing the decision.

Two conditions must be met in order for FDI to be fully reversible. First, the firm must be able to fully recover its investment in physical assets – land, manufacturing facilities, and so forth. The likelihood of full recovery for these assets depends on their marketability, which will be greater to the extent that (1) they are traded in an efficient and liquid market, (2) they have a high number of alternative uses (i.e., they are nonspecific), and (3) the "lemons" problem[7] does not apply. These factors are related because highly specific assets, and those subject to the lemons problem, will not be traded in efficient markets. Consequently, we would expect a firm's foreign investments in land or office buildings to be more reversible than its investments in, say, tools and dies or materials-handling equipment.

Second, for the investment to be fully reversible, the firm must be able to recover the intangible assets that enabled it to undertake FDI in the first place. The firm must either receive full value for these intangibles, or it must be able to prevent their dissemination. Presumably the transfer of these intangibles involved high transaction costs since the firm opted to internalize rather than rely on an alternative mode of entry. High internalization advantages are found where there is tacit knowledge that is difficult to codify and transmit, bilateral monopoly, complementary assets, and in circumstances where the firm fears dissemination of ownership advantages. Precisely these same characteristics make FDI less reversible: the market hazards prompting internalization in the first place now complicate recovery. Transfer of tacit knowledge is difficult and expensive [Teece 1977, 1983; Kogut and Zander 1993]. These costs are sunk; the only way the firm is likely to recover any of them is to sell the investment as a going concern, complete with patents, trademarks, proprietary technology, etc. But selling the investment as a going concern involves valuation problems and implies disclosure of ownership advantages. Likewise, bilateral monopoly and specialized complementary assets entail co-dependence; they make the physical assets less attractive to potential buyers, and they lower the value of the co-dependent assets that the investor retains.

In this manner, the greater the original internalization advantages, the harder it is to recover the investment later: FDI will be *less* reversible the *greater* the internalization advantages. High internalization advantages therefore increase the value of the option to postpone the FDI decision in uncertain environments. Again we arrive at a paradoxical conclusion: higher internalization advantages make FDI less reversible, and thereby increase the likelihood of waiting instead of investing today. This argument is shown in Figure 3.

The degree of reversibility will depend on recovery of both physical and intangible assets. Recall the example of the drug company. Some of the investment's physical assets may be specialized and will be worth less without the patent that permits the buyer to manufacture the drug. Further, the buyer of

FIGURE 3
Internationalization Advantages and Reversibility
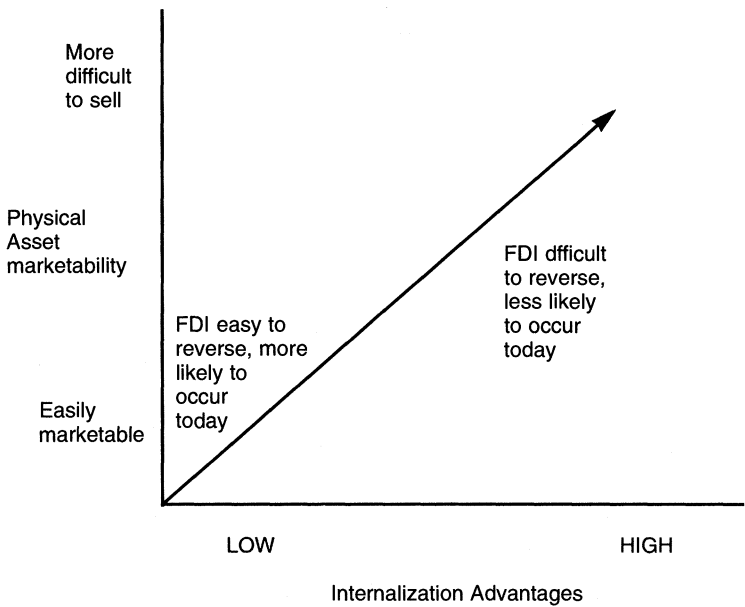
the plant, even if it does not receive the patent, will at least gain the codifiable portion of knowledge embodied in the technology. If the local appropriability regime [Teece 1987] provides weak intellectual property protection – or if the uncertainties include reversion to a political system with a weak appropriability regime – the knowledge leakage embodied in the technology will make reversibility lower. Contrast this with FDI by a service firm, say a consultancy. The necessary physical assets are general purpose and easily saleable; the knowledge transfer is embodied in teams of people and can be withdrawn with them; and the firm's name cannot be placed convincingly on products produced by others. Consequently, reversibility is high and there is little benefit to postponing investment.

