Diversifizierung zentraler Währungsreserven in Newly Industrialized Countries

(Diversification of Foreign Exchange Reserves in Newly Industrialized Countries)

von

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Currency

AUD	Australian dollar
CAD	Canadian dollar
CHF	Swiss franc
DEM	Deutsche Mark
DKK	Danish krone
FRF	French franc
GBP	Pound sterling
HKD	Hong Kong dollar
ITL	Italian lira
JPY	Japanese yen
NTD	New Taiwan dollar
SGD	Singapore dollar
THB	Thai baht
USD	Unites States dollar

Others

ASEAN	Association of Southeast Asian Nations
BIBF	Bangkok International Banking Facility
BIS	Bank for International Settlements
BNL	Banca Nazionale del Lavoro
CAEC	Council for Asia-Europe Cooperation
CAPM	Capital Asset Pricing Model
CEPII	Centre d'Etude Prospectives et d'Informations Internationales
EMS	European Monetary System
EMU	European Monetary Union
EZB	Europäische Zentralbank
GSIC	Government of Singapore Investment Corporation
IFS	International Financial Statistics

IMF	International Monetary Fund
MAS	Monetary Authority of Singapore
NBER	National Bureau of Economic Research
NIC	Newly Industrialized Country
OECD	Organization for Economic Co-operation and Development
PRC	People's Republic of China
ROR	Rate of Return
ROW	Rest of the World

1. INTRODUCTION

There are two basic aspects of discussions concerning reserve management, i.e.,

- what factors influence the actual and optimal level of monetary reserves, and
- what factors influence the actual and optimal currency composition of monetary reserves for a given level of these monetary reserves.[1]

In 1960 Triffin[2] posed the dilemma of a dollar-exchange standard. According to Triffin, the demand for monetary reserves was growing faster than the supply. This problem could be solved by the U.S.A. continuing its deficit, but would however progressively undermine confidence in the USD and provoke massive attempts to convert the USD into gold. The logical consequence is a system collapse. On the one hand, it was an inadequacy or slow increase of monetary reserves to initiate an intensive discussion about the demand for them and their optimal level for the central bank. On the other hand, the danger of the system collapsing through the substitution of gold for the USD also sparked a considerable theoretical and empirical literature concerning the composition of monetary reserves.[3]

The discussions in the 1960s have identified many important determinants of the demand for monetary reserves and provided us many measures for their adequacy, whose application is still widely spread. The topical concerns of these discussions have not experienced any basic changes since the 1960s. In contrast to the discussions concerning the demand for monetary reserves, the topical concerns of the theoretical and empirical literature about the composition of monetary reserves have undergone several great changes.

In the 1960s the subject matter was, whether the dollar exchange standard would be viable indefinitely, or whether the portfolio policy of central banks was motivated by independent portfolio management or dominated by cooperative restraint intended to prevent a system collapse. A formal model of the dollar exchange standard's development constructed by

[1] Cp. Miller, N.C. (1995), p. 60.
[2] Triffin, R. (1960).
[3] Cp. Williamson, J. (1973).

Kenen[4] denied the possibility of indefinite viability, although empirical evidence[5] showed that cooperative restraint of the gold-conversion policy was implemented between the major central banks. The USD and the gold played the main roles in discussions during this period.

In the late 1970s a sharp shift on the part of central banks towards holding reserve currencies other than the USD was believed to have contributed to the depreciation of the USD. Some feared that this development might destabilize financial conditions in the international monetary system. This provoked the international debate of 1979 about whether and how SDRs might be substituted for the 'dollar overhang.'[6] A trend towards diversification of monetary reserves began to be suggested as a natural evolution for several reasons, for example, the polycentrilization of the world economy, the switch of exchange rate arrangement in many countries, the expansion of international capital markets, and increased depth in foreign exchange markets. All these reasons suggested the relative importance of the USD and gold as monetary reserves would diminish. The main role in the discussions was played no more by the USD and gold, but by the USD and other reserve currencies, i.e., the DEM, the JPY, and the GBP. The problem of reserve diversification concerned more the official foreign exchange reserves than the entire monetary reserves since then.

In the 1980s the issue of reserve diversification lost much of its earlier interest. One of the main reasons is that the currency composition of aggregate foreign exchange reserves seems to have been relatively stable since 1980.[7]

In the late 1990s monetary union in Europe held the promise of profound change for international finance. The issue of reserve diversification regained its earlier interest among researchers and practitioners under the influence from the European Monetary Union. A single currency, the Euro, circulates in the economies, which together as a whole face the world as the largest single-currency area and the largest single trading bloc. It is believed that the Euro will share the relative importance of the US dollar as a major international currency in the long run.

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[4] Kenen, P.B. (1960).
[5] Kenen, P.B. (1963).
[6] Horii, A. (1986), p. 3.
[7] Horii, A. (1986), p. 3.

This development is of special interest for Newly Industrialized Countries, which have accumulated huge monetary reserves because of long-term current account surpluses or capital inflows. Thus, the main purpose of this dissertation is to solve the following question: how will the emergence of the Euro influence the currency composition of the NICs' monetary reserves?

Taiwan and Thailand are chosen as our investigation subjects. Why our investigation focuses on these two NICs is based on the fact that they are two extreme examples of the spectrum of the Asian Crisis of 1997. Some determinants of their reserve management might play some roles for the Asian Crisis' outbreak. An investigation of these determinants could provide us an explanation for the Asian crisis at the same time.

The second chapter of this dissertation defines the concept of monetary reserves. We derive also their functions from the balance of payments and the central bank balance sheet. Since monetary reserves are only one dimension of international currency use and depend on other dimensions, an investigation about the reciprocal relationship between them is necessary. The conditions, which an international currency should satisfy, are enumerated and analyzed subsequently.

The third chapter identifies central banks' motives for reserve holdings according to Keynes' theory. The transaction motive and the precautionary motive are categorized as intervention-related motives. They are all based on the functions of monetary reserves, for which the concrete operation is foreign exchange market intervention. Portfolio-related motives are based on the function of monetary reserves being a part of foreign assets. We will justify these motives theoretically.

In the fourth chapter we review some important previous studies concerning the currency composition of monetary reserves. On the basis of them, a distinction between transaction balance and idle balance is made. According to this distinction we find there are two levels of monetary reserves' diversification. The framework and basic assumptions for empirical study are also derived from foregoing considerations.

The transaction balance is made of intervention currencies. The choice of intervention currencies is dependent on the choice of foreign exchange vehicle currency and the choice of pegging currency. The fifth chapter will be completely devoted to the issue about the choice of foreign exchange vehicle currency. Several foreign exchange vehicle theories will be discussed, which illustrate the main factors influencing the emergence of the foreign exchange vehicle currency.

We carry out the empirical investigation in the sixth chapter. The author first tries to give a possible explanation for the Asian Crisis, which happened while the author was writing this dissertation and is an important disturbing factor for our empirical investigation. The main factors influencing reserve management from intervention-related motives are then analyzed. We will estimate the perspective of the Euro as a foreign exchange vehicle currency for our two NICs' central banks and we will investigate the nature of exchange rate regimes in two NICs. We examine also their structure of payments. In order to answer the question about diversification of monetary reserves as idle balance in the two NICs, we carry out an analysis of the portfolio approach, which is based on the basic ideas of Tobin-Markowitz model. Firstly, we try to find the scope for diversifying monetary reserves as idle balance in the two NICs. We then employ historical data to estimate rates of return on the USD and the Euro and their statistical characteristics and try to find their implications.

In the seventh chapter we will review the foregoing investigations. The purpose is to find out how the author has organized his dissertation and the political implications behind all of these theoretical and empirical investigations. Finally, we reach a conclusion for all of them.

2. MONETARY RESERVES AS ONE DIMEMSION OF INTERNATIONAL CURRENCY USE

In this chapter's first section the concept of monetary reserves is clearly defined. We also explain why we put the main focus only on a part of monetary reserves, i.e., official foreign exchange reserves. The second section derives four functions of monetary reserves from the balance of payments and the central bank balance sheet. The third section investigates the different functions of international currency and their relationships. In the fourth section the conditions, which an international currency should satisfy, are enumerated and analyzed in detail. We get, however, no consistent result. The fifth section indicates some deficiencies confronted by traditional international currency theory and shows a possible way toward an international currency theory.

2.1. Definition of monetary reserves

Table 2-1: Central Bank Balance Sheet

Assets	Liabilities
Monetary reserves	Currency in circulation
Domestic assets	Minimum cash reserves
	Excess reserves
	Money market instruments held by commercial banks

First of all, the concept of monetary reserves should be clearly defined and let us begin with the central bank balance sheet. Monetary reserves, which represent the central bank's claims against other countries, are on the asset side and are a part of gross assets held by the central bank. In general, a separation between a country's monetary reserves management and foreign debt management is assumed. This means that central banks manage only gross assets of a country against the rest of the world. Therefore, the liabilities of a central bank do not include foreign debt.

Table 2-2: Components of Monetary Reserves

Monetary reserves				
Non-gold reserves				*Gold-reserves*
Foreign exchange		*IMF*	*SDRs*	
Reserve currencies	very liquid interest earning assets denominated in reserve currencies	*reserve positions*		

Source: Cp. BIS (1988), table 1

The components of monetary reserves are identified in table 2-2. Firstly, a distinction is made between non-gold reserves and gold reserves. Non-gold reserves are in turn subdivided into foreign exchange, IMF reserve positions and SDRs. We will put the main focus on only one item among those mentioned above, namely, foreign exchange reserves. That is based on the following reasons:

- Gold reserves have lost their role as a medium of exchange between IMF and its member countries since a long time ago.[8]

- Taiwan, one of the dissertation's two investigated countries, is not a member of IMF. For this reason, it owns no SDRs and no IMF reserve positions. The level of its Gold reserves has not changed since 1989.[9]

Foreign exchange reserves consist of reserve currencies and very liquid interest-earning assets denominated in reserve currencies. That means that it is not necessary for a central bank to hold foreign cash as their foreign exchange reserves, because they can hold very liquid interest-earning assets denominated in reserve currencies, for example, foreign countries' government bonds.[10] One important characteristic of these two items is that they can be either

[8] "*Durch die Spaltung des Goldmarktes 1968 sind die monetären Goldbestände als Mittel zum Zahlungsbilanzausgleich de facto immobilisiert worden. Die zehn Jahre später in Kraft getretene zweite Änderung der IMF-Übereinkommens legaliesierte die seit 1973 bestehende Währungspolitische Praxis und bewirkte somit die Veränderung des Goldes aus den internationalen Währungsbeziehungen. Das Gold verlor seine Funktion als gemeinsame Bezugsgrößee, sein offizieller Preis wurde abgeschafft sowie seine Verwendung als Zahlungsmittel zwischen dem IMF und dessen Mitgliedern ausgeschlossen.*" See Dehmel, A. (1982), p. 70

[9] Central Bank of China owns 410 tons of gold as reserves. The share of her gold reserves is about 20% of monetary reserves. See 工商時報, Economic Daily News, Sep. 30. 1997.

[10] Miller, N.C. (1995), p. 65.

put into intervention by the monetary authority directly or converted into reserve currencies for intervention with only negligible loss.

Official foreign exchange reserves are thus here defined as gross assets denominated in reserve currencies and held by the monetary authorities, which can be used to intervene directly or indirectly in foreign exchange markets without loss or with only negligible loss.[11]

2.2. Functions of monetary reserves

From the balance of payments and the central bank balance sheet we can derive four functions of monetary reserves.

- Firstly, the most elementary and the most repeated function of monetary reserves is to finance the balance of payments imbalances, or to settle the net balances of a country's international payments.[12] In less formal usage, the balance of payments is the sum of the current account balance, the capital account balance and the statistical discrepancy. It indicates the payments' gap that the monetary authority needs to cover by changing the volume of monetary reserves.[13] Individual payments of international transactions, which include current account transactions and capital account transactions, are made by other economic units than the central bank, such as firms and households. The central bank holds monetary reserves not in view of its own transactions, but as a buffer stock against net balances in transactions of other economic units, which cannot be settled by other economic units themselves. The need of the central bank to make such payments arises from balance of payments identity, which required some balancing item to cover imbalances on the current and capital accounts.[14]

  Such function of monetary reserves as a buffer stock presupposes the function of reserve currencies as a medium of exchange. A balance of payments imbalance indicates the pressure of adjusting either the volume of monetary reserves, or the foreign exchange rate, or the volume of the current account transactions and/or the capital account

[11] Cp. Jarchow, H.J., and Rühman, P. (1989), p. 143.
[12] Cp. Polak, J.J., (1970), p.511.
[13] Krugman, P.R. and Obstfeld, M. (1991), p. 308.
[14] Landell-Mills, J. M. (1989), pp. 709-710.

transactions. Changing the volume of monetary reserves can avoid the costs of adjusting other variables.

- Secondly, the central bank holds and manipulates monetary reserves as a means of managing exchange rates, in order to avoid the costs of adjusting other variables, or even to increase the welfare of their country. For example, they can either draw down their monetary reserves to prevent the domestic currency from devaluation or accumulate their monetary reserves to keep their domestic currency undervalued. To prevent the domestic currency from devaluation means the attempt to avoid the costs of adjustment at a given foreign exchange rate of the domestic currency and at a given domestic interest rate. To keep the domestic currency undervalued means the attempt to keep the current account continuously positive.

  Following the balance of payments theory of exchange rates, the current account is influenced by the exchange rate because it changes relative prices and thus competitiveness.[15] An undervalued domestic currency means an increase of net exports and thereby a current account surplus. A continuous positive current account balance allows countries to raise their standard of living and the rate of economic growth.[16]

- Thirdly, the central bank can change the volume of monetary reserves to alter the domestic money supply. High power money is the sum of currency in circulation, minimum cash reserves and excess reserves. The two sides of the central bank balance sheet are equal, that is, the sum of monetary reserves and domestic assets equals the sum of monetary liabilities, i.e., the sum of high power money and money market instruments held by commercial banks. When the central bank buys (sells) monetary reserves from the public, both its assets and liabilities increase (decrease). If the central bank stops at that point, the reserve transaction is said to be non-sterilized. This sort of monetary reserve transaction is similar to a domestic open market operation in its impact on high power money. The only difference is that the central bank can alter high power money through a change in their foreign asset holdings (rather than monetary liabilities).[17]

[15] Dornbusch, R. (1980), p. 8.
[16] Cp. Miller, N.C. (1995), p. 72 and genannt Klaßen, M.L. (1993), p. 57.

Table 2-3 highlights the impact of non-sterilized reserve transaction on the balance sheet. An increase (decrease) of monetary reserves leads to an increase (decrease) of high power money, ceteris paribus. Changing the volume of monetary reserves means injecting high power money into the economy or withdrawing it from circulation, and affecting macroeconomic conditions at last.[18] Table 2-4 shows the impact of an open market operation on high power money. A decrease (increase) of money market instruments leads to an increase (decrease) of high power money, ceteris paribus. Therefore, monetary reserve transactions can be used by the central bank actively as an instrument of monetary policy and as a substitute for open market policy. More often, official reserve transactions are not autonomic, but rather induced.

Table 2-3: Monetary Reserve Transaction without Sterilization

Assets		Liabilities	
Monetary reserves	+(-)	High power money	+(-)
Domestic assets	0	Money market instruments held by commercial banks	0

Table 2-4: Open Market Operation

Assets		Liabilities	
Monetary reserves	0	High power money	+(-)
Domestic assets	0	Money market instruments held by commercial banks	-(+)

The concrete operation for the above three functions is intervention in the foreign exchange market. An intervention is defined as an outright sale or a purchase of reserve currencies in the foreign exchange markets by the monetary authorities.[19]

- Fourthly and finally, monetary reserves are a part of gross assets held by a central bank and at the same time by an economy as a whole.[20] They are a store of national wealth. If it is necessary, monetary reserves can serve as collateral or as a "sweetener" for external

[17] Cp. Edison, H.J. (1993), p. 9.
[18] Krugman, P.R. and Obstfeld, M. (1991), p. 308.
[19] Almekinders, G.J., and Eijffinger S. C.W. (1991), p. 32.
[20] Cp. Kern, M. (1976), p. 131.

borrowing.[21] They represent also the claims of a central bank against other countries. Leaving aside the unidentified item, every monetary reserve transaction is systematically recorded both in holders' and liability reports. Consequently, every change in monetary reserves in holders' reports should have corresponding changes in liability reports and vice versa. The counterpart items to changes in monetary reserves are

- current account deficit,
- capital account outflows and
- changes in reserve assets of reserve currency countries.[22]

An investigation about the relationship between monetary reserves and their counterpart items should be the key in solving the so-called Triffin's dilemma.

2.3. Functions of international currencies

Monetary reserves consist of reserve currencies and very liquid interest-earning assets denominated in reserve currencies. The reserve currency's role is only one dimension of its role as an international currency and is not independent of other dimensions. An investigation about the currency composition of monetary reserves implies an investigation about the reciprocal relationship between the different dimensions of its role as an international currency at the same time.

An international currency is a currency which is used by non-residents for purpose not necessarily related to domestic considerations[23] and therefore fulfills three basic functions of money in the international monetary system. The three basic functions are medium of exchange, store of value, and unit of account. Medium of exchange is the first of these functions. The other two functions stand on a different footing from the medium of exchange function.[24] Any medium of exchange must be a store of value and also implies a unit of account. On the contrary, many stores of value, e.g., 10-year Treasury bonds, and units of

[21] Horii, A. (1986), p. 40.
[22] Cp. BIS (1988), p. 37.
[23] Funke, N., and Kennedy, M. (1997), p.25.
[24] Dornbusch, R. and Fischer, S. (1984), pp. 249-250.

account do not circulate as media of exchange.[25] The following table summaries the functions of international currencies.

Table 2-5: Functions of International Currencies

	Private use			Official use
Int'l medium of exchange function	Substitution currency	International transactions vehicle	Foreign exchange vehicle	Intervention currency
Int'l unit of account function	Quotation currency			Pegging currency
Int'l store of value function	Investment currency			Reserve currency in the narrow sense

Source: Cp. Talvas, G. (1991), p. 2 and Hartmann, P. (1996), table 2.

- **International medium of exchange functions**

A country's currency could be used for the local transactions in another country. Such international currency is called a substitution currency. International currency as a medium of exchange is also used by residents of two different foreign countries to settle their current account and capital account transaction contracts with each other. In such a situation it is designated as international transactions vehicle in the narrow sense. The currency of one of the two counterparts can be used for the settlement of their international transaction contracts. In such a situation it is designated as international transactions vehicle in the broad sense.[26] The structure of payments, i.e., payment flows between countries, depends upon the choice of international transactions vehicle, which is in turn determined by fundamental trade and investment motives.

In foreign exchange markets many transactions originally intended to exchange one currency against another are actually undertaken in two transactions in the interbank

[25] Hartmann, P. (1996), p.4.
[26] Hartmann, P. (1996), p. 4-5.

market; first an exchange of currency one against a foreign exchange vehicle and then an exchange of the foreign exchange vehicle against currency two.[27] The structure of exchange, which refers to the actual transactions on the foreign exchange markets, is determined by the structure of payments.[28]

Official agents, e.g., central banks, conduct transactions in foreign exchange markets. Central banks may sell or buy foreign currencies to influence the exchange rate. Foreign currencies held for intervention are usually called intervention currencies. In order to minimize transactions cost, central banks usually hold the foreign exchange vehicle currencies as intervention currencies. On the other hand, it is undeniable, that the choice of pegging currencies is also the dominant factor affecting the choice of intervention currencies. Other things being equal, the central bank of a country will tend to hold more of its transactions balance in the form of a given currency, if its domestic currency pegs to it.[29] The choice of intervention currencies is therefore not only dependent on which currencies are used as foreign exchange vehicle currencies, but also on the nature of the foreign exchange rate regime.

- **International unit of account functions**

Inside a country, prices of commodities and services are quoted and aggregated in the national currency. With the national currency as an unit of account we can also make price comparisons.[30] International currency is used as a unit of account in invoicing international trade, denominating financial instruments, and used by official agents to define exchange rate parities.[31] In the following chapters, we label international currency that invoices international trade or denominates financial instruments as the quotation currency, and international currency that defines exchange rate parities as the pegging currency.

[27] Hartmann, P. (1996), p. 5.
[28] See Krugman, P. (1980).
[29] Eichengreen, B. and Frankel, J. A. (1996), p. 351.
[30] Kindleberger, C.P. (1981), p.13.
[31] Kwan, C.H. (1994), p. 158.

International medium of exchange and international unit of account functions usually go hand in hand.[32] For example, once a contract is denominated in the exporter's currency, its currency is usually the medium of exchange. Sometimes, measures can be taken to hedge foreign exchange risk, but at the time of settlement, payment is typically made and accepted in the same currency.[33] Therefore, it is usually assumed that the quotation currency and the international transaction vehicle currency for an international transaction are identical. For this reason, the choice of quotation currency, as well as the choice of international transaction vehicle currency, is determined by fundamental trade and investment motives and influences the choice of foreign exchange vehicle currency. Likewise, the choice of pegging currency in a country is at least partly determined by its current account factors and capital account factors and is in turn a determinant for the choice of its intervention currency.

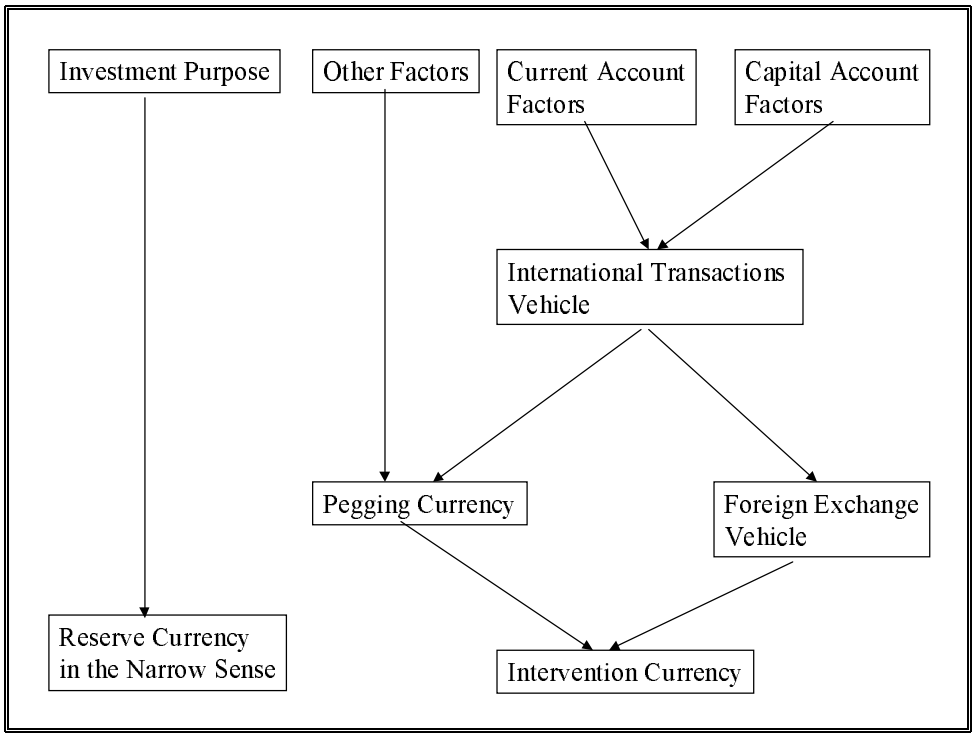
- **International store of value functions**

A store of value is an asset that maintains value over time and can be used to make purchases at a future date.[34] An international currency as a store of value serves as an investment asset held by economic agents.[35] Central banks may hold an international currency and financial assets denominated in it may be held as foreign exchange reserve for investment purpose.[36] An international currency as a store of value is designated as investment currency, when held by private agents, and as reserve currency in the narrow sense,[37] when held by central banks.

The author summarizes some of the above-mentioned relationships, which are relevant for further discussion between different functions of international currency in the following figure. The arrows indicate the causal relationships. For simplicity, the feedback effects, which are developed in a dynamic process, will not be taken in account. For example, the choice of international transactions vehicle is actually influenced by the choice of the pegging currency and foreign exchange vehicle. Nonetheless, these causal relationships are ignored.

[32] Alogoskoufis, G. and Portes, R. (1997), p. 66.
[33] Talvas, G. (1991), p.6.
[34] Dornbusch, R. and Fischer, S. (1984), p.250.
[35] Cp. Kwan, C.H. (1994), p. 158-159.
[36] Cp. Talvas, G. (1991), p.2.

Figure 2-1: Relationships between Different Dimensions of International Currency Use



2.4. Determinants for international currency use

this section discusses determinants for the international currency use. We begin with some general considerations, according to which determinants for international currency use will be classified under three groups. They are necessary conditions, sufficient conditions and promotional mechanisms. In the subsequent subsections we apply the above determinants as the indicators to estimate the Euro's perspective as an international currency.

2.4.1. General considerations

Two question can be raised here: Which conditions must be satisfied before a currency can be used internationally?[38] How far will the Euro, in relation to the USD, fulfill these conditions?

[37] In another place of this dissertation the author designates the foreign currencies held as foreign exchange reserves as reserve currencies, independent of for which purpose they will be used.

Following Talvas,[39] we classify relevant conditions, which are determinants for international currency use, under three groups. They are necessary conditions, sufficient conditions and promotional mechanisms.

The first group is the necessary conditions, which signify confidence in the value of the candidate currency and must be fulfilled by its issuing country. If these conditions deteriorate, it is impossible for the candidate currency to be used as an international currency, no matter how well the issuing country satisfies the other conditions. Better fulfillment of such conditions, however, does not indicate a more important role of a candidate currency as an international currency. For this reason, how far the Euro fulfills the necessary conditions will not be quantitatively measured. We will only show whether the Euro could be qualified as a candidate currency. The necessary conditions include the following candidates:

- internal and external stability,
- capacity and willingness of the issuing country, and
- open financial markets.

The second group is the sufficient conditions. They signify the issuing countries' relative economic importance in the world and determine the relative importance of various international currencies, such as which currency can better fulfill them and better function as an international currency. For this reason, they will be quantitatively analyzed, when it is possible. They could include the following conditions:

- deep and broad financial markets and
- the issuing country's economic size.

