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Some advances in supporting international financial management decisions

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Nr. 248

**Some Advances in Supporting
International Financial Management Decisions**

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Some Advances in Supporting International Financial Management Decisions¹

1. Introduction

Corporate financial management deals with controlling risk- and return characteristics of cash flows. While the same is true for International Financial Management (IFM) of Multinational Corporations (MNCs), the means to achieve these financial goals as well as the relevant environment are different in the international setting:

- more innovative financial instruments are being traded on international financial markets, which offer opportunities for both hedging and speculating purposes,
- the extent to which cash flows are subject to risk is different both in the short-run (e.g. exchange rate risk) and in the long-run (e.g. country risk),
- IFM generally takes place in large Multinational Corporations, where subsidiaries' activities have to be coordinated according to the company's financial policy.²

Decisions in domestic financial management can therefore be considered a subset of the decisions involved in IFM.³ Recognizing this as well as the fact that academics have not been interested in the field of 'International Business Finance'

¹ This research has been supported by the Deutsche Forschungsgemeinschaft (DFG). It summarizes and extends the following publications as a final report of project SCHM 412 5-3:

- Hinz, H.: Internationales Finanzmanagement: eine Bibliographie, in: Manuskripte aus dem Institut für Betriebswirtschaftslehre der Universität Kiel, No. 219, 1988,
- Hinz, H.: Devisentermingeschäfte zur selektiven Absicherung offener Fremdwährungspositionen - ein portfeuilletheoretischer Ansatz, in: Schellhaas, H. et al. (Eds.): Operations Research Proceedings 1987, Heidelberg 1988, pp. 374-381,
- Hinz, H.: A Transshipment-Type Model for the Optimal Allocation of Foreign Currencies in Multinational Corporations, Management International Review, Vol. 29, No. 2, 1989, pp. 53-58,
- Hinz, H.: Industrielles Devisenmanagement in der Bundesrepublik Deutschland, Österreichisches Bank-Archiv, Vol. 37, No. 8, 1989, p. 759-774,
- Hinz, H.: Optimierungsansätze für das Devisenmanagement, Kieler Schriften zur Finanzwirtschaft, No. 7, Kiel 1989,
- Hinz, H.; Ralfs, D.: Optimale Sicherungsentscheidungen mit Devisentermingeschäften unter Unsicherheit, in: Manuskripte aus dem Institut für Betriebswirtschaftslehre der Universität Kiel, Nr. 194, 1987,
- Hinz, H.; Rusch, K.: Ein interaktives Programmsystem zur heuristischen Finanzplanung im multinationalen Unternehmen, in: Manuskripte aus dem Institut für Betriebswirtschaftslehre, Kiel, Nr. 200, 1987.

² See also Rudolph, B.: Internationales Finanzmanagement, in: Macharzina, K.; Welge, M. (Eds.), Handwörterbuch Export und Internationale Unternehmung, Stuttgart 1989, Columns 651-664.

³ See Albach, H.: Die internationale Unternehmung als Gegenstand betriebswirtschaftlicher Forschung, Zeitschrift für Betriebswirtschaft Supplement, No. 1, 1981, pp. 13-24.

for too long, it becomes obvious why textbooks on this topic have not been able to develop an integrated approach to the set of decisions involved yet.⁴ Rather, the discussion of institutional aspects has been their dominating feature until now, or as *Donald Lessard* puts it, "*International Finance [...] is frustrating because many of the practical problems at hand remain beyond the reach of existing theoretically based approaches*".⁵

Therefore, in order to improve decisions in IFM, a suitable research objective is to build implementable decision models in a step-by-step approach in those areas of IFM which can be considered research gaps of high relevance.⁶

To help the reader get an apprehension of the major problems involved in IFM, the important decision clusters are summarized in figure 1. Our focus will be on three of the problem areas shown, one at a time: First, the determination of financial positions resulting from operations of subsidiaries will be discussed. Second, the set of decision alternatives available to IFM at that point will have to be evaluated in terms of return and risk characteristics. These can be divided into two groups: internal ^{Maßnahmen} measures will be invoked whenever it seems more efficient to 'make' a future cash flow profile rather than 'buy' financial instruments on external markets.⁷ As examples of intra-company measures, the timing of cash flows as well as the process of netting-out of payables and receivables between subsidiaries will be considered.

⁴ See, for example,

Weston, J.F.;Sorge, B.W.: International Managerial Finance, Homewood 1982,
Eiteman, D.K.;Stonehill, A.I.: International Business Finance, 4. Ed., Reading 1986,
Shapiro, A.C.: Multinational Financial Management, 2. Ed., Boston 1982,
Rodriguez, R.M.;Carter, E.E.: International Financial Management, 2. Ed., Boston 1982,
Levi, M.: International Finance, New York 1983,
Aliber, R.Z.: Exchange Risk and Corporate International Finance, London 1978,
Pippenger, J.E.: Fundamentals of International Finance, Englewood Cliffs 1984,
Buckley, A.: Multinational Finance, Southampton 1986,
Bergendahl, G. (Ed.): International Financial Management, Stockholm 1982,
Sweeney, A.;Rachlin, R. (Eds.): Handbook of International Financial Management, New York 1984,
Stern, J.M.;Chew, D.H. (Eds.): New Developments in International Finance, New York 1988,
Hinz, H.: Internationales Finanzmanagement: eine Bibliographie, in: Manuskripte aus dem Institut für Betriebswirtschaftslehre der Universität Kiel, No. 219, 1988,
Hinz, H.: Industrielles Devisenmanagement in der Bundesrepublik Deutschland, Österreichisches Bank-Archiv, Vol. 37, No. 8, 1989, p. 759-774.