Alternatively, consider knowledge-seeking FDI by a technology firm. The firm intends to produce and sell locally, but its main motivation is to augment its technology accumulation by tapping into the local knowledge infrastructure [Pavitt 1988]. The FDI requires both an investment and a transfer of specialized knowledge. Also, there will be an on-going need for knowledge transfers, both as advances made at home are transferred abroad, and knowledge derived in the host is transferred home [Teece 1983]. But because each firm's pattern of technology accumulation leads it to develop its own unique trajectory, the physical assets and less tangible ownership advantages are likely to be co-specialized with complementary assets retained by the parent at home. Internalization advantages obviously are high. If the firm seeks to reverse its

investment, other firms are likely to lack necessary complementary assets. Moreover, as with the drug company, the buyer may gain the codifiable portion of the technology. In sum, the investment will be difficult to reverse. As with the cases above, high internalization advantages make the FDI less reversible; they increase the value of the option to "wait and see" and make FDI today less likely rather than more likely.

IMPLICATIONS FOR FUTURE RESEARCH

In summary, we propose that FDI opportunities be measured on two new dimensions: their delayability and their reversibility. When these dimensions are considered, some counterintuitive inferences emerge. Higher levels of some ownership advantages confer high delayability, and high internalization advantages make FDI less reversible. As a result, FDI today becomes less likely. In the language of corporate strategy, monopolistic advantages preserve a gateway to entry; they allow the firm to delay FDI in the knowledge that it will still be able to enter at a later date. Similarly, irreversibility is analogous to an exit barrier; the firm knows that if it undertakes FDI, it will face high losses later if it changes its mind. The prospect of these losses, in turn, acts as an entry barrier: they make it more attractive to postpone the FDI decision until after the uncertainty has been resolved.

The option to change one's mind or to postpone a decision has value only in the face of uncertainty. The resolution of uncertainty will tend to cause the firm to relinquish other options and make the investment decision today; the presence of uncertainty increases the value of the option to "wait and see." Highly unique ownership advantages and high internalization advantages create the ability to invest profitably today, but they also give the firm valuable options when exogenous uncertainty is high. When waiting will reveal important information, the options surrendered by undertaking FDI today may be more valuable than the investment, and the firm should postpone the investment decision. The presence of ownership and internalization advantages is necessary, but not sufficient, for FDI at a point in time. Indeed, when exogenous uncertainty confers a positive option value on waiting, high ownership and internalization advantages will have the opposite of their usual effects.

The dimensions of reversibility and delayability provide insights for future research on both FDI behavior and the choice of entry mode. Existing theory suggests that high uncertainty will lead to transactional market failure, increasing the advantages of internalization [Dunning 1988b; Vernon 1983]. Hill et al. [1990], however, have argued that uncertainty and instability lead firms to prefer modes of international production that permit low investments, such as licensing. Incorporating the concepts of delayability and reversibility can help to reconcile this divergence. Consider the case where a firm confronts low delayability but also low reversibility. Given high uncertainty, irreversi-

bility makes FDI unattractive, but low delayability implies that the firm risks being locked out if does not participate in some form. Negotiating an arm's-length licensing agreement will be difficult given the high internalization advantages (e.g., tacit knowledge, complementary assets). These factors suggest that a joint venture, especially with a local partner, would be attractive: it reduces the investment, allows for early entry, and facilitates knowledge transfer. When the uncertainties are resolved, the partners may seek a new arrangement, a view consistent with findings that international joint ventures are unstable [Beamish 1985]. Contrast this with the case of low delayability but high reversibility. Even given high uncertainty, the firm has no reason to wait – high reversibility means that it can undertake FDI now at low risk.

