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Essays on segmentation in international currency and asset markets: Implications for corporate finance

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ESSAYS ON SEGMENTATION IN INTERNATIONAL CURRENCY AND ASSET MARKETS: IMPLICATIONS FOR CORPORATE FINANCE

by

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CHAPTER I

INTRODUCTION

Segmentation in international capital markets, due to a variety of market imperfections, is a common theme in recent literature on international asset pricing. [See for example, Black (1974), Stulz (1981,1984), Errunza and Losq (1985), and Eun and Janakiramanan (1986).] These studies focus on the implications of specific barriers to investment on the pricing of assets in an environment with no exchange risk.[1] Unfortunately, the same progress has not taken place in a second major area of finance,namely, international financial management. The volume of literature addressing this area is very small. Few studies (i.e. Adler (1974), Adler and Dumas (1975a and 1975b), Stapleton and Subrahmanyam (1977) and Senbet (1979)), have looked at the implications of international market segmentation for corporate financial policy. There is a general presumption in this literature that segmentation can create valuable opportunities to those who can devise methods for bypassing imperfections. However, these studies ignored exchange risk and/or default risk and/or assumed that firms' cash flows and exchange rates were independent. Moreover, direct implications for firm valuation, thus project finance, have not been fully pursued.

The purpose of the present study is to analyze the effect on firm value of long–term international financing in a simple scenario of segmented markets[2] in which exchange risk and default risk interact. Our analysis is independent of taxes,

[1]Other studies in international asset pricing have taken an alternative approach. They have chosen the complete market integration paradigm and have examined the impact of exchange risk. [i.e. Solnik(1974), Grauer, Litzenberger and Stehle(1976), Stulz(1981) and Adler and Dumas(1983).] Thus, there has not yet appeared a single international pricing model that simultaneously addresses market segmentation and exchange risk.

[2]We will elaborate on the notion of international market segmentation and its implications in Chapter II of this study.

transactions costs or any agency, incentive, signalling or informational implications of international financing decisions. Instead, the study concentrates on the "elemental variables" effecting value in an international context (i.e. differential interest rates and exchange rates). In this rudimentary analysis, we allow for the possibility of default. These sources of uncertainty coupled with market imperfections which cause segmentation of national capital markets, will be crucial in the derivation of our results.[3]

The model developed in this study is based on a state–preference analytical framework. This framework can capture the essential features of international market segmentation, and exchange and default risk structures, while allowing us to derive self–explanatory valuation functions in closed form. Using this basic model, we analyze the conditions under which a firm can create value by engaging in a variety of financial contracts within segmented national capital markets. Thus, Chapter II is devoted to derivation of our basic model and a discussion of international market segmentation.

In Chapter III, we attempt to answer some fundamental research questions related to international debt such as: Should firms borrow abroad instead of domestically? Is it possible for firms to create value by conventional debt contracts? If so, is there an optimal amount of borrowing?

The theoretical investigation undertaken in this chapter concentrates on international corporate debt for two reasons. First, it is not uncommon for firms to

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[3]In particular, misalignment of exchange rates and interest rates will play a pivotal role in our discussions. Widely fluctuating exchange rates since the abolition of Bretton Woods Agreement on fixed exchange rates together with foreign exchange controls have enhanced the conditions for existence of these misalignments. Morever, in 1979, the US Federal Reserve Board announced a major policy change which resulted in increased volatility of US interest rates. Under the new policy, Fed's target switched from interest rate levels to monetary aggregates. The dual impact of highly fluctuating exchange rates and volatile interest rates, coupled with restrictions on trading and short–selling, on international parity relations will be discussed in more detail in Chapter II.

seek foreign debt to finance foreign ventures.[4] Second, the question of default risk across national currencies is, as of now, uncharted territory in the literature. Thus, our analysis offers some new steps in that direction.

We show that if a firm issues international debt when market conditions are "right", and appropriately chooses the states of nature in which it defaults, it is possible to raise aggregate firm value and to increase shareholder wealth. This positive effect originates from a synergistic fit of the exchange rate, state price and firm's cash flow patterns over states. We model firm valuation in segmented capital markets and derive a "difference in value" function for a firm deciding to issue domestic or international debt.

After our analysis of the conventional debt contract, in Chapter IV, we investigate a new financial engineering product, namely the swap agreement. As we all know, introduction of new instruments in the international capital markets have proliferated in the last decade. [See for example, Dufey and Giddy (1981), Cooper (1986), and BIS (1986).] The swap contract is one of these new instruments that had a rapid evolution and a high degree of success.[5]

A swap is a financial transaction in which a firm that has issued one type of debt instrument agrees to exchange streams of interest payments over time with a firm that has issued another type of debt instrument. The two main types are currency swaps and interest rate swaps. The major difference in these two is that the exchange occurs in the same currency in an interest rate swap. A currency swap, however, generally refers to a transaction in which two counterparties

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[4]OECD's **Financial Statistics Monthly** reports that new international financing arranged in 1986 was approximately 250 billion dollars, 50% of which was in the form of bond issuance. These amounts were more than double of those in 1983. Bond issuance also gained in importance compared to other financing arrangements such as bank loans, bankers' acceptances, note issuance etc.

[5]NY Times April 10,1988 issue quotes the recent volume of the market as $1 trillion.

exchange specific amounts of two different currencies at the outset and repay over time both interest payments and the principal. Fixed interest rates are used in each currency and in some cases there is no initial exchange of principal.

The origins of currency swaps is to be found in back–to–back or parallel loan arrangements of the 1970's. A parallel loan is a financing technique where one company, with either surplus or easy access to a certain currency, agrees to make it available to another company in return for the second company making available its own currency. The agreement involves two loans of equivalent amounts in two currencies for the same maturities. These loans have parallel interest and principal repayment schedules. The major problem with a parallel loan was that if one party defaulted, the other party was not released of its obligation to make contractual payments. This problem was overcome by new contracts devised in 1980's. Now the exchange is conditional on both parties ability to pay. If one party defaults, the other is released from its obligation.[6]

A large impetus was gained in this evolving market of swaps by the $290 million World Bank – IBM currency swap of 1981. It was nominated as one of "the deals of the year" for demonstrating the most creative financing technique.[7] The transaction was put together as to simultaneously serve the funding requirements of IBM and World Bank in 1981. Since 1978 the Bank had raised most of its funds in German marks, Swiss francs and Japanese yen to benefit from the lower interest rates in these markets. It wanted to borrow more at these lower rates but was

[6]Beidleman(1985) views a currency swap as "an important legal innovation since it provided better security in the event of default than was available with the questionable right of offset employed with parallel or back–to–back (BTB) loans." He further states that parallel or BTB loans are based on security law, whereas currency swaps are based on contract law where the rights of the parties are clearly stated. Under contract law, if one party does not perform, the contract is void and the other party has no obligation to perform.

[7]See "Swapping Currencies with the World Bank," **Institutional Investor**, December 1981, 98–101.

facing the problem of saturating these markets due to its volume of borrowings. On the other hand, IBM had several outstanding bond issues in these currencies which it wanted to convert into dollar borrowing given the appreciation of the dollar in 1981. The World Bank issued U.S. dollar denominated long–term bonds and converted the proceeds into German marks on the spot exchange rate, thus, ending up with assets that will generate future income in German marks. However, its liability was in U.S. dollars. IBM had the opposite situation. Its liability was in German marks but it desired to convert it into a dollar liability. Therefore, through the swap contract each party ended up with a liability in the desired currency.[8]

The success of the IBM – World Bank swap was followed by other deals both in international capital markets and in domestic capital markets. Although the currency swap was the forerunner, the volume of interest rate swaps has taken over that of the currency swap. From swapping funds in one currency for a second currency, it was a logical step to swapping one type of funds for a second type within the same currency.[9] By now, both practitioners and academicians and regulators have acknowledged the existence of this market and a lot of concern is given to its economic significance.

The non–academic press has shown a tremendous interest in this new

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[8]For a more detailed description of 1981 IBM–World Bank Swap look in Antl(1983), 135–140.

[9]The Survey results released by International Swap Dealers Association (ISDA) reports the volume of interest rate and currency swaps executed in the first half of 1987 as $225 billion, or $450 billion on an annualized basis. This was the first survey conducted to report on international swap market activity. The survey covers 13 currencies and includes reports from 51 dealers responsible for a large portion of the market. Of the $225 billion total, interest rate swap transactions accounted for $181.5 billion and currency swap transactions accounted for $87 billion. The total figure reported for 1986 was $190.3 billion. On the results of the survey, ISDA chairman Patrick de Saint–Aignan of Morgan Stanley commented as: "these new figures furnish additional evidence that swaps are an increasingly dominant presence throughout the global market place. Fueled by market volatility and currency fluctuations, the swap market has become universally recognized by financial managers around the world as an effective means of hedging portfolios against risk."

financing technique, resulting in much speculative writing concerning its existence and importance. Few academic studies have yet focused on economic analysis of swaps [i.e. Park (1984), Bicksler and Chen (1986), Smith, Smithson and Wakeman (1986a and 1986b), Turnbull (1987).] These studies do not go much beyond the factual explanations of this new instrument in the professional literature. Nonetheless, one of the major issues under scrutiny is the economic rationale for the existence and evolution of the swap market. Most of the literature agrees that cost savings in financing is the major incentive for the firms engaging in these contracts. It is also recognized in the literature that any satisfactory explanation of the existence of the swap market must identify the sources of the cost savings. There seems to be a debate on what might constitute a good candidate. The debate centers around whether financial arbitrage across different capital markets can explain the source of economic benefits of swapping. It is very popular among most of the practitioners and a few academicians (Beidleman (1985), Bicksler and Chen (1986)), that cost savings, resulting from financial arbitrage, explains a large share of the recent evolution of the swap market. Some academicians, on the other hand, (Smith, Smithson and Wakeman (1986a,1986b), Turnbull (1987)) argue against this view on the basis that "the very process of exploiting this kind of opportunity should soon eliminate it." Their second argument against financial arbitrage is that the swap should be a zero–sum outcome even if financial arbitrage is the source of economic benefits of these swap agreements. These studies also dismiss the importance of financial arbitrage in an efficient, complete and integrated world or domestic capital market, but do not question if the markets really possess these characteristics.

In the same studies, the presence of tax and regulatory arbitrage and other market imperfections are suggested as possible reasons for the parties to benefit in a swap agreement. For example, Smith, Smithson and Wakeman (1986a,1986b) suggest that the favorable tax treatment of zero coupon bonds in Japan and/or limitations on the amount a pension fund can invest in non–yen denominated bond issues can lead to swaps induced by tax and regulatory arbitrage. They also claim that as long as the various tax and regulatory codes are unchanged, there will always be opportunities for tax and regulatory arbitrage unlike financial arbitrage.[10] What they fail to question is that financial arbitrage is the derivative of market segmentation caused by the cited regulations and imperfections in the world capital markets. If these imperfections are admitted to the capital markets, the notion of financial arbitrage is a natural consequence as will be further explained in Chapter II of this study. One of the purposes of this study will thus be to reconcile these seemingly contradictory views about the sources of cost savings due to arbitrage. It will be shown that in an imperfect world capital market characterized by goverment regulations and restrictions on free trading of securities (termed as segmented international capital markets), financial arbitrage is possible.

However, to argue cost savings advantages of swaps or other financial contracts, we will base our analysis on present values rather than interest rate differentials. As Turnbull (1987) has shown, the latter analysis can be misleading if financial instruments differ in design and risk. Thus, instead of invoking rate differentials in borrowing or swapping, we will invoke the concept of value creation since any cost savings due to rate differentials will necessarily enhance shareholder value.

In particular, Chapter IV of this study will argue that a currency swap agreement is almost never a zero–sum outcome in a segmented world capital market in which arbitrage opportunities are not ruled out. However, we will also show that

[10]Besides arbitrage arguments, costly information and incomplete markets are cited as the reasons for the evolution of the swap market. Since our analysis will not be related to these issues, we choose not to elaborate on them in this study.

a non–zero outcome does not necessarily lead to positive benefits. The total value gain of the two counterparties can be positive only under certain market conditions and for certain cash flow patterns of the two counterparties.

Another major issue related to this new financing technique and also discussed in Chapter IV concerns analysis of default. How to assess credit risks in swaps encountered by counterparties or the intermediary is a prominent question yet to be answered by practitioners and academicians. Our analysis will shed some light on this issue, as well. In particular, we will show the effect on value creation of a performance failure of the swap counterparties and suggest that the default option on a swap contract may be an independent source of value. For this reason, our model relies firmly on the specifications of default resolution in a swap agreement. Therefore, Chapter V is devoted to a discussion of institutional facts about default in a swap document. Chapter VI concludes the study.

CHAPTER II

THE BASIC MODEL, INTERNATIONAL MARKET SEGMENTATION AND FINANCIAL ARBITRAGE

The purpose of this chapter is to introduce the variables and notation to be used in the analyses of the study. We also develop a simple model of contract valuation which becomes the base for different contracts analyzed in the following chapters. A discussion of international market segmentation, the main assumption of our arguments, follows.

The Basic Model

The scenarios analyzed in this study will deal with a pair of firms. To ease the presentation and without loss of generality, we assume that one of these firms is a domestic firm with domestic shareholders and a foreign opportunity (subsidiary). The foreign opportunity will generate cash flows in foreign currency next period but needs to be financed by foreign currency today. Similarly, the other firm is a foreign firm with foreign stockholders and a domestic opportunity (subsidiary), thus in need of domestic currency. We must emphasize that these two firms are chosen to be symmetrical in terms of their opportunities to ease our analysis of the swap contract. In case of the debt contract, we will be concerned with only one of these firms.

For simplicity, we restrict ourselves to a two date world, indexed by $t = o,T$. The financing and investing decisions are made at $t = o$, the cash flows from the opportunities are realized at $t = T$.

Valuation of these opportunities will be determined in the state–preference model. An event space[11] (Ω, β, μ) is given where $s \epsilon \Omega$ represents a state of the world. Ω can be interpreted as an n–dimensional space denoted by n state variables (i.e. R^n). β is the σ–Algebra of the Borel sets of R^n. μ is the ordinary Lebesgue measure on R^n. The state price measure ϕ can be interpreted as another real valued function (a σ–finite measure) defined on β and taking on values in the interval [0,1]. Due to differences in the economies and investors, there will be a different function ϕ observed in each of the two countries, namely $\phi(B)$ and $\phi^*(B)$ for $B \epsilon \beta$. In our notation, "*" will designate the foreign country.

We assume that these state price measures $\phi(B)$ and $\phi^*(B)$ are both absolutely continuous with respect to the Lebesgue measure on R^n, $\mu(B)$, (i.e. $\phi << \mu$ and $\phi^* << \mu$). This assumption leads us to state that there exists a unique, finite–valued, measurable function $\varphi(s)$ on R^n such that

$$\phi(B) = \int_B \varphi(s)\, d\mu$$

for every $B \epsilon \beta$. Since $\phi(B)$ is finite, $\varphi(s) = \frac{d\phi}{d\mu}$, the Radon–Nikodym derivative of ϕ with respect to the Lebesgue measure, μ. Similarly, there exists $\varphi^*(s) = \frac{d\phi^*}{d\mu}$. Both $\varphi(s)$ and $\varphi^*(s)$ are finite–valued, measurable functions and are integrable.

Each opportunity promises a state contingent cash flow denominated in the currency of the country where the opportunity is located. $X^*(s)$ will be the cash flow to the foreign opportunity if state is s. In general, we will view the cash flows $X^*(s)$ as a finite–valued, measurable function on R^n and integrable, $X^* : R^n \to R^+ < \infty$. The corresponding function, $X(s)$, for the domestic opportunity can be designated as $X : R^n \to R^+ < \infty$.

Proceeds from the issuance of any claims in the foreign country of the opportunity or any cash flows accruing to the stockholders residing in the domestic country will have to be translated at the prevailing exchange rates at dates t =

[11]The event space is assumed to be a totally sigma–finite measure space equipped with a complete measure.

o,T. e_o will be the (domestic currency/foreign currency) spot exchange rate at $t =$ o. At $t = T$, $e_T(s)$ will be the (domestic currency/foreign currency) spot exchange rate contingent on state s. $e_T(s)$ will also be viewed as a finite–valued, measurable function on R^n and integrable, $e_T : R^n \to R^+ < \infty$. The (foreign currency/domestic currency) spot exchange rate applicable to domestic firm's revenues will be $e_T^{-1}(s)$ which is also a finite–valued, measurable function and integrable denoted by e_T^{-1} : $R^n \to R^+ < \infty$.

Payoffs to the claimants on the cash flows of the opportunities will be functions of X, X*, e_T, and e_T^{-1}. We will designate $R(X, X^*, e_T, e_T^{-1})$ to be the payoff function to claimants, a finite–valued, measurable and integrable function, $R : R^n \to R^+ < \infty$. Furthermore, we define the value of the cash flows to be a set function defined on β. We can express value in the domestic market (for example) as

$$(1) \qquad V(B) = \int_B R(X,X^*,e_T,e_T^{-1})\varphi(s)\, d\mu$$

for every $B \epsilon \beta$.[12]

The above expression is our basic valuation model which we modify to value different financial contracts, particularly the debt contract in Chapter III and the Swap contract in Chapter IV.

In valuation of these financial instruments, we make a crucial assumption

[12]Here we assume that $V << \phi$ and $\phi << \mu$ for totally sigma–finite measures μ, ϕ and V . This allows us to use the following relationship:

$$\frac{dV}{d\mu} = \frac{dV}{d\phi} \cdot \frac{d\phi}{d\mu}$$

Furthermore, since $\phi << \mu$ and R is a finite valued function for which $\int R d\phi$ is defined, then

$$V = \int R d\phi = \int R \frac{d\phi}{d\mu} d\mu$$
$$V = \int R \varphi d\mu$$

about international capital markets. We assume that national capital markets are complete, efficient and frictionless in each country, but they are segmented. Thus, we must next elaborate on international market segmentation and its implications on asset valuation.

International Market Segmentation and Asset Valuation

Imperfections in the international capital markets are so prevalent that one should think of them as rules rather than exceptions. Progress can be made while ignoring them, yet, they must ultimately be confronted in any analysis that takes a further step into reality.[13] Controls on foreign exchange, restrictions on free trade of securities and shortselling, investor preferences towards domestic assets, differential tax treatments, transactions costs that differ from one country to the other are important imperfections causing significant deviations from the perfectly integrated, efficient single market model. One or a combination of these imperfections result in national markets to be segmented.

National capital markets are segmented if two assets with identical pay offs do not have the same value in each market, as translated by the current exchange rate.

The cause of this segmentation can be legal restrictions imposed by goverments or individual irrationality in investment behavior.[14] Evidently, the issue is an empirical question. Kohlhagen (1983), Jorion and Schwartz (1986) and

[13]This is not to diminish the significance of similar imperfections in the domestic market which are very often unduly dismissed.

[14]Jorion and Schwartz(1986) classified market imperfections into two categories; indirect barriers and legal barriers. The first group of imperfections are caused by investor inertia and lack of information, whereas the latter is more generally linked to restrictions imposed by goverments. (e.g. Canadian pension funds are not allowed to hold more than 10% of their assets in foreign securities.) They also claim that their findings indicate that a major source of segmentation is legal barriers. The recent paper by Gultekin, Gultekin and Penati(1987) supports this conclusion.

Gultekin, Gultekin and Penati (1987) have addressed the issue of market segmentation versus integration. These empirical studies hypothesize that if national capital markets are segmented, the price of risk should be different in the two countries. The evidence they present supports their market segmentation hypothesis.

With market segmentation, many of the firm's financial decisions become relevant. One problem is that different market imperfections lead to different implications for asset pricing and corporate finance. The relevance of different firm financial decisions are specific to the kind of imperfection assumed.[15] In this study, we ignore imperfections due to taxes, transactions costs or informational problems and assume that the major cause of segmentation is restrictions put on trading of securities and shortselling. In particular, domestic investors are not allowed to purchase the international bond issues of domestic firms.[16] Furthermore, foreign investors are restricted from holding domestic equity. In the next two chapters, we will trace the implications of these imperfections on firm's international borrowing and swapping decisions.