⁵ Lessard, D.: International Financial Management: Theory and Applications, Reading 1986, p. 5.

⁶ Madura,J.; McCarty,D.E.: Research Trends and Gaps in International Financial Management: A Note, Management International Review, Vol. 29, No. 1, 1989, pp. 75-79.

⁷ See Hinz, H.: Optimierungsansätze für das Devisenmanagement, Kieler Schriften zur Finanzwirtschaft, No. 7, Kiel 1989.

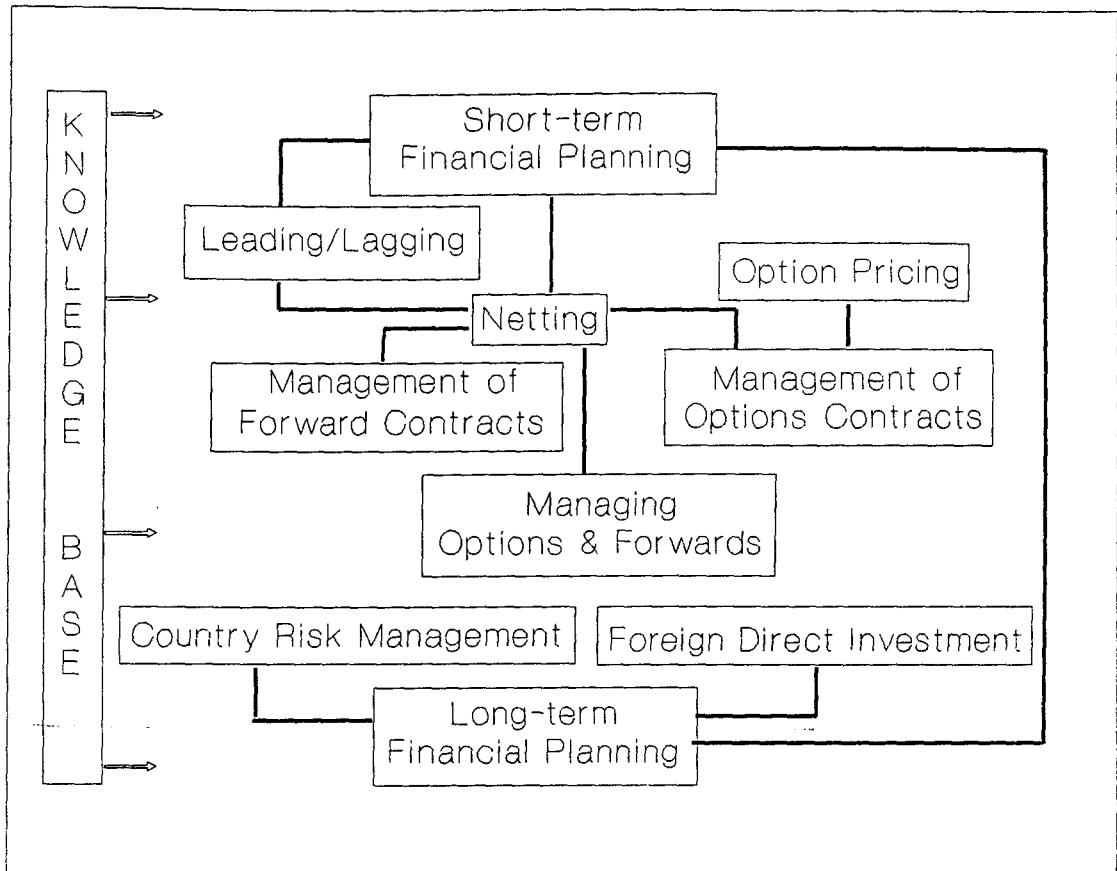


Figure 1: Decision Clusters in IFM

The final step discussed involves the evaluation of external instruments, such as forward contracts, currency futures, and currency options. These will be discussed primarily with respect to their potential for currency risk exposure management. A portfolio-type model to managing foreign exchange cash flows and external financial instruments will be presented.

2. Financial Planning at the Subsidiary Level

The quality of decision-making in IFM is a function of the correctness and timeliness of the data used. On the subsidiary level, the planning process involves a precise estimate of the amounts, the timing, and the denomination of future cash flows. As a first step, former business activities will have to be inspected with respect to their cash flow implications. This includes payables and receivables which will turn into cash-outflows and -inflows respectively during the planning period (see Figure 2).