The third group is the promotional mechanisms. For example, a current account surplus over a protracted period can serve as a promotional mechanism for the international use of a nation's currency. The net export of capital can induce non-residents to acquire the candidate currency balances in order to service their obligations denominated in this currency. Another reason is that the importer needs claims in the exporter's currency so that they can pay for imports from the surplus country. This process also enhances the candidate currency's

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[38] For discussions about these conditions see also Issing, O. (1997), Dehmel, A. (1982), Talvas, G. (1991), Siglienti, S. (1981), Bergsten, C.F. (1997).
[39] Talvas, G. (1991).

international use.[40] Since a current account surplus is only a promotional mechanism, its erosion does not necessarily undermine the international use of a currency.

In the succeeding subsections we will discuss the necessary conditions and sufficient conditions in detail. An analysis of promotional mechanisms will be ignored in the subsections in this chapter, since they are not determinants for a currency's international use. It does not mean, however, that such an analysis will be ignored in this dissertation, because an issuing country's current account imbalance might in influence its currency's expected rate of return.[41]

2.4.2. Necessary condition for the Euro as international currency: its Internal and external stability

Economists have traditionally associated a currency's performance with its value or quantity. The average rate of a currency' inflation or its predictability are used as a proxy for its money quality.[42] It is said that a high inflation rate or a high degree of uncertainty around that expected inflation rate increases the costs of holding a currency as an international store of value and even as a medium of exchange, because international transactions often entail a lapse of time between the initiation and completion of a transaction. As purchasing power parity theory suggests, the developments of the price level and foreign exchange rate are closely related with each other. Moreover, the external stability is a minor image of the internal stability.[43] Relatively high and/or variable rates of inflation lead to exchange rate depreciation and variability, and that increase the costs of acquiring information and making efficient calculations about the prices for tradable goods and capital assets.[44]

An interesting finding from Padoa-Schioppa and Papadia's work[45] is that the currency composition of industrialized countries' monetary reserves seems to have no correlation with the money quality of reserve currencies. The two authors used the average rate of inflation as

[40] Talvas, G. (1991), p.11.
[41] Cp. 6.3.2.
[42] See Klein, B. (1974), and Padoa-Schioppa, T. and Papadia, F. (1984).
[43] Müller, H. and Straubhaar, T. (1998), p. 284.
[44] Talvas, G. (1991), p. 3-4.
[45] Padoa-Schioppa, T. and Papadia, F. (1984).

the proxy for money quality. There are several possible explanations for this finding.[46] In the context of international currency use, a currency's inflation rate and/or predictability influence indirectly the mean and variance of its exchange rate, or eventually the mean and variance of its rate of return. The transaction costs of an international currency might be determined by other factors than its inflation rate or predictability. It is nonetheless unreasonable that a currency with hyper-inflation could be used as an international currency. Therefore, the internal and external stability should be regarded as necessary conditions rather than the major determinants for international currency use.

Because of its political independence, the ECB is expected to be able to strictly follow the objective of a stable price level. The Maastricht treaty also favors price stability with the potential conflict against the objectives, which the ECB pursues.[47] Therefore, an extreme expansionary monetary policy of the ECB could be only that which has a low probability. An extreme high inflation rate, which exceeds the baseline and deteriorates the Euro's fulfillment of necessary conditions, is thus not likely in the Euro Area.

Artus[48] has analyzed several scenarios concerning price stability after unification. Following him, when an ECB, which mostly aims at stabilizing inflation, is assumed, two relevant scenarios can be described as follows:

- If, before unification, the monetary policies pursued in other European countries than Germany were expansionary, and if their main effect was to devalue their local currencies against the DEM, the Bundesbank had to implement a rather stimulating policy to stabilize the DEM, and EMU will tighten the monetary policy in the Euro Area.[49]
- If the Bundesbank was mostly concerned about price stability, it could decrease import prices by revaluing the DEM against other European Countries. However, after unification such a policy is not applicable any more. The EMU can imply therefore a more restrictive monetary policy.[50]

Artus' research points out that at least a severe deterioration of price stability in the Euro Area is not likely to happen after unification. This is under the condition of no matter how

[46] "*First, the central banks of industrialized countries are not profit-maximizers. Second, the role of the dollar in official uses remains more dominant than in private uses.*" Padoa-Schioppa, T. and Papadia, F. (1984), p. 86-87
[47] Fußhöller, T. (1997), p. 59 and Thiel, E. (1998), p. 8.
[48] Artus, P. (1996).
[49] Artus, P. (1996), p.30.

restrictive or expansionary the Bundesbank would implement its monetary policy, which is in turn under the condition that the monetary policies in other European countries than Germany were expansionary.

The question of the Euro's external stability breaks into two issues: the volatility of the bilateral USD/EUR rate and the volatility of the Euro with respect to non-USD currencies. Two policy arguments suggest a more stable USD/EUR rate than a USD/DEM rate in the euro area.[51]

Firstly, the exchange rate policy remains the prerogative of the European Council.[52] If there are differences of national preferences for an exchange rate policy, the collective determination of a united exchange rate policy in the European Council could increase the policy weight placed on exchange rate stability. The DEM has displayed somewhat higher volatility than its neighboring currencies. If this reflects policy preferences, rather than mere size differences, the Euro's managers might be expected to try harder to stabilize the Euro than the DEM's managers have tried to stabilize the DEM.[53]

Interest rate policy in the Euro Area indeed responds to business conditions in a large heterogeneous area rather than to conditions in one country. Business cycles in countries with such a large area like the Euro Area are not always positively correlated. Sometimes they counterbalance each other. In fact, before the 1990s, the output gap of the EU as a whole swung less widely than did the output gap for Germany. This suggests the potential for a more stable interest policy in the Euro Area as a whole more so than Germany.[54] A more stable interest rate policy implies a more stable foreign exchange rate policy.

The Euro's exchange rate volatility in relation to non-USD currencies will to some extent depend on the exchange rate regime in these non-USD countries. When these countries peg their local currencies to the Euro, the volatility of the Euro against these currencies will be low. A low external volatility is a result rather than a cause of Euro-pegging, which is in turn partly

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[50] Artus, P. (1996), p. 30.
[51] McCauley, R.N. (1997), p. 46-47.
[52] Rose, F.J. (1997), p. 222.
[53] McCauley, R.N. (1997), p. 46-47.
[54] McCauley, R.N. (1997), p. 46-47.

determined by the Euro's role as a major international transaction vehicle and partly by international agreements.

"*Under floating one could expect a higher volatility of the euro exchange rates as compared to ecu exchange rates, since the character of the ecu as a basket of different currencies implies some diversification effects which would vanish with the disappearance of these currencies.*"[55] That the Euro's higher volatility than that of the ecu would be an obstacle for it to become a major foreign exchange vehicle currency is hardly justified. It is nearly impossible to measure whether such a higher volatility would exceed the line base and mean a lost of confidence.

2.4.3. Necessary condition for the Euro as international currency: its supply and Triffin's dilemma

Regarding the internationalization of the Euro, ECB's attitude is very neutral: "*Da die internationalisierung des Euro an sich kein Ziel der einheitlichen Geldpolitik ist, wird das Eurosystem die Internationalisierung seiner Währung weder forcieren noch blockieren.*"[56] Can this neutral attitude be justifiable or only an unfounded political announcement?

Issuing the international currency is supposed to bring seigniorage to the issuing country, the ability to finance balance of payments deficits with liabilities in its own domestic currency which other countries will accept without an effective limit. This means that the issuing country has considerable freedom to avoid correcting the deficit. Despite this advantage, both Germany and Japan resisted the international use of their currencies for fear that high and fluctuating demand for them would have destabilizing effects on their domestic price level.[57] More important is that "*Both governments ... wanted to avoid the conflict between the provision of liquidity and the preservation of confidence that had plagued the dollar, and in a different sense, the pound sterling.*"[58] This conflict is known as Triffin's dilemma.

[55] Hartmann, P. (1996),. P. 23.
[56] EZB (1999), p. 35.
[57] Eichengreen, B. and Frankel, J.A. (1996), p. 362.
[58] Henning, R. (1994), pp. 317-319.

According to Triffin, the demand for international currency is growing faster than the supply. This problem could be solved by the U.S.A.'s continuing trade deficit, which would however progressively undermine confidence in the USD and provoke massive attempts to convert the USD into gold. The logical consequence is the system collapsing. Will the EMU be confronted by Triffin's dilemma, if the Euro is used as the international currency? Before answering this question, we should be sure that it is a correct question. In the author's view the correct question might be whether Triffin's dilemma still exists after the collapse of the Bretton Woods system.

The Bretton Woods system had a special feature: Monetary reserves in the rest of the world were made of only gold and the USD, which was the only major currency that was freely convertible. That is, the USD is the only international money. In addition, there was no capital mobility.

The U.S.A. could finance its trade deficit by exporting either gold or USD. However, the supply for international currency could be increased only the rest of the world could accumulating monetary reserves, i.e. Monetary Reserves-USD, by increasing the U.S.A.'s liabilities to the rest of the world, i.e. Currency-USD held in ROW. In other words, only when the U.S.A. financed its trade deficit by issuing more USD could the supply for international currency then raise. The following table describes this situation. We utilize a model of two countries, i.e., the issuing country (the U.S.A.) and the rest of the world (ROW), for illustration.

Table 2-6: International Money Supply without Capital Mobility

Central Bank Balance Sheet of the Issuing Country (the U.S.A.)

Assets		Liabilities	
Domestic Assets	(+)	Foreign Liabilities-Currency(USD) held in ROW	(+)

Balance Sheet of the Commercial Banks in the Issuing Country(the U.S.A.)

Assets	Liabilities
	Liabilities for the U.S.A.'s Central Bank (+)
	Foreign Liabilities on ROW' Commercial Banks (-)

Central Bank Balance Sheet of the Rest of the World

Assets	Liabilities
Monetary Reserves-USD (+)	Currency-ROW (+)

Balance Sheet of the Commercial Banks in the Rest of the World

Assets	Liabilities
Domestic Assets-Currency(ROW) (+)	
Foreign Assets-Claims on the U.S.A.'s Commercial Banks (-)	

Firstly, the trade imbalances were settled by the commercial banks of both countries. The U.S.A.'s trade deficit increased the foreign liabilities of its commercial banks and the counterpart, i.e., the foreign asset of ROW's commercial banks. In order to eliminate such an imbalance, the central bank in U.S.A. issued and lent more USD in circulation to the commercial banks in U.S.A., which in turn transferred USD to the commercial banks in ROW to repay their foreign liabilities. The commercial banks in ROW sold their USD to the ROW's central bank. This raised the ROW's currency in circulation and monetary reserves-USD held by the ROW's central bank.

In the process of international currency supply, one decisive characteristic of the Bretton Woods system is that the net foreign asset distribution between two central banks of U.S.A. and ROW was a zero-sum game. In other words, the net foreign assets of the issuing country's central bank had to fall for net foreign assets of ROW's central bank to rise. This is the source of the Triffin's dilemma.

In a world with capital mobility, however, the net foreign asset distribution between the two central banks of U.S.A. and ROW can be no more a zero-sum game. The supply for international currency can also be increased through the issuing country's capital outflows. The commercial banks in the U.S.A. export capital to the rest of the world by increasing deposits denominated in USD held by the commercial banks in the rest of the world. This leads to an increase in the U.S.A.'s commercial banks' foreign assets and their foreign liabilities, i.e., deposits held by ROW's commercial banks, at the same time. Therefore the foreign assets, i.e., deposits denominated in USD at the U.S.A.'s commercial banks, and foreign liabilities of the commercial banks in the rest of the world are also increased. The supply for international currency is thus financed. In such a case, the supply for international currency has nothing to do with the net foreign assets distribution between two central banks. The source of Triffin's dilemma is thus eliminated. The following balance sheets describe this situation.

Table 2-7: International Money Supply with Capital Mobility

Central Bank Balance Sheet of the Issuing Country (the U.S.A.)

Assets	Liabilities

Balance Sheet of the Commercial Banks in the Issuing Country (the U.S.A.)

Assets	Liabilities
Foreign Assets-Claims on the Rest of the World (+)	Foreign Liabilities-Deposits held by ROW's Commercial Banks (+)

Central Bank Balance Sheet of the Rest of the World

Assets	Liabilities

Balance Sheet of the Commercial Banks in the Rest of the World

Assets	Liabilities
Foreign Assets-Deposits on the USA' Commercial Banks (+)	Foreign Liabilities on U.S.A.s' Commercial Banks (+)

When the development of Eurocurrency markets for the major reserve currencies are taken into account, the resurrection of Triffin's dilemma seems to be more impossible. The issuing country's current account deficits and capital outflows constitute the primary sources of the international currency, i.e., the 'world monetary base,' on which the process of financial intermediation between governments, central banks, and official and private international financial institutions builds. The Eurocurrency markets can create deposit money denominated in reserve currencies affecting neither the foreign assets nor liabilities of the issuing countries' central banks and thus multiplying the initial supply of international currencies.[59] The EMU will not be plagued by Triffin's dilemma.

2.4.4. Sufficient condition for the Euro as international currency: financial markets in the Euro area

Financial markets are open in that they are free of control.[60] That an international currency functions as a medium of exchange and unit of account, i.e., as vehicle currency and quotation currency, implies that such a currency can be converted into other currencies, which is handled in the foreign exchange markets at any time and for any volume.[61] This is the basic requirement for a currency as an international medium of exchange. Convertibility presupposes that no capital control or foreign exchange control is installed. When a capital control or foreign exchange control is introduced in a country, its domestic currency is not able to act as an international medium of exchange. Moreover, a capital control or foreign exchange control means that the foreign economic agent cannot freely get access to this candidate currency, and thus use it as a vehicle to convert his own domestic currency to his trade partner's domestic currency or vice versa. Such a measure obviously increases transaction costs for participants of international transactions and prevents them from efficient management of foreign exchange exposures acquired through international transactions.[62]

The Euro owns undoubtedly a free financial market. Until now it fulfills all the necessary conditions. However, how far it can reach the status of international currency depends on the

[59] Buira, A. (1995), p. 9.
[60] Talvas, G. (1991), p.4.
[61] Kern, M. (1976), p.27.
[62] Hartmann, P. (1996), p.9.

sufficient conditions. The sufficient condition investigated here is whether the Euro's financial markets will be broader and deeper than that of the USD.

Financial markets are broad, in that they occupy a large assortment of financial instruments; and deep, in that they have well-developed secondary markets.[63] Broad and deep financial markets of an international currency guarantee liquidity of the financial instruments denominated in it. Liquid instruments mean smooth management of funds denominated in the candidate currency. With these highly-liquid instruments, economic agents can easily borrow or lend necessary funds for foreign trade and foreign exchange transactions and pay only negligible costs. By intervention, central banks, like private economic agents, can also easily borrow or lend necessary funds denominated in the candidate currency for foreign exchange transactions. The supply and demand for the instruments denominated in the candidate currency is thus strengthened through its financial markets, and the transaction costs for this currency's use as an international medium of exchange, and especially as a foreign exchange vehicle currency, is reduced.

The financial markets of the Euro's predecessor currencies are narrower than that of the USD. There is a less assortment of financial instruments on these markets. For example, until recently, the German finance ministry could not float part of its debt as treasury bills because of the Budesbank's opposition to short-term finance.[64] Consequently, a powerful instrument for fund management was not accessible to market participants. The evidence also suggests that market fragmentation in Europe may have kept the issuers from denominating their liabilities in the Euro's predecessor currencies.[65]

The introduction of the Euro brings structural changes. Firstly, segmentalization of the European financial markets resulting from different local currencies used is eliminated through the Euro. The integration is moreover supported by the TARGET system.[66] The integrated financial markets in the Euro area alone can thus attract capital inflows.[67]

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[63] Talvas, G. (1991), p.4.
[64] McCauley, R.N. (1997), p. 21.
[65] McCauley, R.N. (1997), p. 42.
[66] "*Handlungsrahmen für die Geldpolitik mit den auf Wertpapierpensionsgeschäften beruhenden Offenmarktoperationen on des Geldmarkts födern. Unterstützt wird die integration zudem durch das TARGET-System, das sich aus den miteinander verbundenen Echzeit-Bruttoabrechnungssystemen (RTGS-Systemen) der am Euro-Währungsgebiet teilnehmenden Mitgliedstaaten zusammensetzt.*" Duisenberg, W.F. (1998), p. 3
[67] Heumann, D.W. (1998), p.4.

Secondly, an integrated financial market has also a greater assortment of financial instruments.[68] This will increase the demand and the supply of the financial instruments denominated in the Euro. For example, if there are more European governments bonds available, an underwriter of a large bond issued in Euro could more easily hedge against movements in the underlying Euro yields by shorting large blocks of European government bonds. Issuing costs might fall and more issuance in the Euro might be induced.[69] On the other hand, investors could find more alternatives for their excess funds.

Finally and most importantly, the increasing breadth and depth of the Euro's financial market reduces transaction costs. Thus, more and more market participants are attracted to the Euro's financial market and transaction volume will rise. That again leads to a reduction in transaction costs. Such a virtuous circle results from the network externality involved, which is only possible after the emergence of an integrated financial market in the Euro area with efficient technical infrastructure.[70] An efficient technical infrastructure is the responsibility of both the authorities and the market and cannot occur in one big bang.[71]

2.4.5. Sufficient condition for the Euro as international currency: the Euro area's economic size

A large economy has naturally a large base for its currency and is less vulnerable to external shocks than smaller ones.[72] Eichengreen and Frankel[73] estimate that each 1 percentage point rise in one of the three major international currency countries' (U.S.A., Germany and Japan) share of gross world product is associated with a rise of 0.5-1.33 percentage points (depending on whether GDPs are calculated at market of PPP exchange rates) in its currency's share of central bank reserve holdings. We can simply assume that the same relationships apply to private markets.[74] A large size of trade flows especially encourages the use of the candidate

[68] Krupp, H.J. (1998), p.8.
[69] McCauley, R.N. (1997), p. 42.
[70] EZB (1999), p. 43.
[71] Giovannini, A. (1997), p. 14.
[72] Bergsten, C.F. (1997), pp. 25-26.
[73] Eichengreen, B. and Frankel, J.A. (1996), pp. 363-366
[74] Bergsten, C.F. (1997), p. 26.

currency as an international transaction vehicle. Economic size is by no means a concept free of ambiguity. There appear to be the following candidates:[75]

- the issuing country's population,
- the share of the issuing country in total world GDP, and
- the share in world exports.

These indicators are chosen in the following table to illustrate the relative economic size of the Euro Area against the U.S.A.

Table 2-8: Some Economic Indicators of the Euro Area, U.S.A. and Japan in 1998

Indicator	Unit	The Euro Area	U.S.A.	Japan	Source
Population	Mio	292	270	127	Eurostat
GDP	Mrd EUR	5,773	7,592	3,375	IWF (WEO)
Share on world GDP					
-measured in current exchange rate	%	22.2	29.3	13.0	IWF (WEO)
-measured in purchasing power parity	%	15.5	20.8	7.4	IWF (WEO)
Exports					
-share on GDP	%	17.8	10.9	11.5	ECB, IMF
-share on world exports	%	20.1	16.3	7.6	ECB, IMF

Source: EZB (1999), table 1.

The population of the Euro area was 292 million in 1998, which exceeded that of the U.S.A., 270 million. However, the Euro area's GDP is only 76% of the U.S.A.'s GDP evaluated at actual exchange rates. The GNP in the Euro area is therefore only 22,2% of the world's GDP, while the U.S.A.'s GDP is 29,3% of the world's GDP. Of course, this result is not determinative. Four potential member countries will join the Euro area with high probability and taking account of this possible change, the relative importance of its underlying economy against the U.S.A. could also reverse.

[75] Cp. Dehmel, A. (1982), p. 29 and Talvas, G. (1991), p.9.

With respect to the relative importance of trade flows, the above table shows another picture. The Euro area's exports were 20.1% of the world's exports. In contrast with that, the U.S.A.'s exports were only 16.3% of the world's exports.

Thus, we have gotten no consistent results. A different indicator shows different figures respectively.

2.5. A possible way toward a theory of international currency

In 2.4.5 we have used some indicators to measure whether the Euro will dominate the USD as a major international currency. We have gotten no consistent results. Each indicator shows a different figure respectively. This indicates the impossibility for quantitatively measuring how far the Euro fulfills the sufficient conditions in order to determine whether the Euro will dominate the USD as a major international currency. As this chapter showed, there are many sufficient conditions. Each sufficient condition has in turn several indicators. We can use bond markets, security markets, or the foreign exchange market as proxy for financial markets. We can utilize their trading volume or an assortment of financial instruments to indicate their depth and breadth. The population, the share in total world GDP, or the issuing country's share in the world's exports can be employed to estimate a currency's prospect as an international currency. The consequence will thus be the same as that of 2.4.5: Each indicator shows a different figure respectively and we will never get a consistent result.[76] This deficiency results from two fundamental problems.

The first problem is that 'international currency' is a concept with several dimensions. First of all, we must decide which dimension of this concept we are discussing. In this dissertation we investigate the Euro's role as a reserve currency in the broad sense.

The second problem is that these dimensions are not independent of each other. The second step is to research the reciprocal relationships between them. We should choose the relevant indicators to measure whether the Euro will rival the USD for the concerned dimension according to the structure of these relationships illustrated in figure 2-1. Before the relevant

indicators can be eventually chosen, we need more theoretical insights as to the determinants for these dimensions and their reciprocal relationships.

As for the next step, we should investigate the motives for holding monetary reserve, in order to illustrate how do central banks choose their reserve currencies.

[76] Cp. Herz, B. and Cieleback, M. (1999).

3. MOTIVES FOR HOLDING MONETARY RESERVES

While deciding the level and currency composition of their foreign exchange reserves, the central bank is intimately influenced by the objectives served by reserve holdings. Many aspects of these influences, for example political and economic ones, have been extensively discussed in numerous studies of monetary reserves demand.[77] To identify the basic motives behind these objectives, we should trace back to Keynes' theory of the demand for money.

Keynes[78] identified three motives for holding money:

- the transactions motive, which is the need for money to make regular payment;
- the precautionary motive, which is the need for money to meet unforeseen contingencies; and
- the speculative motive, which is the need for money to take advantage of the uncertainties about the money value of other assets that an economic agent can hold.[79]

This conventional identification of the three motives behind an individual holding money can be applied to the central bank's reserve holdings, but with some modifications.[80]

Three principal motives for the central banks to hold foreign exchange reserves can be identified likewise as follows:

- transactions motive,
- precautionary motive, and
- speculative or portfolio-related motive.

The transactions motive and the precautionary motive are categorized as intervention-related motives in the following. The transactions motive and the precautionary motive for an economic agent arise from the same fact that the future receipts is not necessarily equal to the future outlays for him at any given point in time. Therefore, an economic agent must hold money in order to pay for a deficit when receipts fall short of outlays.[81] The difference

[77] Ben-Basset, A. (1980), p. 286.
[78] Keynes, J.M. (1952), p. 170.
[79] Dornbusch, R. and Fischer S. (1984), pp. 250-251.
[80] Roger, S. (1993), p.10.
[81] Duwendag, D., Ketterer, K.H., Köster, W., Pohl, R. and Simmert, D.B. (1993), p. 90.

between the above two motives is whether the deficit can be forecasted. When the deficit is regular, the motive to hold money is assigned to the transactions motive. When the deficit is irregular and contingent, the motive to hold money is assigned to the precautionary motive. For the central bank, motives are all based on the functions of monetary reserves, for which the concrete operation is foreign exchange market intervention. Section 2.2 indicates that there are three such functions of monetary reserves. Two of them have to do with exchange rate policy, while the other one is related to domestic money supply. Since the latter function is relatively seldom utilized and already illustrated in 2.2., a more detailed discussion about it will be ignored in the following.[82] The intervention-related motives will be investigated in this chapter's first section in detail and we will focus only on the motives relating to exchange rate policy.

Portfolio-related motives are based on the function of monetary reserves being a part of foreign assets. According to Keynes, an economic agent uses his money holdings to maximize the end-period-value of his wealth in an uncertain world. This traditional approach will be criticized in this chapter. In the second section, we use the Tobin--Markowitz model to justify the need for monetary reserves held for portfolio-related motives. However, its limit will be also discussed.

3.1. Intervention-related motives

In this section, the reserve holding for intervention-related motives will be justified, and the determinants for the optimal level and the currency composition of monetary reserves held for intervention-related motives will be discussed. The balance of payments imbalances are often considered to be the most important source of the necessity for intervention. For this reason, the alternative responses to the balance of payments imbalances are identified at first. The Mundell-Fleming model will be employed to illustrate how the fixed and flexible exchange rate regimes work ideally. It will be pointed out that some assumptions behind the Mundell-Fleming model are unrealistic, in order to deny the main conclusion that the flexible exchange rate regime could eliminate the need for intervention. Secondly, some evidence against the

[82] A central bank may use monetary reserve transactions as an substitute for an open market policy, if its open market is not developed well enough, e.g., the Switzerland. Sometimes monetary reserve transactions as an instrument of domestic monetary policy have better effects than others. This aslo justifies the need for monetary reserves out of intervention-related motives.

Mundell-Fleming model's conclusion is proposed. The need for intervention results from some facts that the capital account transactions outweigh the current account transactions and that they are more volatile, rather than stabilizing. The overshooting models cannot explain sufficiently the range of the capital account transactions' volatility. Thirdly, a model of "bank runs" is employed to explain the volatility of the capital account transactions. The author will also illustrate evidence to support the explanation. Finally, the author will investigate the optimal level's determinants and the currency composition of monetary reserves proposed by previous studies.

3.1.1. Fixed exchange rate regime versus flexible exchange rate regime

Balance of payments is the sum of the current account, the capital account balance and the statistical discrepancy. Therefore, balance of payments deficits, which need to be covered by central banks, result from the current account imbalance and/or the capital account imbalance. When a country's balance of payments turns out not to be in balance, pressures emerge to change the exchange rate of the domestic currency. There are the following choices in response to exchange market pressures, i.e.,

- adjustment of current account balance, or
- adjustment of capital account balance, or
- adjustment of the level of monetary reserves, i.e., foreign exchange market intervention.