After this brief introduction, we can now analyze the implications of international market segmentation on asset valuation in general, employing the definitions and notation of the previous section. Initially, suppose that investors in both markets can trade all available securities with no restrictions on shortselling. There exists an asset in the foreign market with an income of $X^*(s)$ (in foreign

[15] We should also keep in mind that default risk adds another dimension (as discussed later in this study) which may render irrelevance propositions unlikely in segmented markets.

[16] This is a very common imperfection due to the institutional fact that international bonds (either Eurobonds or foreign bonds) are initially offered to investors outside the country of the borrower. For example, a Eurobond issue by a US firm is not made available to US investors before three months, known as the seasoning period. Within that period, investors purchasing bond certificates must prove that they are not US residents. This imperfection is the core of our argument especially in Chapter III where we discuss international debt.

currency) at $t = T$, and a domestic perfect substitute with an income of $X(s) = X^*(s)e_T(s)$. Consider the following investment strategy for a domestic investor. Sell short the foreign asset in the foreign market and convert the proceeds to domestic currency at e_o. Buy the domestic perfect substitute in the domestic market. The cash flow of this transaction at $t = T$ is 0, and at $t = o$ is

(2) $$e_o\{ \int X^*(s)\varphi^*(s)\, d\mu \} - \int X^*(s)e_T(s)\varphi(s)\, d\mu$$

To avoid arbitrage, the following should hold

(3) $$e_o\{ \int X^*(s)\varphi^*(s)\, d\mu \} = \int X^*(s)e_T(s)\varphi(s)\, d\mu$$

A sufficient condition for (3) to hold or (2) to be identically equal to zero is

(4) $$e_o\varphi^*(s) = e_T(s)\varphi(s) \qquad \text{a.e.}$$

(3) can be rewritten as

(5) $$\int X^*(s)(e_o\varphi^*(s) - e_T(s)\varphi(s))\, d\mu = 0$$

Note that the conditions specified in (4) are sufficient but not necessary for the integral condition (5) to hold. However, in complete and fully integrated markets, where there are no restrictions on shortselling and trading of all available securities, the parity conditions in (4) should hold $\forall s \epsilon \Omega$ (a.e.). This is true since, in such a market, pure securities can be freely packaged and unpackaged. Condition (4) will necessarily result in such a world since no arbitrage in the valuation of any of the existing securities traded in any one of the markets will be possible.

Condition (5) will hold for every asset since all assets are traded. Irrelevance of any new contracts written will also be ensured. However, once we introduce restrictions on trading and impediments to short–selling, the above integral condition need not hold for those assets that cannot be traded by the investors of both countries. For those assets, (5) will not be valid. This necessitates that the state by state parities of condition (4) do not hold.[17] Equivalently,

(6) $$e_0 \varphi^*(s) \neq \varphi(s) e_T(s) \quad \text{for a subset with nonzero measure}$$

The above condition (6) is the way we describe market segmentation in our study. We later develop contract valuations in the context of segmented international capital markets as defined in this condition. The existence of these state by state disparities will be the source of valuation discrepancies in those discussions.[18]

We agree that exchange rates and state prices (and implicit interest rates) are deemed to have the close relationship designated by (4), at equilibrium, in a world where the capital markets are perfect and fully integrated. However, we also know that one is not determined by the other. Rather, they are determined jointly by supply and demand of capital, international trade and inflationary expectations. Hence, we believe that in a world characterized by various imperfections (capital controls, restrictions on trading and short–selling, exchange controls etc.) and in which both exchange rates and interest rates fluctuate widely, one cannot expect arbitrage to take place instantaneously and effectively to ensure the close relationship in (4). This will be especially true for longer periods and for arbitrage

[17]Note that this does not preclude the law of one price to prevail in the case of dual listings.

[18]As will be clear later, for the purpose of our study it is sufficient that (6) is true only for a subset of Ω .

opportunities that demand large volume of funds.[19]

Our discussions on this issue may sound ad hoc. We must admit that to adequately capture the implications of various restrictions put on trading and exchange rates on these parity relationships nothing short of a general equilibrium model is needed, where all these variables and imperfections are endogenized. Then, we would not have to impose the market segmentation condition (6) ab initio. Yet, given the variety of market imperfections and the complexity of the problem, it is well beyond our current abilities to handle. Instead, we attempt here to examine the implications of international market segmentation to corporate finance by arguing that condition (6) is most likely to be valid in an imperfect world capital market in which both exchange rates and interest rates fluctuate widely.[20] Hence, we argue that regulatory arbitrage is a major cause of financial arbitrage and both will persist as long as free capital movements are restricted by goverment controls.

The condition stated in (4) is a very strong one and, as we discussed above, can only be achieved if the markets are complete and perfectly integrated. A weaker condition that might hold even in a segmented international capital market is an integral condition known as Uncovered Interest Rate Parity (IRP). It can be explained as follows.

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[19]Beidleman(1985) argues that professional arbitragers will be ineffective or insufficient in these cases. He further argues that firms may perform arbitrage–like transactions to capture the benefits. These opportunities may diminish when the firms move funds from one country to the other. However, there will be other opportunities opened as long as the imperfections persist and exchange rates and interest rates remain volatile.

[20]Recent empirical findings of Gultekin, Gultekin and Penati(1987) support our argument. Using APT, they have shown that after the liberalization of capital controls in Japan, risk, when expressed in a common numeraire, has the same price in both the Japanese and US securities markets. Contrary to this findings, however, they were not able to show the equality of risk premia and the risk free rate for the period prior to the liberalization of 1980. These empirical findings imply discrepancies in value of two assets that are perfect substitutes in two different markets whenever there are capital controls. Thus, in such a case, our integral condition in (5) is not likely to hold and condition (6) follows.

The no arbitrage condition for a riskless asset is given by

(7) $$e_o \int \varphi^*(s)\, d\mu = \int e_T(s)\varphi(s)\, d\mu$$

Note that $\int \varphi^*(s)\, d\mu = \frac{1}{r^*}$ where r^* is the risk free rate in the foreign country. Thus, (7) can be rewritten as

(8) $$\frac{e_o}{r^*} = \int e_T(s)\varphi(s)\, d\mu$$

It is important to note that condition (8) may hold, which is equivalent to uncovered IRP, and should hold in the case where investors are not restricted from trading the risk free asset and there are forward markets for foreignn currency for the maturity (o,T). However, it does not imply that condition (4) holds which is a much stronger condition. Thus, with risky assets, it may still be possible to observe violation of the equality in (3).[21]

Moreover, we can make another observation concerning IRP. In the above discussion, we carried the arbitrage argument from the point of view of domestic investors. Similarly, a foreign investor may sell–short an asset in the domestic capital market with income of X(s) at $t = T$, and convert proceeds to foreign currency at e_o^{-1}, and buy a perfect substitute of the same asset in the foreign capital market. To avoid arbitrage,

(9) $$e_o^{-1} \{ \int X(s)\varphi(s)\, d\mu \} = \int X(s)e_T^{-1}(s)\varphi^*(s)\, d\mu$$

should hold where a sufficient condition is

[21]This point will be clarified with a numerical example in Chapter III.

(10) $$e_0^{-1}\varphi(s) = e_T^{-1}(s)\varphi^*(s) \qquad \text{a.e.}$$

which is identical to (4). Thus, for the stronger condition to obtain, it does not matter which set of investors are chosen to demonstrate the parity conditions. However, this is not true for the weaker condition. The no arbitrage condition for a riskless asset in the foreign capital market becomes

(11) $$\frac{1}{e_0 r} = \int e_T^{-1}(s)\varphi^*(s)\, d\mu$$

where r is the risk free rate in the domestic market. This result may not be identical to the previous one in (8). To see the implications of this, we compare the two results.

(8) and (11) can be rewritten as (12) and (13) respectively.

(12) $$\int e_0\varphi^*(s) - e_T(s)\varphi(s)\, d\mu = 0$$

(13) $$\int e_0^{-1}\varphi(s) - e_T^{-1}(s)\varphi^*(s)\, d\mu = 0$$

If both (12) and (13) are true simultaneously, it would mean that, given the same set of e_0, $e_T(s)$, ϕ and ϕ^*, IRP holds with respect to both sets of investors. We should note that if international capital markets were fully integrated, (12) and (13) would trivially equal zero, the simple reason being that (4) implies (10) almost everywhere. In other words, if (4) is true, then (12) is identically zero. Since (10) is equivalent to (4), (13) would necessarily equal zero. However, our presumption is that (4) is not a true representation of the relationship between exchange rates and state price measures in a segmented international capital market. Under this paradigm, we can introduce a number of scenarios concerning the risk free asset.

Suppose there are no restrictions on trading of the risk free assets alone by both set of investors in the two, otherwise segmented, markets. Further assume that these traders can sell short unlimited amounts. In such a scenario, we again expect (12) and (13) to equal zero simultaneously, or

$$(18) \qquad \int e_0\varphi^*(s) - e_T(s)\varphi(s)\, d\mu = \int e_0^{-1}\varphi(s) - e_T^{-1}(s)\varphi^*(s)\, d\mu$$

The above equality is ensured under the condition that

$$(19) \qquad \int (e_0 + e_T^{-1}(s))\varphi^*(s) - (e_0^{-1} + e_T(s))\varphi(s)\, d\mu = 0$$

Condition (19) is again an integral condition which, if valid, assures no arbitrage opportunities available on the trading of the risk free asset in each of the two segmented capital markets. Thus, other than a set of e_0, $e_T(s)$, ϕ and ϕ^* that makes (19) equal zero, it is not possible to show that IRP is a round trip arbitrage. To demonstrate this point we should look into (8) and (11) and see if they imply each other, in general.

$$(20) \qquad \int e_0\varphi^*(s) - e_T(s)\varphi(s) d\mu \iff \int e_0^{-1}\varphi(s) - e_T^{-1}(s)\varphi^*(s) d\mu$$

The RHS of (20) can be rewritten as

$$(21) \qquad \int \varphi(s)\left(\frac{1}{e_0} - \frac{\varphi^*(s)}{e_T(s)\varphi(s)}\right) d\mu$$

which is equivalent to

(22) $$\int \varphi(s) \left[\frac{e_T(s)\varphi(s) - \varphi^*(s)e_0}{e_0 e_T(s)\varphi(s)} \right] d\mu$$

(22) can be simplified to

(23) $$-e_0^{-1} \int e_T^{-1}(s)(e_0\varphi^*(s) - e_T(s)\varphi(s))\, d\mu$$

It is evident that (23) does not imply the LHS of (20). To see the significance of this result, suppose one set of investors alone (the foreign investors) are restricted from trading the domestic risk free asset. The domestic investors, however, can trade the risk free assets of both markets. The unrestricted domestic investors will ensure that (12) holds (i.e. IRP holds for the domestic investors alone). However, this does not imply that (13) is simultaneously true. In other words, as can be seen from (23), the set of e_0, e_T, ϕ and ϕ^* values that makes (12) identically zero will not necessarily ensure (13) to equal to zero. Since the foreign investors are restricted, arbitrage opportunities will still be possible in trading of risk free asset in the foreign market. We can alternatively argue that whenever the arbitrage opportunities for the risk free asset on the domestic side cease to prevail, there will be an arbitrage opportunity created in the opposite direction. We will see the implications of this observation for swap financing later in the study.

We can take our discussion of IRP one step further. Another possible scenario is the case where both sets of investors are restricted from trading the risk free assets, or the risk free assets do not exist for the maturities of interest to us. In such a case, neither (12) or (13) may hold. It is interesting to note here that any positive deviation from (12) will not be offset by an opposite deviation in (13). As can be seen in (23), the presence of e_0^{-1} and $e_T^{-1}(s)$ will make the magnitudes of the deviations different.

Now, let us reconsider the above arguments assuming that forward sale and purchase of the currencies are possible. (8) and (11) can be rewritten as

(24) $$\frac{e_o}{r^*} = \frac{e_f}{r}$$

(25) $$\frac{1}{e_o r} = \frac{1}{e_f r^*}$$

where e_f is the interest rate parity forward rate. If both sets of investors (domestic and foreign) have equal access to the forward market, there will be a unique forward rate established and that rate e_f is equal to $\frac{e_o r}{r^*}$, as implied by (24) and (25). When such a rate is established, there are no arbitrage opportunities available in trading the risk free assets. However, if either one or both sets of investors are restricted from sale or purchase of foreign currencies forward, the above relationship will not be true. This might not be a too far–fetched observation, if one recalls the empirically verified deviations from IRP. Frenkel and Levich (1975,1977) associated these deviations to the existence of transactions costs. However, recent studies (Deardorff (1979) and Bahmani–Oskoee and Das (1985)) conclude that transactions costs cannot by themselves explain these deviations. They invoke the existence of other factors besides transactions costs. One of these factors was suggested by Keynes (1923)[22] as being the institutional constraints which limit traders' position taking, whether for arbitrage or other purposes.

Moreover, once we admit deviations from IRP, it will be easier to allow condition (6) to represent the state price–exchange rate relationship rather than condition (4). Thus, in the rest of the study, we rely on the validity of condition (6) to derive our results related to contract valuation.

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[22]Keynes, J.M. A **Tract on Monetary Reform**, London: Macmillan, 1923.

CHAPTER III

VALUATION OF INTERNATIONAL DEBT CONTRACT

We now turn to an analysis of the conventional debt contract in the context of international market segmentation. A conventional debt contract can initially be offered to investors outside the country of the borrower either as a "Eurobond" or as a "foreign bond". This chapter will examine both of these contracts from the point of view of the borrowing entity. The specific problems to be investigated are: (1) whether shareholder wealth can be increased by issuing domestic debt claims against a foreign opportunity in a segmented or integrated world capital market, (2) the impact of market segmentation on the value of the foreign opportunity when it is financed by international debt contracts, (3) the extent and nature of value creation due to default.

The next section of this chapter values the foreign opportunity in the domestic market. The following sections discuss the value of the same opportunity had it been valued in the foreign market and the difference in value of the two valuations. A section on analyzing the default option implicit in risky international debt follows. Finally, we present a numerical example that clarifies our valuation results.

Valuation of the Opportunity in the Domestic Market

Our simple scenario assumes that a firm, with domestic stockholders, has available a foreign investment opportunity. This investment opportunity requires a foreign currency expenditure and generates cash flows in the foreign currency as well. The firm is considering a new issue of equity to expand its debt capacity and will finance the rest of the project through domestic and/or international borrowing.

The opportunity promises a state contingent cash flow denominated in foreign currency. $X^*(s)$ will be the pay off to the foreign opportunity if the realized state is s. In this chapter, $X(s)$ will designate domestic cash flows of the same firm. e_0, e_T, $\varphi(s)$ and $\varphi^*(s)$ are the same as described in Chapter II.

Furthermore, let D and D^* be the promised payments on debts denominated in domestic currency and in foreign currency, respectively.

Employing the above definitions and notation, we now construct a simple model to value the foreign opportunity in the domestic market. Consider the firm issuing debt denominated in the foreign currency. D^* is promised to be paid to bondholders at $t=T$. Assume that this debt has priority over debt denominated in domestic currency. Under this contract, the payoffs to foreign bondholders in each state will depend on the amount of debt issued, D^*. Thus, the event space Ω will be divided into two subsets. $A = \{ s : X(s)+e_T(s)(X^*(s)-D^*) \geq 0 \}$ will be the set of states $s \in \Omega$ where cash flows cover the debt obligation, D^*. In set A, foreign bondholders will be paid the full amount of the promised payment. The complement of A in Ω, $A' = \Omega - A$, will constitute those states $s \in \Omega$ where cash flows fall short of D^*. The foreign debt liability of the firm is valued implicitly by the domestic investors. Their valuation is based on the pay–offs to foreign debt in the domestic currency at the prevailing exchange rate e_T, at $t=T$. Thus, pay–offs to foreign

debt translated into domestic currency are

$$(1) \qquad R_f = \begin{cases} e_T(s)\ D^* & \forall\ s \in A \\ X(s)+e_T(s)X^*(s) & \forall\ s \in A' \end{cases}$$

Note that due to our segmentation argument, the domestic investors are not allowed to purchase the foreign debt issued. Here, the cash flows to foreign debt are valued by domestic investors as a "cost" (shadow price) of issuing foreign debt. Thus, the value of this liability in the domestic market will be based on domestic state price measures, $\phi(s)$.

(2) $$V_f = D^* \int_A e_T(s)\varphi(s)\, d\mu + \int_{A'} (X(s)+e_T(s)X^*(s))\varphi(s)\, d\mu$$

Suppose the firm also issues domestic debt (or debt denominated in domestic currency) which it sells in the domestic market. Investors in the domestic debt of the firm are paid only after the foreign debt obligation is met. Thus, the set A, in turn, will be subdivided into $AB = \{ s : X(s)+e_T(s)(X^*(s)-D^*) \geq D \}$ and $AB' = A-AB$. Payoffs to domestic debt are

(3) $$R_d = \begin{cases} D & \forall\ s \in AB \\ X(s)+e_T(s)(X^*(s)-D^*) & \forall\ s \in AB' \\ 0 & \forall\ s \in A' \end{cases}$$

Evidently, domestic debt holders are paid in the second contingency only if there is some positive cash flow left after foreign debt payoffs are met. Hence, they have the chance of being paid nothing at the end, as designated by the third contingency. The market value of domestic debt is

(4) $$V_d = D \int_{AB} \varphi(s)\, d\mu + \int_{AB'} (X(s)+e_T(s)(X^*(s)-D^*))\varphi(s)\, d\mu$$

Similarly, payoffs to equity will have the following pattern

(5) $$R_e = \begin{cases} X(S)+ e_T(s)(X^*(S)-D^*)-D & \forall\ s \in AB \\ 0 & \forall\ s \in AB' \cup A' \end{cases}$$

Thus, the market value of equity is

(6) $$V_e = \int_{AB} [(X(s)+e_T(s)(X^*(s)-D^*))-D]\varphi(s)\, d\mu$$

The total value of the opportunity when valued in the domestic market is the sum of the values of the individual securities.

(7) $$V_o = V_f + V_d + V_e$$

Substituting (2), (4), and (6) into (7), we get

(8) $$V_o = \int (X(s)+e_T(s)X^*(s))\varphi(s)\, d\mu$$

Note that in this valuation, segmented markets and exchange risk play no role and we end up with a simple version of the MM irrelevance proposition in the international context. It does not matter how the pay–offs are distributed, as long as they are valued in the same market by the same set of investors. Value is independent of the currency denomination of debt issues. However, this is not the case when the debt is valued by foreign investors. Our assumption is that capital markets in the two countries are segmented and that international debt, if issued, will be purchased by investors in the foreign market. The valuation implications of this assumption will be discussed in the next section.

Market Segmentation and Firm's International Borrowing

Up to this point, our analysis has focused on valuation effects of international borrowing when the opportunity was valued by domestic investors in the domestic market. We showed that if the promised pay–offs of the opportunity were valued by the same set of investors, as would be the case in a single integrated capital market, the international, as well as, the domestic borrowing decisions of the firm would be irrelevant. But our assumption is that national capital markets are segmented and there are two distinct sets of investors residing in their respective countries. In particular, if international debt is issued, initially it will be purchased, thus valued by, the investors of the foreign country. Moreover, our presumption is that, due to certain market imperfections that cause segmented capital markets, for a subset with nonzero measure, $\varphi(s)e_0 \neq \varphi^*(s)e_T(s)$, as explained in the previous chapter.

We now turn to the effects of issuing international debt on the valuation of the foreign opportunity, in segmented national capital markets. International debt can be denominated in the foreign currency (foreign debt) or in the domestic currency (Eurobonds)[23].