Financial Plan (Thousands of Currency Units) Currency Denomination: Irish Pound				
	October	November	December	Jan
Exogenous Funds				
Beginning Balance				
Production				
Capital Investments				
Other				
Endogenous Funds				
Payables				
Receivables				
Other				
Ending Balance				

Figure 2: Planning Operative Cash flows at the Subsidiary Level⁸

The columns indicate the periods whereas the rows show different exogenous sources and uses of cash, enabling the planner to come up with the net cash position from operations 'before decision' per period. After aggregating these net positions per currency, a decision concerning the management of cash positions is asked for, whose outcome will typically be some type of bank order.

At this point, a simple 'what-if'-type model can be a valuable planning aid, because the impact of future installment payments can readily be evaluated.

Financial Plan (Thousands of Currency Units) Currency Denomination: Irish Pound				
	October	November	December	Jan
<u>Exogenous Funds</u>				
Sale				
Prod				
Inve				
Begi				
<u>Endo</u>				
Paya				
Rece				
Other				
Endi				

<i>Credit Terms</i>				
	Starting Period: October			
	Amount : 2000 IRPounds			
	Ending Period : January			
	Interest Rate : 12 %			

<i>Installment Payments for Period Oct-Jan</i>				
Principal	500	500	500	500
Interest	20	15	10	5
Net Cash	140	-471	160	110

Figure 3: Estimating the Impact of Short-Term Borrowing⁹

⁸ See Hinz, H.; Rusch, K.: Ein interaktives Programmsystem zur heuristischen Finanzplanung im multinationalen Unternehmen, in: Manuskripte aus dem Institut für Betriebswirtschaftslehre, Nr. 200, Kiel 1987, S. 8.

⁹ See Hinz, H.; Rusch, K., *ibid.*, p. 9.

Consider, for example, the situation in Figure 3: the operative net cash position (including credit arrangements of former periods) has been planned for the four periods ahead, and it is now the treasurer's task to decide on the amount and the type of loan to be taken.

Depending upon the credit arrangements available from banks, the decision-maker can then use sensitivity analysis to estimate the impact of different types of loans. The loan planned in this example involves 2000 IRPounds leading to overall cash balances as shown in the bottom row. Still, a negative cash balance is planned for the period ahead the decision maker has to take care of.

The procedure described constitutes an easy-to-implement, practical approach to financial planning. The drawback to heuristic or simulative approaches in general is in the fact that they cannot guarantee optimality. This is different with optimization approaches, whose objective is by definition to find 'the best' solutions. Generally, though, the assumptions needed for optimization purposes are not acceptable to practitioners.

So far in our example, IFM has accomplished a multiperiod, (close to) zero-balance, satisfactory cash flow scenario from the subsidiaries' perspective. In order to be able to better account for companywide risk and return objectives, the following sections adopt a centralized point-of-view in order to be able to exploit potential economies of scale from the MNC's perspective.

3. Internal Instruments in Centralized IFM

3.1 Modelling the MNC's Financial Network

Internal instruments in IFM are directed towards controlling intra-corporate cash flows with respect to multiple problem areas. For one thing, the allocation of liquid funds from operations of subsidiaries has to be viewed with respect to return implications. The majority of approaches proposed in this context are based upon mathematical programming techniques, some of which employ network-type models in order to minimize liquid funds' allocation costs.¹⁰

¹⁰ See, for example,

Rutenberg, D.P.: Maneuvering Liquid Assets in a Multi-National Company, *Management Science* Nr. 10, 1970, pp. B671-B684,

Srinivasan, V.: A Transshipment Model for Cash Management Decisions, *Management Science*, No 10, 1974, pp. 1350-1363,

Shapiro, A.C.: Payments Netting in International Cash Management, *Journal of International Business Studies*, No. 3, 1978, pp. 51-58,

Bergendahl, G.: Multi-Currency Netting in a Multinational Firm, in: Bergendahl, G. (Ed.), *ibid.*, pp. 149-173.

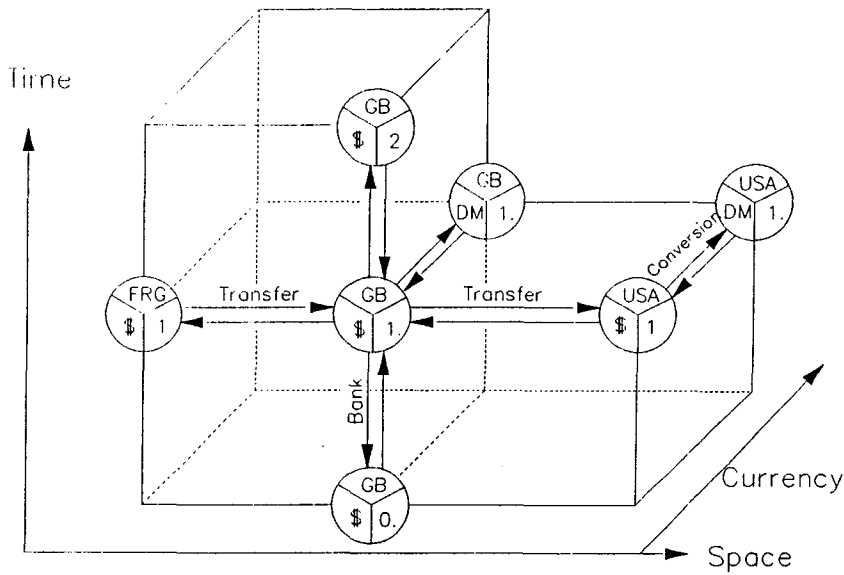


Figure 4: Network Model of an MNC

The idea behind these systems is simple: the multinational company is portrayed as a network, whose vertices stand for possible states of nature of the company's subsidiaries, whereas the edges are supposed to be the set of possible decisions. In a multiperiod framework the model's elements can be thought of as shown in figure 4.