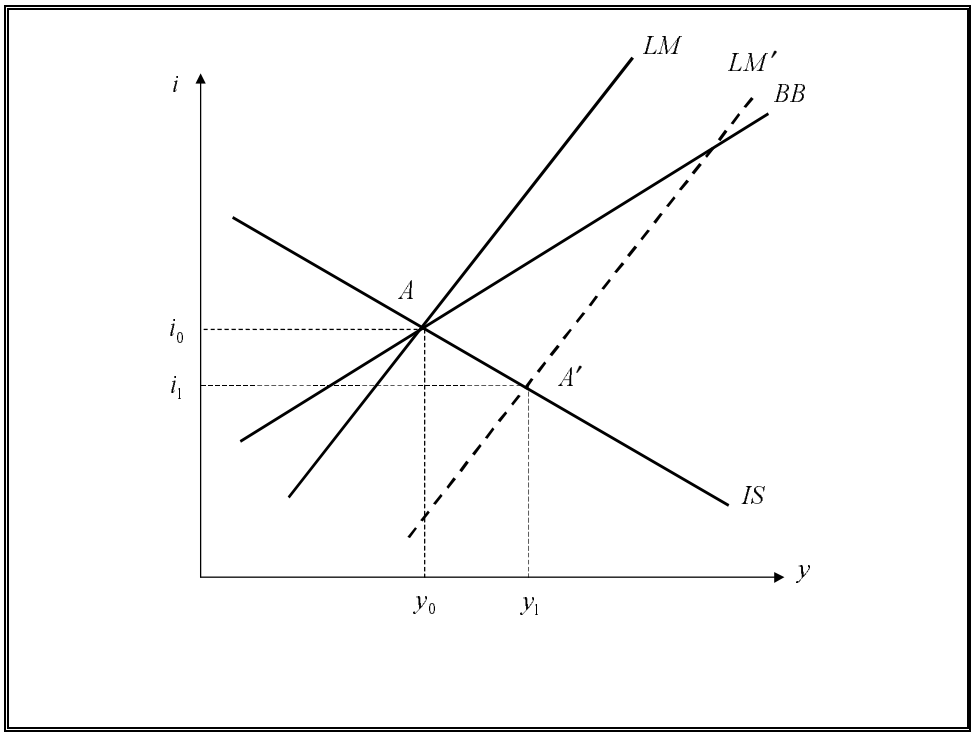
In other words, if there were complete certainty that balance of payments would always be in balance at any given moment in time, there would be no need from intervention-related motives to hold monetary reserves. Likewise, if this country were willing and able to adjust instantaneously to any imbalance that might occur in the current account and/or capital account there would be no need for monetary reserves.[83] Similarly, if the domestic currency's exchange rate against foreign currencies were not constrained in any way, there would be no need at all for monetary reserves.[84] However, there are costs associated with these adjustment processes, and the existence of such costs may be independent of which exchange rate regime this country adopts. To the extent that countries wish to avoid these adjustment costs, there

[83] Heller, H. R. (1966), pp. 300-301 and Carli, G. (1980), p. 369.
[84] Cohen, B.J. (1975), p. 414.

will be motives to hold monetary reserves. This argument is founded on the basis of past experience.

Under the Bretton Woods System of fixed exchange rates, intervention was used to help maintain the exchange rate within a narrow band around the official par value. The central banks adjusted the level of monetary reserves in response to exchange market pressures, in order to avoid the costs of adjusting current account and/or capital account balance. We can use the Mundell-Fleming model to illustrate this argument. Figure 3-1 shows the Mundell-Fleming model for the case of imperfect capital mobility under a system of fixed exchange rates.

Figure 3-1: Monetary Shocks under the Fixed Exchange Rate Regime

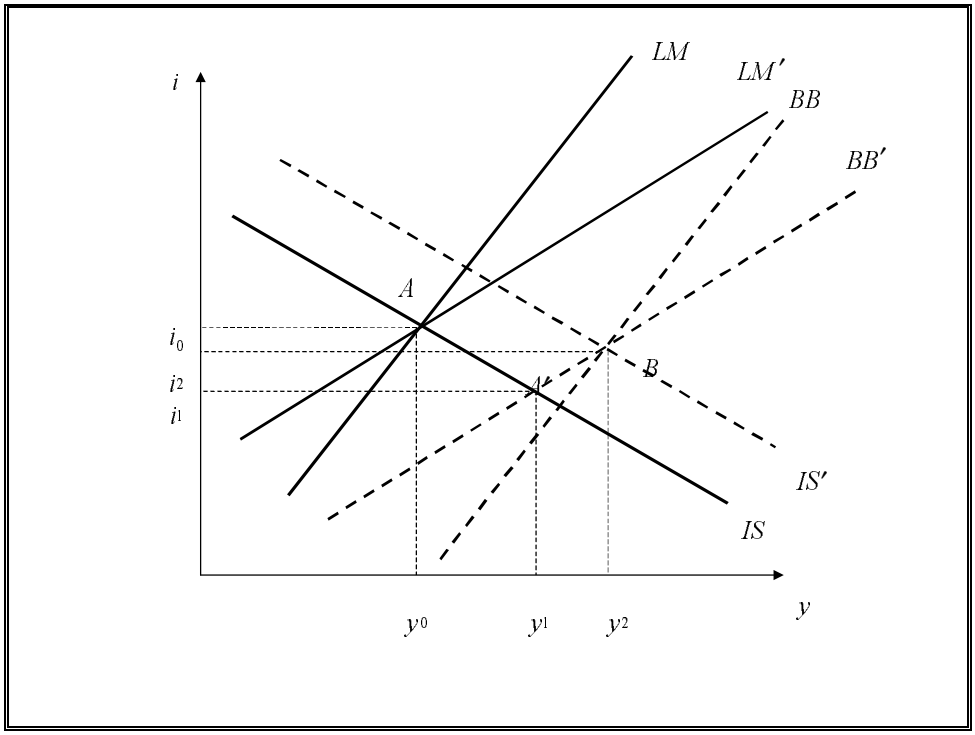


Consider a monetary expansion indicated by the rightward shift of the LM schedule ($LM \Rightarrow LM'$). The impact effect is to lower interest rates ($i_0 \Rightarrow i_1$) and to increase income ($y_0 \Rightarrow y_1$). The decline in the interest rate leads to capital outflows, with the increase in income leading to a reduction in net exports. These two effects result in a balance of payments deficits. The pressure to depreciate the domestic currency emerges, and the central bank intervenes in the foreign exchange market. A sale of monetary reserves by the central bank

leads, ceteris paribus, to a decrease of high power money,[85] which in turn leads to a monetary contraction indicated by the leftward shift of the LM schedule ($LM' \Rightarrow LM$). The balance of payments is again in balance. This country can therefore be rid of the costs of adjusting the current account and/or capital account balance.

With the breakdown of the Bretton Woods system in 1973, it was assumed at first that the demand for monetary reserves would drop significantly if the world moved to a system of flexible exchange rates. The central banks would refrain from intervention in the foreign exchange market and leave the exchange rate to be determined by market forces.[86] The exchange rate adjustment would maintain that the balance of payments is always in balance. The adjustments of the monetary reserves' level, current account and/or capital account balance thus become unnecessary.[87] This argument can be illustrated with the Mundell-Fleming model. Figure 3-2 shows the Mundell-Fleming model for the case of imperfect capital mobility under a system of flexible exchange rates.

Figure 3-2: Monetary Shocks under the Flexible Exchange Rate Regime



[85] See table 2-3.
[86] Bigman, D. (1980), p. 295.
[87] Cp. Filc, W. (1981), p. 216 and Argy, V. (1982), p. 1.

Consider again a monetary expansion indicated by the rightward shift of the LM schedule ($LM \Rightarrow LM'$). The impact effect is to lower interest rates ($i_0 \Rightarrow i_1$) and to increase income ($y_0 \Rightarrow y_1$). These two effects lead to exchange rate depreciation, which enhances competitiveness, thus raising net export and the supply of foreign exchange, and shifting the IS curve ($IS \Rightarrow IS'$) and the BB curve to the right ($BB \Rightarrow BB'$) until we reach point B. The balance of payments is again in balance. This country can therefore be rid of interventions and the costs of adjusting the current account and/or capital account balance.

One of the Mundell-Fleming model's assumptions is that the Marshall-Lerner condition holds. This assumption guarantees that a depreciation improves the current account. Futhermore, the Mundell-Fleming model implicitly assumes that the improvement in the current account is always sufficient to compensate the balance of payments shocks. The capital account transactions stay in the background and have no influence on income and the interest rate.[88] Such assumptions are, however, unrealistic.

3.1.2. Current account transactions versus capital account transactions

The current account imbalances of one country may result from seasonal or temporal differences in the business cycle it and its trade partner countries have; or from the systematic, but somewhat irregular, fluctuation in its earnings due to shifts in the demand for exports, which affects prices or quantities, or both; or from the interest burden of its external debt.[89]

The current account transaction motive was very important for developing countries in the past, for which it was often difficult to finance a current account deficit with external debt. Because their credit-worthiness was not good enough, the cost of external debt financing will be much higher than that of holding monetary reserves. Such consideration is particularly suitable for countries, (for example, Taiwan in the past), where extensive exchange controls

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[88] *„Besonderes Gewicht in traditionellen Theorien der Zahlungsbilanz und des Wechselkurses keynesianischer Provenienz wird auf den internationalen Leistungsverkehr gelegt. Der internationale Kapitalverkehr tritt in den Hintergrund, weil damit im Unterschied zum internationalen Leistungsverkehr keine unmittelbaren Einkommenseffekte verbunden sind. Bleiben die Zinssätze von internationalen Kapitalbewegungen unberührt, passen sich allein die Wechselkurse am Kassa- und Terminmarkt entsprechend der Zinsparitätenthoerie einem gegebenen internationalen Zinsgefälle an, so werden Einkommenseffekte nur von Leistungsströmen zwischen den Ländern bewirkt.*“ Filc, W. (1981), p. 20

[89] Hipple, F. S. (1974), p. 1 and Flanders, J.M. (1971), p. 4.

are implemented and a high proportion of the country's foreign currency transactions is channeled through the central bank.[90] That is one reason why Taiwan tried to hold a very high level of monetary reserves.

Table 3-1: Breakdown of the Capital Account Transactions

Long term		Short term	
Foreign direct investment	Portfolio investment	Interbank borrowing and lending	Trade credit

Table 3-1 illustrates the breakdown of the capital account transactions according to IMF. Firstly, a distinction is made between long-term and short-term capital flows. Long-term capital flows are in turn subdivided into foreign investment and portfolio investment. Foreign direct investment is closely associated with multinational companies' setting up subsidiaries abroad. With foreign direct investment, the multinational companies own and control the income-generating assets. Portfolio investment, such as the purchase or sale of foreign bonds in primary and secondary domestic financial markets, implies certain rights over income from holding a financial asset such as a bond, but the bondholder does not become directly involved in the income-generating process. Short-term capital includes such items as interbank borrowing and lending, or trade credit. Interbank borrowing and lending are highly volatile, especially between offshore and onshore financial markets.[91] Foreign direct investment and trade credit are not quickly reserved, while the fluctuations of portfolio investment and interbank borrowing and lending are volatile. These quickly-reserved capital flows between different countries may change their direction because of differential economic fundamentals, or even changes in market conditions and sentiments.[92]

The capital account transactions, which outweigh the current account transactions in many countries, are more important for monetary reserves management. Monetarists assume that profit-maximizing speculators would always push the exchange rate toward its equilibrium level.[93] The stabilizing capital account transactions could thus offset current account imbalances and enable current account imbalanced countries to economize on the use of

[90] Roger, S. (1993), S. 11.
[91] Peebles, G. and Wilson, P. (1996), p. 171.
[92] Cp. Hipple, F. S. (1974), p. 4.

official foreign exchange reserves.[94] Nonetheless, it has become clear that a clean flexible foreign exchange rate regime would expose the country to undue fluctuations in its exchange rate.[95]

In 1980, only seven years after the breakdown of the Bretton Woods system, Frenkel wrote the following statement: "*One of the striking features characterizing the international money system since the early 1970s has been the continued use of international reserves even though, legally, the system has been characterized as a flexible exchange rate regime.*"[96] The empirical evidences show that world holdings of monetary reserves have grown rapidly since the end of the Bretton Woods system.

Table 3-2: Total Monetary Reserves Minus Gold
(in billions of SDR: End of Period)

	1963	1973	1983	1993	1998
All Countries	26.6	116.8	362.3	797.6	1,242.3
Industrial Countries	19.2	79.9	206.2	413.4	552.8
Developing Countries	7.5	36.9	156.1	384.2	689.6

Source: International Monetary Fund, Annual Report, various issues.

A number of models have been proposed to demonstrate theoretically that even if the so-called rational expectation hypothesis holds, the exchange rate may still overshoot its equilibrium value.[97] The flexible exchange rate regime did not eliminate the need for intervention and therefore the need for monetary reserves. Without active management, market forces do not stabilize exchange rate fluctuations, but rather may push them to unwarranted levels.[98] Exchange rate fluctuations may provide false signals to reallocate resources and lead to a costly and unnecessary transition of labor and capital.[99] The absence of exchange rate stability may create damaging uncertainties that can lead to an unwillingness to enter into intertemporal contracts between countries. Because of these economic costs, traditionally governments have been reluctant to leave the determination of the domestic

[93] Friedman, M. (1953).
[94] BIS (1988), p. 23.
[95] Bigman, D. (1980), p. 295.
[96] Frenkel, J.A. (1980), p. 169.
[97] For example, Dornbusch, R. (1976), Niehans, J. (1977), Bigman, D. (1980).
[98] Bigman, D. (1980), p. 289.
[99] Bigman, D. (1980), p. 290.

currency's exchange rate in the hands of foreign exchange markets. To some degree they always commit themselves to some kind of limitation on exchange rate flexibility.[100] This could explain why the demand functions for monetary reserves were not substantially altered by the breakdown of the Bretton Woods system.

In the overshooting models, overshooting is explained by the different adjustment speeds in asset and goods markets. As the Mundell-Fleming model, they neglect the volatility of capital account transactions as an important factor causing overshooting. The fluctuations of the capital account transactions are more violent and less predictable than that of the current account transactions. A country's balance of payments imbalances, which ultimately require its central bank to absorb or inject monetary reserves, are often caused by sudden capital inflows or outflows. Even when a balance of payments imbalance is triggered by a large fluctuation in the current account, the necessity to draw down monetary reserves crucially depends on the behavior of capital account transactions, whether stabilizing or destabilizing.[101] Thus, the demand for holding monetary reserves is due in large part to the actual and potential variations in capital flows.[102] We need some other theories to explain the need for monetary reserves resulting from overshooting whose range cannot be explained on the basis of fundamental economic factors. And then we can justify the need for monetary reserves held for intervention-related motives.

3.1.3. Intervention and foreign exchange market inefficiency

In some respects, the factors that cause excess volatility of exchange rates (i.e. overshooting) resulting from the fluctuations of the capital account transactions are similar to those that create instability in financial institutions, i.e. bank runs. Both of these two phenomena are subject to imperfect information, multiple equilibria and the prisoner's dilemma.[103]

Diamond and Dybvig proposed a model of multiple equilibria to explain the emergence of bank runs.[104] At first, it is assumed that a commercial bank's portfolio consists of demand

[100] Cohen, B.J. (1975), p. 414, Eichengreen, B. and Frankel, J.A. (1996), p. 341.
[101] Horii, A. (1986), p. 26.
[102] Niehans, J. (1970), p. 60.
[103] Cp. Crockett, A. (1997), p. 14.
[104] Diamond, D.W., and Dybvig, P. (1983).

deposits, which are repayable on demand at par, and illiquid assets, which can only be sold at short notice by accepting a loss. The illiquidity of assets is assumed to result from production technology, which provides low levels of output per unit of input if operated for a single period, but high levels of output if operated for two periods.[105] The demand deposit contracts have multiple equilibria. If the good equilibrium dominates, depositors' withdraws take place randomly over time. The bank depositors retain confidence in the bank's solvency, even if they anticipate a positive probability of bank runs, provided that the probability is subjectively assumed to be small enough. A commercial bank can thus hold enough liquidity to meet normal withdrawals.

Because of imperfect information, the depositors will be never sure whether they estimate the bank's net worth correctly. The depositors' expectations depend on some random economic variables, e.g., a bad earnings report, a commonly observed run at some other banks, or even sunspots, which need not have anything to do with a bank's fundamentals. The good equilibrium is therefore very fragile.[106] If something happens to change the bank depositors' expectations and to accelerate the rate of deposit withdrawal, the bank runs equilibrium may dominate. In that equilibrium, all bank depositors rush to withdraw their deposits. Such a sudden withdrawal can force the bank to sell their illiquid assets at a loss. Finally, the bank can fail, even if the bank might be fully solvent under normal withdraws conditions.[107]

The apparent irrational behavior of the bank depositors' running on banks can be explained by the prisoner's dilemma. The bank depositors recognize that their deposits might be worth their face value providing that they agree collectively to refrain from precipitate withdrawal and the bank is therefore allowed to hold its illiquid assets to term. Since all of them believe that it seems to be hardly possible for them to collude, it becomes rational for them to seek to withdraw their deposits at first chance before the bank gives out all of its assets.[108]

The same logic can be applied to explaining overshooting of exchange rates. Firstly, we begin with the evidence supporting this statement. The so-called "forward discount puzzle" can be found for many different currencies at different periods. It means that a higher than

[105] Diamond, D.W., and Dybvig, P. (1983), p. 402.
[106] Diamond, D.W., and Dybvig, P. (1983), pp. 409-410.
[107] Crockett, A. (1997), p. 6, Diamond, D.W., and Dybvig, P. (1983), pp. 403-410.
[108] Crockett, A. (1997), p. 6.

usual interest rate abroad leads to a domestic currency's appreciation.[109] This phenomenon contradicts what the interest rate parity theory suggests. According to this theory, a higher interest rate should be offset by depreciation so that speculators make no more money on average in one country or another. Cochrane[110] has proposed an example of the "forward discount puzzle", which is reproduced in table 3-3.

Table 3-3: Forward Discount Puzzle

	DEM	GBP	JPY	CHF
Mean appreciation	-1.8	3.6	-5.0	-3.0
Mean interest differential	-3.9	2.1	-3.7	-5.9
b, 1975-1989	-3.1	-2.0	-2.1	-2.6
R^2	0.026	0.033	0.034	0.033
b, 1976-1996	-0.7	-1.8	-2.4	-1.3

Source: Corchrane, J. H. (1999), p. 24.
Note: The first row gives the average appreciation of the dollar against the indicated currency, in percent per year. The second row gives the average interest differential – foreign interest rate less domestic interest rate, measured as the forward premium – the 30 day forward rate less the spot exchange rate. The third through fifth rows give the coefficients and R^2 in a regression of exchange rate changes on the interest differential = forward premium,

$$s_{t+1} - s_t = a + b(f_t - s_t) + \varepsilon_{t+1} = a + b(r_t^f - r_t^d) + \varepsilon_{t+1}$$

where s = log spot exchange rate, f = forward rate, r^f = foreign interest rate, r^d = domestic interest rate.

The first row shows the average appreciation of the dollar against the indicated currency. The second row gives the average interest differential. According to interest rate parity theory, these two numbers should be equal. This means that interest rates should be higher in countries whose currencies depreciate against the USD. The second row shows the right pattern. Although the numbers in the first and second rows are not exactly the same, the difference between them is not statistically different from zero.[111] Average inflation, depreciation, and interest rate differentials line up in the long term as the interest rate parity theory suggests.

The third and fifth rows give the coefficients in a regression of exchange rate changes on the interest differential. According to the interest rate parity theory, an extra percentage point of

[109] Filc, W. (2000), p. 15.
[110] Cochrance, J.H., (1999).
[111] Cochrance, J.H., (1999), p. 24.

an interest rate differential should be accompanied by one extra percentage point of expected depreciation. Thus, the number should be +1.0 in each case, but the third and fifth rows illustrate the opposite pattern.[112] This means that a higher than usual interest rate abroad leads to appreciation of the indicated currency in the short term.

The above evidence implies that speculators as well as depositors are subject to imperfect information, multiple equilibria, and the prisoner's dilemma. Because of imperfect information, the speculators will never be sure whether the current exchange rate is an equilibrium exchange rate, or sustainable. The exchange market, as well as the commercial banks, may be subject to multiple equilibria.[113] In the short term, the current exchange rate is regarded to be sustainable and consistent with economic fundamentals, if the good equilibrium dominates. The speculators will thus invest in the country with a higher interest rate and its currency therefore appreciates.

Since the speculators' expectations do not necessarily depend on economic fundamentals, the good equilibrium is also fragile. If there are some triggering events that change the speculators' expectations and the weight of market opinion becomes convinced that the current exchange rate is unsustainable, the expectations can validate themselves because of the prisoner's dilemma. If other market participants are selling the currency, it becomes rational for all speculators to seek to take a short position even if the underlying position of the currency is sound. The country may thus be forced to depreciate its currency.[114] In the long term, the depreciation will correspond to the higher interest rate.

Filc has therefore reached the following conclusion: "*Sich selbst überlassene Devisenmärkte gelangen nicht automatisch stets zu Lösungen, also* zu *Devisenkursen, die als informationseffizient und gar allokationseffizient zu bezeichnen sind. Vielmehr können sie gesamtwirtschaftliche Fehlentwicklung erzeugen.*"[115]

Since the capital account transactions are not stabilizing in the short term and their fluctuations cannot be explained on the basis of fundamental economic factors, the need for

[112] Cochrance, J.H., (1999), p. 24.
[113] Eichengreen, B. and Wyplosz, C. (1993).
[114] Cp.Filc, W. (2000), p. 13 and Crockett, A. (1997), p. 15.
[115] Filc, W. (2000). P.17.

monetary reserves as intervention are justified because of the costs resulting from exchange rate instability. Aside from this, a reliance on intervention should be justified by claims that it can influence the level of exchange rates and/or reduce their volatility.[116] Theoretically, there are three transmission mechanisms for intervention in the foreign exchange market, i.e. the monetary approach, the portfolio balance approach, and the signaling effect.

- According to the monetary approach, domestic and foreign assets are deemed to be perfect substitutes. Unsterilized intervention changes the level of high power money and thus changes broader monetary aggregates. It affects the exchange rate just as conventional changes in monetary policy.[117]

- According to the portfolio balance approach, domestic and foreign assets are regarded as imperfect substitutes. The economic agent optimizes its wealth (composed of domestic and foreign currencies and bonds) in terms of mean-variance considerations, which are affected by the relative supplies of assets. Intervention affects the relative supplies of domestic and foreign bonds and thus the expected rates of return on these assets, which should in turn change the exchange rate.[118]

- According to the signaling theory, intervention affects the exchange rate by providing information about the views and intentions of the central bank and thus influencing the expectations prevailing in the foreign exchange market.[119]

3.1.4. Determinants of the optimal level and currency composition of monetary reserves

After justifying the intervention-related motives, a discussion about the optimal level determinants and currency composition of monetary reserves held for them is necessary for our investigation.

Regarding the optimal level of monetary reserves held for intervention-related motives, it has been traditionally suggested to use the level of imports[120] or the variability of the current

[116] Baillie, R. and Osterberg, W. (1997), p. 917.
[117] Edison, H.J. (1993), p.8.
[118] Cp. Edison, H.J. (1993), p. 10.and Baillie, R. and Osterberg, W. (1997), p.911.
[119] Cp. Edison, H.J. (1993), p. 4.and Baillie, R. and Osterberg, W. (1997), p.911.

account transactions[121] as an indicator measuring the level of a country's official foreign exchange reserves. Similarly, an intuitive hypothesis regarding the currency composition of monetary reserves held for the intervention-related motives may be expressed as follows: the share of a particular reserve currency should be a positive function of the share of the trade with the reserve center issuing that currency.[122]

To the extent that the capital account transactions outweigh the current account transactions and they are more volatile, the level of imports could be expected to be poor indicators measuring the optimal level of monetary reserves. Similarly, the share of seller's currency or a specific quotation currency in total imports could not be expected to be an important determinant of the currency composition of monetary reserves. In this context it has been suggested that the total cumulative gross capital inflow of quickly reversed funds (such as portfolio investments and interbank borrowing and lending) should serve as a proxy for the potential volatility of the balance of payments. Moreover, in order to prevent its currency from a sudden and serious devaluation, a country should raise the level of monetary reserves with increases in the cumulative gross capital inflow of easily reversible funds, such as portfolio investment and interbank lending funds.[123] Likewise, the share of a reserve currency should be positively related to the reversible liabilities to foreigners denominated in it.[124]

Only the balance of payments imbalances (and not the current account imbalances and/or the capital account imbalances) can sufficiently signify exchange market pressures. It has been suggested that the optimal level for a country's monetary reserves should be dependent on the volume of international transactions by the country's residents and the variability of its balance of payments.[125] Correspondingly, the share of a reserve currency should be positively related to international transactions invoiced in it, which include more than just the volume of current and capital account transactions with the reserve currency country but also any trade with third countries that is invoiced in currency.[126] In other words, the share of a reserve currency in monetary reserves should be positive with its use as the international transaction vehicle in the broad sense.

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[120] Cp. Levy, V. (1983), p. 90 and Niehans, J. (1970), p. 58.
[121] Machlup, F. (1966).
[122] See 4.3.
[123] Miller, N.C. (1995), p.74.
[124] Miller, N.C. (1995), p.72.
[125] Miller, N.C. (1995), p.62.

Despite the intuitive appeal of the above arguments, they all ignore a simple fact that central banks use monetary reserves held for intervention-related motives in order to participate in foreign exchange transactions. The optimal level of monetary reserves should be thus a positive function of the actual or potential volume of foreign exchange market transactions by the central bank. Likewise, central banks' decisions as to the currency composition of monetary reserves held for intervention-related motives do not appear to merely reflect the underlying use of currencies in international transactions, i.e., the structure of payments. Foreign currencies held for intervention are usually called intervention currencies. In chapter 2, it is pointed out that the choice of intervention currencies depends on the choice of foreign exchange vehicle currencies and the nature of the foreign exchange rate regime.

The choice of currencies used as the foreign exchange vehicle is predominantly determined in foreign exchange markets.[127] In foreign exchange markets, demand factors play a very important role determining which currencies are used as the foreign exchange vehicle. "*Since there is no supranational authority that can impose the use of a single currency, these issues are decided in the marketplace, by the behavior of public and private agents of all countries.*"[128] It will be demonstrated in chapter 5 that the structure of payments determines the structure of exchange. The structure of payments is in turn determined by current factors and capital account factors, or in other words, by the choice of international transaction vehicle currencies.[129]

In contrast with the choice of the exchange vehicle currency, the choice of the country's pegging currency is partly guided by international agreements, and partly influenced by, here again, current account factors and capital account factors. For this reason, the official exchange rate arrangement is not necessarily identical with the actual management of exchange rates. For example, a country may peg its currency to the USD, but change its parity so frequently that its exchange rate against the USD fluctuates just like that of a floating currency. On the contrary, a country may peg its currency to a basket of major currencies, in which the

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[126] Miller, N.C. (1995), p.74.
[127] Krugman, P. (1984), p. 261.
[128] Alogoskoufis, G. and Portes, R. (1997), p. 61.
[129] The above statements will be demonstrated in the chapter 5.