We first analyze the case of foreign debt. Keeping in mind that D^* is the promised payment at $t=T$ on foreign debt sold to foreign investors, we see that foreign investors will be paid in full in set A where $A = \{ s : X(s)+e_T(s)(X^*(s)-D^*) \geq 0 \}$. $A' = \Omega - A$ is the subset of states in which default occurs. To find the total value of the opportunity, we need to value foreign debt once again in the foreign market based on the pay–offs to foreign investors.

$$(9) \qquad R_f = \begin{cases} D^* & \forall\ s \in A \\ X(s)e_T^{-1}(s)+X^*(s) & \forall\ s \in A' \end{cases}$$

Thus, the market value of foreign debt as valued by foreign investors in the

[23]Certainly there are other institutional factors that distinguish foreign bonds and Eurobonds. In this chapter, we concentrate on the differences in denomination only.

foreign currency is

(10) $$V_f^* = D^* \int_A \varphi^*(s)\, d\mu + \int_{A'} (X(s)e_T^{-1}(s)+X^*(s))\varphi^*(s)\, d\mu$$

V_f^* is simply the amount that the firm would collect from overseas for its foreign debt. To find the total value of the opportunity at t=o, V_f^* is converted into domestic currency at the rate e_o. The total market value of the project in domestic currency is then

(11) $$V_o' = e_o V_f^* + V_d + V_e$$

If (11) is compared to (7), it is immediately apparent that these two different value assessments for the same project differ to the extent that $e_o V_f^*$ deviates from V_f. In other words, the value of foreign debt, valued as a liability in the domestic market, may be different from the value of the same obligation, valued as a claim in the foreign market. This discrepancy would be impossible if the same set of investors had the opportunity to trade all the securities issued by the firm to finance this project, as we have seen in the previous section. We now turn to computation of the "difference in value" function which is

(12) $$\delta V_o = V_o' - V_o = e_o V_f^* - V_f$$

Using (2), (10) and (12), it can be shown that

(13) $$\delta V_o = D^* \int_A (e_o\varphi^*(s) - e_T(s)\varphi(s))\, d\mu +$$

$$\{e_0\int_{A'}(X(s)e_T^{-1}(s)+X^*(s))\varphi^*(s)d\mu - \int_{A'}(X(s)+e_T(s)X^*(s))\varphi(s)d\mu\}$$

Let $D^* = X^*(s) + Z^*(s)$, where $Z^*(s)$ stands for the unsecured portion of foreign debt given state s. Using this definition and (13), and recalling that $\frac{1}{r^*} = \int \varphi^*(s)\, d\mu$, we get

(14) $$\delta V_0 = D^* \left(e_0\, r^{*-1} - \int e_T(s)\varphi(s)\, d\mu \right) +$$

$$\{e_0\int_{A'}(X(s)e_T^{-1}(s)+X^*(s)-D^*)\varphi^*(s)d\mu-\int_{A'}[(X(s)e_T^{-1}(s)+X^*(s)-D^*)e_T(s)]\varphi(s)d\mu\}$$

This function is the "difference in value" when foreign debt is sold to foreign investors instead of domestic investors. It can be shown that the same function would have obtained had one compared the value of domestic debt sold to domestic investors to the value of foreign debt sold to foreign investors. Thus, the above function can be viewed as the difference in value of the investment opportunity when foreign debt is used in financing instead of domestic debt. The first term in the expression represents the difference in value between two default–free bonds issued in the two countries. The two terms in the brackets represent the difference in domestic valuation of a foreign and a domestic debt claim over the subset of states in which default occurs. The issuance of foreign debt is desirable if and only if $\delta V_0 > 0$.

Recalling the argument that, in a fully integrated and complete international market, the parity conditions in (II.4) should hold $\forall\, s \in \Omega$, it can easily be shown that δV_0 will disappear in such a world. In other words, the irrelevance proposition is still preserved even if foreign debt is exclusively sold to foreign investors. As long as the two capital markets are fully integrated in the sense of no impediments to ownership of existing assets with no resrictions on short selling, the parity conditions in (II.4) hold, and firms' international borrowing decisions are a matter of indifference. It is worth noting that the irrelevance proposition is reestablished in a two country world if and only if markets are complete and fully integrated. The complete markets assumption is not sufficient as would be the case in a similar domestic setting[24].

However, our presumption throughout the paper is that national capital markets are segmented to some degree as suggested by some empirical findings. This implies that if two assets, which are close or perfect substitutes, are not traded in both markets simultaneously, there will be no mechanism to ensure the equivalence of their values. Thus, disparities in the exchange rate/state price measure relationships, presented in (II.6), will be observed. Under these conditions, evidently, the choice of domestic versus foreign debt will not be irrelevant. It will be possible for the "difference in value" function to be non–zero.

Upon examination of (14), assuming disparities in (II.6), we derive a number of implications for corporate international borrowing policy. First, if the firm issues default–free debt (i.e. $A' = \phi$), then the second term in the brackets of (14) vanishes, and δV_0 depends only on interest rate parity (IRP) holding. Obviously if IRP holds, there will be no incentive for the firm to issue default–free foreign debt. If, however, there are deviations from IRP, then issuing default–free debt will depend on the sign of the deviation. Specifically, if $e_0 \, r^{*-1} > \int e_T(s)\varphi(s) \, d\mu$, firms should borrow as much default–free debt as they can[25] in the foreign market.

Furthermore, considerations of risky debt enriches the picture considerably

[24]In a domestic setting where $e_0 = e_T(s) = 1$ (ignoring inflation) irrelevance would rely on the equivalence of state prices if the debt of the firm is valued in a separate market from its equity. See Rubinstein(1973) for a similar argument.

[25]Kim and Stulz(1987), within a supply and demand framework, give a discussion on why these "bargains" are not arbitraged away instantly.

since two possibilities become evident. First, the initial term in (14) may be positive, indicating preferences for default–free foreign debt, but the term in brackets may be negative, indicating simultaneous counterincentives for foreign risky debt. Second, even if arbitrage can take place with default–free instruments and the initial term vanishes, incentives may still exist for the issuance of foreign debt. The firm will issue risky foreign debt whenever the initial term in the brackets is greater than the second term.

At this point it is worthwhile to examine the terms in the brackets of (14), and to try to state what conditions will make the difference between the two terms negative or positive. For simplicity, in the rest of the analysis we assume that the promised pay–offs will only come from the foreign income of the opportunity, $X^*(s)$. Then, (14) will simplify to

$$\text{(15)} \qquad \delta V_0 = D^* \left(e_0 r^{*-1} - \int e_T(s)\varphi(s)\, d\mu \right) +$$

$$\left\{ e_0 \int_{A'} (X^*(s) - D^*)\varphi^*(s)\, d\mu - \int_{A'} [(X^*(s) - D^*) e_T(s)]\varphi(s)\, d\mu \right\}$$

Examining the expression in the above brackets, we can see that the function $(X^*(s) - D^*)$ is always negative since $A' = \{ s : X^*(s) < D^* \}$. This implies that both integrals over A' have negative values. We can interpret the first (second) term in the brackets as the value lost by not being able to pay the full promised amount, D^*, to foreign (domestic) debtholders in states $s \in A'$. In those states, investors are only paid $X^*(s)$ instead of D^*. This occurrence creates an "opportunity value loss" depicted by the negative values of the integrals. However, we should note that this is not a real value loss for the firm. The firm is receiving the fair market value of its payments in each state. The "opportunity value loss" stems from issuing risky debt instead of default–free debt. Thus, the sign of the difference in the brackets of (15) depends upon the magnitudes of the "opportunity value loss" in the two markets due to issuing risky debt. Specifically, this difference is positive (negative) if the loss in the foreign market (domestic market) is less than in domestic market (foreign market). Therefore, positive (negative) differences should lead to foreign (domestic) debt issuance.

The conditions that will lead to a positive difference between the two terms in the brackets of (15) can be analyzed as follows. (15) can be equivalently written as

$$(16)\quad \delta V_0 = D^*\int(e_0\varphi^*(s)-e_T(s)\varphi(s))\,d\mu + \int_{A'}(X^*(s)-D^*)(e_0\varphi^*(s)-e_T(s)\varphi(s))d\mu$$

We can easily see that the parity conditions in (II.4) are essential to the determination of the sign of the difference in brackets. For any given state, in the first term of (16), $(e_0\varphi^*(s)-e_T(s)\varphi(s)) > 0$ is the desirable condition. It is interesting to note that in the second term, precisely the opposite (inequality reversed) condition is desired since the terms, $(X^*(s)-D^*)$, are always negative $\forall$ $s\in A'$. This is not counterintuitive once we recall the argument about "opportunity value loss". It simply points out the fact that if the "opportunity value loss" in the foreign market is smaller than in the domestic market, then risky foreign debt should be issued.

Assume IRP so that only the second term in (16) matters. The expression (16) will be positive if, for a subset with nonzero measure in A', $e_0\varphi^*(s)<e_T(s)\varphi(s)$. An alternative way of viewing the expression in (16) is as a weighted sum of the state price/exchange rate relationships, $(e_0\varphi^*(s)-e_T(s)\varphi(s))$, where the weights are the $(X^*(s)-D^*)$ terms. For some states $s\in\Omega$, the market conditions (the state

price/exchange rate relationships) will be desirable in the sense we discussed above. But, naturally, other states will exist where the opposite condition is true. If the firm can limit the default states $s \in A'$ to that subset of Ω where the desirable conditions hold, it will surely benefit. But this will not be technically feasible because the breakdown of Ω into A and A' is not arbitrary. It depends on the firm's payment capacity in each state, namely $X^*(s)$, and the level of promised payment to bondholders, D^*. In fact, as mentioned above, the sign of (16) depends on a weighted sum of desirable and undesirable market conditions where the weights $(X^*(s)-D^*)$ are firm specific. Thus, it becomes reasonable for the firm to search for a level of debt (optimal), given the market conditions and its payment capacity, which makes the expression in (16) the most positive.

Similar derivations and arguments can be carried out for international debt denominated in domestic currency, namely Eurobonds. The resulting "difference in value" function will be

(17) $$\delta\hat{V}_0 = e_0\int_B De_T^{-1}(s)\varphi^*(s)\,d\mu - \int_B D\varphi(s)\,d\mu + e_0\int_{B'}(X(s)e_T^{-1}(s)+X^*(s))\varphi^*(s)\,d\mu - \int_{B'}(X(s)+X^*(s)e_T(s))\varphi(s)\,d\mu$$

where D is the promised payment in domestic currency and $B = \{ s : X(s)+X^*(s)e_T(s) \geq D \}$. Thus, $B' = \Omega - B$, and $s \in B'$ are those states in which default occurs. (17) can be rewritten as

(18) $$\delta\hat{V}_0 = D\,(e_0\int e_T^{-1}(s)\varphi^*(s)\,d\mu - r^{-1}) - e_0\int_{B'}(De_T^{-1}(s)-X(s)e_T^{-1}(s)-X^*(s))\varphi^*(s)d\mu + \int_{B'}(D-X(s)-X^*(s)e_T(s))\varphi(s)d\mu$$

After dropping the domestic cash flow function, X(s), (18) can be simplified to

(19)
$$\delta\hat{V}_0 = D\left(e_0\int e_T^{-1}(s)\varphi^*(s)\,d\mu - \frac{1}{r}\right) +$$
$$\left\{e_0\int_{B'}(X^*(s) - De_T^{-1}(s))\varphi^*(s)d\mu - \int_{B'}[(X^*(s) - De_T^{-1}(s))e_T(s)]\varphi(s)d\mu\right\}$$

Note that (19) is not identical to (15) for two reasons. First, the promised payments to foreign debtholders are no longer a fixed amount but are variable based on exchange rate variations. Foreign investors view the Eurobond as a variable rate claim and value it accordingly. Second, due to this fact, the subset of states where the firm defaults is different for Eurobonds. In other words, $A' = \{ s : X^*(s) < D^* \}$ but $B' = \{ s : X^*(s) < D\, e_T^{-1}(s) \}$ and, obviously, they are not equal subsets of Ω. Thus, the currency in which the international debt is denominated (i.e. domestic versus foreign) definitely matters for firm's borrowing decisions as does the set of investors to which the issue is sold.

Examination of (19) reveals that the issuance of Eurobonds will be desirable whenever $\delta\hat{V}_0 > 0$. Furthermore, the same market conditions that made foreign debt desirable will also be supporting Eurobonds. For example, assuming IRP holds, an expression similar to (16) is

(20)
$$\delta\hat{V}_0 = D\int e_T^{-1}(s)(e_0\varphi^*(s) - e_T(s)\varphi(s))d\mu +$$
$$\int_{B'}(X^*(s) - De_T^{-1}(s))(e_0\varphi^*(s) - e_T(s)\varphi(s))d\mu$$

Assuming IRP, it can easily be seen that the only change from (16), besides the difference in sets A' and B', is in the weights, $(X^*(s)-De_T^{-1}(s))$, given the market conditions in each state s. The weights are now complicated by the fact that the promised payoff depends on the variable exchange rate. Thus, state by state, if the market conditions are conducive to foreign bonds, they will also be conducive to Eurobonds. But the impact on value of these conditions will have different magnitudes due to the differences in weights and the differences in subsets where the firm defaults. Thus, "the difference in value" functions, δV_0 and $\delta\hat{V}_0$, will almost always be different.

International Debt and Default Option

Since Black and Scholes (1973), it is very common in corporate literature to view corporate liabilities as combinations of simple option contracts. In particular, the value of risky debt is shown to equal the value of a risk free bond with the same maturity and promised amount minus the value of a put written on the value of the underlying assets of the firm. The strike price of the put is the same as the promised payment on the risky debt. A simple interpretation of this relationship is that risky debt should always have equal or less value than a risk free debt with the same terms since the value of the put option cannot be negative.

We now turn to our valuation formula (15) which gives the difference in value of the opportunity if financed by foreign debt instead of domestic debt. (15) can be rewritten as

(21)
$$\delta V_0 = \left\{ \frac{e_0 D^*}{r^*} - \int D^* e_T(s)\varphi(s)\, d\mu \right\} -$$

$$\left\{ e_0 \int_{A'} (D^* - X^*(s))\varphi^*(s) d\mu - \int_{A'} (D^* e_T(s) - X^*(s) e_T(s))\varphi(s) d\mu \right\}$$

In the first bracket, we clearly have the difference in value of the risk free bond in foreign versus domestic market. As we discussed before, if IRP holds for the domestic investors, this difference is zero. Thus, the firm will issue foreign debt only if the difference in the second bracket is negative. We now turn to examine those two terms of the second bracket. Recall that A' is the set of states where $X^*(s)<D^*$, the states in which default occurs. And also note that $D^*-X^*(s)$ is the pay off at maturity to a put option written on the opportunity with a strike price equal to the promised debt payment. Hence, the first term of the brackets is the value of this put option due to default in the foreign market converted into domestic currency, e_0P^*. The second term, on the other hand, is the value of the same put option if purchased in the domestic market, P. Note that in the valuation of P, the underlying asset is the domestic currency equivalent of the value of the foreign opportunity at maturity, T. However, the strike price is no longer a constant for the domestic investor but is equal to $D^*e_T(s)$. Thus, domestic valuation of this put option has a strike price that is state contingent.

Evidently, the firm will issue foreign debt if $e_0P^*<P$. This implies that for the same default risk, different values are assessed in the two markets. This is of no concern to us, since under our assumption of segmented international markets, the market price of risk has to be different as discussed in Chapter II. What is important to us is that the firm can augment value by issuing risky debt in a foreign market. The above analysis shows that if the value of the default option is less in the foreign market to finance the foreign opportunity, risky foreign debt should be issued instead of risky domestic debt. The firm will lose less value due to possibility of default in the foreign market compared to the domestic market.

To analyze Eurobonds in terms of the default option, we rewrite (19) as

$$(22)\qquad \delta\hat{V}_0 = \{e_0\int De_T^{-1}(s)\varphi^*(s)\, d\mu - \frac{D}{r}\} -$$

$$\{e_o\int_{B'}(De_T^{-1}(s)-X^*(s))\varphi^*(s)d\mu-\int_{B'}(D-X^*(s)e_T(s))\varphi(s)d\mu\}$$

Again, if we assume IRP, The first term in brackets will disappear. In the second bracket, we observe a close similarity to the default option on a foreign bond. The firm will issue Eurobonds if the default option in the foreign market has less value. However, there will be quantitative differences due to the fact that B' is not equivalent to A'. Another difference in valuation of the default option in foreign bonds and Eurobonds will be based on the strike price. In the former case, we have shown that the strike price is state contingent for the domestic investor, the reason being that the debt was denominated in foreign currency. The opposite is true for Eurobonds. Since they are denominated in domestic currency, the strike price is state contingent for the foreign investors. Since valuations in two markets are different, this will be another source of quantitative differences in value of the default option.

Numerical Example

The derivation of the optimal level of international debt and the comparative statics of the "difference in value" functions in (16) and (20) are analytically intractable[26]. Instead we present a brief and simplified example that will illustrate the existence of an interior optimum. Our example will refer to the "difference in value" function in the case of issuing foreign bonds as represented in (16). Similar examples can be worked out for Eurobonds.

The data relating to market conditions and used in the example is contained in Table III.1. The data are arranged so that, initially, IRP holds.

TABLE III.1

DATA

States	$\phi(s)$	$\phi^*(s)$	$e_T(s)$	χ	χ'
1	.15	.16	.6	−.010	+.009
2	.28	.30	.4	+.038	+.039
3	.25	.26	.5	+.005	+.006
4	.09	.09	.7	−.018	−.017
5	.12	.13	.67	−.015	−.014
	Σ=.89	Σ=.94		Σ=0	Σ=.0047

$r = 1.124$
$r^* = 1.064$
$e_0 = .5$ (domestic/foreign)
$e_0' = .505$

$\chi = (e_0\phi^*(s) - e_T(s)\phi(s))$
$\chi' = (e_0'\phi^*(s) - e_T(s)\phi(s))$

[26]Without further assumptions, we don't know if a closed form solution for the optimum in (16) and (20) exists. For a special case, where investors are risk neutral and exchange rate variations are the only source of uncertainty, we were able to solve for the optimality condition for foreign debt.

Suppose there are two domestic firms, A and B, each with a foreign opportunity promising $X^*_A(s)$ and $X^*_B(s)$ respectively. Specifically,

States	$X^*_A(s)$	$X^*_B(s)$
1	247	150
2	155	200
3	100	250
4	279	100
5	195	300

Note that $X^*_A(s)$ and $X^*_B(s)$ are negatively correlated. For each firm, we will compute the "difference in value" function (16) in discrete form stated as

$$\text{(23)} \qquad \delta V_0 = D^* \left(\sum_{s=1}^{5} \left(e_0 \phi^*(s) - e_T(s)\phi(s) \right) \right) +$$

$$\sum_{A'} (X^*(s) - D^*)(e_0 \phi^*(s) - e_T(s)\phi(s))$$

Evidently, when IRP holds, the first term in (23) is always zero. Thus, δV_0 is identical to the value of the second term. In the computation of δV_0, we let D^* equal the discrete cash flows of the firm. The resulting values for firms A and B are presented in Table III.2 below. The δV_0 values for firm A are monotonically decreasing. Therefore, firm A should issue domestic debt. However, firm B is a different case. Issuing risky foreign debt will create value for firm B. Furthermore, there is an interior optimum debt level.

Now, consider a deviation from IRP. Suppose $e_0' = .505$. The impact of this deviation on market conditions can be seen in the last column of Table III.1. The resulting values for (23) are presented in Table III.2 under the heading $\delta V_0'$. It is interesting to note that now it becomes optimal for Firm A to issue default–free foreign debt. However, it is still not desirable to issue risky debt. The interior optimum of Firm B is robust in the face of this deviation.

TABLE III.2

VALUATION EQUATION (20)
FOR TWO HYPOTHETICAL FIRMS A AND B

FIRM A			FIRM B		
D^*	δV_0	$\delta V_0'$	D^*	δV_0	V_0'
0.0	0.00	0.00	0.0	0.00	0.00
100	0.00	**+0.47**	100	0.00	+0.47
155	–0.28	+0.04	150	+0.90	+1.58
195	–1.99	–1.26	200	**+2.30**	**+3.16**
247	–3.45	–2.65	250	+1.80	+2.75
279	–4.02	–3.22	300	+1.05	+2.04

Conclusion

The analysis shows that international debt financing is not irrelevant if national capital markets are segmented. In segmented markets, issuance of foreign debt contracts, under certain market conditions may create value. The value created depends upon the relationship between the future exchange rates, state price measures and cash flows of the firm. If the firms can issue default–free debt, in our framework, favorable deviations from IRP can be the only source of value gains. When such a favorable condition is discovered, firms will want to exploit it as much as possible. At this point default risk gains in importance. The possibility of default will limit the number of states where a certain advantage will persist. Thus, the amount of contracting will be crucial to maximization of the value gain from the opportunity. The essential mechanism leading to interior optimal contract amounts is the trade–off between the foreign exchange/state price measure relationship and default risk.