The choice of the state-variables used to identify the vertices (in this case: homecountry, currency denomination and period) depends upon the relevant decisions. Here, the edges (decisions) symbolize borrowing and lending ('Bank'), cash transfers between subsidiaries, and conversion of currencies.

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- Mulvey, J.M.: A Network Portfolio Approach for Cash Flow Management, *Journal of Cash Management*, No. 1, 1984, pp. 46-48,
 Anvari, M.: Efficient Scheduling of Cross-Border Cash Transfers, *Financial Management* 1986, pp. 40-49,
 Anvari, M.: Cash Transfer Scheduling for Concentrating Noncentral Receipts, *Management Science*, No. 1, 1987, pp. 25-38,
 Hinz, H.: A Transshipment-Type Model for the Optimal Allocation of Foreign Currencies in Multinational Corporations, *Management International Review*, Vol. 29, No. 2, 1989, pp. 53-58.

3.2 Return Implications and the Timing of Foreign Currency Cash Flows

Based upon the financial data generated via heuristic planning as in the procedure described above, financial management very often experiences the fact that there is a chance of influencing the timing of cash flows. Financial management's goal can be stated in very simple terms: speed up ('lead') the collection of receivables and slow down ('lag') payments whenever the cost of changing the flow of cash is less than the return (e.g. interest) from this activity.¹¹

In a decision theoretic framework this goal may be stated as a linear objective function:

$$(1) \quad \sum_{w \in M} \sum_{i=1}^n \sum_{j=1}^n W_{ijw} C_{ijw} = MAX!$$

The (non-negative) decision variables W denote those cash positions whose regular dates of payment will have to be changed according to the optimal schedule developed by the model. The coefficients ' C ' consist of at least three elements: exchange rate, borrowing and lending interest rates, and costs of converting currency denominations make up the relative value of the decision variables.

Technically, shifting of payment dates is restricted by the fact that the total cash flow before optimization cannot be different from the one after optimal leading and lagging. In addition, institutional constraints on leads and lags related to currency denominations exist in some countries.¹² Most of them can adequately be modelled through the use of binary variables (Q). Finally, the volume of payments in certain periods could be restricted due to policy constraints (L). Equations of type (2) and (3) will have to be formulated:

$$(2) \quad \sum_{j=1}^n Q_{ijw} W_{ijw} = Z_{ijw}$$

$$(3) \quad \sum_{i=1}^n W_{ijw} Q_{ijw} \leq L_{jw}$$

Laboratory experiments have shown that depending upon the degrees of freedom in deciding upon the payment dates, the model presented can have a substantial

¹¹ For a discussion of 'Leading' and 'Lagging' see, for example, Eiteman, D.K.; Stonehill, A.I.; *ibid*, pp. 218-220, or Austen, M.; Reyniers, P.: *International Treasury Management Handbook*, London 1986, pp. 153-155,

¹² See Eiteman, D.K.; Stonehill, A.I.; *ibid*, p. 221.

impact upon the performance of IFM. In real-life applications, problems with respect to generating the data input needed to run the model may be encountered with respects to the C's. Also, the deterministic structure of the model may be inadequate in case the data are subject to a high degree of uncertainty.

3.3 Risk Implications

Besides return implications, the actions described so far will also have an impact upon the foreign exchange exposure position of the company. Since IFM is concerned with exposures of operating cash flows, mainly 'transaction exposure' matters for decision purposes.¹³ In order to capture the risk implications of internal actions in IFM, different methodological approaches have been proposed.

Aiming at the minimization of net exposure per country of operation, HOLLIS proposes the installation of a 'netting center'.¹⁴ For implementation purposes, a goal programming model is used to ensure that the net amount of foreign exchange cash flows per currency will be minimal. While her approach is easy to implement, it ignores interdependencies between currencies, because in linear goal programming independence of the objective function's elements is assumed. Similar approaches have been used to capture different institutional aspects of the countries involved¹⁵ or to model different organizational setups in IFM¹⁶.

SOENEN, on the other hand, formulates a Markowitz-type model¹⁷, whose objective is to minimize the currency basket's variance subject to some user-defined rate of return.¹⁸ While the model accounts for covariances between

¹³ For an overview of different exposure measuring techniques see Cornell, B.; Shapiro, A.: Managing Foreign Exchange Risks, Midland Corporate Finance Journal, Fall 1983, pp. 16-31.

¹⁴ Hollis, M.S.: A Multicurrency Model for Short-Term Money Management, Management International Review, No. 2, 1979, pp. 23-30, and
Hollis, M.S.; Murray, L.W.: Multinational Banking Exchange Risk Strategies, Management International Review, No. 2, 1985, pp. 5-11.