USD has a significant share. The currency of this country can be regarded as de facto being pegged to the USD in this case.[130]

The choice of foreign exchange vehicle currencies is a more important determinant for the currency composition of monetary reserves held for intervention-related motives. This is reflected in the fact that many countries use the USD as their intervention currency irrespective of their exchange rate regimes.[131] The predominant role of foreign exchange vehicle currencies is illustrated through their overproportional trading volumes, which is based on a simple fact, that the use as foreign exchange vehicle swells a currency's markets. Indirect exchange between currency Y and Z through X as a foreign exchange vehicle thus increases trade volumes of X both on the seller side and buyer side.

Following Krugman,[132] we distinguish three levels of foreign exchange markets here.

- The first is settlement between non-bank firms. As indicated in chapter 2, the quotation currency and the vehicle currency for an international transaction are usually identical. The international transactions vehicle dominates the first level.

- The second is the retail foreign exchange market in which non-bank firms deal with banks. Because of underlying trade and capital flows, the non-bank firms hold the international transactions vehicle as the transactions balance. The international transactions vehicle dominates also at this level.

- The third is the interbank market. Note that whereas transactions at the above two levels are arranged between importers and exporters, or between sellers and buyers, eventual payments are intermediated through commercial banks. The trade volumes at the interbank market exceed that of the former two markets enormously. Thus this level dominates over the former two. Central banks usually intervene in the interbank market, and foreign exchange vehicle currencies dominate on interbank market. For this reason foreign exchange vehicle currencies are usually held by the central bank as intervention currencies.

[130] Horii, A. (1986),. P.27.
[131] Horii, A. (1986), p. 41.

The structure of payments is determined by the payments flows happened in the first and second level, while the structure of exchange is determined by the transaction flows in the third level. The structure of payments decides the structure of exchange. Current account and capital account transaction flows influence the structure of payments.

3.2. Portfolio-related motives

In this section, the need for diversifying monetary reserves will be justified. However, it is pointed out that portfolio-related considerations should not be applicable for the whole monetary reserves. Firstly, the author criticizes Keynes' portfolio theory and introduces some basic concepts of the Tobin-Markowitz model of portfolio selection. This model provides a framework for analyzing the monetary reserves held for portfolio-related motives and prevents us from some irrelevant critiques. Secondly, the hierarchy of international currencies will be proposed. This builds a limit of portfolio theory and also for the portfolio-related considerations of monetary reserve management. The consequence is a separation of two different sorts of considerations regarding reserve management. One is based on portfolio-related motives, while the other is based on intervention-related motives.

3.2.1. Applying the portfolio theory on reserve management

The portfolio-related motives are based on the function of monetary reserves as a part of the central bank's gross foreign assets.

An economic agent who has wealth has to hold that wealth in specific assets. Those assets make up a portfolio. It is usually assumed that an economic agent always tries to maximize the end-period-value of his wealth. Following Keynes,[133] an economic agent uses his money holdings to maximize the end-period-value of his wealth in an uncertain world. When he expects that the interest rate will rise above an expected normal rate of returns from bonds, our economic agent will hold money and sell bonds in order to avoid a capital loss. When the economic agent expects that the interest rate will drop under the expected normal rate of

[132] Krugman, P. (1984), p. 264.

returns for bonds, our economic agent will buy bonds and give up money holdings in order to earn a capital gain. That means an economic agent holds only either money or bonds.

Two critiques against Keynes can be proposed here.

- Firstly, an economic agent maximizes his utility rather than the end-period-value of his wealth.

- Secondly, while discussing the speculative demand for money, Keynes had not yet any idea about the concept of risk, which was already operationalized.

With the help of modern portfolio selection theory, especially the well-known Tobin-Markowitz model of portfolio selection,[134] we can introduce the operationaliziable concept of risk to explain the speculative demand for money. We measure risk for a single asset or a portfolio by looking at the variance of rate of return provided by it. Furthermore, we assume that economic agents measure the expected utility of their portfolio by looking only at the expected rate of return and variance provided by the portfolio. By doing so, we need one additional assumption. Either of the following should hold:[135]

- that economic agents have a special type of utility function, for example, quadratic utility function, or
- that rates of return offered by assets have a normal distribution, which can be completely described by mean and variance

Assuming that the rate of return on an asset i, $\tilde{r}_i$, is normally distributed with mean r_i and variance $\sigma_{r_i}^2$, we can write our utility function as

(3.2.1-1) $U = U(\tilde{r}_i; r_i, \sigma_{r_i})$.

[133] Keynes, J.M. (1952), pp. 165-174.
[134] Markowitz, H.M. (1952) and Tobin, J. (1958).
[135] Copeland, T.E. and Weston, J.F. (1988), p. 153.

The utility function is usually assumed as a positive function of the mean r_i and a negative function of the variance $\sigma^2_{r_i}$.[136] Our expected utility is

$$(3.2.1\text{-}2)\quad E(U) = \int_{-\infty}^{\infty} U(\tilde{r}_i) f(\tilde{r}_i; r_i, \sigma^2_{r_i}) d\tilde{r}_i ,$$

where

$f(\tilde{r}_i; r_i, \sigma^2_{r_i})$ = the frequency distribution of the rate of return on asset i.

The expected rate of return on a portfolio is simply the weighted average of returns on individual assets, where the weights are the percentage invested in those assets.

$$(3.2.1\text{-}3)\quad r_P = \sum_{i=1}^{n} a_i r_i ,$$

where

r_P = expected rate of return on portfolio

a_i = weight of currency i in the portfolio

r_i = expected rate of return on asset i.

The variance of a portfolio's return is expressed as

$$(3.2.1\text{-}4)\quad \sigma^2{}_{r_P} = \sum_{i=1}^{n} a_i^2 \sigma^2_{r_i} + 2\sum_{i=1}^{n} \sum_{\substack{j=1 \\ j>i}}^{n} a_i a_j \sigma_{r_i r_j} ,$$

where

$\sigma^2_{r_P}$ = variance of r_P

a_i = weight of asset i in the portfolio

r_i = expected rate of return on asset i

$\sigma^2_{r_i}$ = variance of returns on asset i,

[136] Miller, N.C. (1995), p. 60.

$\sigma_{r_i r_j}$ = covariance of r_i and r_j.

The correlation coefficient, ρ_{ij}, between two assets, i and j, is defined as

$$(3.2.1\text{-}5) \quad \rho_{r_i r_j} \equiv \frac{\sigma_{r_i r_j}}{\sigma_{r_i} \sigma_{r_j}}$$

where

σ_{r_i} = standard deviation of r_i

By rearranging the above definition we get another definition of covariance:

$$(3.2.1\text{-}6) \quad \sigma_{r_i r_j} = \rho_{r_i r_j} \sigma_{r_i} \sigma_{r_j}$$

The covariance is thus equal to the correlation coefficient times the product of the standard deviations. Substituting (3.2.1-6) into (3.2.1-4), we have

$$(3.2.1\text{-}7) \quad \sigma^2_{r_P} = \sum_{i=1}^{n} a_i^2 \sigma_{r_i}^2 + 2 \sum_{i=1}^{n} \sum_{\substack{j=1 \\ j>i}}^{n} a_i a_j \sigma_{r_i} \sigma_{r_j} \rho_{r_i r_j} ,$$

It can be rewritten as another more general presentation of the variance of a portfolio's return:

$$(3.2.1\text{-}8) \quad \sigma^2_{r_P} = \sum_{i=1}^{n} \sum_{j=1}^{n} a_i a_j \sigma_{r_i} \sigma_{r_j} \rho_{r_i r_j} .$$ [137]

From the equation (3.2.1-7) we can derive that an economic agent could reduce the risk of his portfolio by including an asset i, when asset i has negative covariance or correlation coefficient with other assets in the portfolio. In practice correlation coefficient is more applicable than covariance, because that its value is independent of unit of measure chosen.

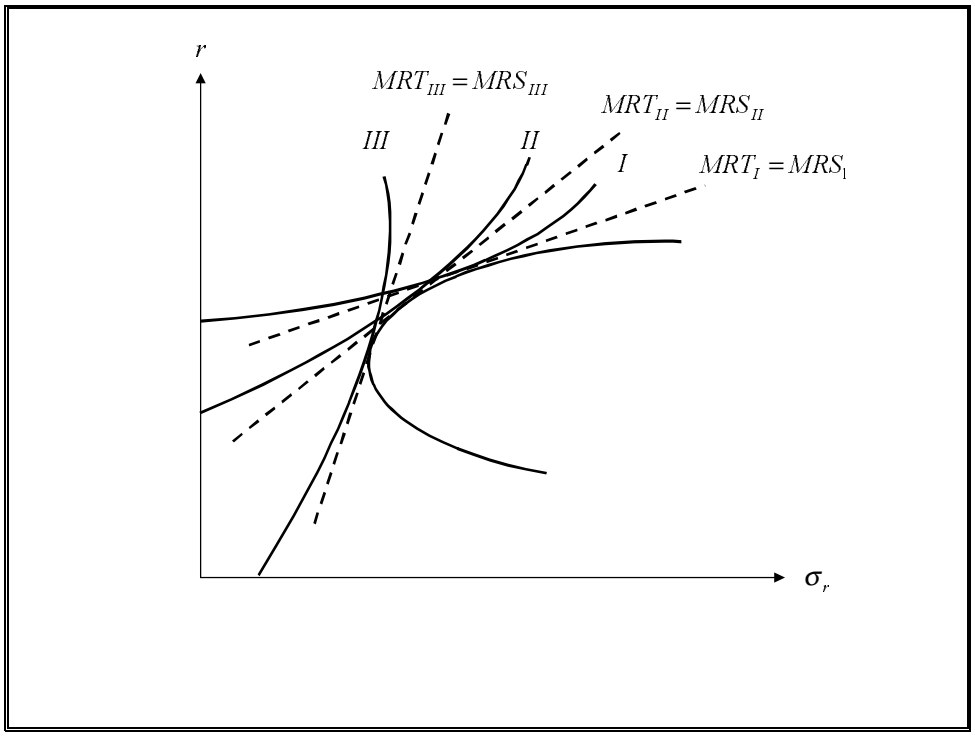
[137] The above presentation about the expected rate of return on a portfolio and its statistical characteristics is rewritten from the sixth chapter of Copeland, T.E. and Weston, J.F. (1988).

We can find the locus of feasible mean-variance opportunities by solving either of the following two mathematical programming problems.

The first defines the minimum variance opportunity set: Min. $\sigma^2_{r_P}$ subject to $r_p = K$, where K is a constant. The minimum variance opportunity set is found by minimizing the risk for a given rate of return.

The second defines the efficient set: Max. r_p subject to $\sigma^2_{r_p} = K$. The efficient set is found by maximizing the rates of return for a given risk. [138]

Figure 3-3: Choices by Economic Agents with Different Utility Functions



When an economic agent's utility function is known, he can maximize his utility by choosing an optimal portfolio, which is where the indifference curve is tangent to the opportunity set. An important feature of the optimal portfolio is that the marginal rate of substitution between risk and return represented by our indifference curves must equal the marginal rate of transformation offered by the feasible mean-variance opportunities. [139]

[138] Copeland, T.E. and Weston, J.F. (1988), p. 170.

(3.2.1-9) $MRS^{r_p}_{\sigma(r_p)} = MRT^{r_p}_{\sigma(r_p)}$.

Different economic agents have different utility functions. Therefore, their optimal portfolios may be different, even though they may have the same assessment of the return and risk offered by risky assets.[140] This can be shown in the figure 3-3.

Certainly, there are differences between the principal factors influencing the central bank and the private sector in managing their portfolios. Some economists believe the two principal factors guiding the private sector's choice of portfolio under uncertainty - risk and expected rate of return – are also applicable to the selection of the central bank's reserves portfolio.[141] In this framework, the objective of a central bank (or a government) like that of a private economic agent is assumed to be utility maximization. However, the central bank is assumed to maximize the representative residents' utility, while the private economic agent is assumed to maximize his own utility.[142]

Central banks hold foreign exchange reserves composed of different currencies and very liquid interest-earning assets denominated in reserve currencies. As the Tobin-Markowitz model suggests, given that the return on most assets is uncertain, it is unwise to hold the entire portfolio in a single risky asset, which has the highest expected rate of return. Such a decision is irrational for an economic agent. Furthermore, when the returns on different assets are negatively correlated with each other, i.e., the returns on assets tend to move in opposite directions, a rational economic agent should diversify his portfolio. These suggestions are also applicable to central banks. More important is that with help of the Tobin-Markowitz model we can avoid some irrelevant critiques against the applicability of risk/return considerations on reserve management.

According to some economists' opinions, that risk/return considerations should not be really appropriate for central banks in managing a reserve portfolio. For example, Siglienti pointed out that risk/return considerations do not play such a great role for central banks in determining their currency composition as it does for the private sector. On the contrary,

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[139] Copeland, T.E. and Weston, J.F. (1988), P. 167.
[140] Copeland, T.E. and Weston, J.F. (1988), p. 168.
[141] Ben-Basset, A. (1984), p. 4.
[142] Miller, N.C. (1995), p. 60.

central banks respond to motivations that are not relevant to the private sector.[143] Deming stated his concern even more slashing as follows:

"*I have no concern whatsoever about how private investors decide to choose between risk and rate of return on portfolios. If they wish to take on risk and speculate in hopes of high returns, that is their business. But I do wonder whether the profit - or rate of return - motive in managing a currency portfolio is really appropriate for central banks, with their financial powers, inside information, and public welfare concerns.*

I recognize that central banks do have a legitimate concern over preserving a "store of value" in their holdings of international reserves. Even central banks deserve some protection against general world inflation. For the most part, however, and especially over reasonable periods of time, interest rates in most countries do adjust to levels that meet this need. The profit maximizing return being sought through currency diversification of international reserve portfolios go beyond this store of value threshold. And the concern that I have is that as one central bank or a group of them seeks these higher returns, there is ultimately at least some burden placed on other central banks elsewhere who end up having to absorb the currencies being sold and supply the currencies being bough."[144]

Such a statement implies that there is something misunderstanding behind this. Central banks seek not the highest rate of returns but the highest utility. Even a very risk averse economic agent or a central bank would diversify his or its portfolio. How they diversify the portfolio depends not only on the mean-variance characteristics of the different assets, but also on the utility function of the economic agent or central bank. In later chapters we will assume that central banks have a high degree of risk aversion, or the optimal portfolio for central banks computed according to any model of the mean-variance approach should represent a low-risk strategy.

The portfolio-related motives do play a role in central banks' decisions regarding the currency composition of foreign exchange reserves. Nevertheless, the scope for diversifying monetary reserves because of portfolio-related motives is not unlimited, when monetary

[143] Siglienti, S. (1981), p. 185.
[144] Deming, F.W. (1981), p. 251.

reserves are mainly held directly or indirectly for intervention in foreign exchange markets. As long as the intervention-related motives are satisfied, it is rational for central banks to diversify their foreign exchange reserves according to their utility functions and the mean-variance characteristics of the different reserve currencies and assets.[145] In general, the scope for portfolio-related motives depends on the adequacy of monetary reserves for intervention, which can be measured in absolute terms or in relative terms.

3.2.2. Critiques on the portfolio theory

Some theoretical critiques against the application of the Tobin-Markowitz model on reserve management can be introduced here.

Firstly, it would be very difficult, if not impossible, to know the locus of an economic agent's utility function, or a central bank, which is defined in terms of mean and variance. For this reason, in practice an economic agent cannot find his optimal portfolio, which is where the indifferent curve is tangent to the opportunity set, but this problem is not impossible to solve. In the next chapter we will see how previous studies tried to solve this problem.

Secondly, there could be a hierarchy of international currencies, which is based on their different money quality. In chapter 2 the author has enumerated three groups of conditions, which are relevant for determining a currency's international role. Not all candidate currencies can satisfy these conditions equally well. For example, the relative economic importance in the world of underlying economies of different candidate currencies can be different, such as the financial markets of different candidate currencies not being equally broad or deep. These sufficient conditions determine the relative importance of various international currencies, i.e., their money quality.

Money quality influences the degree of liquidity and transaction costs of an international currency. The degree of liquidity is reflected sometimes in transaction costs, but more often in the candidate currency's non-pecuniary rate of return. However, the non-pecuniary rate of return designates not only the degree of liquidity of an international currency but also other returns from, e.g., international agreements, following which the candidate currency is used as

[145] Cp. Blackman, C. (1981), p. 158.

a pegging currency. Transaction costs indicate, for example, the brokerage fee for foreign exchange transactions. Thus, the total expected rate of return[146] on currency i is defined as the sum of expected pecuniary rate of return of currency i and the expected non-pecuniary rate of return of currency I minus its transaction costs.

(3.2.2-1) $R_i^T = r_i + R_i^n - C_i$ [147]

where

R_i^T = Total expected rate of return on currency i

r_i = expected pecuniary rate of return on currency i

R_i^n = expected non-pecuniary rate of return on currency i

C_i = Transaction costs of currency i.

The difference of money quality between various currencies is reflected in the difference of the expected non-pecuniary rate of return and/or transaction costs. A higher non-pecuniary rate of return and/or lower transaction costs of a currency indicate its priority in the hierarchy of international currencies. The deterioration of the necessary conditions leads to a negative non-pecuniary rate of return and very high transaction costs of a candidate currency, and finally losing its role as an international currency. The sufficient conditions determine the relative importance of various international currencies. A better fulfillment of necessary conditions and/or sufficient conditions increases the non-pecuniary rate of return or decrease transaction costs. The expected pecuniary rate of return is influenced by the promotional mechanisms. A positive index of a country's promotional mechanisms (for example, a current account surplus or overall surplus) increases its local currency's expected pecuniary rate of return.

In general, the portfolio theory takes only the expected pecuniary rate of return into account. The existence of the expected non-pecuniary rate of return and transaction costs is out of the question for the portfolio theory. The consequence is that the mean variance combinations proposed by the portfolio theory cannot correctly describe the actual mean and variance of the

[146] When we mention rate of return in later chapters, we mean only the pecuniary rate of return.
[147] Cp. Thomasberger, C. (1993), pp. 24-25.

total rate of return. For example, two currencies, 1 and 2, have the same mean-variance characteristics proposed by the portfolio theory. It is, however, possible that currency 1 has broader and deeper international financial markets and therefore higher money quality than currency 2. For this reason, the actual portfolio decisions of the economic agent may not coincide with those suggested by the portfolio theory. The hierarchy of international money quality builds a limit to portfolio theory and also to the portfolio-related considerations of monetary reserve management. For this reason probably, Ben-Bassat, a exponent of the portfolio theory approach, has found an interesting phenomena: "*Since the portfolio of most central banks is fairly large compared with the market for some currencies, central banks will probably limit their holdings of some currencies because of convertibility constraints, even if these currencies are attractive from the return-risk point of view.*" [148]

The above equation indicates a separation of two different sorts of considerations regarding reserve management. One is based on portfolio-related motives, while the other is based on intervention-related motives. Reserve management from portfolio-related motives takes the pecuniary rate of return into account, while reserve management from intervention-related motives takes the non-pecuniary rate of return and transaction costs, i.e., money quality, into account.

[148] Ben-Bassat, A. (1980), p.292.

4. A RE-EXAMINATION OF PREVIOUS STUDIES

The author implicitly assumes in the foregoing chapter that there is a separation between the balance held for intervention-related motives and the balance held for portfolio-related motives. The author assumes further that the balances held for different motives should be analyzed separately, and that all these assumptions need theoretical foundations. Moreover, we need to find out the determinants for the currency composition of monetary reserves held either for intervention-related motives or for portfolio-related motives. A re-examination of previous studies could fulfill these requirements and in the following sections some important authors, who contribute much inspiration for this dissertation, are discussed in detail.

In 4.1 the approaches concerning the optimal level of monetary reserves are reexamined. This re-examination will show the drawback of these traditional approaches and point out a new way.

In 4.2 the author makes a brief introduction about the two approaches concerning the currency composition of monetary reserves of thinking about this issue.

In 4.3 the work of Heller and Knight is reviewed, which is the basis of the intervention-related approach. They point out the major determinants for the currency composition of monetary reserves according to the above approach.

In 4.4 Ben-Bassat provides a standard example for applying the Tobin-Makrowitz model to analyze the currency composition of monetary reserves. According to empirical evidence, the correspondence between actual portfolios and optimal portfolios are not satisfactory. Ben-Bassat agreed that central banks' reserves holdings do not result only from portfolio-related motives.

In 4.5 Dooley, Lizondo and Mathieson suggest that the mean-variance considerations are most logically applied to a country's net foreign asset position rather than to monetary reserves alone. Because of the separation between reserve management and liability management a logical application of the mean-variance considerations to the net foreign asset position is

impossible in practice and a complete exclusion of the mean-variance considerations from reserve management is also impossible in practice. They illustrate also that the structure of exchange, the nature of exchange rate arrangement, the currency composition of trade flows, and debt service exert a significant influence on the currency composition of monetary reserves.

In 4.6 Horii points out that the inapplicability of the portfolio theory approach might result from the mis-specification of the portfolio model and the absence of systematic portfolio considerations in actual reserve management. This inapplicability suggests that central banks might manage only a part of monetary reserves in accordance with mean-variance considerations. For this reason there should be two levels of diversification for monetary reserves, with each one of them subject to different considerations respectively.

In 4.7 some new facts in finance will be illustrated. This section can be regarded as a supplement to the discussions concerning the mis-specification of the portfolio model.

In 4.8, on the basis of foregoing sections, the author will propose a framework for empirical study, which will be carried out in subsequent chapters.

4.1. The approaches concerning the optimal level of monetary reserves

When it came out, Triffin's dilemma provoked intensive discussions concerning the two basic aspects of monetary reserves, namely their level and composition. Since the 1960s the top interest for discussion regarding the level of monetary reserves was how to determine the optimal level of monetary reserves. Three approaches of discussions are identified as follows:[149]

- **The foreign trade approach**

  The reserves/imports ratio (Re/M) is a popularly-cited measure judging the adequacy of an individual country's monetary reserves and regarded as the most important factor determining the optimal level of monetary reserves. This measure was proposed by

[149] Cp. reich87, p. 18-22. and Williamson, J. (1973).

Triffin[150], behind this measure it is assumed that the central bank is the only clearing center, through which all current transactions made by other economic units aside from the central bank are cleared.[151] The main criticism of this measure's use stems therefore from the fact that reserves are used to finance deficits, not trade. Moreover, the importance of capital account transactions by this approach is also neglected. Even Triffin was aware of the inappropriateness of the reserves/imports ratio, and concluded that countries with large export fluctuations required higher ratios.[152]

- **The balance of payments approach**

In contrast to the above approach, the balance of payments approach takes all the current account and capital account transactions into account. Following this approach the expected deficit is the determinant for the optimal level of monetary reserves. For example, Brown[153] suggested that the ratio of reserves to the absolute value of payments imbalance in a particular year should be an appropriate measure of the adequacy of a country's reserves. Such a measure attaches an inappropriate importance to the realized outcome as opposed to the probability distribution of potential outcomes from which it was drawn. This indicates the need for a stochastic approach to the subject, for which it was soon filled by Kennen and Yudin.[154] They assumed that each country's reserve changes could be described by a simple Markov process, and they then proceeded to estimate a demand-for-reserves function. Such a statistical description of reserves' behavior over time were later incorporated in the optimization approach.

- **The optimization approach**

This approach assumes that central banks choose their reserve level by a rationally-optimizing decision. Among various authors of this approach, Heller[155] was probably the first one to consider at the same time the probability of reserves depletion, the marginal benefit, and the marginal cost of reserves holding. He presented an explicit formula, which

[150] Triffin, R. (1947).
[151] The other possible clearing centers are, for example, foreign exchange banks or even foreign trade companies themselves.
[152] Triffin, R. (1947).
[153] Brown, W.M. (1964).
[154] Kennen, P.B. and Yudin, E.B. (1965).

enables us to tell whether the actual level of official foreign exchange reserves is absolutely larger or smaller than the optimal level. According to Heller, the marginal cost of reserves holding (MC_f) is the opportunity cost of holding foreign assets in a liquid form of reserves.

Because the avoidance of expenditure adjustment would be beneficial to the country involved, the marginal benefit of reserves holding is equal to the marginal cost of adjusting national expenditure (MC_a) such that the external imbalance is eliminated. Defining π_i as the probability with which a country will have to use expenditure reduction as a means of providing for external balance, Heller provided this formula:

(4.1-1) $$MC_f = \pi_i * MC_a$$

Various authors further developed this approach, including Clark, Kelly, Streeter, Agarwal and Britto and Heller.[156] Among them, Britto and Heller[157] revised Heller's basic assumption, that only expenditure policies are relevant, and suggested that we may substitute the cost of exchange rate adjustment in place of the cost of expenditure adjustment. According to Britto and Heller, the cost of exchange rate adjustment is measured by the welfare loss caused by terms of trade deterioration. An intertemporal optimizing approach, which incorporates the possibility of fundamental disequilibrium into the analysis, was made by Niehans.[158] Two later authors, Hamada and Ueda,[159] revised Heller's formula in a random walks framework and showed that the effect of elements such as drift or serial correlation in the balance of payments, time lags in economic policies, and speculative reserve movements, can be explicitly incorporated into the formula's analytical expression.

The common drawback of the above three approaches is that they all implicitly assume that the fluctuations of either the balance of payments imbalances, or of the foreign exchange rates can be explained on the basis of fundamental economic factors. In chapter 3 the author already illustrated that this assumption should be unrealistic. Moreover, it is also suggested that the

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[155] See Heller, H.R. (1966).
[156] See Williamson, J. (1973), p. 691.
[157] See Britto, R. and Heller, H.R. (1973).
[158] Niehans, J. (1970).
[159] See Hamada, K. and Ueda, K. (1977).

optimal level of monetary reserves should be thus a positive function of the actual or potential volume of foreign exchange market transactions by the central bank. This suggestion seems to be very simple, but can be used as a new starting point for further discussions.