These conclusions, within our simple framework, seem robust. Within the same framework, our analysis can easily be extended to include other market imperfections such as taxes, transaction costs, agency costs and bankruptcy costs which influence firm's capital structure choice. The firm's optimal capital structure will ultimately depend on the interactions of all these imperfections. Thus, our optimal amount of contracting based on the particular imperfection chosen is just a step towards the determination of optimal international capital structure of a firm. These benefits and costs of debt financing must be considered along with default risk to obtain the firm's optimal international financing mix. Some of the above imperfections will enhance the value gain argument of our paper, but others might be countervailing. Thus, our paper is just a first step in the formulation of firm's international debt financing policy.

Other interesting issues for further research within our framework will be to analyze the impact of fluctuations in inflation on asset valuation. Doing so, we will introduce a new source of uncertainty and capture its interaction with the other random variables of our model. Last, but not least, other financial policies of the firm such as hedging, mergers and joint ventures will be fruitful areas for further research within our framework.

CHAPTER IV

VALUATION OF CURRENCY SWAP CONTRACT

Our analysis of the conventional debt contract in segmented international markets has revealed interesting results. One wonders if the same market representation will explain the existence of an innovative financial product, the swap contract. Thus, in the present chapter, we modify our basic model to accomodate the features of currency swaps, again using the definitions and notation of Chapter II. In particular, we will look into the valuation of foreign opportunities when they are financed by currency swaps.

The principal areas of inquiry here are: (1)the conditions under which the exchange among the two counterparties will have a zero–sum outcome; (2)whether financial arbitrage as described in Chapter II will enhance shareholder value in swap financing, as well.

The next section of this chapter introduces and models the currency swap and derives conditions for a zero–sum outcome. The following two sections discuss riskless and risky swaps as financing instruments in segmented international capital markets. A brief section on the default option of a swap contract follows. Finally, we present a numerical example and give further discussions of the solutions of our model and conclude the chapter.

Currency Swaps in Integrated International Capital Markets

Innovative attempts to appropriate economic benefits from segmentation in international financial markets have led to a variety of new and specialized swap contracts. As these negotiated, non–standard contracts evolved over the last decade, they have taken on different features. They are variously called foreign–exchange swaps, back–to–back or parallel loans, exchange of borrowings, currency swaps, credit swaps, etc.

In our study, we will analyze the basic structure common to these contracts and call that generic form a "currency swap". Under this arrangement, there will be a transfer of different currencies between two parties at $t = o$, and reversal of the cash flows at $t = T$,[27] at the same rate of exchange which is negotiated in advance at $t = o$. This contract can be viewed as a simultaneous borrowing and lending decision bypassing the spot and forward exchange markets.[28] In this way, the parties don't use the capital and currency markets, but engage in a contract between themselves for their financing needs.

Since these contracts are non–standard and specialized, bankruptcy enforcement is not clear to market observers. Disputes between counterparties have so far been settled in secret, not in court, and their number has been few.[29] However, as will be further discussed in Chapter V, the legal document of a swap agreement is designed such that failure to pay any obligation at its discretion does not favor the defaulting party. This is true, at least, for the current exchange of payments.[30] The defaulting party is still liable for the current payment and for a compensation amount based on the future loss of the other party. The implications of this practice for our one period model is that it is reasonable to assume no incentive for

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[27]As we explained in the Introduction, a swap contract includes a multiperiod exchange of payment streams. The exchange of payments at each due payment date can be viewed as a forward contract since the payments are obligatory. For this reason, Smith et al. (1986) has viewed the swap agreement as a portfolio of forward contracts. In our model, T may stand for any one of the scheduled payment dates in the future.

[28]This structure is tantamount to a practice where counterparties agree to exchange their fixed rate obligations in two different currencies at scheduled due dates. The simplifications in the structure presented is that these fixed rates are zero for both parties. Thus, there is an exchange of principals at the two designated dates, $t=o,T$.

[29]See Christopher Stoakes, "How to Terminate a Swap?," **Euromoney**, April 1985.

[30]This issue will be clear in our discussion of the provisions of the legal document of a swap agreement concerning Events of Default in the next chapter.

any party to default at its discretion. However, as we mentioned above, in the case of insolvency the bankruptcy enforcement of a swap contract is still very fuzzy. For that reason, we will assume a simple resolution in case of default based on insolvency. If one party does not perform its obligation, the contract is void. Each party ends with its own cash flow.

In this agreement, each party must make a simultaneous borrow and lend decision where the amount borrowed by one equals the amount lent by the other. We let D and D^* be the swapped amounts in domestic currency and foreign currency respectively, i.e. the amounts exchanged at t=o. These are also the amounts promised to be exchanged back at t=T for certain. The decision on D and D^* will result in an exchange rate $e_0^* = D/D^*$ which may be different from the spot exchange rate, e_0. This will be the effective forward rate at t=T.

First, we look at the swap agreement from the perspective of the domestic firm.[31] At present, the cost of the opportunity in the foreign market is known and denoted as I^*. The firm has slack in domestic currency, S. The source of the slack is not designated but we assume that the amount of slack owned by the firm will allow it to undertake the opportunity. We allow for the possibility that proceeds from issuing domestic securities can be the source of the slack. In that case, we claim that the firm will engage in a swap contract to finance the opportunity only if the contract allows the firm to create value above that of using its own slack and current spot exchange markets.

Furthermore, without loss of generality, we assume that there is only one group of claimants for each firm in their respective domestic capital markets; namely the stockholders. This assumption is made solely to simplify the analysis. Introduction of other domestic claimants will have no consequence on the results of

[31]In this chapter, we refer to firms with symmetrical opportunities as mentioned in the scenario developed in the beginning of Chapter II.

the analysis in this study. As we have shown in our earlier analysis, issuing domestic claims is irrelevant to valuation.

Equipped with the above definitions and notation, we now construct a simple model to value the foreign opportunity when the domestic firm uses its slack to finance it. This will be a benchmark case to compare the value of the same opportunity had it been financed by a currency swap arrangement.

If the domestic firm with the foreign opportunity uses slack, it has to convert it to foreign currency at e_o^{-1}. At t=T, its stockholders will claim the total cash flow in foreign currency of the opportunity but will have to convert it to domestic currency at $e_T(s)$. Thus, returns to equity, $R_E(s)$, will be the product of $X^*(s)$ and $e_T(s)$ and will be valued using state price measures in the domestic market, $\phi(s)$.

The value of the opportunity using slack can be shown as

(1) $$V = (S - e_o I^*) + \int R_E(s)\varphi(s)\, d\mu$$

or

(2) $$V = (S - e_o I^*) + \int X^*(s) e_T(s)\varphi(s)\, d\mu$$

In this valuation, segmented markets play no role. The reason is that only one group of investors claims the cash flows and values them at present. As we will see later, this will not be the case when the firm engages in a currency swap to finance the opportunity.

In brief, we view the currency swap contract as the domestic firm borrowing D^* from and lending D to the foreign firm at t=o. At t=T, these amounts are promised to be reversed. If any or both parties default, the contract is breached.

At t=o, the domestic firm will end with a cash position $S - D - e_o(I^* - D^*)$. At t=T, pay offs to domestic stockholders will be based upon the effectiveness of the contract. So the event space Ω will be divided into two subsets, one being the set of states, $s \epsilon \Omega$, where the contract is effective. We call this subset B. Then, $B = \{ s : X^*(s) \geq D^* \text{ and } X(s) \geq D \}$. $B' = \Omega - B$ will be the set of states, $s \epsilon \Omega$, where the contract is void. Therefore, for $s \epsilon B$, returns to domestic stockholders will be $(X^*(s) - D^*)e_T(s) + D$ and for $s \epsilon B'$, they will be $X^*(s)e_T(s)$.

Thus, the value of the foreign opportunity to the domestic firm under this arrangement will be

$$(3) \qquad \hat{V} = (S - e_0 I^*) + (e_0 D^* - D) + \int_{B'} X^*(s) e_T(s) \varphi(s)\, d\mu$$

$$+ \int_{B} ((X^*(s) - D^*) e_T(s) + D) \varphi(s)\, d\mu$$

Equivalently,

$$(4) \qquad \hat{V} = (S - e_0 I^*) + (e_0 D^* - D) + \int X^*(s) e_T(s) \varphi(s)\, d\mu$$

$$+ \int_{B} (D - D^* e_T(s)) \varphi(s)\, d\mu$$

We now compute the difference in value of the opportunity under the alternative ways of financing. Denote $\delta V = \hat{V} - V$ as the difference in value due to using a currency swap instead of slack to finance the foreign opportunity. Thus,

$$(5) \qquad \delta V = (D^* e_0 - D) + \int_{B} (D - D^* e_T(s)) \varphi(s)\, d\mu$$

Recalling that $D = D^* e_0^*$, the above valuation formula can be rewritten as

(6) $$\delta V = D^*\{(e_o - e_o^*) + \int_B (e_o^* - e_T(s))\varphi(s)\, d\mu\}$$

(6) can be equivalently expressed as

(7) $$\delta V = D^*\{(e_o - e_o^*) + \int (e_o^* - e_T(s))\varphi(s) d\mu + \int_{B'} (e_T(s) - e_o^*)\varphi(s) d\mu$$

It is interesting to note that bringing in the integrated market condition (II.6) will not effect the term in brackets even if we temporarily assume $e_o^* = e_o$. Under the above assumption and recalling that $\frac{1}{r} = \int \varphi(s) d\mu$, (7) reduces to

(8) $$\delta V = D^*\{ (\frac{e_o}{r} - \frac{e_o}{r^*}) + e_o \int_{B'} \varphi^*(s) - \varphi(s)\, d\mu \}$$

Thus, swap financing looks relevant even in integrated capital markets.[32] But before stating any conclusions, we must analyze the problem from the counterparty's perspective.

Similarly (see (5)), the difference in value function of the foreign firm can be written as

(9) $$\delta V^* = (De_o^{-1} - D^*) + \int_B (D^* - De_T^{-1}(s))\varphi^*(s)\, d\mu$$

Recalling that $D^* = De_o^{*-1}$, (9) becomes

(10) $$\delta V^* = D\, \{(e_o^{-1} - e_o^{*-1}) + \int_B (e_o^{*-1} - e_T^{-1}(s))\varphi^*(s)\, d\mu$$

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[32]Note that in a domestic market in which there is a single risk free rate and a single set of state price measures, δV vanishes.

which can be expressed as

(11) $\delta V^{*}=D\{(e_{o}^{-1}-e_{o}^{*-1})+\int(e_{o}^{*-1}-e_{T}^{-1}(s))\varphi^{*}(s)d\mu+\int_{B'}(e_{T}^{-1}(s)-e_{o}^{*-1})\varphi^{*}(s)d\mu\}$

Note that δV is expressed in domestic currency units at t=o. We, therefore, convert δV^{*} into domestic currency at e_o to make the value comparisons. Thus, we let $\hat{\delta V}^{*} = e_o \delta V^{*}$ and rewrite (7) and (11) as (12) and (13) respectively

(12) $\delta V=D^{*}\{(e_{o}-e_{o}^{*})+e_{o}^{*}\int(1-\frac{e_{T}(s)}{e_{o}^{*}})\varphi(s)d\mu+e_{o}^{*}\int_{B'}(\frac{e_{T}(s)}{e_{o}^{*}}-1)\varphi(s)d\mu\}$

and using $D = D^{*}e_{o}^{*}$

(13) $\hat{\delta V}^{*}=D^{*}\{(e_{o}^{*}-e_{o})+e_{o}\int(1-\frac{e_{o}^{*}}{e_{T}(s)})\varphi^{*}(s)d\mu+e_{o}\int_{B'}(\frac{e_{o}^{*}}{e_{T}(s)}-1)\varphi^{*}(s)d\mu\}$

Now, we can use the strong condition derived in Chapter II about integrated capital markets, condition (II.4), and rewrite (13) as

(14) $\hat{\delta V}^{*}=D^{*}\{(e_{o}^{*}-e_{o})+\int(\frac{e_{T}(s)}{e_{o}^{*}}-1)\varphi(s)d\mu+e_{o}^{*}\int_{B'}(1-\frac{e_{T}(s)}{e_{o}^{*}})\varphi(s)d\mu\}$

Since (12) and (14) are exactly offsetting, any negotiated e_{o}^{*} (including $e_{o}^{*} = e_{o}$) will end in a zero sum outcome. Thus, in a complete and perfectly integrated international capital market, the benefit of one party will come at the expense of the other. Therefore, there will be no agreement to swap. Another way of looking at this is to add the δV and $\hat{\delta V}^{*}$ functions, to arrive at a total difference in value function for the swap, $T\delta V$. It can easily be seen that $T\delta V$ is identically equal to zero in this case.

However, once we assume that the international capital markets are segmented and (14) is not a valid expression, a different result obtains. Thus, we analyze (12) and (13) in light of the fact that condition (II.4) is not likely to occur.

Riskless Swaps

Let us first consider a default free swap. If the swap is effective in all states of the world, then $B' = \phi$. For the moment, assume that the investors in both markets can freely trade the risk free asset, and there is a forward market for the two currencies to which all traders have equal access. Under these conditions, we discussed in Chapter II that both (II.7) and (II.10) hold simultaneously. Using these relations, δV and $\hat{\delta} V^*$, (12) and (13), can be written as

(15a) $$\delta V = D^* \{ (e_0 - e_0^*) + (\frac{e_0^*}{r} - \frac{e_0}{r^*}) \}$$

(15b) $$\hat{\delta} V^* = D^* \{ (e_0^* - e_0) + (\frac{e_0}{r^*} - \frac{e_0^*}{r}) \}$$

Comparing these expressions reveals that the default free swap at any negotiated e_0^* has a zero sum outcome, in a world in which IRP holds both ways. In such a world, one expects e_0^* to equal e_f, the market equilibrium interest parity forward rate. This zero outcome result is trivially true in the market described above. However, as we discussed in Chapter II, we believe that the above representation is not, in general, valid for international capital and currency markets. Furthermore, empirical studies have shown that the actual forward rate deviates from the interest rate parity forward rate, and these deviations cannot be explained by transactions costs totally.[33] In light of these observations, we contend that (15a) and (15b) are not valid, and e_0^* does not necessarily equal the interest rate parity forward rate, e_f.[34] This is possible since the parties involved in a swap agreement can negotiate the forward exchange rate applicable to the agreement, fashioning a tailor–made contract. Furthermore, we have shown in Chapter II that if one set of investors is unrestricted to trade the risk free assets (for example domestic investors), then (II.7) holds. Consequently, (15.a) will be a valid expression. However, as (II.7) does not imply (II.10) in this case, (15.b) is still not valid. Moreover, in most instances, the swap contract covers maturities for which forward currency markets do not exist. In those cases, there is no trading in the forward markets that could guarantee $e_f = \frac{e_0 r}{r^*}$. With all these considerations, δV and $\hat{\delta}V^*$ in (15a) and (15b) may not equal zero even if the swap contract is default free. Therefore, we choose to analyze the default free swap case using equations (12) and (13) instead of (15a) and (15b). (12) and (13) for a default free case can be rewritten as

$$\delta V = D^*\{(e_0 - e_0^*) + e_0^* \int (1 - \frac{e_T(s)}{e_0^*}) \varphi(s)\, d\mu\} \tag{16}$$

$$\hat{\delta}V^* = D^*\{(e_0^* - e_0) + e_0 \int (1 - \frac{e_0^*}{e_T(s)}) \varphi^*(s)\, d\mu\} \tag{17}$$

which are general expressions for (15a) and (15b).

If we add (16) and (17) together we obtain

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[33]See Deardorff(1979) and Bahmani–Oskoee and Das(1985).

[34]e_0^* , chosen in this case, might be the actual forward rate observed in the market. Since we have yet no specification of a market forward rate other than e_f , we are unable to make any references at this point.

$$(18) \qquad T\delta V = D^* \int \left(1 - \frac{e_o^*}{e_T(s)}\right)(e_o \varphi^*(s) - e_T(s)\varphi(s)\; d\mu$$

As can easily be seen from (18), assuming the validity of (II.12) alone will not assure a zero sum outcome. Therefore, even if we assume that domestic investors are not restricted from trading the risk free assets in both markets, to analyze the gains from a default free swap, one should investigate (16), (17) and (18). We contend that in a market in which there are restrictions on trading the risk free assets, and/or on shortselling and not all traders have access to the forward market, it will be worthwhile for swap counterparties to search for an exchange rate e_o^* different from e_f such that (16), (17) and (18) are the most positive.

We should first note that in these expressions, there is nothing firm specific. The search for the optimal e_o^* will depend on market conditions alone; specifically, state price measures in the two countries, and spot and future exchange rates. The e_o^* chosen will be the optimal swap exchange rate for all counterparties engaged in default free currency swaps in these two markets. Once the optimal e_o^* is known to the swap counterparties, they will want to swap as much as possible at this rate, but will be limited by the supply of funds that are default free. Thus, in a default free swap, e_o^* is the only decision variable for the market participants.

Examining expressions (16) and (17), we see that the domestic firm will want to set e_o^* as high as possible, whereas the foreign firm will desire the lowest possible e_o^*. As a matter of fact, the benefits of a higher e_o^* for the domestic firm will be at the expense of the foreign firm. Thus, they should look for an optimal e_o^* that maximizes their benefits jointly. To this end, we can examine the function, $T\delta V$, and see the conditions that will make it the most positive.

(18) can be rewritten as

(19) $$T\delta V = D^* \int e_o^*(1 - \frac{e_T(s)}{e_o^*})\varphi(s) + e_o(1 - \frac{e_o^*}{e_T(s)})\varphi^*(s)\, d\mu$$

Looking at (19), it becomes clear that the states in which $(1 - \frac{e_o^*}{e_T(s)})$ are positive and favorable for the foreign firm will be the states unfavorable to the counterparty, the domestic firm. In other words, $(1 - \frac{e_o^*}{e_T(s)}) > 0$ implies that $e_o^* < e_T(s)$. In a state in which this is true $(1 - \frac{e_T(s)}{e_o^*})$ will be negative, thus unfavorable to the domestic firm. Furthermore, although $(1 - \frac{e_o^*}{e_T(s)})$ and $(1 - \frac{e_T(s)}{e_o^*})$ will necessarily have opposite signs, they will not be of the same magnitudes. Nevertheless, we can argue that given any e_o^*, Ω can be divided into two subsets E and E' such that $E+E'=\Omega$. $(s \epsilon E)$ will be those states that are favorable to the domestic but unfavorable to the foreign firm. This implies that E' will include the states in which e_o^* is favorable to the foreign but not favorable to the domestic firm. Since state price measures are different for the two counterparties, they might be inversely related. In that case, if domestic state price measures, $\phi(s)$ are high in E compared to E', the overall gain of the domestic firm might be positive. For the counterparty to gain as well, there should be high state price measures in E', where exchange rates are favorable to it. Another way of looking at this argument is by analyzing (18) where the total gain to both parties is expressed together. In this way $T\delta V$ is expressed as a weighted sum of market conditions $(e_o\varphi^*(s) - e_T(s)\varphi(s))$ and $(1 - \frac{e_o^*}{e_T(s)})$ terms. As we discussed above, any e_o^* will subdivide Ω into favorable and unfavorable states. For $T\delta V$ to be most positive, e_o^* should be chosen such that favorable market conditions and favorable $(1 - \frac{e_o^*}{e_T(s)})$ terms are positively correlated.

Looking into (19) again, we can see that one solution will be where the individual gains are both the most positive. However, it is also possible that they can choose e_0^* as to maximize (18) regardless of relative shares in the total gain. This solution may turn out to be better than the previous one in terms of total gain, but might result in one of the parties being worse off. For the latter solution to be feasible, the counterparties should work out sharing rules for the total gain such that both are at least as well off as in the former solution. This would imply a transfer of funds from the party that is better off to the counterparty. The transfer can take place at present if there is an initial exchange of the swapped amounts. The initial exchange rate can be different from the swap exchange rate and favor the party who is worse off. Another way to transfer funds is that the party that is better off promises to pay the other party a fee (at t=T), whose present value compensates for the present loss of that party.[35] Whichever the solution, the key to a positive toal gain in a default free swap agreement is the inverse relationship between state price measures in the two markets.