We outline below several avenues of empirical research. One research path would be to examine the FDI behavior of firms seeking to exploit patents. Our framework asserts that firms with high (i.e., more monopolistic) ownership advantages will be likely to delay FDI in uncertain environments. By this reasoning, the model would predict that at the firm level, controlling for country and industry effects, patent life would have a quadratic relationship with the probability of entry when exogenous uncertainty is high. Firms with patents of very short duration would be unlikely to enter at all into foreign production; they might license or simply forego the sales. In contrast, firms with patents of medium duration would be more likely to enter now, while those firms whose patents have a longer life would be more prone to delay FDI and wait for uncertainty to be resolved. Alternatively, delayability could also be tested at the firm level using profitability data. Strong ownership advantages confer quasi-rents; these should be reflected in profitability measures. Other things equal and assuming low reversibility, we would predict that first entrants into a host country characterized by high uncertainty would not be those with the highest profitability in their industry.

Our framework asserts that given high uncertainty, irreversibility of investment will make it more likely that FDI will be delayed, but that if the investment is easy to reverse, FDI will be undertaken. We have argued that the greater the internalization advantages, the less reversible is FDI. Complex technology is often cited as an inducement to internalization: firms want to protect proprietary elements from dissemination and its large tacit component encounters market hazard and transfer cost problems [Teece 1983]. Given that such equipment is likely to be highly specialized as well, FDI based on complex technology is likely to have low reversibility. We would expect that within a given industry, firms specializing in the creation of complex technology would spend a higher proportion of their sales on research and development. Therefore, controlling for other factors, we predict that within an industry, firms with higher R&D spending would not be the first to undertake FDI in countries with high uncertainty; rather, the first entrants would have R&D ratios closer to the industry norm.

Another means of examining our hypotheses would be a historical study on a country that underwent a period of high exogenous uncertainty and then became more stable. The pattern of early versus subsequent investors, both within industries and across industries, could be used to examine the impact of delayability and reversibility on the FDI decision.

IMPLICATIONS FOR HOST COUNTRIES

Options to engage in profitable FDI are valuable to firms but do not immediately benefit host countries. Countries must induce firms to relinquish the option and move forward with investment. How can firms be induced to give up the option and engage in FDI? In brief, FDI today must be made more valuable than the option to "wait and see." Two of the determinants of the relative value of these choices – the delayability and reversibility of the FDI – are largely beyond the control of host country governments. The third determinant – uncertainty – is not. However, uncertainty and risk have numerous aspects, and only some of these are relevant to the decision to invest today versus postponing the decision.

It is frequently noted that while surveys of executives consistently conclude that political stability matters for FDI, studies which have attempted to find an empirical link between instability and actual FDI flows have met with only limited success.[8] A possible cause of this contradiction is that what executives mean by instability may not be what the studies measure. Delayability and reversibility on the one hand, and instability on the other, are to some extent substitutes in causing firms to choose FDI today over postponement of the decision. A firm would invest in the presence of even very high instability if its FDI were fully reversible. A firm might not invest, even under relative stability, if its FDI were very delayable, especially if it had other more pressing opportunities and scarce managerial resources. This substitution effect suggests why attempts to find a direct empirical link between instability and FDI flows have met with only limited success to date.

Instability must be defined carefully before arguing its relevance for the FDI decision. If it is defined or measured as a range of outcomes, we expect, other factors being constant, that higher instability will lead firms to postpone the FDI decision. Let us return to Pindyck's numerical example. Recall that the NPV of investing today was $300 while the NPV of postponing the investment decision was $386. The uncertainty to be resolved was the market price of widgets, which was to be either $50 or $150. Now suppose that the market price of widgets is to settle at either $90 or $110 – the range of outcomes is narrower. The NPV of investing today remains at $300, and will always be higher than the NPV of postponing the decision, which now is $200. Therefore, a wider range of outcomes around an expected value will increase the option value of delay and the probability of postponement, while a narrower range will decrease the option value and increase the probability of FDI today.

However, if we measure instability by the frequency of change, our conclusions will be different. Recall Pindyck's example: it is clear that what causes the "wait and see" option to dominate is that the uncertainty will be resolved; new information will arrive. Suppose, however, that the price uncertainty was never to be resolved and that the price of widgets was expected to fluctuate randomly forever between $50 and $150. Now, the firm should go ahead with the investment today; the "wait and see" tactic has no value. Arguably, an investment in which returns are to be forever random has much higher risk and more "instability" than one in which uncertainty will be resolved after one year. Yet this riskier and more unstable investment would be undertaken today, while the more stable one would not.