4.2. The intervention-related approach versus the portfolio theory approach

The subject matter of discussions concerning the composition of monetary reserves before the late 1970s was about the viability of the dollar-exchange standard, and hence gold and the USD played the main role. Economists[160] in the Bretton Woods era, such as Levy[161] or Makin,[162] who have studied the composition of monetary reserves, dealt only with the allocation of monetary reserves between gold and the USD and regarded the economic forces underlying the substitution of the USD for gold as significant in determining the viability of the dollar-exchange standard.[163] Since the late 1970s their special roles as chief reserve assets have vanished. Instead, the role of reserve currencies other than the USD have become increasingly more important. The need to diversifying monetary reserves between different reserve currencies has become inevitable.

Just as there is no „general" theory for the optimal level of monetary reserves that can integrate all factors influencing central banks in managing their monetary reserves, so too is there no „general" theory for the optimal composition of monetary reserves.[164] Corresponding to the motives for reserves holding, two approaches about the issue of reserves' currency composition are identified as follows:

- the intervention-related approach and
- the portfolio theory approach.

These two approaches are the international equivalent to the two well-known approaches to the demand for domestic money, i.e., Baumol's inventory model[165] for the transactions demand for money and Tobin's portfolio selection theory[166] for the speculative demand for money.[167]

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[160] Ben-Bassat, A. (1980), pp. 285-286
[161] Levy, H. (1978).
[162] Makin, J.H. (1971).
[163] Makin, J.H. (1971), p. 818.
[164] Roger, S. (1993), p. 35.
[165] Baumol, W.J. (1952).
[166] Tobin, J. (1958).

The intervention-related approach argues that the proportion of monetary reserves denominated in a particular currency should be directly or indirectly related to the currency composition of the authorities' exchange market activities. Traditionally, the intervention currencies are regarded as being identical with the pegging currencies. According to this approach the currency composition of monetary reserves are also influenced by the trade with the reserve currency countries. We can further extend this approach to include the currency denomination of debt payments as a determinant of reserves' currency composition.[168]

The portfolio theory approach adopts the well-known Tobin-Markowitz model of portfolio selection to determine the optimal currency composition of monetary reserves. It posits that central banks attempt to manipulate their monetary reserves in order to maximize the representative residents' utility. Central banks measure the expected utility by looking only at the expected rate of return and risk associated with monetary reserves. The utility function is usually assumed as a positive function of the rate of return and a negative function of the risk. Central banks identify the feasible opportunity set either by minimizing the risk for a given rate of return or by maximizing the rates of return for a given risk. They can then maximize their utility by choosing an optimal portfolio, which is where the indifferent curve is tangent to the opportunity set.

4.3. Heller and Knight: the basis of the intervention-related approach

The empirical work of Heller and Knight[169] provides an important basis for further developments. According to Heller and Knight, the mean-variance considerations do not appear to be particularly relevant to the problem concerning the currency composition of monetary reserves. In choosing the actual currency composition of monetary reserves, a central bank must seek to minimize the transactions costs on the one hand, which are incurred in exchanging one currency for another, and the risks on the other hand, which arise from uncertainty about future movements in exchange rates between the reserves currencies. The former consideration gives a central bank an incentive to concentrate its holdings in a single reserve currency. The latter consideration prompts a central bank to hold its monetary

[167] Miller, N.C. (1995), p. 60.
[168] Miller, N.C. (1995), p. 68.

reserves in its pegging currency or distribute its holdings across different currencies according to the weights in its pegging composite basket. These two considerations make a country's exchange rate arrangement to be an important determinant of currency composition of its monetary reserves.

Heller and Knight[170] divided their 76-country sample into two subsamples for each of the four reserve currencies respectively according to whether or not they pegged their exchange rate to the reserve currencies in question. They then calculated and compared the means of the weights of the reserve currency in question for the two subsamples respectively. This test confirmed that there is indeed a relationship between exchange arrangement and currency composition of monetary reserves. It showed but two exceptions at the same time: "*first, countries tend to hold a high proportion of dollars whether they are dollar peggers or not. Second, the snake countries, in accordance with the European System of Narrower Exchange Rate Margins, tend to hold dollars almost exclusively.*"[171] Finally, the above test showed also that few central banks keep their foreign exchange reserves entirely in the reserve currency to which they peg.

Because of this finding, Heller and Knight argued that a country's holdings of a particular reserve currency are also a positive function of its trade with that reserve currency country. When a country's residents are heavily engaged in trade with a particular reserve currency country, the possibility of imbalances and intervention in that reserve currency increases and the central bank has a further motive to hold that currency. Consequently, the central bank of the country in question will hold more of a reserve currency as its trade share with that reserve currency country increases.[172]

Heller and Knight used cross-sectional regression analysis to justify the above hypotheses and their main results are summarized as follows:[173]

- In general, the results are regarded as reasonably satisfactory.

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[169] Heller, H. R. and Knight, M. (1978).
[170] Heller, H. R. and Knight, M. (1978), pp. 12-15.
[171] Heller, H. R. and Knight, M. (1978), p. 27.
[172] Heller, H. R. and Knight, M. (1978), p. 16.

- On the one hand, the constant term for the USD indicates that the sample's countries tend to hold 66 per cent of their foreign exchange reserves in the USD independent of whether they peg their domestic currency to the USD or not, while the constant terms for the other reserve currencies are very small and are not significantly different from zero. On the other hand, the exchange rate regime variable for the USD is not significant. These two facts lead to the conclusion that countries hold the USD irrespective of whether they are USD peggers or not.

These results indicate not only that there are motives other than intervention that play some role for reserve management, but also that the choice of intervention currencies does not necessarily depend only on the choice of pegging currencies. In chapter 2 the author indicated that the currency composition of monetary reserves for intervention purpose depends on the choice of the currencies, which are dominant for foreign exchange transactions and the choice of actual pegging currencies. The former may indeed be more important as the USD is the dominant currency on foreign exchange markets. This could explain why countries hold the USD irrespective of whether they are USD peggers or not.

4.4. Ben-Bassat: a standard model of the portfolio theory approach

Ben-Bassat [174] proposed a standard model of the portfolio theory approach. Other economists, for example, Jager and de Jong, [175] have provided similar models and although their technical assumptions are somewhat different, the techniques employed are basically the same. In the following, only Ben-Bassat's model is reexamined in detailed fashion, because it is quoted much more frequently than other models.

First of all, Ben-Bassat[176] assumed that the main reason for holding foreign exchange reserves is to finance imports, and thus defined the rate of return on currency i as

(4.4-1) $r_i = (1 + r_F(i))/(1 + E_i) - 1,$

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[173] Heller, H. R. and Knight, M. (1978), pp. 17-22.
[174] Ben-Bassat, A. (1980) and (1984).
[175] Jager, H. and de Jong, E. (1984).

where

r_i = expected rate of return on currency i

$r_F(i)$ = nominal interest rate of currency i

E_i = rate of change of the exchange rate of currency i in relation to the import currency basket.

Currency i's rate of return is expressed in terms of the basket of import currencies in the above equation. Accordingly, the rate of return and risk of the reserve portfolio will be also expressed in terms of the basket of import currencies. This implies that the optimal currency composition of monetary reserves will also depend on a country's consumption pattern, since a country's imported consumption is paid for in import currencies. The next step is to identify the locus of feasible mean-variance opportunities.

(4.4-2) min. $\sigma^2{}_{r_P} = \sum_{i=1}^{n} a_i^2 \sigma_{r_i}^2 + 2\sum_{i=1}^{n}\sum_{\substack{j=1 \\ j>i}}^{n} a_i a_j \sigma_{r_i r_j}$

subject to

$\sum_i a_i = 1;$

$a_i \geq 0;$

$r_P = \sum_{i=1}^{n} a_i r_i$,

where

$\sigma_{r_P}^2$ = Variance of r_P

r_P = expected rate of return of the reserve portfolio

a_i = weight of currency i in the reserve portfolio

r_i = expected rate of return on currency i

$\sigma_{r_i}^2$ = variance of returns on currency i,

[176] Ben-Bassat, A. (1980), p. 287.

$\sigma_{r_i r_j}$ = covariance of r_i and r_j.[177]

According to 3.2.1, equation (4.4-2) can be rewritten as

$$(4.4\text{-}3)\ \min.\ \sigma^2_{r_P} = \sum_{i=1}^{n} a_i^2 \sigma_{r_i}^2 + 2\sum_{i=1}^{n}\sum_{\substack{j=1 \\ j>i}}^{n} a_i a_j \sigma_{r_i} \sigma_{r_j} \rho_{r_i r_j}$$

where

$\rho_{r_i r_j}$ = correlation coefficient of r_i and r_j.

The objective function and three constraints are explained as follows:

- The objective function represents the variance of the reserve portfolio.

- The first constraint is a general constraint for the Tobin-Markowitz model.

- The second constraint, $a_i \geq 0$, means that central banks limit themselves to positive balances in the various currencies. This implies that the central bank would not borrow in that currency and invest the proceeds in a different currency. It is assumed that there is a separation between the management of monetary reserves and management of external debt.[178]

- The third constraint, $r_P = \sum_{i=1}^{n} a_i r_i$, means that there are no riskless assets.

In order to get one point on the minimum variance opportunity set, we should minimize risk subject to the return being some level, plus add a restriction that the sum of the proportions invested in each currency equal 1 and that investment in each currency is positive or zero. The problem is a quadratic programming problem.[179] In this step, no unique solution for the vector of weights can be found, since the central bank's utility function has not yet been defined.

[177] Ben-Bassat, A. (1984), p. 7,
[178] Ben-Bassat, A. (1984), P.8.
[179] .Cp. Elton, E.J. and Gruber, M.J. (1991), pp. 72-73

Therefore, there is an infinite set of solutions, each representing an alternative efficient combination of return and risk.

In order to find the central bank's optimal risk and return combination at the feasible mean-variance opportunity set's point of tangency, indifference curves for the central bank should be defined on risk and return. In reality, such indifference curves cannot be given. Ben-Bassat solved this problem by using the minimum variance portfolio or the market portfolio as the optimal portfolio.

The minimum variance portfolio is defined as the portfolio with the minimum variance on the feasible mean-variance opportunity set. The market portfolio can be determined at the point of tangency between the feasible mean-variance opportunity set and the straight line, which rises from the riskless asset return, i.e., the capital market line. The market portfolio represents a relatively low return-variance strategy and would be very similar to that of using a specific utility function that assumes a relatively high degree of risk aversion on the central banks' part.[180]

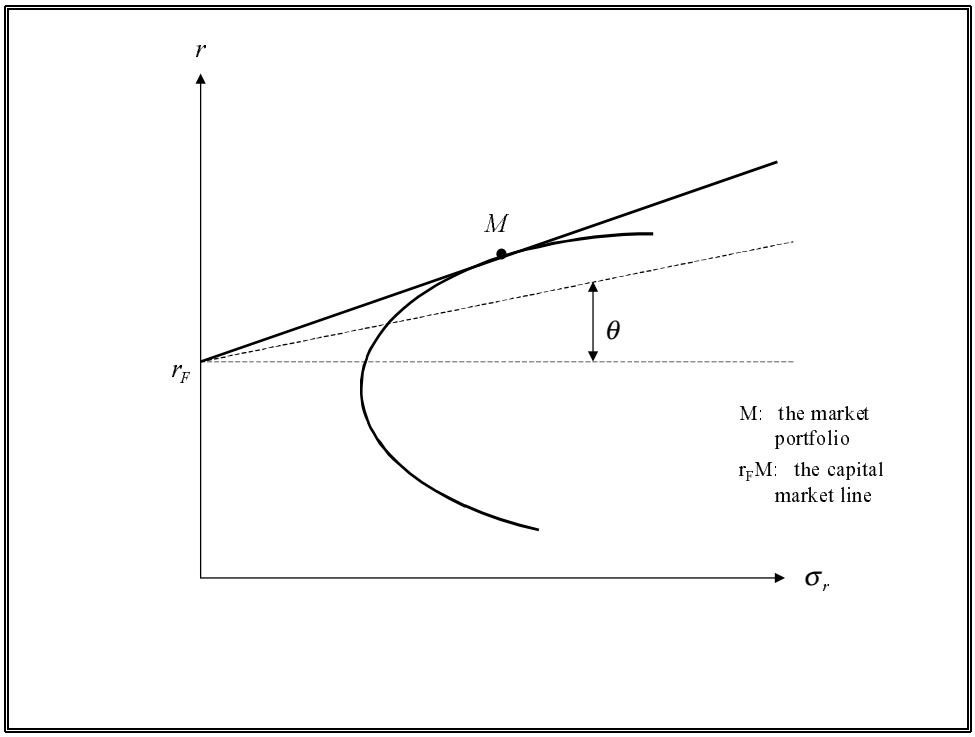
When the risk and return are expressed in terms of a single reference currency, the interest rate on treasury bills denominated in that currency is then taken as the riskless asset return. In Ben-Bassat's model the risk and return are expressed in terms of a basket of currencies. He used the average of interest rates on treasury bills in these currencies, expressed in terms of the import basket.[181]

In this step, the decision concerning the basket of reference currencies or the single reference currency is of considerable importance, because it affects the currency composition of the optimal reserves portfolios. While the rate of return expressed in different currencies is unaffected by the choice of the reference currency, the same is not true for risk. The reason is that the reference currency should be regarded as a riskless asset, while the other currencies are risky assets. For a central bank, the return and risk of its reserves portfolio are expressed in terms of the USD, with the USD as a riskless asset, while the other currencies of its reserves portfolio are risky assets. In the case of another central bank, the return and risk of its reserve

[180] Ben-Bassat, A. (1980), p. 293.
[181] Ben-Bassat, A. (1980), p. 293

portfolio are expressed in terms of the DEM, the DEM being a riskless asset, while the other currencies of its reserves portfolio are risky assets. Clearly, the optimal currency composition of the above two reserve portfolios will not be identical.[182]

Figure 4-1: The Market Portfolio



We can find the market portfolio by the following procedure:[183]

(4.4-4) max. $\theta = \frac{r_P - r_F}{\sigma_{r_P}}$,

subject to

$\sum_i a_i = 1;$

[182] Ben-Bassat pointed out, "*Our two central banks will choose identical portfolios only under two extreme assumptions: perfect positive correlation between the exchange rates of the different currencies (which is equivalent to assuming a single world currency) and perfect capital markets. Since these conditions are not fulfilled, the optimal portfolio will vary by country different currencies (which is equivalent to assuming a single world currency) and perfect capital markets . Since these conditions are not fulfilled, the optimal portfolio will vary by country.*" Ben-Bassat, A. (1984), p. 7

[183] Cp. Elton, E.J. and Gruber, M.J. (1991), p. 72 and Ben-Bassat, A. (1980), p. 293.

$a_i \geq 0,$

where

σ_{r_P} = Standard deviation of r_P

r_F = riskless asset return.

Once again, this problem is a quadratic programming problem.

We can now compute the optimal currency composition, and compare it with the actual composition for any central bank. Such a comparison would enable us to test central banks' attitude toward profit and risk and the performance of portfolio management.[184]

The findings of Ben-Bassat (1980) is summarized as follows:

- The feasible mean variance opportunity set for Israel for 1972-76 is estimated in terms of imports. This estimate is based on monthly observations of returns for the major reserve currencies and gold. Ben-Bassat used the minimum variance portfolio as the optimal portfolio, and as such it turns out to be very similar to the currency composition of the Israeli import basket. This fact reflects a strategy of hedging against fluctuations in the exchange rates of import currencies.[185]

- Ben-Bassat found a highly negative correlation between the USD and the European currencies. This explains why the minimum variance portfolio consists of roughly half USD and half European currencies.[186]

- Ben-Bassat used the market portfolio as the optimal portfolio to analyze the aggregate data of industrial countries and semi-industrialized and developing countries, which was provided by Heller and Knight. He compared the market portfolio with the actual currency composition in each group and found a fairly close correspondence between the actual and market portfolio of the semi-industrial and developing countries. Nevertheless, the

[184] Ben-Bassat, A. (1980), p. 292.
[185] Ben-Bassat, A. (1980), pp. 288-290.
[186] Ben-Bassat, A. (1980), p. 291.

proportion of the USD in the actual portfolio is 14 percent higher than that in the market portfolio. Ben-Bassat attributed this difference to the performance of portfolio management, political and other factors, and admitted that the risk and return considerations are the main, but not the sole, considerations for reserve management. On the other side, the correspondence between the actual and market portfolio in the case of industrialized countries is very low. This demonstrates that the risk and return considerations play a greater role in semi-industrialized and developing countries than in industrialized ones.[187]

The findings in Ben-Bassat (1984) are very similar with that in Ben-Bassat (1980):

- The USD's rate of return and the European currencies' rate of return in import-basket terms for each country in both 1972-76 and 1972-80 have a high negative correlation. Such a negative correlation led central banks to create portfolios consisting primarily of the USD on the one hand and European currencies on the other.[188]

- This time Ben-Bassat computed the optimal portfolios and compared them with the actual portfolios in 1980 in addition to that in 1976. For semi-industrialized and developing countries, the comparison showed an even more closer correspondence between the optimal portfolio and the actual portfolio in 1980 than that in 1976. The gap between the optimal portfolio and the actual portfolio in the case of snake countries in both 1976 and 1980 is especially large. Ben-Bassat attributed this to the fact that snake countries were constrained not only by considerations of international monetary stability but by mutual currency agreements. The other industrialized countries' performance in 1980 ranked them between the group of developing and semi-industrialized countries and the snake countries, because these countries had an interest in maintaining the stability of the international monetary system.[189] One thing Ben-Bassat did not consciously mention was that the USD's proportion in actual portfolios are significantly higher that in the optimal portfolios for all three groups in both years. This phenomenon indicates that portfolio-related motives cannot sufficiently describe the reserves holding. Moreover, it may indicate the USD's special role for central banks' intervention.

[187] Ben-Bassat, A. (1980), pp.293-295
[188] Ben-Bassat, A. (1984), p. 18.

Ben-Bassat concluded that the three factors influencing the optimal currency composition of a country's reserve portfolio are

- a country's motivations for holding reserves,
- the risk and return of the various reserve currencies, and
- a country's interest in maintaining international currency stability.[190]

Dellas and Yoo[191] employed the Tobin-Makrowitz model to reexamine the role played by the mean-variance considerations for reserve management. In contrast to previous studies, they showed some important improvements:[192]

- For the first time in the literature they were able to use data on the currency composition of an individual country's foreign exchange reserves.

- They used the actual currency shares of imports instead of country import shares.

- Unlike Ben-Bassat, who used the minimum variance portfolio or the market portfolio as the optimal portfolio against which to compare the actual portfolio held by the central bank, Dellas and Yoo used an efficient portfolio as the optimal portfolio, whose rate of return corresponded to the actual standard deviation. Such a portfolio is represented by Portfolio D in figure 4-2.

Dellas and Yoo used actual monthly data for the 1980-87 period to examine the optimality of the Republic of Korea's central bank currency composition of foreign exchange reserves. Their results showed a very close correspondence between the benchmark portfolio and the actual portfolio. They concluded that their results "*offer some support to the notion that mean-variance considerations do play a role in portfolio selection for the Bank of Korea*".[193] However, such support may be attributed to the benchmark portfolio they chose. The benchmark portfolio D always lies close to the actual portfolio. Thereupon, Dellas and Yoo conducted a more formal test of the CAPM along the lines suggested by Engel and

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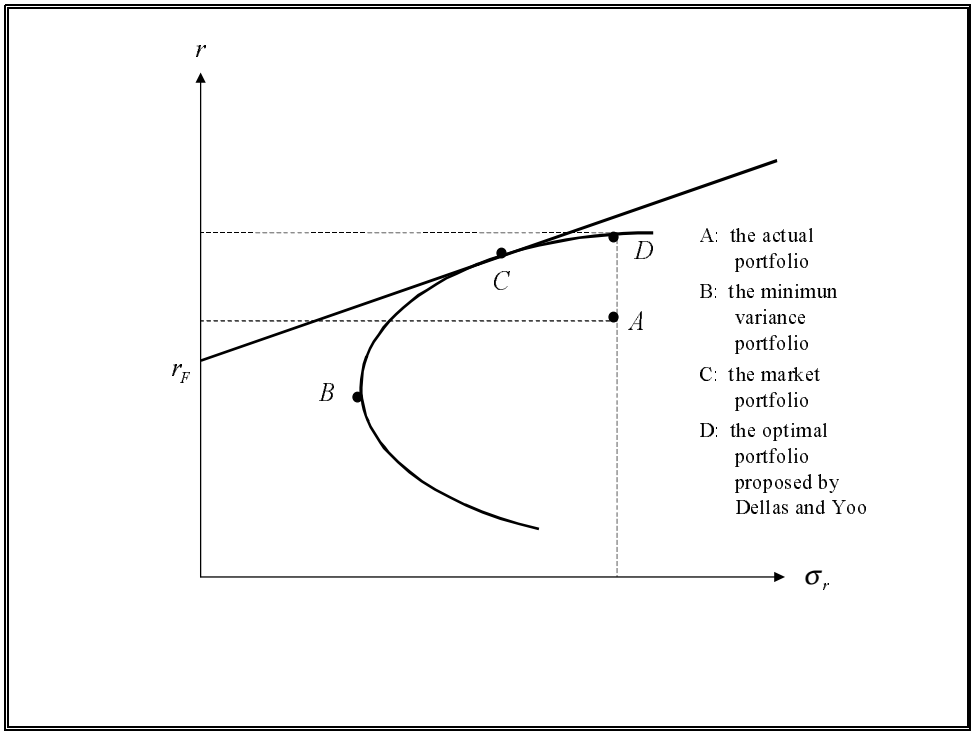
[189] Ben-Bassat, A. (1984), p. 11-14.
[190] Ben-Bassat, A. (1984), p. 4
[191] Dellas, H. and Yoo, C. (1991).
[192] Dellas, H. and Yoo, C. (1991), p. 407.
[193] Dellas, H. and Yoo, C. (1991), p. 410. Della's examination of the behavior of the industrial and developing country groups offered also the role played by the mean-variance considerations. See Dellas, H.(1989).

Rodrigues.[194] This test led to the conclusion that "*the portfolio decisions of the Korean central bank do not offer strong support to the mean-variance model.*"[195]

Figure 4-2: Different Optimal Portfolios



Source: Cp. Roger, S. (1993), figure 9.

In summary, Ben-Bassat provided a standard example for applying the Tobin-Makrowitz model to analyze the currency composition of monetary reserves. Moreover, Ben-Bassat, Dellas and Yoo proposed some benchmark portfolios, which can be used as the optimal portfolio in the condition that the utility function is unknown. According to their studies, the correspondence between the actual portfolios and the optimal portfolios are not satisfactory, and Ben-Bassat, Dellas and Yoo all agreed that central banks' reserves holding does not result only from portfolio-related motives.

4.5. Dooly, Lizondo and Mathieson's contribution: the inapplicability of the mean-variance considerations to monetary reserves

[194] Engel, C., and Rodrigues, A. (1986)
[195] Dellas, H. and Yoo, C. (1991), p. 411.

Following Heller and Knight, Dooley, Lizondo and Mathieson[196] suggested that the currency composition of monetary reserves would most likely reflect central banks' transaction needs in the foreign exchange market. The basic thrust of Dooley's argument is that the mean-variance considerations are most logically applied to a country's net foreign asset position rather than to monetary reserves alone, which are a part of a country' gross foreign assets held by the central bank. Their model incorporated the role of the transaction costs into the traditional mean-variance approach and provided a description of the central banks' asset (or liability) positions in each potential currency of denomination. Their argument is formally described as follows:[197]

Suppose a situation occurs in which there are only two reserve currencies for a country: currency 1 and currency 2. This country's net asset position in currency i equals the sum of the holdings of assets in currency i, A_i, and the issuance of liabilities in currency i, L_i.

(4.5-1) $$N_i = A_i - L_i .$$

Assume that the overall size of the net foreign asset position, W is taken as exogenous. The country can hold foreign assets in currency i which yield a random rate of return that has a mean of r_i and a variance of $\sigma_{r_i}^2$. Alternatively, the country can borrow in currency i and must pay $r_i + d_i$, where d_i is a positive constant that reflects the spread between the lending and borrowing rates. The net interest earned on a given net foreign asset position is $r_i(A_i - L_i) - d_i L_i$.

The expected rate of return on the country's overall net foreign position will be given by

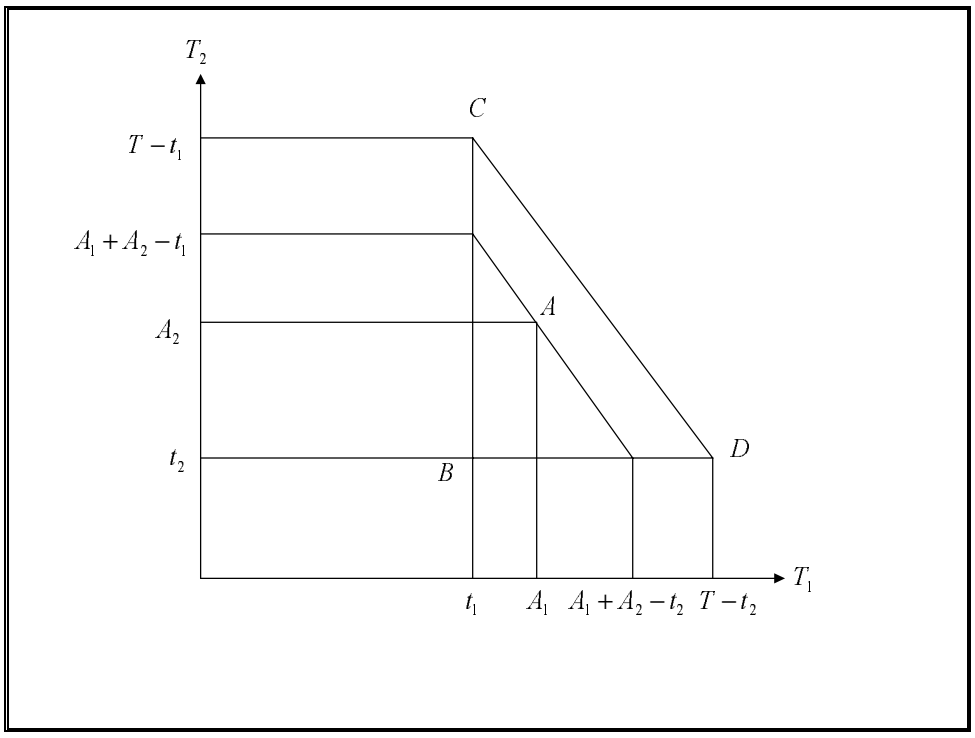
(4.5-2) $$m = r_1(A_1 - L_1) - d_1 L_1 + r_2(A_2 - L_2) - d_2 L_2$$
$$= (r_1 + d_1)N_1 + (r_2 + d_2)N_2 - d_1 A_1 - d_2 A_2 .$$

The return's variance will therefore equal

[196] Dooley, M.P. , Lizondo, J.P. and Mathieson, D.J. (1989).
[197] Dooley, M.P. , Lizondo, J.P. and Mathieson, D.J. (1989), pp. 393-398.