Risky Swaps

In a default free swap, it is clear that whenever the terms in the brackets of (18) and (19) turn out to be the most positive, the swap partners will want to increase the contract amounts as much as possible. At this point default risk gains in importance. In this section we will analyze swaps with default and argue that the option not to reverse the deal in some states at T is an independent source of value.

We investigate the implications of default in a swap contract by examining (12) and (13) which are represented below as (20) and (21) under the assumption

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[35]Beidleman(1986) briefly points out to the market practice where one of the parties pays to the other party a fee that is negotiable to compensate for the expected changes in exchange rates.

that there is no initial exchange.

(20) $$\delta V = D^* e_0^* \{ \int (1 - \frac{e_T(s)}{e_0^*}) \varphi(s) d\mu + \int_{B'} (\frac{e_T(s)}{e_0^*} - 1) \varphi(s) d\mu \}$$

(21) $$\hat{\delta} V^* = D^* e_0 \{ \int (1 - \frac{e_0^*}{e_T(s)}) \varphi^*(s) d\mu + \int_{B'} (\frac{e_0^*}{e_T(s)} - 1) \varphi^*(s) d\mu \}$$

Similar to the default free swap case, we compute the function for total gains, $T\delta V$, by adding (20) and (21) together to obtain

(22) $$T\delta V = D^* \{ \int (1 - \frac{e_0^*}{e_T(s)}) (e_0 \varphi^*(s) - e_T(s) \varphi(s)) d\mu + \int_{B'} (\frac{e_0^*}{e_T(s)} - 1) (e_0 \varphi^*(s) - e_T(s) \varphi(s)) d\mu \}$$

Examining (20), (21) and (22) reveals that in a swap with default, there is a pair of decision variables for the firms, namely (D^*, e_0^*). (D^* becomes a decision variable since the set B' is dependent on the choice of D^* level.) Here, there are two different optimization criteria. One criterion is where the firms act independently and search for the optimum (D^*, e_0^*) pairs that will make the terms inside the brackets of (20) and (21) the most positive. Inspection of these valuation equations will show that the optimal pairs will differ for each party. Hence, under this criterion, the swap contract will not be feasible unless there is an intermediary.[36]

The alternative criterion is where the counterparties optimize jointly. As discussed with a default free swap, joint optimization implies a search for a single pair (D^*, e_0^*), and a common set B' in this case, where $T\delta V$ is maximized. The

[36]Discussion of the intermediation function appears in the next chapter.

solution is attained by maximizing (22), in which case, the total gain, regardless of individual shares, is maximized. If there is no possibility for sharing the total gain among the counterparties, the solution can be constrained as to guarantee that both δV and δV^* are positive. We will discuss more about these solutions and criteria later in this chapter. Here, we choose to emphasize the implications of the default option on the value of a currency swap contract.

First, we notice that B' (as well as D^* and e_0^*) is dependent on the cash flows of the two firms, by recalling that $B' = \{ s : X(s)<D^*e_0^* \text{ and } X^*(s)<D^* \}$. Also note that in B', the two firms end up with their own cash flows. In any given state, if there is a gain or loss to one party, that gain or loss will be reversed if the contract is void due to default in that particular state. This becomes apparent upon examining the terms in (20) and (21).

Looking at (20), one can see that for $s \epsilon B'$, what is positive in the first term is negative in the second. This observation suggests that if B' is constrained to those states where the firm would naturally lose, default might not be bad. In other words, if the swap contract is set such that it is effective in every state of the world, there will be states, $s \epsilon \Omega$, where $(1 - \frac{e_0^*}{e_T(s)}) > 0$. But in other states, it will be negative. If B' turns out to be the subset where $(1 - \frac{e_0^*}{e_T(s)}) > 0$, the firm loses that gain in the second term of the brackets. On the other hand, if B' is designed such that in those states $s \epsilon B'$, the firm would have lost in the swap arrangement, default becomes desirable.[37] The reason is simply the fact that by avoiding the loss, the firm will augment value.

Similar arguments can be made from the perspective of the counterparty by

[37]This is contrary to the commonly observed market practice where participants try to avoid default by engaging in swaps with counterparties that have high credit ratings.

examining (13). We can once again state (as we did in the riskless swaps) that, in states $s \in B'$, whenever one party gains, the other loses, but the gains and losses are of different magnitudes. This means that a swap contract is not a zero sum outcome.

The two firms should now search independently or jointly for a set B' where the value gains are maximized. The optimal amounts of swapping will depend on the interactions of firms' cash flows, thus on default, and market conditions. Favorable or unfavorable market conditions are based upon exchange rate outcomes and the contract rate, e_0^*. However, B' is strictly related to firm specific variables, the state contingent cash flows and how they relate to state contingent market conditions. It is our contention that the firm should devise ways to change the pattern of their cash flows such that B' contains most of the unfavorable states.

Default on a Currency Swap Contract As a Put Option

The default features of currency swaps are highly suggestive of an option contract. To analyze the option–like properties of a swap contract, we rewrite (20) and (21) as

$$(23) \qquad \delta V = D^*\{\int (e_0^* - e_T(s))\varphi(s)d\mu - \int_{B'} (e_0^* - e_T(s))\varphi(s)d\mu\}$$

$$(24) \qquad \delta V^* = D\{\int (\frac{1}{e_0^*} - \frac{1}{e_T(s)})\varphi^*(s)d\mu - \int_{B'} (\frac{1}{e_0^*} - \frac{1}{e_T(s)})\varphi^*(s)d\mu\}$$

Note that for each firm the values of default free swap contracts (the first terms in the brackets of (23) and (24)) are identical to those of forward contracts, with no possibility of default in their respective currencies. This is no surprise since we modelled the swap agreement after a forward contract. What is of interest, however, is the second term within the brackets of (23) and (24). The emergence of the second term is obviously due to the possibility of default of the counterparties.

Recall that the pay offs to a put option written on domestic currency can be expressed as max $[0, (e_0^* - e_T(s))]$, where e_0^* is the exercise price. Specifically, the pay offs to this put option are positive in those states in which $e_0^* > e_T(s)$, and are equal to $(e_0^* - e_T(s))$. These pay offs are identical to the terms we see in the second term of (23). Had B' been equal to $\{ s : e_0^* > e_T(s) \}$, those states that are unfavorable to the domestic firm, the value of the default option, as expressed in the second term, would have been identical to a put option on domestic currency. However, this is not the case and $B' = \{ s : X^*(s) < D^* \text{ and } X(s) < D^* e_0^* \}$. Evidently, B' is dependent on nonperformance of the counterparties based on their cash flows rather than on the relationship between e_0^* and $e_T(s)$. In particular, B' is a collection of states where $e_0^* \gtrless e_T(s)$. Thus, we can interpret this default term as a "hybrid" put option where the pay offs are identical to that of a put on domestic currency, but effective in those states of nature in which the counterparties default. The states in which the positive pay offs are realized are more reminiscent of a put option interpretation of risky debt in Chapter III, with the addition of two–way default of a swap contract.

Thus the value gain of a domestic firm due to swap financing can be expressed as the value of a forward contract on domestic currency with no default minus the above "hybrid" currency put option. Exactly the same argument can be made for the foreign firm in foreign currency units.

Numerical Example

Now we present numerical examples to illustrate some of the points made in the previous sections. By assigning plausible values to the market parameters concerning the δV and $\hat{\delta V}^*$ functions, we show how swap partners can increase shareholder wealth in segmented national capital markets. We do not explore the case of integrated markets, since the swap agreement has a zero sum outcome in such a world.

The formulae to be used in computations are discrete versions of equations (12) and (13). They are

$$\delta V = D^*[(e_o - e_o^*) + e_o^* \Sigma (1 - \frac{e_T(s)}{e_o^*}) \phi(s) + e_o^* \Sigma_{B'} (\frac{e_T(s)}{e_o^*} - 1) \phi(s)] \tag{25}$$

and

$$\hat{\delta V}^* = D^*[(e_o^* - e_o) + e_o \Sigma (1 - \frac{e_o^*}{e_T(s)}) \phi^*(s) + e_o \Sigma_{B'} (\frac{e_o^*}{e_T(s)} - 1) \phi^*(s)] \tag{26}$$

Similarly, the function $T\delta V$, expressed in (22) can be rewritten in discrete form as

$$T\delta V = D^*[\Sigma (1 - \frac{e_o^*}{e_T(s)})(e_o \phi^*(s) - e_T(s)\phi(s)) + \Sigma_{B'} (\frac{e_o^*}{e_T(s)} - 1)(e_o \phi^*(s) - e_T(s)\phi(s))] \tag{27}$$

We note that if the swap is default free, $B' = \phi$, then the last term in each of the above formulae is zero.. Thus, a default free swap is a special case where the partners do not consider the states in which the contract is void.

We carry the computations using data based on two different regimes. Under Regime I, the state price measures of the two economies are positively correlated. Regime II is distinguished by the inverse correlation of the state price measures. The data for both regimes are found in Table IV.1.

We consider two pairs of firms. Pair A consists of two partners or counterparties to the swap agreement having positively correlated cash flows,

TABLE IV.1

DATA

States	Regime I* $\Phi(s)$	Regime I* $\Phi^*(s)$	Regime I* $e_T(s)$	Regime II $\Phi(s)$	Regime II $\Phi^*(s)$
1	.12	.13	.6	.12	.17
2	.25	.24	.4	.25	.08
3	.20	.18	.45	.20	.12
4	.08	.08	.65	.08	.24
5	.12	.12	.7	.12	.18
6	.18	.17	.372	.18	.13
	Σ=.95	Σ=.92		Σ=.95	Σ=.92

r = 1.053
r^* = 1.087
e_o = .5 (domestic/foreign)

* Given these market conditions IRP holds for domestic investors.

TABLE IV.2

FIRMS' CASH FLOWS

States	PAIR A X(s)	PAIR A X*(s)	PAIR B X(s)	PAIR B X*(s)
1	75	150	75	200
2	100	200	100	150
3	125	250	125	100
4	50	100	50	300
5	150	300	150	50
6	25	50	25	250

though in different currencies. As opposed to Pair A, the firms in Pair B are characterized by inversely correlated cash flows. The difference between the two pairs can be interpreted as a firm swapping with another in the same line of business versus swapping with another in different line. Table IV.2 contains the state contingent cash flows for Pairs A and B. Note that to control for the size effect, the sizes of the domestic and foreign opportunities are chosen to be almost identical.

In the computation of (25), (26) and (27) there are two decision variables controlled by the counterparties, namely the swapped amount in foreign currency D^* and the rate at which the exchange occurs, e_o^*. Note that D^* and e_o^* together determine D, the swapped amount in domestic currency. In our computations, we let D be the discrete cash flows of the domestic opportunity. For e_o^*, we try different values. For each value of e_o^* chosen, there is a series of D^* values corresponding to the D values described above, since $D=D^*e_o^*$. Cash flows presented in Table IV.2, with these D and D^* values, determine the breakdown of Ω into B and B'.

Initially we let $e_o^* = e_o = .5$, the current spot rate. This implies that there is no value gain or loss due to exchange of principals at t=o. Thus, we can concentrate on the impact of future state contingent variables on value. Results of computations for both pairs under the two regimes are presented in Table IV.3.

As discussed in the previous sections, the counterparties can either optimize independently depicted by the best outcomes in the δV and $\hat{\delta V}^*$ columns of Table IV.3, or

they can optimize jointly. Search for the best outcome of the $T\delta V$ column in Table IV.3 reveals the case for joint optimization. The values of δV, $\hat{\delta V}^*$ and $T\delta V$ for different cases of default are detailed in the same table. We first examine the default free case where $B' = \phi$. Under Regime I, where the state price measures are positively correlated, it is not possible for both parties to gain. Although the domestic firm can have positive δV, the overall gain seen in $T\delta V$ is always negative. This result rules out the possibility for the domestic party transferring value to the foreign counterparty so that both end up with positive value changes. On the contrary, when the state price measures are inversely correlated (Regime II) both parties to the swap agreement augment value, simultaneously depicted by positive values of δV, $\hat{\delta V}^*$ and $T\delta V$.

The more interesting issue is the possibility that the counterparties can do better by increasing the amounts swapped (the swap is no longer default free). Under this consideration, a number of cases emerge. In general, each party can obtain a better outcome at some higher level of swapping. This is intuitive, since, at some point, the default occurs in the unfavorable states to a particular party, thus releasing its burden. However, optimal amounts of swapping associated with the best outcomes of each party do not necessarily match. Thus, in our framework where there is no intermediation, their best alternative is to search for the maximum $T\delta V$ value. The overall positive gain can be shared making both parties better off. Under Regime I, there is no $T\delta V$ value which is positive. It seems, in our simple framework, when the state price measures are positively correlated, the swap never pays. However, in a world characterized by Regime II, the conclusion is quite the contrary. The swap outcome will always do better than a zero sum transaction. It appears that for both pairs, the optimal amount of swapping is 50 to 100. This is the case where default occurs in states 5 and 6. Inspection of calculations shows that these are the states where the high state price measures correspond to unfavorable states. Thus, by defaulting in those simultaneously unfavorable states, both parties are better off as compared to a default free swap. Thus, we say that default should not be avoided if the counterparties position themselves so that they default in states that are unfavorable to both.

Finally, we cannot say that the above conclusions change dramatically when the outcomes of Pair A are compared to those of Pair B. The difference is that the dispersion of outcomes is more compact for Pair B, since the inverse relationship in cash flows limits the states where both parties can serve their obligations.

Moving on in our analysis, we now investigate the impact of using rates of exchange, e_o^*, other than e_o in the swap arrangement. We point out that it will be more convenient to drop the initial exchange at t=o, since it will have no effect on $T\delta V$ values. Also, the values computed will be comparable to those in Table IV.3. We try two values for e_o^*. We initially let $e_o^* = .55$ and present the outcomes in Table IV.4. Similarly Table IV.5 contains the values based on computations in which $e_o^* = .45$.

The conclusions that can be drawn from the outcomes presented in Tables IV.4 and IV.5 will be summarized briefly. First, the values arrived at for δV and $\hat{\delta V}^*$ are more pronounced either way (positive and negative) due to exchanging at a rate different than e_o. Specifically, a higher rate, $e_o^* = .55$, results in higher positive value gains for the domestic firm at the expense of the foreign counterparty. Evidently the situation is reversed for the case where we allow e_o^* to equal .45. Second, comparing $T\delta V$ values in all three tables, we observe that under Regime I, the negative outcomes are still robust. Finally, it seems like the both parties will be better off by exchanging at a rate higher than the current spot rate, given the current market conditions and future exchange rates. This is suggested by the higher value (+5.47) that is achieved for the best outcome of $T\delta V$ when we let $e_o^* = .55$. Thus, it is reasonable for the counterparties to search for an optimal e_o^* in the range $e_o^* > e_o$. It should also be noted that the best outcome corresponds to a higher level of swapping (100 to 182) when we choose e_o^* to be .55 instead of the current spot rate of .5.

TABLE IV.3

VALUATION EQUATIONS (25), (26) AND (27)

UNDER THE ASSUMTION THAT

$$e_o = e_o{}^* = .5$$

PAIR A

			REGIME I			REGIME II		
D	D*	S∈B'	δV	δV*	TδV	δV	δV*	TδV
25	50	φ	+0.25	-1.60	-1.35	+0.25	+1.40	+1.65
50	100	6	-1.80	-0.30	-2.10	-1.80	+5.05	+3.25
75	150	4,6	-0.90	-1.80	-2.70	-0.90	+3.45	+2.55
100	200	1,4,6	+1.20	-4.60	-3.40	+1.20	+1.80	+3.00
125	250	1,2,4,6	-4.75	+1.75	-3.00	-4.75	+4.75	0.00
150	300	1,2,3,4,6	-7.20	+5.10	-2.10	-7.20	+7.65	+0.45

PAIR B

			REGIME I			REGIME II		
D	D*	S∈B'	δV	δV*	TδV	δV	δV*	TδV
25	50	φ	+0.25	-1.60	-1.35	+0.25	+1.40	+1.65
50	100	5,6	+0.60	-2.00	-1.40	+0.60	+2.50	+3.10
75	150	3,4,5,6	+1.95	-2.85	-0.90	+1.95	+0.60	+2.55
100	200	Ω	0.00	0.00	0.00	0.00	0.00	0.00
125	250	Ω	0.00	0.00	0.00	0.00	0.00	0.00
150	300	Ω	0.00	0.00	0.00	0.00	0.00	0.00

* The best outcome, if positive, in each column is underlined.

TABLE IV.4

VALUATION EQUATIONS (25), (26) AND (27)

UNDER THE ASSUMPTION THAT

$e_o \neq e_o^* = .55$

PAIR A

			REGIME I			REGIME II		
D	D*	S∈B'	δV	δV*	T δV	δV	δV*	T δV
25	45	φ	+2.25	-3.65	-1.10	+2.55	-0.65	+1.90
50	91	6	+2.25	-3.65	-1.44	+2.25	+1.50	+3.75
75	136	4,6	+4.49	-6.32	-1.83	+4.49	-0.27	+4.22
100	182	1,4,6	+7.11	-9.46	-2.35	+7.11	-1.64	+5.47
125	227	1,2,4,6	+0.37	-1.59	-1.22	+0.37	+1.34	+1.74
150	272	1,2,3,4,6	-4.94	+3.54	-1.40	-4.94	+5.30	+0.36

PAIR B

			REGIME I			REGIME II		
D	D*	S∈B'	δV	δV*	T δV	δV	δV*	T δV
25	45	φ	+2.25	-3.65	-1.10	+2.55	-0.65	+1.90
50	91	5,6	+3.90	-4.87	-0.97	+3.90	+0.27	+4.17
75	136	3,4,5,6	+4.26	-5.37	-1.11	+4.26	-0.27	+4.01
100	182	Ω	0.00	0.00	0.00	0.00	0.00	0.00
125	227	Ω	0.00	0.00	0.00	0.00	0.00	0.00
150	272	Ω	0.00	0.00	0.00	0.00	0.00	0.00

TABLE IV.5

VALUATION EQUATIONS (25), (26) AND (27)

UNDER THE ASSUMPTION THAT

$$e_o \neq e_o^* = .45$$

PAIR A

			REGIME I			REGIME II		
D	D*	$S \epsilon B'$	δV	δV^*	$T\delta V$	δV	δV^*	$T\delta V$
10	25	ϕ	-1.24	+0.44	-0.80	-1.24	+1.80	+0.56
25	56	6	-3.64	+1.99	-1.68	-3.67	+4.79	+1.12
50	111	4,6	-5.07	+2.55	-2.50	-5.07	+5.39	+0.32
75	167	1,4,6	-3.67	+1.09	-2.58	-3.67	+4.51	+0.84
100	222	1,2,4,6	-8.18	+4.77	-3.41	-8.18	+7.10	-1.08
125	277	1,2,3,4,6	-10.21	+5.96	-4.25	-10.21	+8.86	-1.35
150	333	Ω	0.00	0.00	0.00	0.00	0.00	0.00

PAIR B

			REGIME I			REGIME II		
D	D*	$S \epsilon B'$	δV	δV^*	$T\delta V$	δV	δV^*	$T\delta V$
10	25	ϕ	-1.24	+0.44	-0.80	-1.24	+1.80	+0.56
25	56	5	-0.71	-0.22	-0.93	-0.71	+2.24	+1.53
50	111	4,5,6	-0.98	+0.17	-0.81	-0.98	+1.83	+0.85
75	167	2,3,4,5,6	-3.95	+2.76	-1.19	-3.95	+3.59	-0.36
100	222	Ω	0.00	0.00	0.00	0.00	0.00	0.00
125	277	Ω	0.00	0.00	0.00	0.00	0.00	0.00
150	333	Ω	0.00	0.00	0.00	0.00	0.00	0.00

Conclusion

We summarize the major findings of this chapter as follows:

(1)If the international capital markets are complete and fully integrated, the currency swap contract has a zero sum outcome with no exceptions.

(2)On the contrary, if we believe in the segmented national markets paradigm, the swap arrangement **never** has a zero sum outcome.[38] Even the risk free swap can be transacted at some contractual exchange rate and between certain markets (those with inversely correlated state price measures) so that both parties augment their shareholder wealth.

(3)The option of default in a swap contract is an independent source of value. If the counterparties regulate their state contingent cash flow patterns as to limit the states in which default occurs to unfavorable ones, they will increase shareholder wealth beyond that of a default free swap.