¹⁵ See Philippatos, G.C.; Christofi, A.: Liquid Asset Management Modeling For Inter-Subsidiary Operations of Multinational Corporations: A Goal Programming Approach, Management International Review, No. 2, 1984, pp. 4-14.

¹⁶ See Hollis, M.S.: Short-term Foreign Exchange Risk Management: Zero Net Exposure Models, Omega, No. 3, 1978, pp. 249-256, and
Hollis, M.S.: A Decentralized Foreign Exchange Risk Model, Management International Review, No. 3, 1980, pp. 53-66.

¹⁷ Markowitz, H.M.: Portfolio Selection: Efficient Diversification of Investments, New York 1959.

¹⁸ Soenen, L.A.: The Optimal Currency Cocktail - A Tool for Strategic Foreign Exchange Management, Management International Review, No. 2, 1985, pp. 12-22.

currencies, their numerical estimation is non-trivial. Also, the nonlinear form of the variance formula increases the computational complexity of the problem. The usefulness of SOENEN'S approach further depends upon the ability of IFM to change the composition of the company's currency basket: the longer the planning horizon, the greater the probability that IFM will be in a position to change the company's currency basket.

4. External Instruments in Centralized IFM

4.1 Institutional Basics

To further adjust prospective cash flows with respect to their risk/return-profile, IFM has a choice of buying or selling cash flows on the international financial markets ('External Measures'). Three instruments are of major importance due to their distinctly different abilities to change the characteristics of foreign currency denominated cash flows: forwards, futures, and options.¹⁹

Traditionally, *foreign currency forwards* have been used to hedge or speculate in the currency markets. They are completed contracts in the sense that, for example, the seller of forward currency has the obligation to deliver the contractual amount at the date specified. Generally, banks will tailor contract specifications to the needs of their corporate clients.²⁰

Futures differ from forwards in that they are standardized contracts which are being traded on securities exchanges.²¹ The advantage to standardization of contracts is obvious: the market's liquidity is generally high, which makes it easy to resell contracts entered into. On the other hand, customers may have problems finding the type of contract that exactly meets their 'special' needs.

As opposed to forwards or futures, *foreign exchange option contracts* produce different risk scenarios, because they imply uncertainty as to whether the owner of the contract will 'exercise' the option at the specified date (european-type option) or during the lifetime of the option (american-type option).²² The owner of a long

¹⁹ For a synopsis of the pros and cons of various hedgers see Abuaf, N.: The Nature and Management of Foreign Exchange Risk, in: Stern, J.M.; Chew, D.H. (Eds.), *ibid.*, p. 43.

²⁰ See, for example, Weston, J.F.; Sorge, B.W., *ibid.*, pp. 94-121.

²¹ See Fitzgerald, M.D.: *Financial Futures*, London 1983.

²² See Giddy, I.H.: Foreign Exchange Options, *Journal of Futures Markets*, Vol. 3, No. 2, 1983, pp. 143-166.

position in call options, for example, is entitled to buy a certain amount of currency in case he wishes to do so. There is no obligation involved. Since option positions, therefore, induce nonsymmetrical risk positions between partners, the person gaining the right to exercise the option has to pay a premium to the option writer in turn.

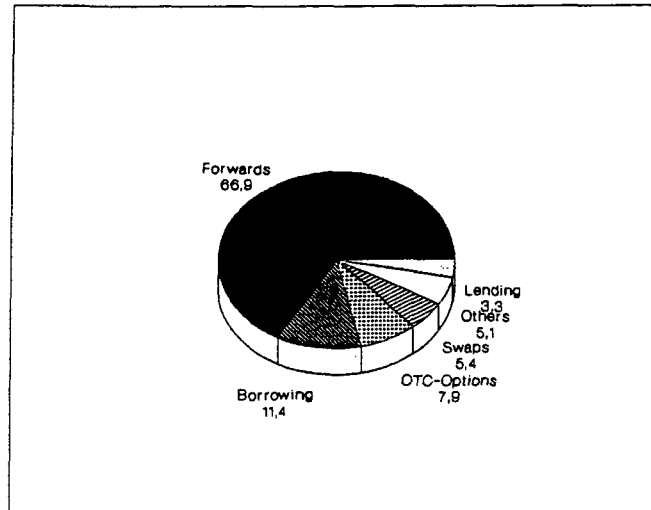


Figure 5: Typical Hedge Portfolio [55 German Industrials]

Empirical research on treasury managements' foreign exchange exposure activities shows that typically a combination of the instruments described is used to manage the corporations' foreign exchange position.²³ The average hedge portfolio of Westgermany's largest multinationals, for example, has been found to have the structure shown in figure 5.²⁴

4.2 The Pricing of Options on Foreign Exchange

The catalyst for some of the major advances in finance theory has been the seminal paper of BLACK/SCHOLES on the derivation of theoretical prices for premiums on stock options.²⁵ Drawing on these findings, GARMAN/KOHLHAGEN have shown that currency options can be valued in a similar framework, thereby laying

²³ See, for example, the interviews of major treasurers in MacRae, D. et al.: Foreign Exchange - Managing Corporate Risk, Euromoney, No. 5, 1990, pp. 138-141.