(4.5-3) $\sigma^2 = N_1^2\sigma_{r_1}^2 + N_2^2\sigma_{r_2}^2 + 2N_1N_2\sigma_{r_1r_2}$.

Figure 4-3: Reserve Holdings and Transaction Structure



Source: Dooley, M.P. , Lizondo, J.P. and Mathieson, D.J. (1989), figure 2.

Assume that the country's reserve holdings are represented by point A in Figure 4-3, with A_1 of currency 1 and A_2 of currency 2. Next, assume that the amount of transactions the country undertakes in each currency in each time period can be described by three possible states of nature:

(t_1, t_2) occurs with probability π_1 (point B in Figure 4-3)

$(t_1, T-t_1)$ occurs with probability π_2 (point C in Figure 4-3)

$(T-t_2, t_2)$ occurs with probability π_3 (point D in Figure 4-3),

with $T \succ t_1 + t_2$ and $\pi_1 + \pi_2 + \pi_3 = 1$.

There are two types of transaction cost, given this transaction structure.

- The first type is the cost of converting one currency into another.

- The second type is associated with the possibility that the country may exhaust its reserve holdings. Such an outcome could force the country to engage in emergency borrowing, which is assumed to be relatively costly.

The above two types of transaction costs are taken as being represented by quadratic functions of the amounts involved. The incurred transaction costs in each possible state of nature are described as follows:

Possible state of nature	The first type of cost	The second type of cost
point B in Figure 2	0	0
point C in Figure 2	$\pi_2 c(A_1 - t_1)^2$	$\pi_2 p(T - A_1 - A_2)^2$
point D in Figure 2	$\pi_3 c(A_2 - t_2)^2$	$\pi_3 p(T - A_1 - A_2)^2$

Symbols c and p are parameters associated with the conversion from one currency to another and with reserve shortages, respectively.

As a result, the expected overall transaction costs for holding reserves A_1 and A_2 are given by

(4.5-4) $E(tc) = \pi_2 c(A_1 - t_1)^2 + \pi_3 c(A_2 - t_2)^2 + (\pi_2 + \pi_3) p(T - A_1 - A_2)^2$.

In determining its foreign asset and liability position, the country assumes to maximize its utility function:

(4.5-5) max. $U = m - b\sigma^2 - E(tc)$,

subject to

$W = A_1 + A_2 - L_1 - L_2 = N_1 + N_2$.

Selecting N_1, N_2, A_1 and A_2 so as to maximize equation (4.5-5) and substituting m, σ^2 and $E(tc)$ with equation (4.5-2), (4.5-3) and (4.5-4), respectively, yield the following first-order conditions:

(4.5-6) $\dfrac{\partial U}{\partial N_1} = 0$ (4.5-7) $\dfrac{\partial U}{\partial N_2} = 0$

(4.5-8) $\dfrac{\partial U}{\partial A_1} = 0$ (4.5-9) $\dfrac{\partial U}{\partial A_2} = 0$

The first-order conditions yield

(4.5-10) $N_1 = \dfrac{(r_1 + d_1 - r_2 - d_2)}{2bd} + W\dfrac{(\sigma^2_{r_2} - \sigma_{r_1 r_2})}{D}$

(4.5-11) $N_2 = \dfrac{(r_2 + d_2 - r_1 - d_1)}{2bd} + W\dfrac{(\sigma^2_{r_1} - \sigma_{r_1 r_2})}{D}$,

where $D = \sigma^2_{r_1} + \sigma^2_{r_2} - 2\sigma_{r_1 r_2}$, and A_1, A_2 and A are given by

(4.5-12) $A_1 = \dfrac{\pi_3 A + \pi_2 t_1 - \pi_3 t_2}{(\pi_2 + \pi_3)} + \dfrac{d_2 - d_1}{2c(\pi_2 + \pi_3)}$

(4.5-13) $A_2 = \dfrac{\pi_2 A + \pi_3 t_2 - \pi_2 t_1}{(\pi_2 + \pi_3)} + \dfrac{d_1 - d_2}{2c(\pi_2 + \pi_3)}$

(4.5-14) $A = \dfrac{2p(\pi_2 + \pi_3)^2 T + 2c\pi_2\pi_3(t_1 + t_2) - (\pi_3 d_1 + \pi_2 d_2)}{2p(\pi_2 + \pi_3)^2 + 2\pi_2\pi_3 c}$.

- Equations (4.5-10) and (4.5-12) indicate that the country's net foreign asset position in each currency is determined by the expected rate of return (or borrowing costs), the variances

and covariances of these rates of return on each currency, and the degree of relative risk aversion.

- Equations (4.5-12)-(4.5-14) indicate that the country's gross asset position in each currency is determined by transaction costs associated with currency conversion and reserve shortages, and by the minimum and maximum levels of potential exchange market transactions. Therefore, the currency composition of monetary reserves will be influenced by these transaction considerations.

Dooley, lizondo and Mathieson's argument is thus formally justified.

Two derivations can be made as follows:[198]

- From equations (4.5-10) and (4.5-11), it is derived that not only the rate of return on official foreign exchange reserves but also the rate of return on gross liability in each reserve currency should be taken into account, when optimizing a country's net foreign asset position.

- On the one hand, a country can choose an efficient portfolio of its net foreign asset position according to mean-variance considerations as equations (4.5-10) and (4.5-11) suggest. On the other hand, its central bank can choose an optimal portfolio of monetary reserves according to transactions considerations as equations (4.5-12) and (4.5-13) suggest, but still maintain the country's desired net foreign asset position in each currency by altering the currency denomination of the country's liability according to equation (4.5-1). This implies that even if the currency composition of the net asset portfolio is efficient (in a mean-variance sense), there is no reason to expect that the currency composition of official foreign exchange reserves will represent an efficient portfolio.

Nonetheless, Dooley[199] agreed that in reality portfolio optimization with respect to the currency composition of net foreign asset position is not always possible. This is particular likely if a separation between management of official foreign exchange reserves and

[198] Cp. Dooley, M.P. , Lizondo, J.P. and Mathieson, D.J. (1989), p. 390.
[199] Dooley, M.P. (1987). See also Roger, S. (1993), p. 49.

management of foreign liabilities is implemented. Moreover, the ability of manipulating foreign currency positions may be more constrained on the liabilities side than the assets side as a rule. Therefore, it may be more feasible to choose an efficient portfolio of monetary reserves than of a country's net foreign asset position. Even in this case, however, the central bank may well take foreign exchange liabilities into account in determining the optimal currency composition of monetary reserves.

Whether the currency composition of monetary reserves is more determined by transaction considerations than by mean-variance considerations is thus essentially an empirical issue. The results of Dooley's empirical analysis[200] in 1987 is summarized as follows:

- The evidence supports the view that monetary reserves are held for transaction reasons, and currency composition was determined by the consideration that they could be easily liquidated and used to make payments.

- The currency composition of monetary reserves does not appear to be consistent with mean-variance considerations. Two pieces of evidence support this conclusion.

  - The first is that there is a very limited correspondence between the currency compositions of gross and net asset positions. This implies that only one portfolio of them can be efficient in the mean-variance sense.

  - The second is that the share of USD in monetary reserves appears largely to reflect exchange rate movements. A plausible explanation for this phenomena as Dooley suggested is that revaluation effects on the currency composition of monetary reserves were accepted passively simply because they would be quite consistent with the effects of exchange rate movements on transactions needs. Such a reasoning suggest a means to measure the relative importance that transaction considerations has against mean-variance considerations in determining the currency composition of monetary reserves. "*On the one hand, if currency shares in reserves are much more stable at prevailing exchange rates than at constant exchange rates, this suggests that the central bank focuses mainly on portfolio considerations. On the other hand, if currency shares are*

[200] Dooley, M.P. (1987).

much more stable at constant exchange rates, this suggest that the main focus is on transactions considerations."[201] Using this measure, Scott[202] drew his conclusion from the empirical results that neither transaction considerations nor mean-variance considerations necessarily dominate decisions regarding the currency composition of monetary reserves.

Dooley, Lizondo and Mathieson[203] provided an empirical model to estimate the significance of three transaction-oriented variables, i.e., the nature of exchange rate arrangement, the currency composition of trade flows, and debt service. The results justified their hypothesis. These variables exert a significant influence on the currency composition of monetary reserves.

Two additional interesting findings should be mentioned here:

- The industrial countries with flexible exchange rates intervened in USD rather than in other currencies as could occur under certain pegging arrangements throughout the investigated period.[204] This fact indicates that the relative importance of the main vehicle currency against other reserve currencies in the foreign exchange market increasingly affects decisions regarding the currency composition of official foreign exchange reserves by a flexible exchange rate system. This finding justifies the assertion made in chapter 3, that the structure of exchange might also have great influence on the choice of the intervention currency.

- "*Transaction considerations appear to vary in importance from one currency to the next.*" [205] This implies that the relative weight a central bank places on transaction considerations against mean-variance considerations is not a priori determinable.

In summary, Dooley, Lizondo and Mathieson deny Ben-Bassat's emphasis on portfolio-related motives. They demonstrated that mean-variance considerations are most logically applied to the net foreign asset position of a country rather than to monetary reserves alone. Because of the separation between reserve management and liability management, a logical

[201] Roger, S. (1993), p. 51.
[202] Roger, S. (1993), pp. 51-54.
[203] Dooley, M.P. , Lizondo, J.P. and Mathieson, D.J. (1989), pp. 405-407.
[204] Dooley, M.P. , Lizondo, J.P. and Mathieson, D.J. (1989), p. 407.

application of mean-variance considerations to the net foreign asset position is impossible in practice and a complete exclusion of mean-variance considerations from reserve management is also impossible in practice. Although Dooley's empirical evidences show that the currency composition of monetary reserves is mainly determined by intervention-related motives, the relative importance of intervention-related motives against portfolio-related motives is not a priori determinable. They illustrated also that the structure of exchange, the nature of exchange rate arrangement, the currency composition of trade flows, and debt service all exert a significant influence on the currency composition of monetary reserves. They did not, however, provide a complete explanation, which integrates these factors and clarifies the relationships between them.

4.6. Horii: two levels of diversification for monetary reserves

Horii[206] examined the diversification of monetary reserves during the 1970s and 1980s.

His first finding is that the currency composition of reserve holdings cannot be explained in terms of transaction motive determined by current account transactions alone, since capital account transactions have become increasingly important.[207]

His second finding is that the currency composition of foreign exchange reserves is stable during a period of significant changes in exchange rate arrangements. This finding denied the traditional view suggested by Heller and Knight[208], that the nature of exchange rate arrangements is a predominant determinant for the currency composition of monetary reserves.[209] It might mean that the currency composition of monetary reserves depends not only on the nature of exchange rate arrangements but also on the structure of exchange, with the latter playing a more important role.

Finally, Horii calculated the optimal portfolio for industrial countries (excluding the United States, Germany and Japan), where some diversification took place in the first half of the

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[205] Roger, S. (1993), p. 55
[206] Horii, A. (1986).
[207] Horii, A. (1986), p. 26.
[208] Heller, H.R. and Knight, M. (1978).
[209] Horii, A. (1986), pp. 26-33.

1980s. Although he noted that the currency composition of foreign exchange reserves should be studied on an individual country basis, Horii focused on country group data because no information was available on the currency composition of most individual countries' foreign exchange reserves. His model is similar to the one used by Ben-Bassat.[210]

The real rate of return on investment in currency i is approximately expressed as

(4.6-1) $r_i = r_F(i) + E_i - P$,

where

r_i = the real return on investment in currency i

$r_F(i)$ = the unannualized nominal interest rate of reserve currency i in a three-month period

E_i = the percentage change in exchange rate i against the holder's currency in the domestic currency term

P = the inflation rate during the three-month period

a_i = the proportion of currency i in the reserve portfolio

A = vector of a_i.

Term a_i is defined as the proportion of currency i in the portfolio and A as a vector of a_i. Obviously,

(4.6-2) A'e=1,

where e is the unit vector. The mean m and variance σ^2 of the reserve portfolio are expressed as

(4.6-3) $m = A'R$;

(4.6-4) $\sigma^2 = A'VA$,

where

R = the mean return vector of r_i

[210] Horii, A. (1986), pp. 53-54.

V = the covariance matrix of r_i .

The locus of feasible mean variance opportunities is found by minimizing σ^2 subject to (4.6-2) and (4.6-3), i.e., the minimum variance opportunity set. Setting the Lagrangian form,

(4.6-5) $L = A'VA - \lambda_1(A'R - m) - \lambda_2(A'e - 1)$

we obtain the investment proportion of any portfolio which lies on the efficient frontier satisfying the following relations at any given mean of the portfolio return r(p):

(4.6-6) $A = V^{-1}(R,e)X^{-1}(r(p),1)'$.

At the same time, the variance $\sigma^2(p)$ on the efficient frontier is obtained by

(4.6-7) $\sigma^2(p) = (r(p),1)X^{-1}(r(p),1)'$,

where X is a symmetrical matrix whose (1,1) element is $R'V^{-1}R$, (1,2) and (2,1) elements are $R'V^{-1}e$, and (2,2) element is $e'V^{-1}e$.

Horii defined the optimal portfolio as the minimum variance portfolio, which generates the minimum risk for a holder. The utility function of the central banks is ignored by such a procedure. In other words, it is assumed that central banks always hold foreign currencies in such a way that they minimize the risk of losses on their currency holdings. By minimizing (4.6-7) with respect to r(p) we obtain the return on the minimum variance portfolio.

(4.6-8) $r(p)^* = R'V^{-1}e / e'V^{-1}e$.

The optimal composition is thus obtained by substituting $r(p)^*$ in (4.6-6) and represented by the following equation:

(4.6-9) $A^* = V^{-1}e / e'V^{-1}e$.

Horii then constructed two optimal portfolios, 1979 and 1984 portfolios, and compared them with changes in actual currency composition. His findings are summarized as follows:[211]

- The optimal proportion of USD holdings is far below actual holdings in both years. If the optimal portfolio is defined not as the minimum variance portfolio but as the maximum return portfolio adjusted for portfolio risk and the degree of relative risk aversion, the results will then be different. However, in order to increase the USD's proportion in the optimal portfolio to the actual level, it should be assumed that these central banks are tolerant of risk to an unrealistically high degree.

- In contrast, the actual holdings of reserves denominated in DEM, FRF, and GBP are much lower than that in the optimal portfolio.

- The direction, but not the extent, of changes in actual currency composition between 1979 and 1984 were roughly in accordance with those suggested by the efficient portfolio exercise.

Horii has identified two possible reasons for this inconclusive result.[212] The first is a theoretical reason: the mis-specification of the portfolio model. The mis-specification of the portfolio model thus indicates the theoretical inapplicability of it. The other is a practical reason: the absence of systematic portfolio considerations in actual reserve management. The absence of such considerations in actual reserve management indicates therefore its practical inapplicability. His arguments are so restated and supplemented in the following as to be regarded as a general critique on the portfolio theory approach.

Mis-specification is likely to stem from the following factors:

- Rate of return on each reserve currency i is defined differently according to different authors. For example, Ben-Bassat defined it as $r_i = (1+r_F(i))/(1+E_i)-1$, while Horii defined it as $r_i = r_F(i) + E_i - P$. A more fundamental and serious problem may be that we cannot

[211] Horii, A. (1986), pp.35-37.
[212] Horii, A. (1986), p. 38.

exactly define the total expected rate of return on currency i, R_i^T, when we take the money quality of reserve currency into account, as chapter 2 indicates. That means also that the degree of liquidity, transaction costs, and other non-economic considerations involved in currency preference are ignored.

- There is no consensus on the appropriate reference currency or currency basket, in terms of which the rate of return is measured. There are two alternatives employed in previous studies. The first alternative evaluates rate of return on reserve currencies with reference to an index of foreign prices, usually weighted according to import shares from various countries or according to currency shares in the denomination of imports. The second alternative measures rates of return on reserve currencies with reference to a currency basket, against which the central bank in question has an exchange rate target.[213]

- The statistical characteristics of rates of return on different reserve currencies, for example, their means, variances and covariances, may be unstable over time. Changes in these statistical parameters lead to changes in the shape and position of the feasible mean-variance opportunity set. Previous authors usually assumed that the statistical parameters derived from past data constitute a good indicator of central banks' expectations regarding future ones. This assumption is analogous with adaptive expectation. Consequently, portfolios, which appear efficient ex ante based on past statistical parameters, are quite likely to turn out to be less efficient ex post.[214] It is also likely that central banks' expectations regarding these parameters might be quite different from their past movements, and portfolios, which seem to be efficient ex ante for previous authors, might also be not efficient ex ante for the central bank concerned.[215] Thus, Horii proposed that the adaptive expectation should be replaced with the rational expectation. On the basis of rational expectation, central banks have full information about the possible changes of the statistical parameters and will take the right ones into consideration.

- The lack of any dynamic adjustment process in this model may be another reason for mis-specification. This means that the adjustment approach towards the optimal portfolio may be made very slowly. The actual portfolio, which is not in accordance with the optimal

[213] Roger, S. (1993), p. 44.
[214] Roger, S. (1993), p. 45.

portfolio in this period, can be interpreted as the result of an incomplete movement to fill out the gap between the actual and optimal currency compositions already indicated in the previous period. As with Horii, Ben-Bassat associated the observed gap between the optimal and actual portfolio partly due to the dynamic nature of portfolio selection.[216]

The absence of systematic portfolio considerations in actual reserve management is likely to stem from the following factors:[217]

- Central banks may manage reserve holdings out of motives other than portfolio-related ones. This factor may result in a spurious correlation between the directions of changes in the optimal and actual currency composition.

- Even more possibly, central banks may manage only part of their monetary reserves in accordance with a mean-variance model, while holding and managing a significantly larger part on the basis of considerations other than the portfolio-related motive, i.e., intervention-related motives. This implies that central banks with large monetary reserves may have more scope to diversify the currency composition of their monetary reserves on the basis of portfolio considerations.

Because of the absence of systematic portfolio considerations in actual reserve management, Horii distinguished two types of balances of monetary reserves from each other. One is the transaction balance, which is the proportion of monetary reserves held by a central bank for intervention, while the other is idle balance, which is the proportion of monetary reserves held by a central bank for investment. The distinction between the two balances is based on the different motives of reserves holding and the different considerations regarding each type's rate of return.[218] Horii suggested that central banks might manage only the idle balance in accordance with mean-variance considerations, while holding and managing the transaction balance on the basis of intervention-related considerations.

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[215] Horii, A. (1986), p. 57.
[216] Ben-Bassat, A. (1984), p. 25.
[217] Horii, A. (1986), pp. 38-39.
[218] Cp. Horii, A. (1986), p. 46.

Foreign exchange markets and financial markets, in which monetary reserves are placed, are not perfectly efficient, because there are a number of constraints on rapid conversion.[219] For this reason, as long as monetary reserves are held as a transaction balance it is convenient for central banks to hold them in the foreign exchange vehicle currency, which can be used most promptly for interventions. In most exchange markets the USD functions as the foreign exchange vehicle currency. Therefore, most countries use the USD for intervention irrespective of their exchange rate arrangements. It is recognized that the USD's role as the foreign exchange vehicle currency in financial and exchange markets is attributable to its high liquidity and low transaction costs.[220]

As mentioned above, Horii found that the optimal proportion of USD holdings for industrial countries was far below actual holdings in 1979 and 1984. Ben-Bassat's study[221] showed a similar phenomenon, that the USD's actual proportion in developing countries was significantly higher than its optimal share. Such a similarity could be better explained by the absence of systematic portfolio considerations in actual reserve management than by the mis-specification of the portfolio model. This means that the higher actual proportion of USD than its optimal proportion is more attributable to the USD's preferred profile as the foreign exchange vehicle currency.

The idle balance is possibly only a small part of official foreign exchange reserves, while the transaction balance constitutes a significant large part of official foreign exchange reserves.[222] Given the constraints on rapid conversion, the idle balance's scope is limited by the level of monetary reserves. Central banks with a high level of monetary reserves have more scope to apply portfolio-selection theory to diversify their idle balances. For central banks, which have small monetary reserves in relation to their intervention-related motives, the scope for applying portfolio-selection theory is limited.[223]

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[219] "*Firstly, a currency conversion operation involves a cost at least equal to the offer/bid spread. Secondly, not all reserve currencies offer the same range of readily encashable instruments which enable reserves to be held in large quantities. Thirdly, the assumption that a given central bank's transactions in the exchange markets will have no price effects holds good only if the volume converted from investment instruments to transaction instruments is relatively small. Finally, although borrowing can in part substitute for the actual holding of reserves, the cost of short-term financing at a precise moment of need is sometimes not inconsiderable.*" Horii, A. (1986), p. 40

[220] Cp. Horii, A. (1986), pp. 41-42, Müller, H. and Straubhaar, T. (1998), p. 288.

[221] Ben-Bassat, A. (1984).

[222] Horii, A. (1986), p. 38.

[223] Cp. Horii, A. (1986), p.47.

For central banks, which make the distinction between transactions balances and idle balances explicitly, there are two levels of reserve currency diversification, i.e., diversification on the transaction balances and diversification on the idle balances. The former is subject to intervention-related considerations, e.g., the degree of liquidity and the transaction costs. The latter is subject to portfolio-related considerations, e.g., the statistical characteristics of rates of return on reserve currencies.

In sum, Horii's main contribution is to point out the inapplicability of the portfolio theory approach. This inapplicability suggests that central banks might manage only a part of monetary reserves in accordance with mean-variance considerations. For this reason there should be two levels of diversification for monetary reserves and each one is subject to different considerations respectively. Horii pointed out at the same time that the structure of exchange exerts predominant influence on the transaction balance's currency composition.

4.7. Some new facts in finance

Ben-Bassat and most other previous authors used the minimum variance portfolio or the market portfolio as the optimal portfolio, on condition that the indifference curves of central banks are not given. However, these two proxies for the optimal portfolio are not without questions.

Firstly, the assumption behind the minimum variance portfolio is unrealistic. It is assumed by using the minimum variance portfolio that the economic agent maximizes his utility by minimizing his portfolio variance.

Secondly, the market portfolio's applicability is disputable. In order to find a market portfolio, we need to assume the existence of riskless asset return, which Ben-Bassat earlier mentioned. In addition it is also assumed that if all economic agents have homogeneous beliefs about the expected distributions of returns offered by all assets, then all economic agents will perceive the same feasible mean-variance opportunity set. Furthermore, the market is assumed to be in equilibrium. All prices must be adjusted so that excess demand for any asset will be zero and the market portfolio is thus a portfolio in which all assets are held according to their

market value weights. In other words, the percentage of wealth held in each asset is equal to the ratio of the market value of the asset to the market value of all assets.[224]

$$(4.7\text{-}1)\quad w_i = \frac{V_i}{\sum_{i=1}^{N} V_i},$$

where

w_i = the weight of the ith asset in the market portfolio

V_i = the market value of the ith asset

$\sum V_i$ = the total market value of all assets.

The equation for the capital market line is expressed as[225]

$$(4.7\text{-}2)\quad r_P = r_F + \frac{r_M - r_F}{\sigma_{r_M}} \sigma_{r_P},$$

where

r_P = expected rate of return on portfolio

r_F = riskless asset return

r_M = expected rate of return on the market portfolio

σ_{r_M} = standard deviation of r_M

σ_{r_P} = Standard deviation of r_P .

On the basis of the above equation and the concept of the market portfolio developed by Sharpe, Linter and Black, the capital asset pricing model (CAPM) is expressed as

$$(4.7\text{-}3)\quad r_i = r_F + (r_M - r_F)\frac{\sigma_{iM}}{\sigma_M^2},$$

where

r_i = the expected rate of return on asset i

[224] Copeland, T.E. and Weston, J.F. (1988), p. 181.
[225] Copeland, T.E. and Weston, J.F. (1988), p. 181.

r_F = the riskless asset return

r_M = the expected rate of return on the market portfolio

σ_{iM} = the covariance between r_i and r_M

σ_M^2 = the variance of r_M.

That means that the expected rate of return on any asset is equal to the sum of the riskless rate of return and a risk premium. The risk premium is the product of the price of risk and the quantity of risk. The price of risk is the difference between the expected rate of return on the market portfolio and the riskless asset return. The quantity of risk, β_i, is defined as the covariance between returns on the risky asset, i, and market portfolio, M, divided by the variance of the market portfolio.

(4.7-4) $\beta_i = \frac{\sigma_{iM}}{\sigma_M^2}$.[226]

Following the above equation, the CAPM states that the expected rate of return on an asset is higher if it has a high beta, which measure how the asset covaries with the economy.[227]

Equation (4.7-3) is the ex ante form of the CAPM and from it we can derive the ex post form of the CAPM, i.e., $r_{it} - r_{Ft} = (r_{mt} - r_{Ft})\beta_i + \varepsilon_{it}$.[228] The CAPM is usually reformulated as

(4.7-5) $R'_{pt} = \gamma_0 + \gamma_1 \beta_p + \varepsilon_{pt}$,

where

R'_{pt} = The excess return on portfolio p, $(r_{pt} - r_{Ft})$

γ_1 = $r_{mt} - r_{Ft}$,

when it is empirically tested.

[226] Copeland, T.E. and Weston, J.F. (1988), pp. 195-198.
[227] Cochrance, J.H. (1999), p. 1.
[228] Copeland, T.E. and Weston, J.F. (1988), p. 213.

By the empirical test some criteria should be met in order to justfy the CAPM.[229]

- The intercept term, γ_0, should not be significantly different from zero.
- β, the quantity of risk, should be the only variable that explains the expected rate of return on a risky asset.
- The relationship between β and rate of return should be linear and positive.

The first and second criteria state in fact the same thing, that β is the only risk needed to explain expected return. The third criterion supports the CAPM only if β suffices to explain expected return.[230]

With few exceptions, empirical studies show very similar results, which contradict the above criteria.