Moreover, within the framework of market segmentation, we discussed optimal levels of swapped amounts (D^*,D) and the implied optimal exchange rate (e_0^*). The word "optimal" should be interpreted with caution, however. We were not able to demonstrate, either analytically or through numerical examples, that the "optimal" pair (D^*,e_0^*) exists. We pointed out directions in which the counterparties could do better as compared to others. Nevertheless, our basic analysis is a useful start at explaining financial arbitrage as a source of value added in a swap agreement.

The same type of analysis may also be used to explain pure interest rate swaps where the source of uncertainty is the volatility of interest rates instead of exchange rates. From this, we are one step away from explaining more complicated

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[38]Note that this statement excludes the trivial case in which trading the risk free asset is unrestricted for all traders with unlimited short–selling possibilities.

swap arrangements, such as a credit swap. A credit swap is simply a portfolio of a pure currency swap and a pure interest rate swap. The covariability of exchange rates and interest rates is surely the key to the explanation of this type of swaps.

Another issue, closely related to our discussions in the present study, is the swap–driven primary issuance. In the last couple of years, borrowers in the international bond market have combined the issuance of new debt with a currency swap. For example, a borrower can issue a fixed–rate bond denominated in New Zealend dollars and simultaneously swap it with an obligation to pay floating rate dollars. The volume of such transactions is said to have considerably increased in recent years.[39] This arrangement can be viewed as a combination of a foreign bond and a credit swap. Further analyses on these issues, we believe, will be quite promising.

[39]For further discussion see: John Lipsky, "Swap Driven Primary Issuance in the International Bond Market," Solomon Brothers Bond Market Research Publication, 1986.

CHAPTER V

COMMENTS ON INSTITUTIONAL ISSUES RAISED BY CURRENCY SWAP CONTRACTS

In this chapter, we discuss the institutional layout of the swap market and evaluate the commonly held views in the current literature on swaps, in light of the model developed in the present study. Observed institutional arrangements of swaps are discussed widely in non–academic and academic literature with little economic analysis. What we intend to do in this chapter is to survey the institutional issues, mostly pertaining to default risk, and give brief analyses of each based on the results of the previous chapter. We admit that none of these analyses fully reveals the issues under scrutiny. Nevertheless, we give our thoughts on each issue and suggest paths that can be taken in future research.

To facilitate the discussion, observed institutional features of the swap agreement are grouped into three categories: features concerning payment enforcement, concerning participants and concerning difference checks.

Our discussion of these features covers most[40] of the provisions stated in the standardized **Interest Rate and Currency Exchange Agreement** issued by ISDA, International Swap Dealers Association, Inc.[41] A good survey of the institutional details of the swap contract and the swap market is also found in Bank of

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[40]The only major provisions not covered here are the ones related to taxes.

[41]ISDA was formed in 1985 by representatives of an international group of investment, commercial and merchant banks active in interest rate and currency swaps. Its primary purpose is to promote practices conducive to an efficient swap market and to foster high standards of business and commercial conduct. Important ISDA initiatives have included the publication of standard formats of interest rate and currency swap agreements.

International Settlements' (BIS) publication titled **Recent Innovations in International Banking**, April 1986. It provides the regulators' view of the issues pertaining to the existence, evolution and future of the market. In this chapter, we rely heavily on that document.

The Currency Swap Agreement And Default

In modelling the ex–ante valuation of a firm that is engaged in a currency swap contract, payment enforcement procedures are of crucial importance. We have to know the implications on cash flows of the firm of the event of default. For that reason we now turn to the rules and regulations set forth concerning the event of default by the standardized **Interest Rate and Currency Exchange Agreement**, issued by ISDA.[42]

The agreement states that each party is obliged to make specified payments "not later than the due date, for value on that date, in freely transferable funds and in the manner customary for payments in the required currency. Each obligation of each party to pay any amount due is subject to the condition that no Event of Default or potential Event of Default with respect to the other party has occurred". The conditions, just stated, show that payments in a swap agreement are obligatory, and, in that way, it is like a forward contract. However, failure by one party to meet the obligations on payments on due dates releases the counterparty of its obligation. In our model of Chapter IV., we have interpreted this condition in a specific way. We have modelled default as the case where, if one party is insolvent, the other party does not make the obligatory payment. Subsequently, this results in each party being left with its own cash flow. In this section, we intend to

[42]ISDA represents a broadly based group of dealers in swaps. It claims that this Agreement is commonly used in actual practice.

substantiate our modelling of default by exploring the provisions of the swap agreement document concerning the Event of Default, and the subsequent payment enforcement.

In the Swap Agreement, the occurrence of the following constitutes an Event of Default:

1. Failure by one party to pay its payment obligation at the due date
2. Bankruptcy (i.e. insolvency, dissolution or liquidation of one of the parties)
3. Making of representations and warranties that are incorrect or misleading in any material aspect
4. Failure to perform covenants other than promises to pay
5. Merging of one party with another entity that fails to assume obligations of the swap agreement

The agreement may specify other circumstances in which the swap agreement may be terminated without either counterparty being in default.[43] Morever, as specified in the above stated Events of Default, non–payment by one of the counterparties (lines 1 and 2) is not the only reason for an Event of Default to occur. Misrepresentations on given information or on documents used as collateral, or the event of merger that does not respect the swap agreement, may, as well, serve as causes of default for any one party. Since we are not dealing with mergers, and we assume that there is no misrepresentation in terms of information on stated documents in this study, we will concentrate on the implications of the other two occurrences; failure of payment and bankruptcy.

As one can notice, there are two ways of stating non–payment as an Event of Default in the Agreement. One is simply a failure to pay other than the state of bankruptcy. This might be interpreted as a case where the defaulting party is solvent, but simply is not willing to pay . This will be a rational behavior if we

[43]This may be due to changes in tax law or any other law and regulation that makes the payments under the swap illegal or changes the terms of the payments.

bankruptcy. This might be interpreted as a case where the defaulting party is solvent, but simply is not willing to pay . This will be a rational behavior if we recall the breakdown of Ω into states that are favorable and unfavorable to each party. If the market realization of the exchange rate turns out to be unfavorable to one party, that party will have every incentive not to perform its obligation.

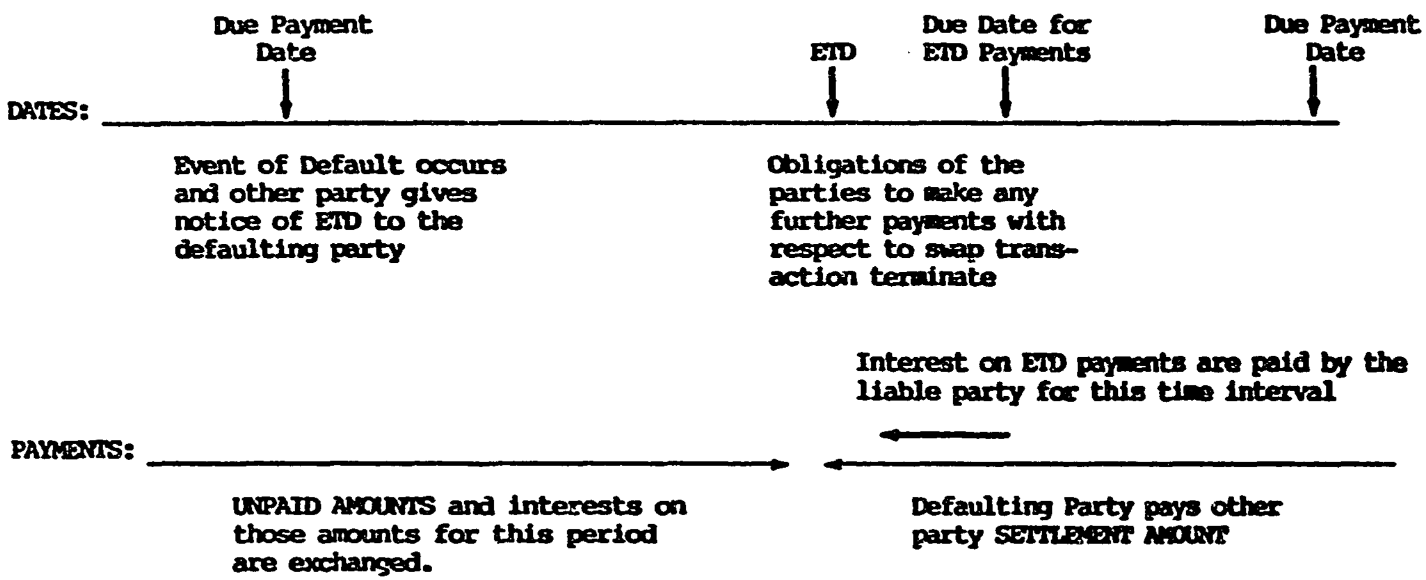
A second way of stating non–payment as an Event of Default is based on the insolvency of the defaulting party. If one or both of the parties are, or are about to become insolvent, this will constitute a true default state, and the Swap Agreement will necessarily terminate.

To investigate the enforceability of the obligatory payments of the Swap Agreement under these two types of Events of Default, we first look into Early Termination Date (ETD) procedures.

It is stated in the Agreement that if at any time an Event of Default with respect to a party has occurred, the other party may designate an ETD. If one party defaults on a due payment day (defaulting party), the other party gives notice of an ETD. However, upon the occurrence of "bankruptcy", ETD will immediately follow. On ETD, the obligations of both parties to make any further payments terminate. However, they have to settle the obligatory payments that were due on the last payment due date prior to ETD. Morever, the defaulting party has to compensate the other party for its future loss. The nature of these ETD payments can be explained by looking at Figure I. Whatever payments have accrued to whichever party after the calculations, that party pays the ETD payment on a designated due date with interest on the payment amount, for the period from ETD to the due payment date of ETD. As depicted in Figure I., there are two types of payments to be made on ETD. One has to do with the "Unpaid Amounts" on the

FIGURE I

ETD PAYMENT SCHEDULE OF A SWAP TRANSACTION



last due payment date at which the Event of Default occurs.[44] The second type of payment is called "Settlement Amount". It is determined by the party not at fault, and is paid by the defaulting party. Settlement Amount is based on the future obligatory payments of the swap trnsaction and is compensation for the non–defaulting party's future loss.[45] The amounts due on ETD by each party is calculated on the basis of current market quotations on the exchange and interest rates, made available by market makers. The final payment is specified as the difference between the sum of the Settlement Amount (SA) and Unpaid Amounts of the defaulting party (UA_D), and the Unpaid Amounts of the other party (UA_O). Thus, on ETD, the defaulting party is liable to pay $\{SA+UA_D-UA_O\}$, if positive. It is further stated in the Agreement that these amounts are "reasonable pre–estimates of loss and not a penalty. Such amounts are payable for the loss of bargain and the loss of protection against future risks".

Note that Settlement Amount assesses the loss of the other party at the rates of a replacement swap that would generate the same payment streams as the swap rate being terminated. It is basically the cost of re–establishing the swap's currency flows at current market rates which have made an adverse change from the point of view of the defaulting party.

In the event of default, our modelling of currency swaps ignores the

[44]Unpaid Amounts are defined in the agreement as "the aggregate of the amounts that became due and payable to such party in respect of all terminated transactions by reference to all periods ended on or prior to such ETD and which remain unpaid as at such ETD, together with interest thereon from the date such amounts became due and payable to such ETD."

[45]In the same Agreement, Settlement Amount is defined as "the sum of (a) the Termination Currency Equivalent of the market quotations for each terminated transaction for which a market quotation is determined; and (b) for each terminated transaction for which a market quotation is not, or can not be, determined the Termination Currency Equivalent of such party's loss". Termination Currency is specified in the agreement and market quotations are defined as "the amount that would have the effect of preserving for such party the economic equivalent of the payment obligations of the parties in respect of such terminated transactions that would, but fot the occurrence of the relevant ETD, fall due after such ETD".

Settlement Amount and its valuation since we are restricted to a single–period analysis. Although the significance of settlement amount in valuation of swap contracts is undisputable, we should admit that its impact can only be captured in the context of a multi–period swap arrangement. We intend to analyze this in the future as part of an extension to our simple model of Chapter IV. Hence, in our discussions here, we will view the obligatory payments to be made on ETD as being equal to $\{UA_D - UA_O\}$, if positive, and as being paid by the defaulting party.

This provision of the agreement clearly shows that the defaulting party is liable to pay its current obligation, no matter how adverse the outcomes on exchange rates are, based on the swap rate. This provision is of particular concern to our model. We see that failure to pay at the discretion of the defaulting party will not release that party of its obligatory payments. If the defaulting party could simply walk away at any payment date at its discretion (whenever the outcome of exchange rates is adverse to it), the swap agreement would make little economic sense. The agreement terminates on ETD, only if the parties settle the obligatory payments that would have taken place on the last due payment date. We can, therefore, say that the agreement has enough enforcement to discourage termination on any due payment date at the discretion of any one of the parties to the Agreement.[46] Thus, in our modelling we included those states in which the exchange rate movements were unfavorable to any one party, but the cash flows of that party were sufficient to cover its obligation, in the set where the swap was effective. That was called set B .

We now turn to the other Event of Default based on non–payment, namely bankruptcy. What happens if one of the parties is insolvent and not able to pay at

[46]This implies that the incentive to terminate a swap should be something other than the current outcome of exchange rates. Factors like changes in future expectations, the desire to shift into other currencies or instruments can be cited.

the due date of the obligatory payments? The swap agreement states that ETD, in such a case, "will be deemed to have occurred". It is further stated that in these circumstances "the amounts determined will be subject to such adjustments as are appropriate and permitted by law to reflect any payments made by one party to the other, under this Agreement during the period from ETD to the date of payment determined". Thus, the Agreement implies that the parties, eventhough they are insolvent, are still liable for the payments determined to be paid on ETD. It is also hinted that the governing law[47] of the contract will take over to settle any disputes. There is no alternative payment schedule specified in the Agreement when ETD occurs due to bankruptcy instead of failure to pay. In practice, the participants and regulators are very much concerned about this outcome since no swap agreement has yet been tested before any court. Therefore, at present, the bankruptcy implications of a swap agreement are unknown.

It should also be noted that in English or New York State law, the most commonly chosen governing laws of the Agreement, the bankruptcy and insolvency rules which apply to a contracting party are those of the country of its incorporation. Consequently, the enforceability of the provision of the Agreement against a bankrupt or insolvent party depends not only on the governing law, but also on the local law where the bankrupt party is incorporated.[48] Thus, in case of bankruptcy, there will be other parties that may have claims on the cash flows of the defaulting party of the swap agreement, and there is no clear distinction as to what will be the amount that can be paid to the other party. Hence, in our model, we assert that whenever one or both of the parties are insolvent, each party ends up with its own cash flow. These states in which the Agreement will be void

[47]Governing law in any swap agreement can be specified as either "English law or the laws of the State of New York".

[48]For a fuller discussion of govering laws of swap agreements see James A. Watkins, "Legal Issues and Documentation," in Antl(1983), 99–113.

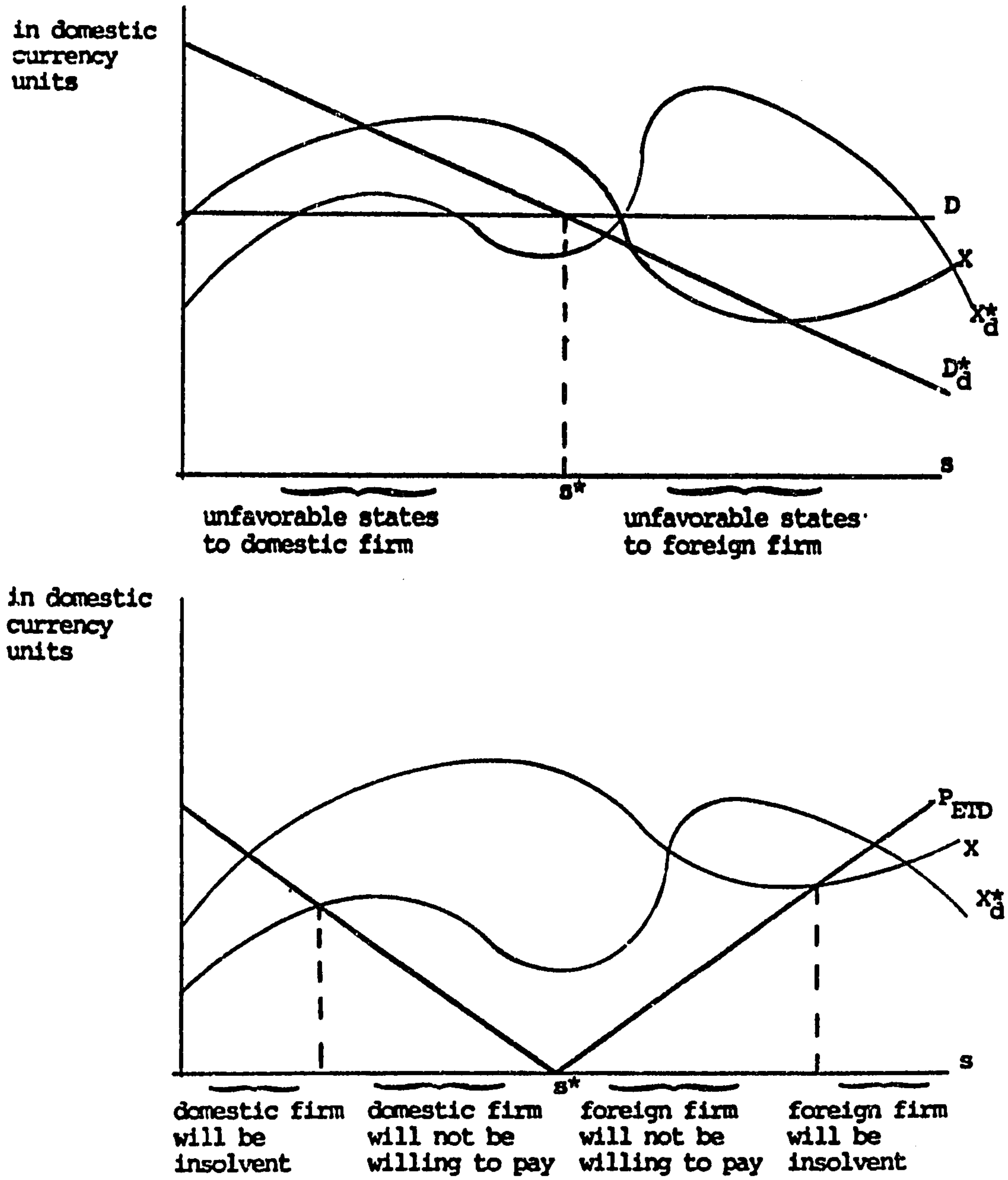
constitutes the set B' in the model.

We can further analyze the implications of the "enforcement" provisions of the Agreement as a basis for the ex-ante valuations of our model by looking at Figure II. In Figure II., we show a swap arrangement where all quantities are translated into domestic currency units. Furthermore, to make exposition easy, we have assumed that the event space is one-dimensional, and have ordered the states with respect to outcomes of the exchange rate.[40] This ensures that we have a straight, continuous line for $D_d^* = e_T(s)D^*$. Thus, s^* is the critical state in which $e_T(s) = e_0^*$. Note that the set of states in which $s < s^*$ constitutes the unfavorable states to the domestic firm since the exchange rates have moved adversely from its point of view (i.e. $e_T(s) > e_0^*$). In these states, what that party is obliged to pay (D_d^*) has a value more than that which it is to receive (D). Similarly, states $s > s^*$ are unfavorable to the foreign firm, the counterparty. Thus, in these respective unfavorable states, it is to the advantage of either party not to perform its obligation on the due date. However, any failure to pay will result in ETD. On such a date, the unpaid amounts on the previous due date are netted, as we discussed previously. The defaulting party pays $(UA_D - UA_O)$. These payments we term P_{ETD} on the second graph of Figure II. The enforceability of these payments by the Agreement divides the unfavorable states into two subsets for each party. In one subset, the party will be solvent to pay P_{ETD}, but will not be willing to pay since the outcome is unfavorable. In the second set, it is not able to pay, thus the contract is breached. The Agreement will force the party to make the payment in the first set, but the payments in the second set are based on bankruptcy proceedings. In our arguments on default in Chapter IV. we suggest

[40]We should be cautious in ordering the states with respect to only one state contingent variable of the discussion. This will result in the other state contingent variables to be discontinuous at some points. Nevertheless, to ease exposition, we have drawn X and X_d^* as continuous curves.