Instability as measured by frequent changes – in the currency, in the price level, in product demand, or in the political elite – may be helpful in predicting the variability in investment returns, but it is not the type of risk that is most important to the decision of whether to invest today or postpone the decision. We would not expect a strong empirical relationship between this definition of instability and FDI flows. To understand FDI behavior, we should focus on the large downside risks that we expect to be resolved and where new information is arriving. In the presence of large and unresolved downside risks, only the most reversible, or least delayable, FDI projects will move forward.

Returning to the example of Russia, the prospects for political and economic reform are still unresolved. Unless delayability is very limited and reversibility is great, we would expect firms considering FDI in Russia to "wait and see." Given the large downside risk, it is difficult for host countries to change this decision. From a bargaining perspective, delayability increases the bargaining power of the potential investor and irreversibility increases investor wariness. Lower tax rates such as those recently introduced in Russia to spur FDI [Hockstader 1994] are unlikely to alter many decisions to postpone FDI. They influence neither delayability nor reversibility, nor do they undo the many downside risks of investing in Russia. Therefore, the option to await more information will be too valuable for many firms for the country to "buy" the option with lower tax rates. While tax breaks and subsidies may matter at the margin, they cannot easily substitute for the resolution of exogenous uncertainty when investment is delayable or reversible. One avenue for future research might examine the types of FDI flows which occur – and do not occur – in highly volatile environments. Put another way, what types of FDI is Russia "giving up" as investors sit by the sidelines?

SUMMARY

Market imperfections theory implies that FDI will occur when its NPV is positive and greater than the NPVs of alternative modes. However, when environmental uncertainty is high and exogenous information is arriving, this

decision rule is compromised if FDI is partially irreversible, or if it is delayable. More durable, less duplicatable ownership advantages give the firm the valuable option of delaying FDI to await critical information. The level of these advantages can be inversely related to the firm's FDI at a point in time. Internalization advantages make FDI less reversible. Other factors constant, therefore, they too may reduce the likelihood of investment today. OLI advantages are necessary but not sufficient for FDI. They explain the "why" but not the "when" of foreign investment. In cases such as the new Russia and South Africa, we must examine the delayability and reversibility of firms' FDI to understand why some firms "jump in" and others wait.

As we noted in the introduction, the finance and strategy literature has historically treated investment as conferring options, but recent work has examined the case of investment that eliminates options. A rich challenge for future research in FDI is to combine these perspectives. In reality, FDI will grant the firm options – for example, the right to further investment or the right to new information. FDI will also eliminate options – for example, the right to not invest, to choose an alternative location, or to wait for critical information. Integrating these perspectives is also a promising avenue for research.

NOTES

1. See "Perspectives," *Harvard Business Review*, May-June 1994, p. 35.

2. In the case of Chang, these are subsequent investments in the same host country but in different industries; for Casson, the subsequent investments are in the same industry but in different countries.

3. Although we have presented only the simple two-period model, the conclusions are generalizable with the use of either dynamic programming or stochastic calculus. The models presented in Pindyck [1991] and Dixit and Pindyck [1994] deal with the case where new information arrives continuously over n periods.

4. While most authors concur generally in their classifications of the different theoretical approaches, they append names to them in contradictory fashion. Both Cantwell and Lizondo, use the term "internalization" theory to refer to the same literature, but Cantwell refers to Hymer, and others, as the "market power" approach while Lizondo (following Dunning and Rugman [1985]) calls it "industrial organization" theory of FDI. Graham and Krugman, in contrast, group both "internalization" and "market power" under the rubric of "industrial organization FDI theory," along with the product cycle model and oligopolistic interaction.

5. Buckley [1983] discusses subtle differences in emphasis between internalization theory and transaction cost economics.

6. Dunning [1993] calls this the trade/location approach. In Cantwell's taxonomy, the macro development models category also includes financially oriented theories but we omit these as they are not pertinent to the points in this paper.

7. The lemons problem refers to the tendency of some assets (e.g., cars, computers) to lose value immediately after they are purchased, because subsequent buyers will assume that the asset might be a "lemon"; otherwise it would not be for sale again.

8. See Brewer [1991] for a discussion of this point, and for relevant citations.

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