- Factors other than β are successful in explaining the portion of security returns not captured by β, for example, the size effect, book-to-market equity (value effect), leverage and E/P ratio. Moreover, The results of Fama and French in 1992 suggest that stock risks are multidimensional.[231] In 1993 Fama and French showed that "*there are common return factors related to size and book-to-market equity that help capture the cross-section of average stock returns in a way that is consistent with multifactor asset-pricing model.*"[232] In order to explain the necessity of multiple factors, which do not seem to be correlated with β, Cochrane pointed out that "*the average investor has a job.*"[233] The CAPM assumes silently that the average investor has wealth coming from investments alone. More realistic is that for an average investor wealth comes both from investments and from jobs. For this reason events like recessions hurt the average investors. Assume two stocks with the same beta, one of which does well during recessions, i.e., bad times, while the other does poorly during recessions. An average investor will prefer the countercyclical stock and is willing to hold it at a lower expected rate of return, since its performance will cushion the decrease in income from jobs. In contrast, the procyclical

[229] Copeland, T.E. and Weston, J.F. (1988), p. 214.
[230] Fama, E.F. and French, K.R. (1996), p. 1948.
[231] Fama, E.F. and French, K.R. (1992), p. 428.
[232] Fama, E.F. and French, K.R. (1993), p. 55. About the criticques against the work of Fama, E.F. and French, K.R. see Black, F. (1993).
[233] Cochrance, J.H. (1999), p. 6.

stock must offer a higher expected rate of return in order to get investors to hold it. Risks, which covary with recessions, will thus matter in determining expected rate of return.[234] For example, the typical value stock has a price that has been driven down due to financial distress and has come back more often than not. For this reason the value stock generates higher expected rates of return. Moreover, the typical stockholder is a proprietor of a small, privately held business, whose income is sensitive to recessions which distress the small firms and value firms. Thus, the value stock and small stock would be required for higher rates of return.[235]

- The tests of Reinganum,[236] Lakonishok and Shapiro,[237] and Fama and French[238] do not support that a relationship between β and rate of return is positive. On the basis of this finding, Roll and Ross showed that different relationships between β and the rate of return, positive, negative or zero, could be produced even with indices, which are quite close to each other and to the efficiency frontier.[239] On the other hand, Haugen and Baker showed a perverse result, that the stocks with highest expected returns have much smaller β than that of the stocks with lowest expected returns.[240] This points to the conclusion that the risk premium is associated with long-term price corrections in an over-reactive market.[241] An over-reactive market overprices growth stocks, for which earnings per share are expected to grow at a faster-than-average rate in the future, and underprices value stocks, for which earnings per share are expected to grow at a slower-than-average rate in the future.[242] This leads to long-term price corrections. Thus, the low-risk, value stocks tend to produce high returns, and the high-risk, growth stocks tend to produce low returns.[243]

The above evidences indicate the invalidity of the CAPM. The invalidity of the CAPM in turn indicates the inapplicability of the market portfolio. Thus, we reach a conclusion that neither the minimum variance portfolio nor the market portfolio is suitable to be used as the

[234] Cochrance, J.H. (1999), p. 6.
[235] Cochrance, J.H. (1999), pp. 7-14.
[236] Reinganum, M.R. (1981).
[237] Lakonishok, J. and Shapiro, A.C. (1986).
[238] Fama, E.F. and French, K.R. (1992), p. 428.
[239] Roll, R. and S. Ross (1992), p. 115.
[240] Haugen, R.A. and Baker, N. (1996).
[241] Haugen, R.A (1996), p. 96.
[242] Haugen, R.A (1995), p. 87.

optimal portfolio. The above discussions can be regarded as a supplement to the discussions concerning the mis-specification of the portfolio model.

4.8. Consequences from previous studies

The intervention-related approach emphasizes the predominant importance of intervention-related variables, i.e., the structure of exchange, the nature of exchange rate arrangement, and the currency composition of trade flows. However, it does not explain the relationships between them, and it does not provide applicable models to determine the currency composition of monetary reserves. Employing such an approach we cannot answer to what extent a central bank should divert its monetary reserves away from the USD into another reserve currency, e.g., the Euro. This shortcoming is made up by the portfolio theory approach. Nonetheless, the applicability of the Tobin-Makrowitz model to monetary reserves is questionable. Horii has identified two possible reasons for his inconclusive result: the mis-specification of the portfolio model and the absence of systematic portfolio considerations in actual reserve management.[244] His arguments are restated and supplemented by the author to be employed as a general critique on the portfolio theory approach.

The discussions concerning the mis-specification of the portfolio model indicate a pessimistic fact that employing the Tobin-Markowitz model to correctly determine the optimal currency composition is theoretically very difficult, maybe even impossible or meaningless. Nevertheless, one fundamental message of the Tobin-Markowitz model should not be denied, and that is that an economic agent could reduce the risk of his portfolio by including an asset i in his portfolio, when asset i has negative covariance with other assets in the portfolio.[245]

On the other hand, the absence of systematic portfolio considerations in actual reserve management was demonstrated unconsciously by economists from the beginning. The optimal proportion of the USD is often, if not always, lower than its actual proportion in most studies. This trend indicates that central banks hold monetary reserves at least partly because of

[243] Haugen, R.A (1995), pp. 101-102.
[244] Horii, A. (1986), p. 38.
[245] See 3.2.1.

intervention-related motives. Heller and Knight have already recognized that "*central banks have broader objectives than simple portfolio optimization.*"[246]

Ben-Bassat also admitted that there are motives other than portfolio-related ones in determining the currency composition of monetary reserves. Thus, he used the import currency basket as the reference currency basket in order to take the intervention-related motives into account. However, his empirical results demonstrated that such a procedure seems to be unsuccessful. His failure arises from applying the Tobin-Markowitz Model to monetary reserves, which he assumed to be held because of intervention-related motives. Dooly demonstrated that mean-variance considerations are most logically applied to the net foreign asset position of a country and that the reserve holdings are influenced mainly by transaction considerations.

Of course it is also undeniable that central banks' goals of reserve management include optimally-diversifying their monetary reserves, or at least, a part of their monetary reserves. One fundamental assumption for our discussion is that there are two sorts of motives for central banks' reserve holdings, i.e., intervention-related motives and portfolio-related motives. For this reason, the author accepts the distinction between the transaction balance and the idle balance proposed by Horii. The operational implication of this distinction is the separation of monetary reserves into two tranches corresponding to different objectives.

The transaction balance is related to intervention-related motives. Reserve currencies, in which the transaction balance is denominated, should be more easily converted to another currency at the precise moment of need or vice versa and they should have financial markets with higher capacity. In other words, they should have a higher degree of liquidity and lower transaction costs. A higher degree of liquidity and lower transaction costs are just concrete indicators for higher money quality. This means that there is a hierarchy of reserve currencies held for intervention-related motives, which is based on their different money quality. As indicated in the third chapter, this hierarchy build a limit for the portfolio-related considerations of reserve management. When central banks want to diversify their transaction balance, they should take the different money quality of possible candidate currencies into account.

[246] Heller, H.R. and Knight, M. (1978), p. 11.

In contrast, the idle balance of monetary reserves is related to portfolio-related motives. All the reserve currencies, in which the idle balance of monetary reserves is denominated, could be assumed to have the same money quality. The expected rates of return on reserve currencies held as the idle balance are assumed to be fully described by the portfolio theory. This means that central banks can apply the portfolio-selection theory on the idle balance to determine its optimal currency composition.

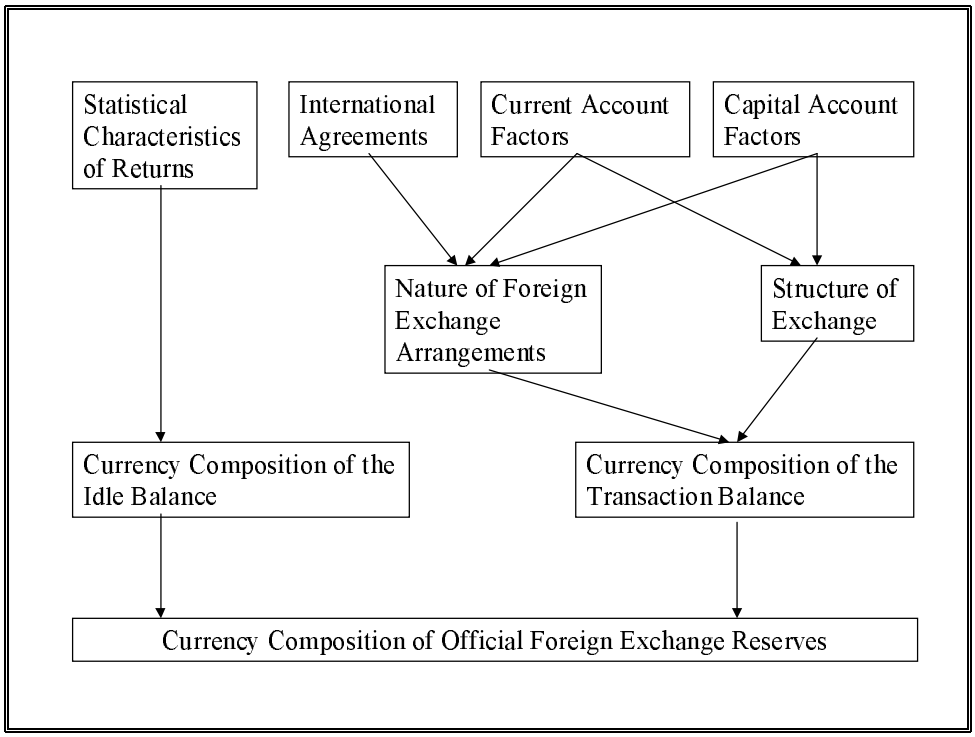
The above distinction might not only be conceptually but also institutional important for some countries. For these countries the transaction balance and the idle balance are managed as two distinct portfolios. They might even be placed under the responsibility of different institutions. For example, Singapore splits the management of foreign assets between the Monetary Authority of Singapore (MAS) and the Government of Singapore Investment Corporation (GSIC): the GSIC manages the country's foreign assets for investment purposes, while the MAS manages the foreign reserves needed for intervention purposes.[247]

For further discussion, the author will follow a simple principle that balances arising from different motives should be separately analyzed.[248] This principle was also followed by Keynesians. They analyzed money holding for transactions demand with an inventory approach, money holding for precautionary demand with Whalen and Tsian's approach, and money holding for speculative demand with the portfolio balance approach. Since the transaction balance arises from intervention-related motives, the money quality analysis will be applied to it, while an analysis of the portfolio theory approach will be applied to the idle balance, which is held because of portfolio-related motives. However, in practice we cannot distinguish the transaction balance from the idle balance for a central bank exactly, since there are no available. Therefore, we also cannot determine the actual scope for applying money quality analysis and/or portfolio-selection theory to diversify official foreign exchange reserves. Furthermore, the mis-specification of the portfolio model indicates also the inapplicability of the Tobin-Markowitz model to monetary reserves. For these reasons we will not try to compute exactly the optimal currency composition of monetary reserves for the two NICs in question and the extent to which they should convert their USD holdings into the Euro. Just the same we cannot determine the weight of money in the whole wealth by applying the

[247] Cassard, M, and Folkerts-Landau, D. (1997), p. 19.
[248] Heinevetter applied the mean-variance approach on the transaction balance. For this reason, his theory contradicts with empirical evidences. Cp. Heinevetter, B. (1978).

inventory approach, the Whalen and Tsian's approach and the portfolio approach at the same time.

Figure 4-4: A Framework for our Empirical Study



The above figure illustrates the framework for our empirical study in the next chapters. The framework has a similar structure with that of the relationships between different dimensions of international currency, since it is based on these relationships.

In the empirical study's first part the author tries to answer the following question: Does it make sense that the central banks in question convert at least a part of their transaction balance of USD into the Euro? Chapter 3 shows that the relative importance of a reserve currency in a central bank's monetary reserves is positively related with the potential volume of this central bank's foreign exchange transactions in the reserve currency concerned. This means that to what extent the Euro will be used as the intervention currency for the two NICs in question should be estimated. Chapter 2 points out that the choice of the intervention currencies depends on the structure of exchange and the nature of foreign exchange arrangements. The former factor is more important than the latter.

The author will investigate in chapter 5 how the market forces decide which currency is a major vehicle in the foreign exchange market. This chapter will be devoted to this issue

completely because of its importance and complicacy and will demonstrate that transaction costs play a determinative role for this issue. In the subsequent chapter, according to determinants for transaction costs, the author will choose indicators to estimate the Euro's prospect as a foreign exchange vehicle currency in relation to the USD in foreign exchange markets. These indicators include the trading volume in foreign exchange markets, the current account factors, and the capital account factors. Moreover, the nature of the two NICs' exchange rate regimes, together with the current account factors and the capital account factors, exerts significant influence on the choice of pegging currencies. The money quality analysis is then finished.

It is assumed that for intervention-related motives central banks hold a significant part of their monetary reserves as transaction balance. The relative weight a central bank places on the transaction balance against the idle balance is not a priori determinable. For this reason, the scope of diversifying the idle balance in the two NICs will be measured before we begin the second part of empirical study.

As the second part of empirical study, the portfolio theory is applied to monetary reserves as the idle balance. This step relies on some assumptions:

- The whole monetary reserves are regarded as idle balance.

- It is assumed that the Euro and USD have the same money quality. That means that we do not take the non-pecuniary rates of return and transaction costs, which are influenced by the money quality of the candidate currencies, into account.

- The central bank's objective is assumed to be the maximization of the representative resident's utility, which is a positive function of the rate of return and negative function of the risk associated with the assets of the central bank.

Since Dooly has demonstrated that the portfolio theory is most logically applied to the net foreign asset position of a country, and the idle balance is a part of the gross asset position of a country, computing its optimal currency composition is meaningless in this step. Nevertheless, we will take the above mentioned fundamental message of the portfolio theory into account,

namely that the proportion of a reserve currency should rise as the rates of return on this currency are correlated negatively with other rates of return. The correlation coefficient of the Euro with the USD and other reserve currencies will be computed, in order to access whether it makes sense for the two NICs concerned to diversify their currency composition of the idle balance from USD to Euro under the influence of the Euro's emergence.

5. FOREIGN EXCHANGE VEHICLE CURRENCY THEORIES

Chapter 4 proposed that balances arising from different motives should be separately analyzed and regarding transaction balance, the dissertation examines to what extent it will be diversified from USD to the Euro. The transaction balance is made of intervention currencies. The choice of intervention currencies is dependent on

- the choice of foreign exchange vehicle currency and
- the choice of pegging currency.

The former is more important than the latter. In foreign exchange markets, market forces play a very important role determining which currencies are used as the foreign exchange vehicle. By contrast, the choice of the country's pegging currency is partly guided by international agreements, and partly influenced by current account factors and capital account factors.

As a first step, this chapter will investigate how market forces decide a currency as a major vehicle in the foreign exchange market. This chapter will be devoted to this issue completely because of its importance and complicacy. Several foreign exchange vehicle theories will be discussed, which illustrate the main factors influencing the emergence of the foreign exchange vehicle currency.

In 5.1 the deficiencies of Swoboda's model and Klein's model are discussed by showing two different structures of exchange. In 5.2 Krugman's model is used to explain the relationship between the choice of foreign exchange vehicle currency and market externality. In 5.3 Hartmann's model explains how equilibrium of a structure of exchange with two vehicle currencies is reached, which have a different status. In 5.4 two determinants for the structure of exchange, i.e., trading volume and exchange rate volatility, are derived from previous studies.

5.1. Structures of exchange in the global market

A currency's role as a major foreign exchange vehicle currency is based on its function as an international medium of exchange, which can be explained by its advantage of transaction costs.[249]

Swoboda[250] applied the basic concepts of the Baumol-Tobin transactions demand inventory mode in a closed economy to his 'vehicle currency theory.' Transaction costs cause economic agents to use some commodities as the common media of exchange in a closed economy. Economies of scale lead them to concentrate only on a few – often only one – commodities for this purpose. Similarly, transaction costs cause economic agents to use an national currencies as international media of exchange. In the absence of a unique international medium of exchange, economies of scale lead economic agents in the foreign exchange markets to concentrate on using a few – often only one – currencies as the foreign vehicle currency.[251] Swoboda's argument can be restated more formally as follows.[252]

Firstly, we assume that an importer trades with one foreign country. He has to meet a stream of foreign currency payments T evenly over a period, and he withdraws foreign cash in discrete lumps from domestic bonds. His optimal real average transaction balance in foreign currency, $\frac{M_f^d}{P}$, will then be

$$(5.1\text{-}1) \quad \frac{M_f^d}{P} = \sqrt{\frac{bT}{2r}},$$

where

b = the brokerage cost of moving from bonds to foreign cash (per transaction)

r = the interest rate on domestic bonds.

From the above equation we can derive the following one:

[249] Magee, S.P. and Rao, R.K.S. (1980), p. 369.
[250] Swoboda, A.K. (1968).
[251] Cp. Dehmel, A. (1982), p. 53, Krugman, P, (1984), p. 262 and Rey, H. (1997), pp. 2-3.
[252] Cp. Swoboda, A.K. (1968)., p. 39 and Chrystal, K.A. (1987), p. 128.

(5.1-2) $$\ln\left(\frac{M_f^d}{P}\right)=\frac{1}{2}\ln\left(\frac{b}{2}\right)+\frac{1}{2}\ln T-\frac{1}{2}\ln r\,.$$

The trading volume elasticity of the average transaction balance is $\frac{1}{2}$. This means that there is economies of scale for transaction balance use.

We now consider the problem of trading with n different currency areas. The importer must meet n different expenditure streams, T_1, T_2, ..., T_n. He will have to hold transaction balances in n different currencies, $\frac{M_{f1}^d}{P}$, $\frac{M_{f2}^d}{P}$, ..., $\frac{M_{fn}^d}{P}$. The optimal total transaction balance will be

(5.1-3) $$\sum_{i=1}^{n}\frac{M_{fi}^d}{P}=\sum_{i=1}^{n}\sqrt{\frac{bT_i}{2r}}\quad i=1,\ldots,n\,.$$

Because of economies of scale, there would be a considerable saving of the foreign cash balance, if the importer concentrates on using a single currency to make the payments. Assuming for simplicity that $T_1=T_2=\ldots T_n$, then the saving of cash balances would be

(5.1-4) $$(n-\sqrt{n})\sqrt{\frac{bT_i}{2r}}\,.$$

So long as $n\succ 1$ and $b,T_i,r\succ 0$, this expression is positive, and this expression is definitely positive as long as $n\succ 1$ and $a,M_1,r\succ 0$. "*This establishes the proposition that there are economic advantages to be derived from the use of vehicle currencies.*"[253]

In 1978 Klein[254] provided a more sophisticated theory for the exchange vehicle currency to explain the role of the USD as the unique foreign exchange vehicle currency at that time. He attributed the predominance of the USD to the fact that with large fixed cost and small or zero

[253] Swoboda, A.K. (1968), p. 41.
[254] Klein, B. (1978).

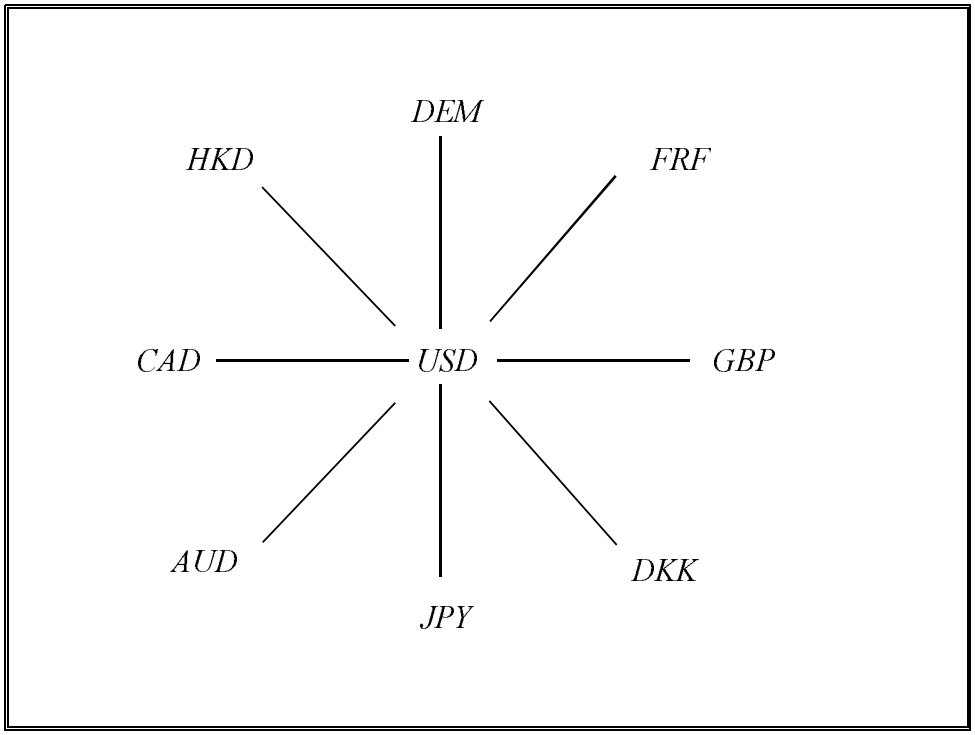
marginal cost of creating money, the money industry is essentially a natural monopoly.[255] The large fixed cost is the opportunity costs concretized by the lost of seigniorage. Consumer confidence in a currency must be built up gradually with a successful performance in the marketplace over time. When a world of positive information costs is assumed, the reliable information about anticipated performance is costly to produce, and the money-supplying firms, which have a good reputation, based on past performance, own a 'brand name capital asset.' Seigniorage is the rate of return on this asset. Seigniorage makes it costly for a money supplier to have unanticipated inflation, to lower money quality of their currencies, and to depreciate their 'brand name capital asset.' Because of a large fixed cost and small or zero marginal cost of creating money, it is economically efficient to use only a single vehicle currency on the foreign exchange markets. And foreign exchange markets are rigid to accept a new currency as a vehicle currency.[256]

Swoboda and Klein justified the role of the USD as the sole vehicle currency of the foreign exchange market in the 1960s, the 1970s and the early 1980s, which Figure 5-1 describes. They, however, did not explain how the market forces decide a specific currency as a foreign exchange vehicle currency. Their theories are microeconomics-oriented and did not take the structure of foreign exchange market into account. The final and most serious deficiency of their theories is that they could not explain why there cannot be only a unique foreign exchange vehicle currency in the foreign exchange market.

In figure 5-1 the exchange structure of the foreign exchange market is understood as a network between currencies. The currencies are the nodes, and the liquid bilateral markets are the arcs connecting the nodes with each other. Only the markets for the USD, the sole foreign exchange vehicle currency, and other currencies were liquid. The other cross-currency transactions were performed through the foreign exchange vehicle currency.[257] The emergence of the DEM as a second foreign exchange vehicle currency changed the structure of exchange in the foreign market from figure 5-1 to figure 5-2.

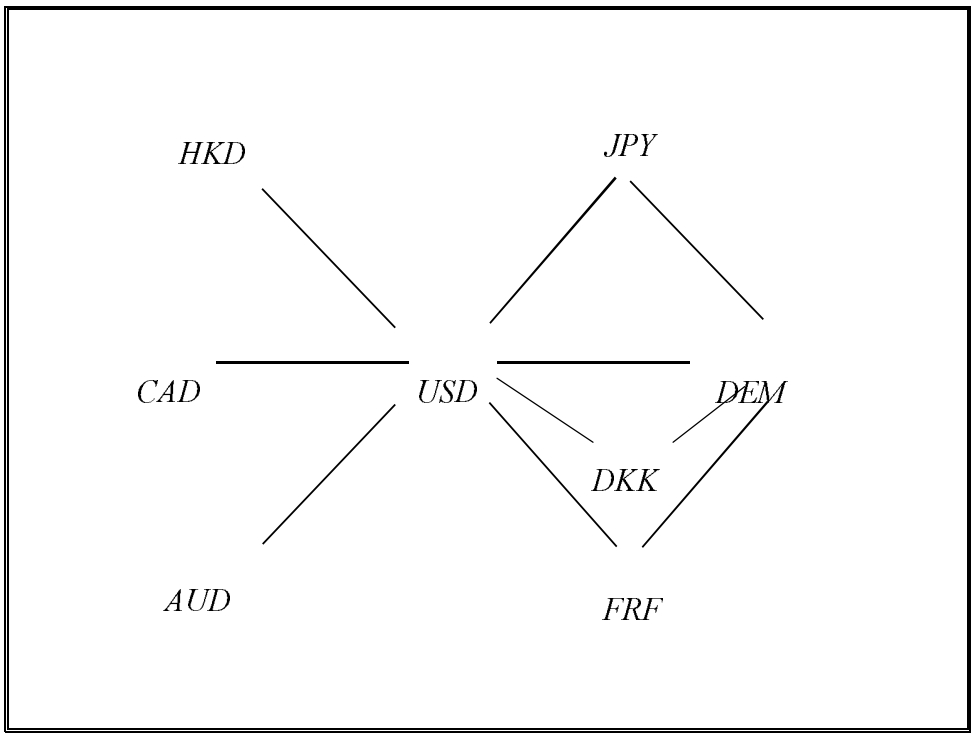
[255] Klein, B. (1978), p. 78.
[256] Klein, B. (1978), pp. 70-82.
[257] Hartmann, p. (1997), p. 135.