FIGURE II

PAYMENTS ON A CURRENCY SWAP ON ETD



X : domestic cash flow of the foreign firm.
X_d^* : foreign cash flow of the domestic firm in domestic currency.
D : swapped amount in domestic currency (to be paid by foreign firm)
D_d^* : domestic currency equivalent of the obligation of the domestic firm in foreign currency.
P_{ETD}: payments to be made by the defaulting party on ETD.

that the firms' manipulate their cash flow patterns over states such that more of the unfavorable states are included in the second subset where it is insolvent.

Participants in Swap Market

End–users and intermediaries constitute the two major groups participating in the swap market. Active end–users in the current swap market are commercial and investment banks and corporations around the world, savings and loan institutions and insurance companies, government agencies, international agencies and foreign states. Large commercial and investment banks and securities companies in the U.S., U.K., Japan, Canada, France, Sweden and Switzerland are among the major intermediaries.

It is interesting to note that commercial and investment banks appear in both groups. What differentiates one from the other is based on their roles in a swap transaction. To understand this better, we look into the evolution of the intermediation function in the swap market.

Conventionally, one expects these two groups to be distinguised by their goals in entering a swap contract. End–users' motivation, as commonly viewed, is either to manage interest or currency exposure (hedging), or simply to bet on the future outcome of interest and exchange rates (speculation). Intermediaries, on the other hand, are said to enter the swap agreement as a broker to earn fees (comissions) for its brokerage services. As we know, the broker brings the two parties together but does not take a position in the transaction. Thus, its income is based on the turnover (volume) of the transaction.

This distinction was clear–cut in the early stages of the evolution of swap contracts. The initial swap arrangements were done on a one–off basis: the swap was not executed until the (broker) intermediary located a counterparty desiring the exact swap specified by a customer. The intermediary had to match (exactly) the currencies, the principal amounts desired and the maturities. Naturally, in this early stage of the swap market, investment bankers were the dominant intermediaries since the arrangement did not demand capitalization on the part of the (broker) intermediary. However, as the swap market evolved in the last few years, the number and variety of end–users have increased. Morever, there appeared a trend to standardize the terms of the swap contract. Thus, an opportunity was created for intermediaries to enter the swap as the actual counterparty to an end–user initiating the agreement. Recently, we observe that most intermediaries act almost exclusively as counterparties.[50] This implies that intermediaries are now acting like (dealers) market–makers by entering a swap agreement for their own account and taking positions on two sides of the contract. Thus,the role of intermediaries has evolved from that of brokers to that of market–makers. This change in the role of the intermediary has also resulted in a shift from investment bankers to commercial banks as being the prominent participants in the swap market.

Another observation in the swap market is that competition in intermediation narrowed the profit margins so that participating as a broker was no longer profitable.[51] Thus, intermediaries' attention was switched to the underlying benefits of the swap arrangement. This resulted in the intermediaries entering swaps as counterparties. These observations imply that a swap is not an innovation instituted by investment bankers to increase their business by offering an

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[50]BIS(1986) and Cooper(1986).

[51]This is a market observation as can be seen in "Swap, Managing the Future," Euromoney, October 1984, 205: "Fees paid for intermediation have also fallen. They were 30 to 40 basis points a year in 1982, but that has fallen to 15, 10 or even less, plus a 1/8 % up–front fee. Brokerage fees are even thinner, from 10 basis points to as little as 1 basis point per transaction. The fees look bad compared with the big margins made in 1982, 1983."

instrument that has no real economic gain to shareholders.[52] The swap as a market innovation did not die when competition among intermediaries forced their profits to zero. Furthermore, it is more recently observed that some large end–users with high credit–ratings arrange swaps without an intermediary.[53]

These observations from the swap market pertaining to the role of the intermediary show that a swap is not an innovative product that has no economic substance. The principle of a swap, that of exploiting the imperfections between markets or within markets to the benefit of all parties, has proved to be significant and persistent. If one imperfection is fully exploited, there will be others across markets and over time until there is one, perfectly integrated world, capital market to which all investors have equal access. The swap market would exist with or without intermediation. This valuable principle of the swap contract, which proves its existence, was the main issue in our analysis of Chapter IV. However, we don't mean that intermediaries do not perform useful functions. Therefore, we now turn to explore and evaluate the role of the intermediary in a swap contract, basing our discussions on our model wherever possible.

It is difficult to explain the existence of intermediaries in a perfect and complete market with no barriers to transfer of information. In such a world, end–users will arrange transactions directly among themselves, avoiding the costs of intermediation. However, once market imperfections are introduced, such as transaction costs, asymmetric information, moral hazard, adverse selection, thus costly information, intermediation starts to make sense. In our stylized model of Chapter IV., we assume that each of the national capital markets are complete and frictionless (no TC, no taxes). Furthermore, our model is a full–information model within and between the markets, and information is costless. It appears that, in

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[52]Finnerty(1987).
[53]BIS(1986).

such a setting, there is little room for intermediation. However, one should be wary of such a conclusion, in light of the crucial role played by segmentation in our results. We now attempt to explain the role of intermediation in the context of our model. We also point out the limitations of our model in explaining some functions performed by intermediaries.

There are two main functions performed by intermediaries:[54] that of aggregating and transforming risks, and that of serving as brokers or market–makers, due to informational problems. We turn to the first function related to uncertainty about future outcomes and sharing of these risks. In Chapter IV., we discuss two alternative criteria in choosing the optimal values for decision variables. One criterion is where the counterparties optimize jointly and search for a common (D^*, e_0^*) pair so as to maximize $T\delta V$. We argue that this alternative is the only feasible criterion within our framework in which there is no intermediation. The other criterion is based on an unconstrained solution where each counterparty comes up with a (D^*, e_0^*) pair that maximizes δV and δV^* independently. This criterion, however, is not feasible unless there appears a third party willing to take positions on each side of the swap transaction. This is obvious since the counterparties would want to swap at different rates and at different amounts. However, intermediation will take place under the condition that optimal $\delta V + \dot{\delta} V^*$ is greater than optimal $T\delta V$. The difference $[\delta V + \dot{\delta} V^* - T\delta V]$ can then be shared among the counterparties and intermediary.[55] We should note that this shared gain is in current values based on the ex–ante valuations of the investors in different markets. These valuations reflect the specified values prescribed to D^*, e_0^* and the resulting B', the set of states in which non–performance occurs by either one of the

[54]Baltensperger(1980).

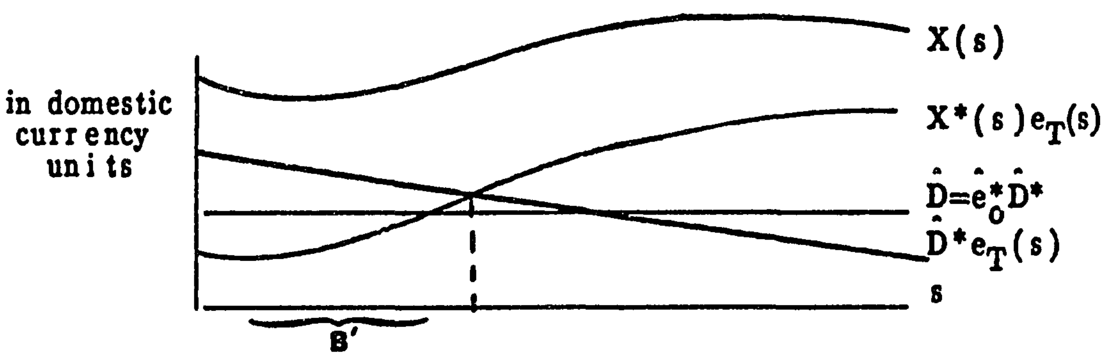
[55]Since the intermediary is now the counterparty to both sides of the swap, we have to assume that the intermediary itself is valued in a third market for our segmentation arguments to be valid.

counterparties. Therefore, any sharing arrangement, when an intermediary is introduced, should take into account these implicit variables, D^*, e_0^*. The intermediary can take out his share of the gain via an up-front fee and/or a fee upon reversal of the swap. This would affect the D^*, e_0^* levels, chosen optimally by the counterparties. There is another point that should be borne in mind with the introduction of a third party to the swap transaction. That is, the pattern of default states of the swap contract changes since, now, the intermediary is the counterparty to each side of the swap agreement. Furthermore, since the intermediary, itself, is taking positions in the swap transaction, the market in which it is operating will be significant, in our framework of segmented markets. Given that the intermediary is also a profit-seeking entity, its decisions will be made to enhance the wealth of its shareholders, based on their valuations. Morever, the intermediary might have incentives that are contradictory to those of the initial counterparties. If the intermediaries' income is based on the effectiveness of the contract, they might have incentives to reduce default states as much as possible. Nevertheless, with all these considerations, sharing arrangements can be worked out so that all the parties, including the intermediary, can benefit. However, modelling these issues, even in our simple framework, is complicated and beyond the scope of this study. Nonetheless, we will discuss some of the above considerations as to shed some light on risk sharing issues in a market with an intermediary acting as a market-maker. In this type of intermediation, the intermediary assumes the risks of two off-setting swap agreements by being the counterparty to each independently. We can now search for implications of this arrangement to our stylized model in Chapter IV.

First, a swap agreement in which one of the parties is an intermediary can be viewed by the counterparty as having no non-performance risk. Thus, the choice of the set B' which determines D^* and e_0^* is solely based on the cash flows of the to always cover its obligation. This is depicted in Figure III., where the event space is again assumed to be one–dimensional and the unit of measurement is the domestic currency. Suppose, based on the δV function, the optimal amount to be swapped is $\hat{D}^*$ with corresponding $\hat{e}_0^*$. It is obvious that the bank will perform its obligation in all states of the world from the point of view of the domestic firm, as implied by B' depending only on $X^*(s)$, the cash flow of the domestic firm. The domestic firm is facing price risk,[56] but no credit (default) risk from the counterparty. The intermediary, however, is exposed to both types of risk at this level.

FIGURE III

DEFAULT STATES OF DOMESTIC FIRM



Looking at the issue from a broader perspective, we should consider other swap agreements the bank may engage in. Evidently, the bank can bundle counterparties in a portfolio instead of trying to match each counterparty. Suppose the bank constructs a portfolio of domestic firms all wanting to swap into the same currency. On the other side, there is another portfolio of foreign companies all

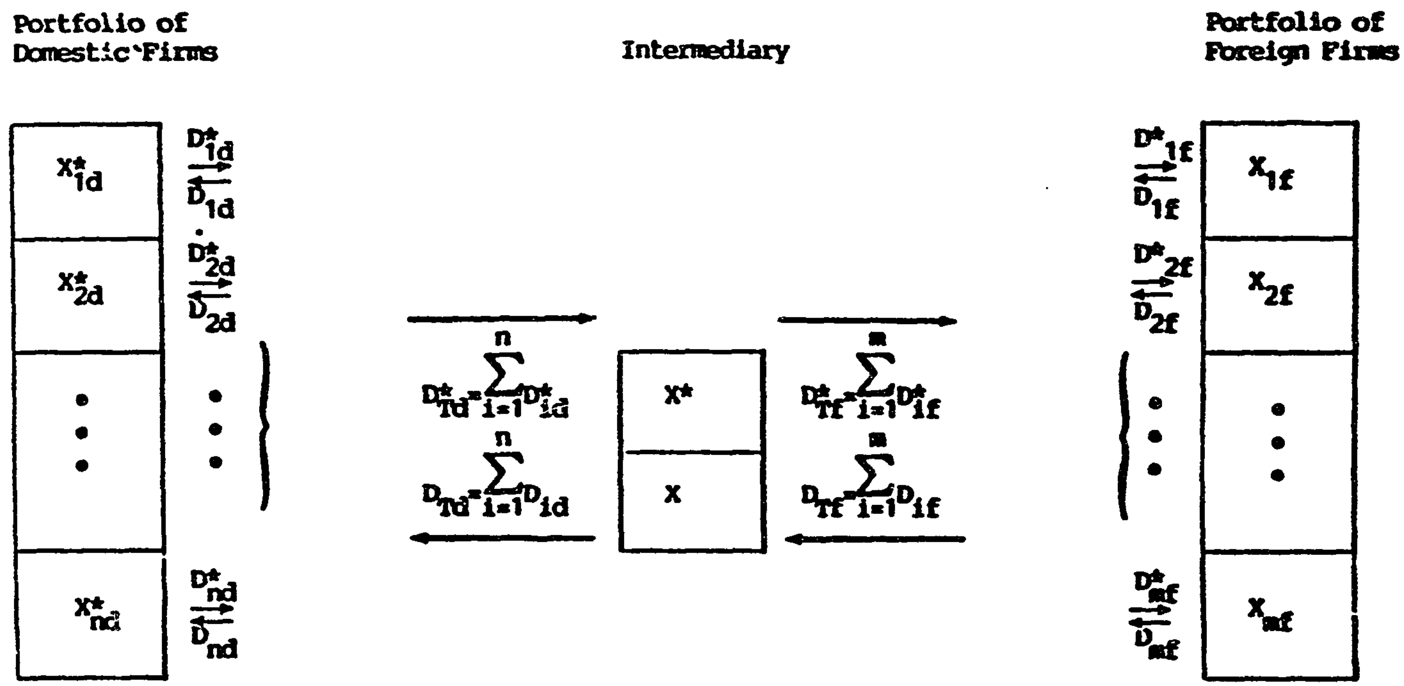
[56]Price risk in a swap contract is due to the fact that interest and exchange rates can change from the date on which the swap is entered. Increased volatility of exchange rates and interest rates make this risk and its transfer as one of the prominent elements of the swap transaction.

Looking at the issue from a broader perspective, we should consider other swap agreements the bank may engage in. Evidently, the bank can bundle counterparties in a portfolio instead of trying to match each counterparty. Suppose the bank constructs a portfolio of domestic firms all wanting to swap into the same currency. On the other side, there is another portfolio of foreign companies all wanting to swap into the domestic currency. This situation is shown in Figure IV. Decisions on D^*_{id} and D_{id} amounts are made by domestic firms based on the best outcomes of their δV functions. Similarly, foreign firms make their D^*_{if} and D_{if} decisions, optimizing $\dot{\delta V}^*_f$ functions. Evidently, by the introduction of an intermediary taking the role of a counterparty and implementing the portfolio approach, the decisions of the end–users are no longer dependent on each other. Morever, they no longer face non–performance on the part of the intermediary. Since these independent optimizations will not be constrained by the non–performance of the counterparty, the parties will be better off compared to the case where each pair had to optimize jointly. This implies that they will be willing to share the extra benefits that would be gained by this intermediation with the intermediary.

What is happening in the above arrangement is that the intermediary is selling insurance to the counterparties. The counterparties on both sides are guaranteed by the intermediary that they will receive D_{id} and D^*_{if} amounts, whenever they are solvent and able to pay D^*_{id} and D_{if}. Obviously, they are less constrained in manipulating their cash flows such that they default in those states that are unfavorable only to them. This will increase their ex–ante value, as discussed in the previous chapter. Thus, they will be willing to pay the intermediary out of this value added for its insurance activity. However, we should note that eventhough the intermediary's insolvency risk seems not to affect any single swap transaction, it is crucial at the aggregate level.

FIGURE IV

CASH FLOWS ON INTERMEDIARY'S PORTFOLIO OF SWAPS



X^*_{id} = cash flow from the foreign opportunity to i'th domestic firm

X_{if} = cash flow from the domestic opportunity to i'th foreign firm

X^* = cash flows in foreign currency available to the intermediary

X = cash flows in domestic currency available to the intermediary

D_{id}, D_{if} = swapped amounts in domestic currency for domestic and foreign firm, respectively

D^*_{id}, D^*_{if} = swapped amounts in foreign currency for domestic and foreign firm, respectively

The intermediary now bears the total non–performance risk. Looking at Figure IV, one can say that as long as $D^*_{Td} \leq D^*_{Tf}$ and $D_{Td} \leq D_{Tf}$, it is safe for the intermediary. However, this would overlook the fact that some of the swaps in either of the two portfolios may default at the due date. If any one of the parties defaults, the total cash flows on that side will shrink, but the intermediary is still not released from its obligations on the other side of the market. Such a default on the part of any firm will result in violation of the condition stated above, i.e. $D^*_{Td} \leq D^*_{Tf}$ and $D_{Td} \leq D_{Tf}$. This creates a situation where the independent cash flows of the intermediary (its capital), X and X^*, will support its obligations to pay.[57] The intermediary is no longer offering riskless aggregate swaps from its side but is facing insolvency risk itself. The amount of capital it has will determine how much riskless swaps it can offer. Basically, the intermediary will use its capital to sell insurance.

As a result of the above intermediation arrangement, the risk sharing in the swap transaction has changed. The counterparties bear only price risk, but no non–performance risk from the other party. On the other hand, the intermediary is exposed to non–performance risk alone based on its portfolio approach. What concerns of the intermediary is the match between (D^*_{Td}, D^*_{Tf}) and (D_{Td}, D_{Tf}) pairs. At which rate each of the individual swaps is transacted is of no immediate significance to its payment capacity of the total liabilities. Matching the counterparties, however, does not reduce its non–performance risk since it has independent obligations to each counterparty. Nevertheless, within the framework of our model, since the intermediary knows the states of the world in which any one

[57]This is a case where the intermediary has to make capital commitments. The market observation that the change in the role of an intermediary from a broker to a market maker paralleled the shift from investment bankers to commercial banks as the dominant participants hints that the role played by the intermediary's capital is significant in this type of a swap arrangement.

counterparty defaults, it may be possible to work portfolio strategies so that default on either side works toward its benefit. This is an issue which deserves further analysis within the framework of portfolio theory.

The above discussion gives some insights into the existence of an intermediary as a market–maker, performing the function of risk aggregation and risk transfer. We haven't yet dealt with the second function of intermediation, specifically, serving as a broker or market–maker to overcome informational problems. As we have pointed out at the early stages of the evolution of the swap market, intermediaries did not take positions in a swap transaction, but merely served as brokers. In this type of arrangement the intermediary does not expose itself to any risks pertaining to either currency rate fluctuations or to non–performance. Nevertheless, it gets paid due to its useful sevices relating to transactions and information costs. Morevever, as the swap market evolved and end–users increased in number and variety, the potential counterparties seemed to be reluctant to accept the credit risks involved in a purely brokered swap. Both end–users viewed an intermediary as a more acceptable counterparty with respect to non–performance. It wasn't feasible for any one party to do the necessary credit analysis. The intermediary was seen to have comparative advantage in credit rating due to its expertise in assessing long–term credit risks. These issues of costly information are central to any swap transaction. The intermediary, investing and specializing in the collection of information about the potential counterparties, can profit by selling this information to the end–users in a swap contract. Since information is costly, the counterparties will demand insurance from the intermediary. Thus, the existence of an intermediary can be related to the fact that the intermediary is better informed about the capital market and credit ratings than are the counterparties. Problems relating to asymmetric information, adverse models can be developed to analyze the informational aspects of a swap transaction and explain the existence and the behavior of the intermediary, within the context of costly information in a swap arrangement. This, we leave for future research.

Difference Checks

A swap agreement may allow the counterparties to exchange only the net cash flows. This procedure is termed "netting" in the standardized **Interest Rate and Currency Exchange Agreement** and is described as follows

"If on any date amounts would otherwise be payable:

i. in the same currency; and

ii. in respect of the swap transaction by each party to the other, ... the aggregate amount that would otherwise have been payable by one party exceeds the aggregate amount that would otherwise have been payable by the other party, ... the party by whom the larger aggregate amount would have been payable pay to the other party the excess of the larger aggregate amount over the smaller aggregate amount".

This procedure is more commonly practiced in the interest rate swaps than in currency swaps. The parties only exchange difference checks written in the currency where both obligations are to be paid. It is the contention of Smith et al.(1986a,1986b) that this procedure results in swaps being less risky than comparable debt arrangements, since, in the case of borrowing, you have to pay total obligations, as it is one sided.