²⁴ Hinz, H.: Industrielles Devisenmanagement in der Bundesrepublik Deutschland, Österreichisches Bank-Archiv, Vol. 37, No. 8, 1989, p. 766.

²⁵ Black, F.; Scholes, M.: The Pricing of Options and Corporate Liabilities, Journal of Political Economy 1973, pp. 637-654.

the foundation for further development of trading tools in foreign currency options.²⁶

The option's value is a function of several variables. As an example, consider a situation with forward rate ($F = 1.90$ currency units), exercise price ($E = 1.92$ currency units), time to expiration ($t = 0.25$ years), interest rate ($r = 12\%$) and volatility ($\text{Sigma} = .1257$).²⁷

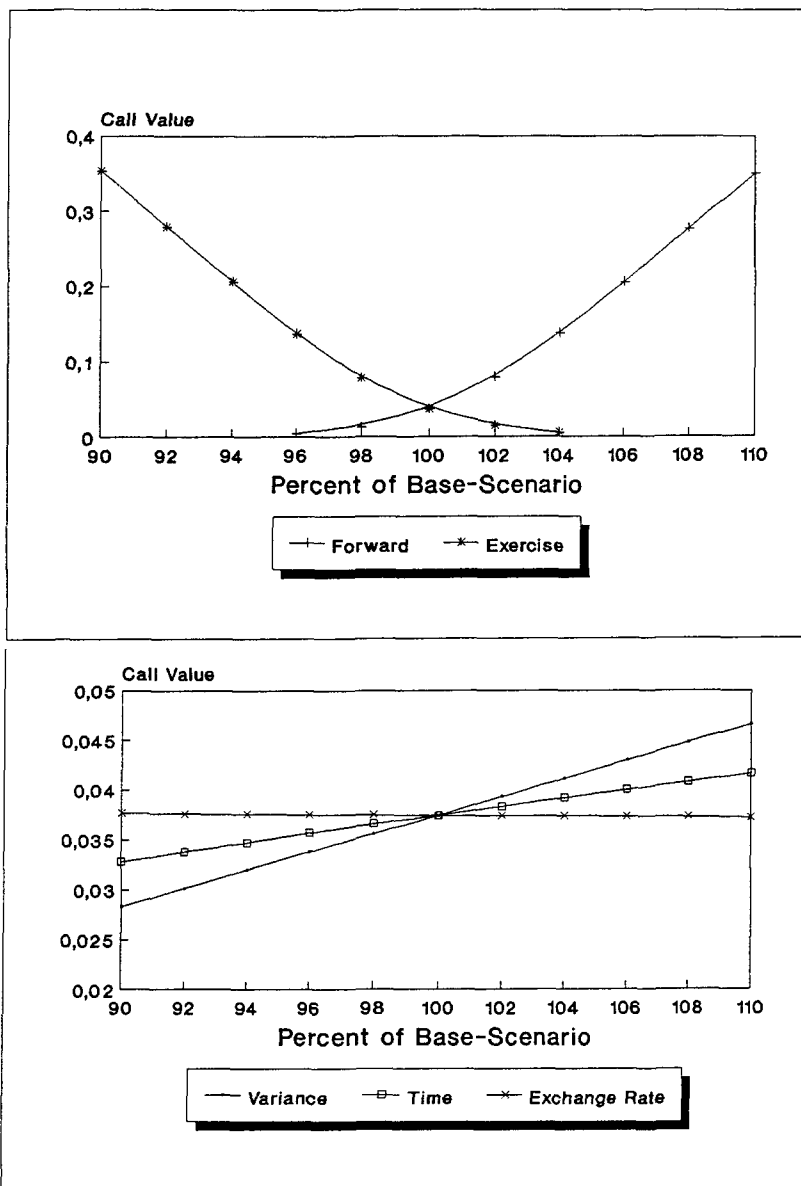


Figure 6: Theoretical Values of Currency Options According to the GARMAN/KOHLHAGEN Model for Different Scenarios²⁸

²⁶ Garman, M.;Kohlhagen, S.: Foreign Currency Option Values, Journal of International Money and Finance 1983, pp. 231-237.

²⁷ See the example in Giddy I.H.: Foreign Exchange Options, The Journal of Futures Markets, Vol. 3, No. 2, p. 162.

²⁸ The partial derivatives of the valuation formula can be found in:

In order to get an impression of the sensitivity of the theoretical call-values with respect to these variables, the base-situation described above has been modified percentagewise, one variable at a time. The resulting diagram is shown in Figure 6. While the impact of changes in forward rate and exercise price on the value of the call is rather strong, the remaining three variables do not seem to have a significant effect.

For industrial treasury management the importance of option pricing models is in the fact that the banks' pricing policies can be controlled in bargaining situations. Also, the company will be in a position to choose rationally among those options which are offered on the exchanges. Therefore, option valuation models should be used by IFM as screening devices before currency options enter portfolio choice considerations as potential alternatives.