Furthermore, they argue that if the swap is used as a hedge, the default risk of both the swap and the underlying debt are reduced. The reason cited is that if there are any non–performance possibilities on debt, the firm will be receiving

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markets model [i.e. Senbet and Taggart(1984), Sharpe(1985)].

al.(1986a,1986b) that this procedure results in swaps being less risky than comparable debt arrangements, since, in the case of borrowing, you have to pay total obligations, as it is one sided.

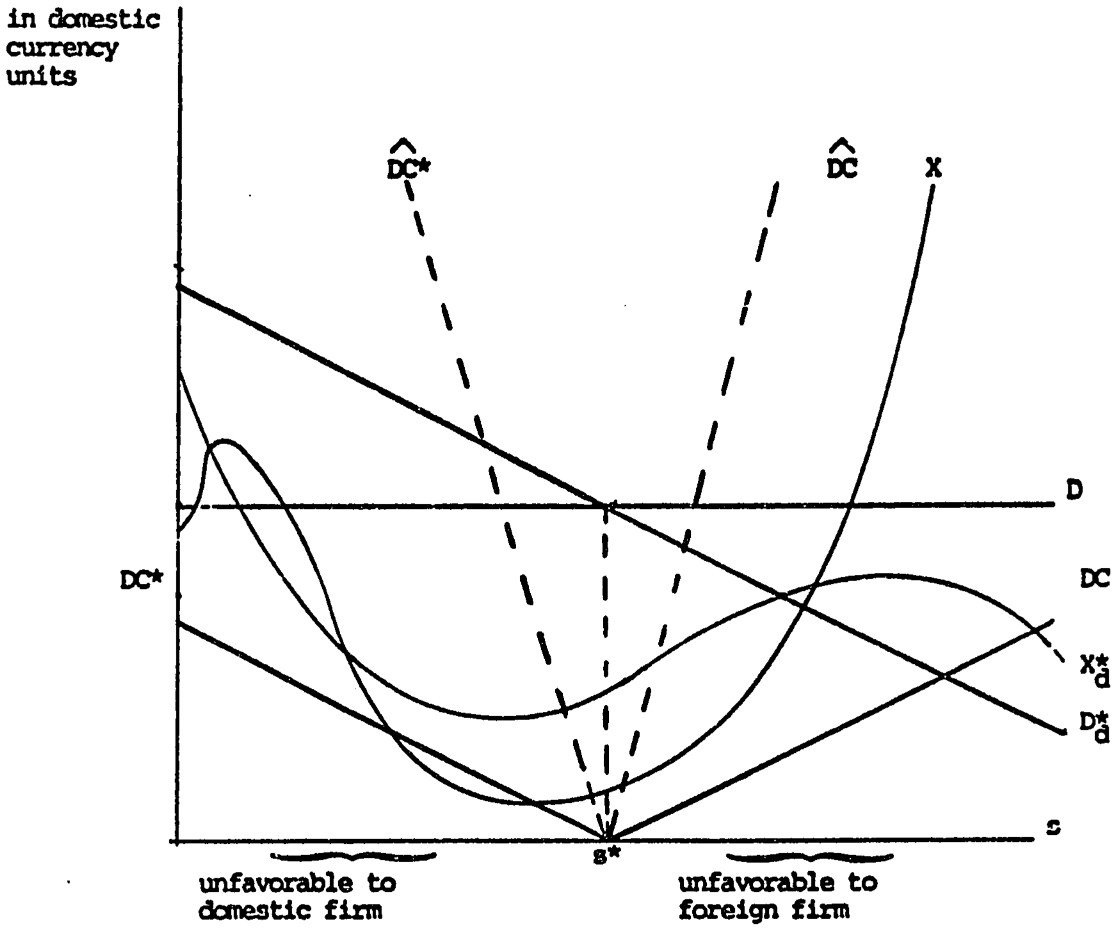
Furthermore, they argue that if the swap is used as a hedge, the default risk of both the swap and the underlying debt are reduced. The reason cited is that if there are any non–performance possibilities on debt, the firm will be receiving difference checks, thus reducing its financial distress. Furthermore, they view the case where the swap is used to speculate, and in this case claim that the probability of default is increased. Although in these discussions they are referring to interest rate swaps, and the practice of exchanging difference checks is more characteristic of interest rate than currency swaps, we attempt to elaborate on and to clarify the above arguments on the basis of the simple currency swap modelled in Chapter IV.

First, we investigate the implications on default of exchanging difference checks instead of total amounts swapped. In Figure V, we show a swap arrangement where all quantities are translated into domestic currency units. Furthermore, to make expositions easy, we have chosen to use a one dimensional event space, and, like in Figure II, have ordered the states with respect to outcomes of the exchange rate. This ensures, again, that we have a straight continuous line for $D_d^* = e_T(s)D^*$. Thus, s^* is the critical state in which $e_T(s) = e_0^*$. At s^* no difference checks are written. In states $s<s^*$ $(e_T(s)>e_0^*)$ the domestic firm's obligation D_d^* is greater than what it has to receive. This results in the domestic firm writing difference checks to the foreign firm. On the contrary, those states $s>s^*$ are those in which it receives difference checks. Thus, in the figure, DC^* shows the amounts of difference checks to be written by the domestic firm based on the notional principals exchanged in the amounts D to D^*. The line DC, on the other hand, refers to difference check amounts written by the foreign firm.

The foreign firm, with income of X, apparently defaults in fewer states when

FIGURE V

PAYMENTS BASED ON DIFFERENCE
CHECKS IN A CURRENCY SWAP



X : domestic cash flow of the foreign firm.
X_d^* : foreign cash flow of the domestic firm in domestic currency.
D : swapped amount in domestic currency (to be paid by foreign firm).
D_d^* : domestic currency equivalent of the obligation of the domestic firm in foreign currency.
DC, DC* : difference checks written by foreign and domestic firms, respectively.

difference checks are exchanged instead of total amounts. The same is true for the domestic firm. Specifically, for the foreign firm, the subset of Ω in which it defaults under the option of exchanging total amounts is $B' = \{ s : X(s)<D$ and $X_d^*(s)<D_d^* \}$. This should be compared to the case where difference checks are written instead, which can be denoted by the subset $\hat{B}' = \{ s : X(s)<DC$ and $X_d^*(s)<DC^* \}$. Since DC<D and $DC^*<D_d^*$ almost everywhere, $\hat{B}' \subset B'$. Thus, we can conclude that each procedure has different nonperformance exposure, and exchanging difference checks will always result in lesser states in which default occurs. However, what we cannot conclude is if this is desirable for the swap partners. As we have shown in our model, what is important in swaps with default is not the number of states in which one defaults, but, rather, the particular state in which default occurs. If exchanging difference checks limits the default states to more unfavorable ones than the alternative procedure, it should be the desirable procedure. Otherwise, the counterparties might be better off exchanging the total amounts or increasing the notional amounts so that DC* and DC functions are steeper as depicted by the dashed lines in Figure V. Thus, selection of the procedure of payments might be used by the counterparties as an instrument to better position themselves in terms of states where default occurs. This might be an alternative to regulating cash flows for the same purpose, as we suggested earlier.

Now, let us take a closer look at how the DC and DC* functions behave. The relationship between the notional amount and the amount of difference checks is straight forward. In general, $DC^* = N^*e_T(s) - N$, where N* and N are the notional amounts in foreign and domestic currencies, respectively. Thus, DC* stands for the amount to be paid by the domestic party and to be received by the foreign party at due date T. Recalling that $N^*e_0^* = N$, DC* can be expressed as follows:

$$DC^* = N^* \max \{ (e_T(s) - e_0^*) , 0 \}$$

Similarly, DC, the amount to be paid by the foreign party and to be received by domestic party can be expressed as[60]

$$DC = N^* \max \{ (e_0^* - e_T(s)) , 0 \}$$

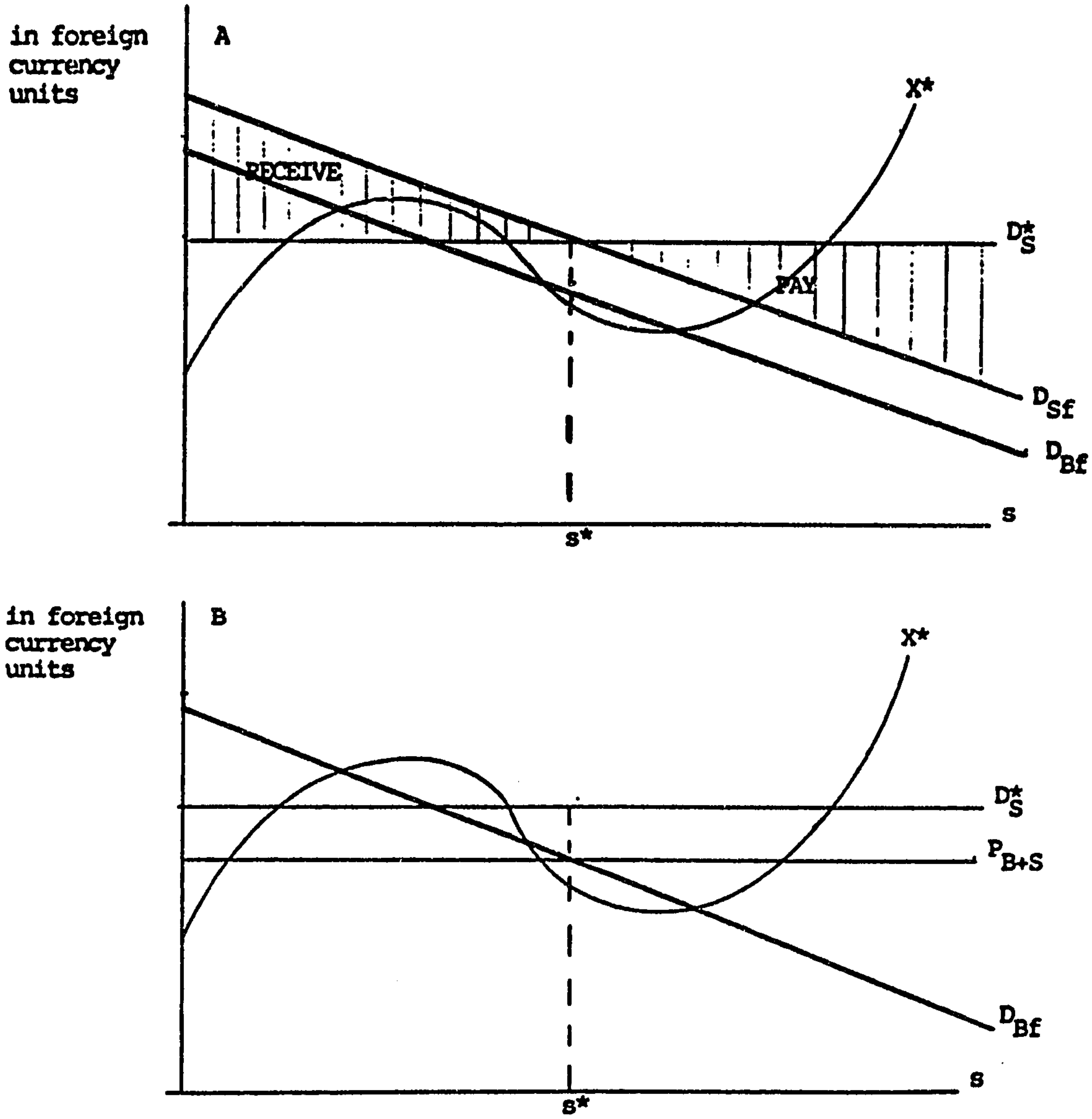
Obviously, the magnitudes of DC* and DC are directly related to the underlying notional amount N*. When N* is increased, both DC and DC* will be increased as depicted by the steeper lines drawn for both, in Figure V. As we see in this simple one–dimensional case, increasing N* will change the content of the set B', as would increasing D*, but in a different way. Thus, choosing the payment scheme, total amounts versus net amounts, has considerable impact on the content of the set B'.

Next, we investigate the issues of hedging versus speculation with respect to their impact on default of a swap contract. First, we should note that the amount of borrowing and the amount of swapping into the currency in which you borrowed are two distinct decisions, as we discussed in our earlier analysis. The optimal amount to be borrowed should be decided independently of the optimal amount to be swapped in the same currency. If a firm has a debt outstanding in a currency that it swaps into, the motivation of its swap is considered hedging. If it swaps with no underlying debt, the swap is considered speculative. Smith et al. (1986a and 1986b) argue that if the swap is used as a hedge, there will be difference checks received which will reduce the probability of default on the swap and debt. (They reverse the reasonoing for a speculative swap.) They believe that the probability of default is higher in a speculative swap. We now reconsider this argument in a general framework referring to Figure VI. Figure VI is another version of our

[60]Note that pay–offs related to DC* payments represent that of a call option on domestic currency. In addition, pay–offs, in case of DC payments, are those of a put. Thus, it is once more made clear that a default free swap contract, whatever the payment scheme, is a transaction in which both parties buy a forward contract on the same currencies and at the same rate.

FIGURE VI

PAYMENTS ON A DEBT AND SWAP COMBINATION



X^* : foreign cash flow of the domestic firm.

D^*_{Bf} : promised payment of the domestic firm on its foreign borrowing converted into foreign currency.

D^*_S : payment (in foreign currency) to be paid by the domestic firm in the swap contract.

D_{Sf} : payment to be paid by foreign counterparty of the swap contract converted into foreign currency.

P_{B+S} : total payments to be made on debt and swap obligations by the domestic firm.

previous expositions, the difference being in the units of currency. Here, all values are converted into foreign currency. Thus, states are ordered in terms of $e_T^{-1}(s)$ such that s^* stands for the state in which $e_0^{*-1} = e_T^{-1}(s)$. Likewise, $s<s^*$ implies $e_T^{-1}(s)>e_0^{*-1}$ and vice versa. In Figure VI, we see the cash flows and obligations to pay of a domestic firm with a foreign opportunity. The firm decides to borrow in domestic currency against its foreign opportunity of an amount equal to D_B. Hence, its obligation is in domestic currency, but its income is in foreign currency. Consequently, it also decides to hedge the foreign exposure by entering into a swap where the amounts D_S and D_S^* have to be exchanged. Both the debt and the swap mature at the same time. We assume that the amount to be received in the swap, D_S, is greater than the promised payment on domestic debt, D_B. Thus, the firm has fully hedged its debt obligation, and swapped in excess with speculative purposes. Suppose, furthermore, it is specified in the swap agreement that the parties will exchange only difference checks. As a result, the domestic firm will pay the difference, $D_S^* - D_S e_T^{-1}(s)$, in the range $s>s^*$ and in the range $s<s^*$ will receive $(D_S e_T^{-1}(s) - D^*)$. Let $D_{Sf} = D_S e_T^{-1}(s)$. Then, the total payments on the debt and swap obligation of the domestic firm, P_{B+S}, can be expressed as

$$P_{B+S} = D_{Bf} + D_S^* - D_{Sf}$$

where $D_{Bf} = D_B e_T^{-1}(s)$. P_{B+S} can be rewritten as

$$P_{B+S} = D_S^* - (D_S - D_B)e_T^{-1}(s)$$

Note that $P_{B+S} = D_S^*$ under the assumption that the firm only covers its debt obligation with the swapped amount, D_S. Therefore, from the perspective of the domestic firm, having a domestic debt and exchanging difference checks is tantamount to a swap where total amounts are exchanged with no underlying debt (totally speculative), under the assumption that the swapped amount, D_S, equals D_B. Thus, there is no distinction between hedging and speculative motives, as far as payments or obligations are concerned, if the amount swapped with a speculative motive equals the hedged amount. Obviously, whenever speculative and hedged amounts differ, adjustments are necessary to P_{B+S}, as designated in the above relationship, $P_{B+S} = D_S^* - (D_S - D_B)e_T^{-1}(s)$. Also note that the same P_{B+S} would obtain had they swapped the total amounts instead of difference checks whenever there is an underlying debt obligation in the currency the swap payments are recieved. In a swap used for hedging, the payment obligations add up to the same amount whether the parties exchange the total amounts or differences.

Looking into Figure VI–B, we can see the implications on default of the strategy of borrowing and simultaneously hedging with a swap agreement. Note that in this agreement, we implicitly assume that the counterparty in the swap transaction is an intermediary so that there is no chance of nonperformance on its part. In Figure VI–B, it is evident that, by hedging the debt obligation via a swap arrangement, the firm has increased its total payments in $s>s^*$ as designated by $P_{B+S}>D_{Bf}$, thus ended up in a less favorable situation. However, the reverse is true in $s<s^*$. In this subset of the event space, the payment obligation of the firm is reduced by the fact that it will be the reciever of difference checks. The implication on default of this change in the payments scheme is also easy to see. In the subset in which difference checks are paid, the number of states in which nonperformance on both debt and swap obligations occur is increased.[61] On the other hand, in the subset where $s<s^*$, the number of states in which the firm defaults is decreased. Thus, we cannot be sure of the overall impact on default of hedging an existing debt via a swap. It depends on the pattern of state contingent cash flows of

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[61]Note that the implicit assumption here is that both debt and swap obligations have the same seniority. If debt obligation had seniority, the firm would default before any payments on the swap are made. In this case, what would the bankruptcy proceedings enforce about swap payments is unknown to the market. The reverse case may happen when the firm is a net receiver. If the firm defaults on its debt prior to receiving the difference check, will the counterparty be still liable? That is another question yet to be answered in practice. Therefore, in this analysis, we assume debt and swap have the same seniority.

the firm, $X^*(s)$, and its relation to exchange rates, $e_T^{-1}(s)$. What we can conclude, however, is that the distinction between the impact of hedging versus speculation motives on default does not have clear implications since these motives can coexist in any swap agreement. The above case was one in which swap was used as a hedge but apparently it did not result in the hedging firm recieving difference checks in all states of the world. So, we cannot conclude that swap used as a hedge reduces the probabilty of default without analyzing the countervailing effect of the states in which the firm has to write difference checks. The latter case was considered as a speculative swap by Smith et al. (1986a, 1986b). As we see, in general, a swap is a contract in which you end up either paying or recieving a difference check. The issue is, however, if we can, ex–ante, state the conditions under which hedging an outstanding debt via a swap agreement is desirable. This issue merits further analysis. Such an analysis would necessitate the specification of certain relationships between the exchange rates and cash flows of the hedging firm. For example assuming perfect correlations might lead to more clear–cut conclusions. Moreover, the above discussion only delineates the changes in the set of default states based on the direction of cash flows, but does not analyze if these changes are to the benefit of the hedging firm. This is another issue to be investigated in future analyses.

To sum up, the default on a swap seems to be less harmful when only the difference between two obligations is exchanged. We argue that this procedure has no consequence unless used as a tool to regulate the states in which default occurs. Morever, it is believed that a debt obligation coupled with a swap as a hedge can cause less damage in financial distress. However, it is our contention that hedging debt with a swap does not have clear implications on default. It might or might not be desirable depending on the relationship between the firm's cash flows and exchange rates.

CHAPTER VI
CONCLUSION

This study has investigated the impact of market segmentation on firm value where the firm engages in international financial contracts. Conventional international debt issues and the innovative financial product, the currency swap, were chosen as the two financial instruments to be analyzed. Our analyses were based on financial arbitrage resulting from restrictions placed on trading and short–selling. We developed contract valuations in the context of financial arbitrage. The value added from such arbitrage depends upon the relationship between the future exchange rates and state–price measures. This suggests that there may be national financing partners among countries in the sense that state–price measures and exchange rate patterns over states make a nice fit. When such a favorable condition is discovered, the firms will want to exploit it as much as possible. At this point, default risk gains in importance. Possibility of default will limit the number of states where a certain advantage will persist. At this point, we suggest that firms actively manipulate their state contingent cash flow patterns, as to default in states that are unfavorable in terms of market conditions (the relationship between exchange rates and state price measures). We found that the default option of firms was an independent source of value in debt and swap contracts executed in segmented international capital markets.

As suggested throughout the study, the basic model developed can be extended in many directions. One line of extensions is to bring other market imperfections such as taxes, transactions costs and agency costs into this framework. Another line of extensions is to use the same framework to analyze other financial decisions (such as joint ventures, mergers, etc.) and other contracts (credit swaps, swap–driven primary issues, etc.).

Morever, the default analysis presented in this study merits much more analysis. Designing the contracts such that default occurs to the best benefit of the parties is an issue for future research.

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