4.3 A Mean-Variance-Approach to Exposure Management

It is the aim of exposure management models to aid IFM in the process of managing its portfolio consisting of foreign exchange cash flows and the instruments described above. The models proposed in the literature differ with respect to the magnitude of the set of decisions they can evaluate simultaneously. While some are capable of the isolated evaluation of certain financial instruments,²⁹ others have been built to improve either financing or investment decisions in MNC's.³⁰ Our approach outlined below will be a useful basis for an

Bank for International Settlements (Ed.): Recent Innovations in International Banking 1986, p. 104.

²⁹ See, for example,

Folks, W.R.: The Optimal Level of Forward Exchange Transactions, *Journal of Financial and Quantitative Analysis*, No. 1, 1973, pp. 105-110,

Anderson, B.: Currency-Basket Loans: a Means for Reducing Foreign Exchange Risks, in: Bergendahl, G. (Ed.), *ibid.*, pp. 54-70,

Hinz, H.: Devisentermingeschäfte zur selektiven Absicherung offener Fremdwährungspositionen - ein portefeuilletheoretischer Ansatz, in: Schellhaas, H. et al. (Eds.): *Operations Research Proceedings 1987*, Heidelberg 1988, pp. 374-381,

Sharda, R.; Musser, K.: Financial Futures Hedging via Goal Programming, *Management Science*, No. 8, 1986, pp. 933-947,

Giddy, I.H.: The Foreign Exchange Option as a Hedging Tool, *Midland Corporate Finance Journal*, No. 3, 1983, pp. 32-42.

³⁰ See, for example, Shapiro, A.C.: International Capital Budgeting, in: Stern, J.M.; Chen, D.H. (Eds.), *ibid.*, pp. 165-180, or

Madura, J.: Development and Evaluation of International Financing Models, *Management International Review*, Vol. 25, No. 4, 1985, pp. 17-27.

integrated decision support system with respect to both financing and investment decisions in managing exposure of IFM.

$$\begin{aligned}
 (1a) \quad & \sum_{i=1}^w (CF_i - F_i) * (PR_i - FR_i) \\
 & - \sum_{i=1}^w \sum_{j=1}^p P_{ij} * pp_{ij} \\
 & - \sum_{i=1}^w \sum_{j=1}^p C_{ij} * cp_{ij} \\
 & - \sum_{i=1}^w \sum_{j=1}^p P_{ij} * \min(0, PK_i) \\
 & + \sum_{i=1}^w \sum_{j=1}^p C_{ij} * \max(0, PK_i)
 \end{aligned}$$

Consider, for example, the situation of the treasurer who is faced with the problem of instrumental choice among options and forwards with respect to a given cash flow statement. We may then define the result from financial activities as in equation (1a).

The difference between the treasurer's prognostic (ex ante) exchange rate (PR) and the current (ex post) forward rate (FR) per currency (i) is used to determine the ex ante profit contribution of the so-called 'open position', which we define as the total of all net cash positions per currency (CF = cash flow) after forward transactions (F = forwards). Clearly, anytime the treasurer observes departures from interest rate parity, his estimate of PR will be different from FR.

The profit contribution of currency options is split into two distinct sources: For one thing, premium payments flow between option buyer and option writer for both put-premiums (P= puts in \$, pp= put premium, j= exercise price) and call-premiums (C= calls in \$, cp= call premium). Also, assuming that the options expire at the end of the planning period, their value will be determined by the difference between exercise price (EP) and the then prevailing exchange rate. From an *ex ante perspective*, each call will be worth the difference between the prognostic exchange rate and the exercise price of the call. In case this difference is thought to be negative or zero, the value of the option is zero, too, because the holder of the option has a choice of exercising the option or not. The double summation recognizes the fact that options contracts may be based upon different exercise prices.

The definition discussed so far may very well serve as the objective function to a Markowitz-type portfolio selection approach to exposure management, which maximizes the expected value of the result from financial activities as in (1b):

$$(1b) \quad E(X) = \max!$$

Technically, such a model supports both investment and financing decisions as long as the decision variables (P, C and F) can take on negative as well as positive values. This approach makes sense in case treasury management is entitled to buy or sell options and forwards (different currencies, exercise prices). Also, the formulation lends itself towards a meaningful evaluation of the instrumental usefulness of options vs. forwards. In case some of the cash flows are considered random variables, the model could help answer the question as to whether options can better cope with uncertainty as opposed to forwards.³¹ Furthermore, for arbitrage purposes the model can be used to detect situations where 'put-call-forward parity' does not hold.³²

In order to reduce treasury management's speculative potential, the implementation of policy-constraints seems in place. For one thing, a limit on the portfolio's variance of the following form may be suitable:

$$(2) \quad \text{Variance}(X) \leq V.$$

Equation (2) is meant to set a constant upper limit (V) to the overall variance of the return of the optioned portfolio. In addition to this theoretically sound formulation, less academic restrictions of type (3) can be thought of:

$$(3a) \quad [CF_i \geq 0 :] C_{ij}, FB_i = 0 \forall j, i$$

$$(3b) \quad [CF_i \geq 0 :] FS_i + \sum_{j=1}^p P_{ij} \leq CF_i \forall i$$

For example, in case cash inflows have been planned ($CF_i > 0$), restrictions (3) inhibit treasury management from reinforcing the planned long position in cash through an increase in either long call or forward positions (FB_i) (3a), while (3b)

³¹ See for example, Agmon, T.; Eldor, R.: Currency Options Cope with Uncertainty, *Euromoney*, No. 5, 1983, pp. 227-228.

³² Klemkosky, R.; Resnick, B.: Put-Call Parity and Market Efficiency, *Journal of Finance*, Vol. 34, 1979, pp. 1141-1155.

ensures that the amount in short forwards (FS_i) plus puts is limited by the long cash position.

The theoretical elegance of (2) is bought at the price of high implementation costs, because under real-world assumptions the variance restriction will be nonlinear and analytically quite hard to handle. Restrictions (3), on the other hand, may serve as reasonable heuristic policy constraints which turn the model into a bounded and easy-to-use decision support system.

The model described has been implemented and tested as a prototype yielding promising results.³³ As an example, consider a situation in which the impact of alternative variance estimates of some currency on the hedge portfolio has to be estimated. The changing structure of the hedge portfolio can be depicted graphically and used as a support device by treasury management. Figure 7 shows that the relation between options and forwards in the hedge portfolio shifts in favor of forwards as uncertainty of the price of the underlying increases. The reader should keep in mind that this result is due to the specific model and data structures used and could be different for, say, different options premia.

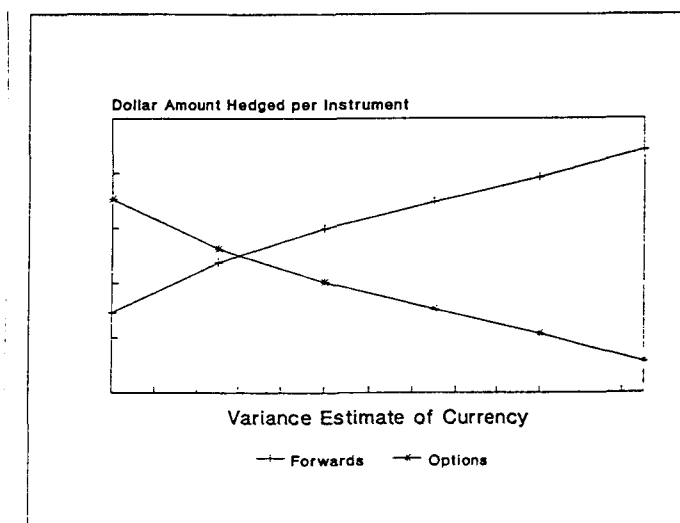


Figure 7: Changing Mix of Options and Forwards as Variance of the Underlying Currency Increases

A mean-variance approach has been presented as one possible way of conducting foreign exchange exposure management. The major advantage is in the fact that it puts the decision-maker in a position to simultaneously evaluate a portfolio consisting of forwards, options and cash flows denominated in foreign currency.

³³ Hinz, H., *ibid.*, p. 236.

5. Conclusion and Outlook

This paper describes relevant decision areas in IFM. Based upon financial information supplied by the subsidiaries, decision models related to internal activities in IFM have been discussed. The majority of these emphasize the improvement of the fund-allocation process. Their ability to rationalize cross-border cash transfers between subsidiaries as well as their flexibility concerning the implementation of institutional aspects turns them into a promising research area for the future. Furthermore, to enhance IFM's performance with respect to risk implications a portfolio-type model has been proposed which may very well serve as the basis for an improved exposure management system in IFM.

Besides theoretical advances in IFM due to model formulation, the prototypical implementation of these models as user-friendly decision support systems has helped to gain further insights into their practical usefulness. Especially the problem of efficiently mixing options and forwards has shown that model formulation and model implementation have to be looked upon as a joint process.

The organizational problem of integrating these different functions in IFM, however, has not been touched upon. The integration process will have to take into consideration different lines of thought: strategic and tactical planning horizons³⁴ as well as different elements in the financial planning process are potential areas subject to planning integration. For strategic planning purposes country risk and political risk will have to be managed through the installation of early warning systems.³⁵ Furthermore, long-term considerations involve capital budgeting decisions³⁶ and the problem of direct foreign investment.

The tradeoff the model builder encounters has been shown to be between simultaneously planning several problem areas for 'global' optimization on the one hand, and - for practical purposes - more precise model building to find 'local' optima in a sequential planning process on the other hand. This is the reason why,

³⁴ See Schmidt, R.: Transnationale Investitions- und Finanzplanung als Portefeuilleplanung, in: Hahn, D.; Taylor, B. (Eds.): Strategische Unternehmensplanung, Würzburg/Wien 1980, pp. 337-355.

³⁵ Schmidt, R.: Early Warning of Debt Rescheduling, Journal of Banking and Finance, Vol. 8, 1984, pp. 357-370.

³⁶ Shapiro, A.: Capital Budgeting for the Multinational Corporation, Financial Management, Spring, 1978, pp. 7-16.

from a methodological perspective, both heuristic, simulation-based approaches and optimization should be considered.

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