Figure 5-1: Structure of Exchange in the Interbank Foreign Exchange Market before the late 1980s



Source: Cp.. Hartmann, P. (1996), figure 1

Figure 5-2: Current Exchange Structure in the Spot Interbank Foreign Exchange Market



Source: Hartmann, P. (1996), figure 2

There are two foreign exchange vehicle currencies with different positions in figure 5-2. The USD has liquid markets with all other currencies, while the DEM's role as a vehicle is largely limited to trading between European currencies. In addition, no currency connects to all the other currencies through the DEM alone.[258]

5.2. Krugman's model: The choice of foreign exchange vehicle and market externality

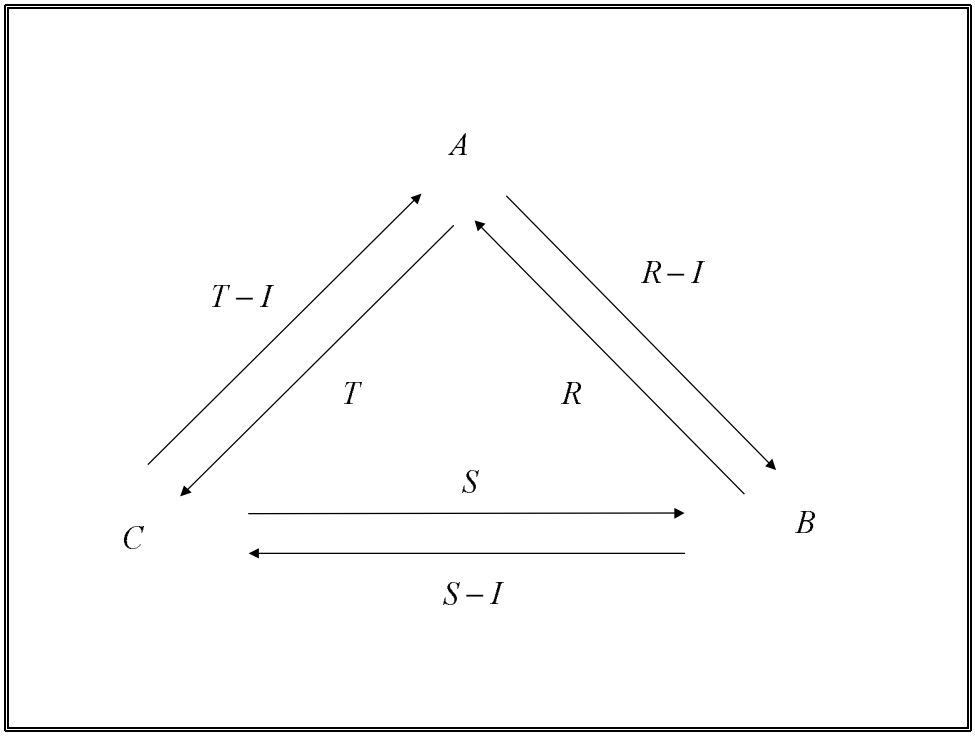
Krugman[259] proposed a model of a three-country, three-currency world. This model justified the emergence of a foreign exchange vehicle currency in terms of its transaction costs advantage. In addition, it linked the emergence of the foreign exchange vehicle currency to the structure of payments, which is determined by the pattern of international transactions, and explained why transaction costs for different currencies should be different.

Following Krugman, the structure of payments is distinguished from the structure of exchange. The former refers to payment flows between countries; the latter refers to the actual transactions on the foreign exchange markets.[260]

In a three-country world a structure of payments illustrated in figure 5-3 is assumed. Payments by residents of one country to residents of another are indicated by arrows. For example, country A runs a surplus of I in its transactions with country B. Payments need not be bilaterally balanced. Country B must then run a surplus of I with C, and C a surplus of I with A to maintain balance of payments equilibrium. Once transaction costs are introduced, two kinds of structure of exchange can actually arise. Figure 5-4 gives the first type; figure 5-5 illustrates the second type, while α, β and γ denote the currency of A, B and C, respectively. The two-headed arrows represent the trading volume in the $\alpha\beta$, $\beta\gamma$ and $\gamma\alpha$ markets.

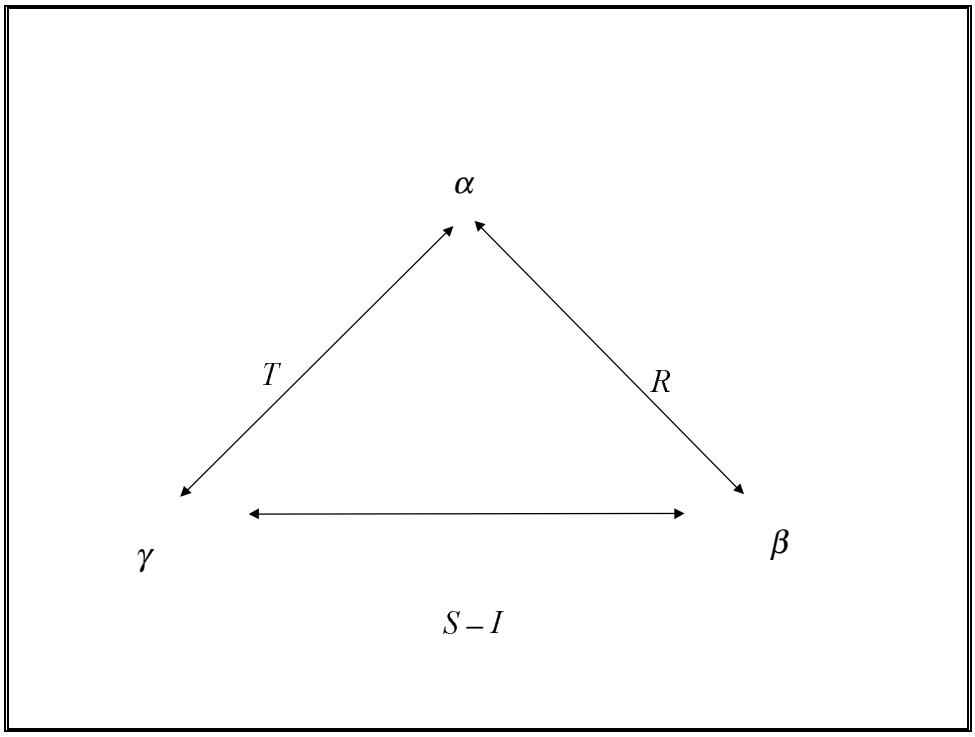
[258] Hartmann, p. (1997), p. 137.
[259] Krugman, P. (1980).
[260] Krugman, P. (1980), p. 513.

Figure 5-3: The Structure of Payments for a Three-Country World



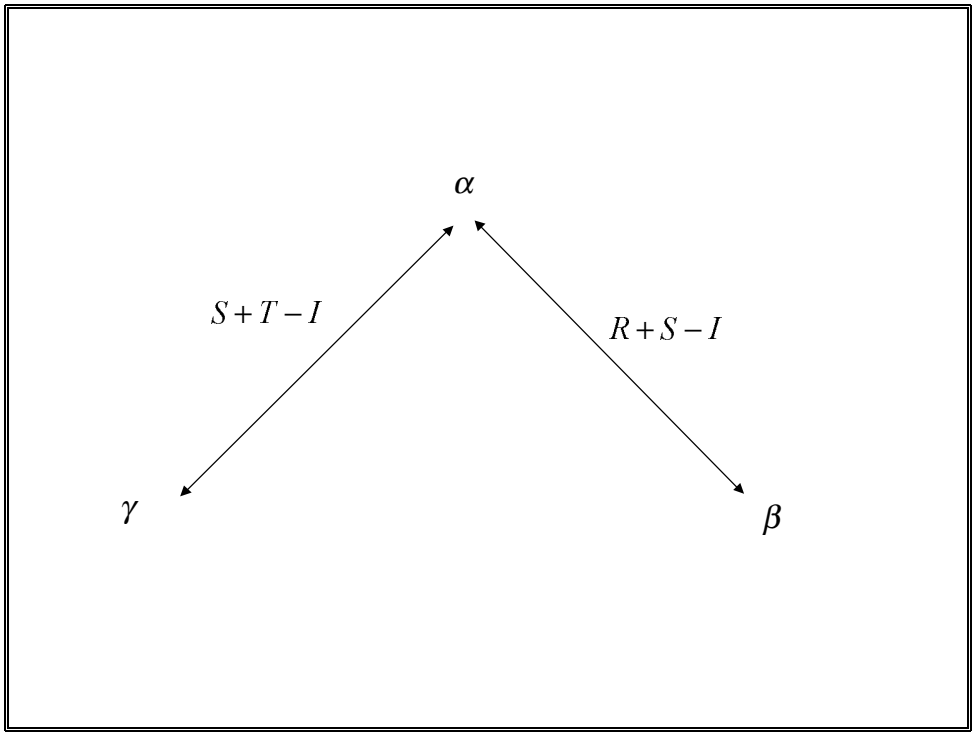
Source: Krugman, P. (1980), figure 1.

Figure 5-4: Partial Indirect Exchange



Source: Krugman, P. (1980), figure 2.

Figure 5-5: Total Indirect Exchange



Source: Krugman, P. (1980), figure 3.

The first type of structure of exchange is called a partial indirect exchange. Assuming that alpha is used as the vehicle currency, the residents of C make payments of I to B indirectly, first purchasing alphas and then exchanging these for betas. They continue to purchase S-I betas directly, however. At the same time residents of B and A engage only in direct exchange. Finally, all three markets are cleared.

The second type of structure of exchange is designated as total indirect exchange. Assuming that alphas are used as the vehicle currency, all payments between B and C are made indirectly, through the medium of alphas. The $\beta\gamma$ market disappears, while the $\alpha\beta$ and $\gamma\alpha$ markets have the indicated volumes. The existing markets then clear, since all three countries are in a balance of payments equilibrium. It should be noted that we could also have the above two kinds of structure of exchange with betas or gammas as the vehicle.

It is assumed that in each of the three markets market participants must pay a brokerage fee proportional to the transaction size. This proportion will be $t_{\alpha\beta}$, $t_{\beta\delta}$ and $t_{\delta\alpha}$ in the $\alpha\beta$, $\beta\gamma$ and $\gamma\alpha$ markets, respectively. Krugman demonstrated that the alphas will be used as the

foreign exchange vehicle currency in any case, when $t_{\alpha\beta}$ and $t_{\delta\alpha}$ are both less than $t_{\beta\delta}$. Two equilibrium structures are possible:

- If $(1-t_{\alpha\beta})(1-t_{\delta\alpha}) \prec (1-t_{\beta\delta})$ - i.e., if indirect exchange is more costly than direct – the equilibrium structure will be one of partial indirect exchange,

- If $(1-t_{\alpha\beta})(1-t_{\delta\alpha}) \succ (1-t_{\beta\delta})$ - indirect exchange is less costly than direct – the equilibrium structure will be one total indirect exchange. [261]

The crucial question for our purpose is which factors lead to such difference in transaction costs among the three currencies? Krugman related the structure of transaction costs to the structure of payments.[262] Furthermore, he assumed that transaction costs as a proportion of the transaction decrease in the trading volume. We then have

(5.2-1) $t_{\alpha\beta} = F(V_{\alpha\beta}),\ F'(V_{\alpha\beta}) \prec 0;$

(5.2-2) $t_{\beta\delta} = F(V_{\beta\delta}),\ F'(V_{\beta\gamma}) \prec 0;$

(5.2-3) $t_{\delta\alpha} = F(V_{\delta\alpha}),\ F'(V_{\gamma\alpha}) \prec 0,$

where $V_{\alpha\beta}$, $V_{\beta\delta}$ and $V_{\delta\alpha}$ are the trading volume in the three markets, respectively.

When the exchange structure is one of partial indirect exchange, and we are concerned solely with which currency is the vehicle, the relationship between choice of foreign exchange vehicle currency and trading volume, for the structure of payments in Figure 5-3, is given as follows:

[261] Krugman, P. (1980), pp. 517-519.
[262] Krugman, P. (1980), p. 519.

Vehicle currency	$V_{\alpha\beta}$	$V_{\beta\delta}$	$V_{\delta\alpha}$
α	R	S-I	T
β	R	S	T-I
γ	R-I	S	T

When payments are symmetrical, i.e., $R = S = T$, the relationship between choice of foreign exchange vehicle currency and the trading volume will be

Vehicle currency	$V_{\alpha\beta}$	$V_{\beta\delta}$	$V_{\delta\alpha}$
α	T	T-I	T
β	T	T	T-I
γ	T-I	T	T

This relationship suggests that any currency can serve as the foreign exchange vehicle currency.

When A is dominant in world payments, i.e., $T - I \succ S$ and $R - I \succ S$, only the alpha will be used as the foreign exchange vehicle currency. If one were try to make the beta the vehicle, we would have $V_{\alpha\beta} = R$ and $V_{\beta\delta} = S \prec T - I = V_{\gamma\alpha}$. This means that $t_{\alpha\beta}$ and $t_{\beta\delta}$ are not both less than $t_{\delta\alpha}$, and implies that the structure of transaction costs would still lead market participants to carry out indirect exchange through the alpha. The same is also valid for the scenario in which the gamma would be used as the foreign exchange vehicle currency.

These results suggest that only the currency of a country that is important in world payments can serve as a foreign exchange vehicle currency. Krugman illustrated further that the predominance of a foreign exchange vehicle currency makes it more possible that all transactions between other currencies are carried out through it indirectly.

Assuming that the alpha is used as the foreign exchange vehicle currency and that the structure of payments is that of Figure 5-3, two structures of exchange are possible, which are illustrated in figure 5-4 and 5-5.[263]

- **Partial indirect exchange**

In this structure of exchange the trading volume in the three markets respectively are $V_{\alpha\beta} = R$, $V_{\beta\delta} = S - I$ and $V_{\gamma\alpha} = T$. The partial indirect exchange can be an equilibrium, if indirect exchange is more costly than direct, or $(1-t_{\alpha\beta})(1-t_{\delta\alpha}) \prec (1-t_{\beta\delta})$. Substituting the trading volume for the brokerage fee, i.e. transaction costs, we have $[1-F(R)][1-F(T)] \prec [1-F(S-I)]$. This is more likely the case if transaction costs do not decrease too rapidly as the trading volume increases.

- **Total indirect exchange**

In this structure of exchange the trading volume in the three markets respectively are $V_{\alpha\beta} = R+S-I$, $V_{\beta\gamma} = 0$, and $V_{\gamma\alpha} = S+T-I$. The total indirect exchange can be an equilibrium, if indirect exchange is less costly than direct, or $(1-t_{\alpha\beta})(1-t_{\delta\alpha}) \succ (1-t_{\beta\delta})$. Substituting the trading volume for the brokerage fee, i.e., transaction costs, we have $[1-F(R+S-I)][1-F(S+T-I)] \succ [1-F(0)]$. This is more likely the case if transaction costs decrease very rapidly as the trading volume increases. In other words, if there is great market externality, the total indirect exchange is the only possible structure of exchange.

Rey[264] has recently developed a more sophisticated and complicated three-country and three-currency model. Her main conclusions are very similar with that of Krugman. She finds also that "*if the externality is greater than a certain value* $\bar{\alpha}$*, then the optimal structures of exchange are always totally indirect, which currency being used depending on the trade parameters.*"[265]

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[263] Krugman, P. (1980), p. 522. In the following reasoning Krugman made several errors, which the author has corrected by himself and is responsible for corrections alone.
[264] Rey, H. (1997).

Krugman and Ray's conclusion is based on the assumption that transaction costs decrease in the trading volume. Do empirical works support this assumption? Hartmann[266] found a strong negative relationship between predictable dollar/yen spot volume and spot spreads. Bessembinder[267] found a negative correlation between spreads and predictable traded volumes, but the volume effect is not statistically strong. Black's work[268] indicated a negative long-run relationship between traded volumes and spreads and a positive relationship between exchange rate volatility and spreads. Fleming[269] concluded: "*Numerous studies have related bid-ask spread to trading activity and price volatility for a variety of financial markets. These studies generally find a negative relationship between volume and bid-ask spreads and a positive relationship between price volatility and bid-ask spreads.*"

Aside from trading volume, another determinant for transaction costs is exchange rate volatility. By introducing exchange rate volatility, Hartmann developed his model with two vehicle currencies.

5.3. Hartmann's model: A structure of exchange with two vehicle currencies

Krugman and Rey's model with a three-country, three-currency world cannot describe a structure of exchange as that illustrated in figure 5-2. Aiming at equilibria with two foreign exchange vehicle currencies, a world with at least five currencies is necessary. Furthermore, a great market externality leads to a completely centralized exchange structure. For these reasons, Hartmann[270] used a five-currency world and the differences in volatilities of the exchange rate to justify why the current structure of exchange is that way and is illustrated in figure 5-2.

Following Hartmann, the dealer's expected profit on the bilateral market between currency i and currency j, π_{ij}, is

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[265] Rey, H. (1997), p.25.
[266] Hartmann, P. (1995).
[267] Bessembinder, H. (1994)
[268] Black, S. (1991).
[269] Fleming, M. (1997), p. 21.
[270] Hartmann, P. (1997).

(5.3-1) $\pi_{ij} = s_{ij} x_{ij} - \alpha_{ij} \sigma_{ij}$,

where

s_{ij} = dealer spread

x_{ij} = total expected trading volume

σ_{ij} = expected volatility of the short-run exchange rate

α_{ij} = a parameter

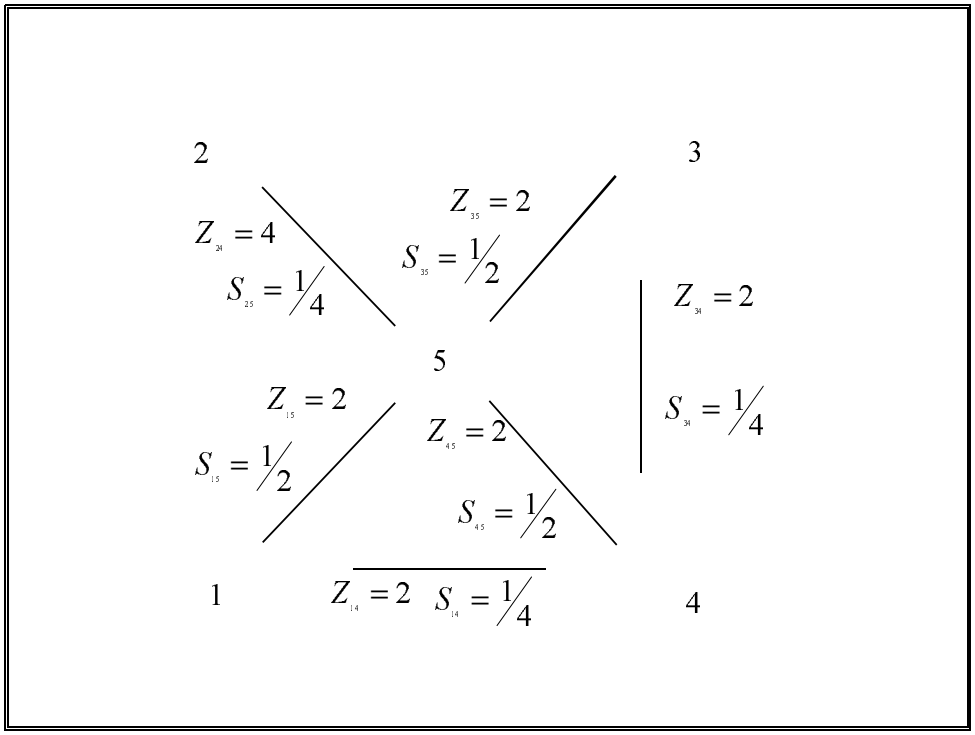
The dealer's spread can be regarded as a transaction cost and is defined as the difference between the offer rate and bid rate. It is the dealer's choice variable. In a competitive world, a profit-maximizing dealer will have to set s_{ij} on a level such that his profits vanish ($\pi_{ij}^{*}[s_{ij}^{*}] = 0$). We then have

(5.3-2) $s_{ij}^{*} = \dfrac{\alpha_{ij} \sigma_{ij}}{x_{ij}}$.

This means that the expected exchange rate volatility increases the spread and the expected trading volume decreases the spread.

If the spreads in the *ij* market is larger than the sum of the spreads in the *ik* and *kj* markets, i.e., $s_{ij}^{*} \succ s_{jk}^{*} + s_{kj}^{*}$, then *k* becomes a vehicle currency. Any exchange between currency *i* and *j* will be carried out through currency *k*, and all the originally desired volume of transactions on the *ij* market, x_{ij}, switches to the *ik* and *ki* markets. Thus, the final volume of transactions (*z*) will be $z_{ij} = 0 \prec x_{ij}$, $z_{ij} = x_{ik} + x_{jk}$ and $z_{kj} = x_{kj} + x_{ij}$. In Krugman's terminology the matrix of originally desired trading volumes $X = (x_{ij})$ may be named the structure of payments and the matrix of final trading volume $Z = (z_{ij})$ may be named the structure of exchange.

Figure 5-6: Equilibrium in an Asymmetric Foreign Exchange Market with two Vehicle Currencies



Source: Hartmann, p. (1997), figure C.5.

An equilibrium is defined by Hartmann as "*a (symmetric) matrix of spread* S^**, such that no dealer has an incentive to deviate from the optimal spread* s_{ij}^* *he has chosen, given the pricing of all the other dealers* s_{-ij}^**.*"[271] In addition, Hartmann assumed that reopening a formerly closed market involves some set-up costs γ_{ij}.

Instead of deriving conditions for a structure of exchange equilibrium with two foreign exchange vehicles in a five-currency world from formal reasoning, Hartmann gave an example of such an equilibrium and justified it. This example is shown in figure 5-6. The structural similarity between figure 5-6 and 5-2 is apparent.

All original desired payments, x_{ij}, and set-up costs γ_{ij} are assumed to be one.

$x_{ij} = 1 = \gamma_{ij}$.

Some asymmetry in exchange rate volatilities is introduced. Volatilities among currencies 1, 3, and 4 are lower than others and equal $1/2$, i.e., $\alpha_{13}\sigma_{13} = 1/2 = \alpha_{14}\sigma_{14} = \alpha_{34}\sigma_{34}$, while the remaining volatilities equal one. In such a world there are two vehicle currencies, 4 and 5. Currency 2 is exchanged through 5 alone, while currencies 1 and 3 are exchanged against each other through currency 4.

For example, the final trading volume on the 1,5 market, Z_{15}, for example, equals 2.

$$Z_{15} = X_{15} + X_{12} + X_{13} + X_{14} = 1 + 1 + 0 + 0 = 2$$

Currency 1 is exchanged against currency 5 directly and against currency 2 through currency 5, while the transactions between currency 1 and currency 3 and 4 are not carried out through currency 5. The dealer spread on the 1,5 market therefore equals $1/2$.

$$S_{15} = \frac{\alpha_{15}\delta_{15}}{Z_{15}} = \frac{1}{2}.$$

Hartmann hypothesized that the structure of exchange illustrated in figure 5-6 is a market equilibrium. Two tests are undertaken by Hartmann to check the sustainability of this structure of exchange as an equilibrium.

- Firstly, no bilateral currency exchange can be made with a lower spread than with the exchange chains hypothesized in figure 5-6. "*For example exchanging 1 against 3 through 5 would cost* $1/2 + 1/2 = 1$ *unit, while exchanging 1 against 3 through 4 costs only* $1/4 + 1/4 = 1/2$."[272]

- Secondly, the dealer cannot open a formerly closed market and change the structure of exchange to realize a positive profit. For example, exchanging currency 1 against

[271] Hartmann, P. (1997), p. 141.
[272] Hartmann, P. (1997), p. 142.

currency 2 directly would involve set-up costs and cost $\frac{\alpha_{12}\delta_{12}}{Z_{12}}+\gamma_{12}=\frac{1}{1}+1=2$ unit, while exchanging currency 1 against currency 2 through currency 5 costs only $\frac{1}{2}+\frac{1}{4}=\frac{3}{4}$.

Hartmann, like Krugman and Rey, pointed out the following conclusions:[273]

- The wide use of a currency in international transactions fosters its potential to become a foreign exchange vehicle currency.

- Market externality, which is represented by the increased trading in vehicles, the resulting reduction in transaction costs and the cost of changing the structure of exchange, implies that the role as the foreign exchange vehicle currency is self-reinforcing.

Furthermore, Hartmann also pointed out:[274]

- High exchange rate volatility, which increases the spread, i.e., transaction costs, is a factor detrimental for vehicle use. This conclusion is consistent with our theory that external stability is a necessary condition for international currency use.

- Some asymmetry is necessary for an equilibrium of the structure of exchange with two vehicle currencies. The low volatility between the DEM and other European currencies can explain why the DEM could replace the USD as the vehicle currency in intra-European foreign exchange transactions.

5.4. Determinants for the structure of exchange

Krugman's model suggests that only the currency of a country that is important in world payments can serve as a foreign exchange vehicle currency. By assuming that transaction costs as a proportion of the transaction decrease in the trading volume, he related the structure of transaction costs with the structure of payments, which in turn determines the structure of

[273] Hartmann, P. (1997), p. 143.
[274] Hartmann, P. (1997), p. 143.

exchange. His model's main conclusion is therefore that the role of the foreign exchange vehicle currency is self-reinforcing. Ray and Hartman also reached the same conclusion.

Once the currency of an economically-dominant country becomes established as a foreign exchange vehicle currency, it is then less costly for all transactions between the others to be carried out through it indirectly, if transaction costs decrease very rapidly as the trading volume increases. The more markets switch to the foreign exchange vehicle currency, the lower the transactions costs of exchange through it will be. Moreover, the lower transaction costs attract more markets to switch to indirect exchange through the foreign exchange vehicle currency. The market externality implies therefore some circularity in the use of the foreign exchange vehicle currency and a certain tendency towards concentration.[275] More importantly, it is also responsible for the costs of changing the incumbent structure of exchange, which makes the structure of exchange to exhibit a good deal of inertia.

Market externality can indeed explain why the USD dominates foreign exchange markets more than its fundamentals suggest. It is brought about by the development of deep and broad financial markets, or more precisely, foreign exchange markets. The reduction in transaction costs result from opening up more and more formerly closed markets and thus attracting more and more trading volume. Therefore, the dominance of the USD as a major foreign exchange vehicle currency is supported by the fact that "*The United States 'exported' with the Dollar the financial structure supporting it.*"[276]

The market externality, on the other hand, implies also that once a currency becomes established as the foreign exchange vehicle currency it will continue in that role, even if its underlying economy loses its original dominance in international transactions. The incumbent foreign exchange vehicle currency is favored by inertia, but if the structure of exchange is very far away from what the structure of payments suggests, inertia will be overcome. This means that a big shock might shift the structure of exchange from one equilibrium to another and thus have lasting effects.[277]

Is it likely, that the introduction of the Euro will be such a big shock?

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[275] Hartmann, P. (1996), p.8.
[276] Siglienti, S. (1981), p. 188.
[277] Krugman, P. (1984), p. 268.

Because of market externality, the USD predominance will not change overnight. Whether the Euro will replace the USD as the major foreign exchange vehicle currency will depend on firstly whether in the long run the introduction of the Euro will change the incumbent structure of payments dramatically enough. This is determined by international transactions both in current account and capital account. Moreover, the Euro must create its market externality by developing deep and broad foreign exchange markets to lower transaction costs. Issing asserted directly: "*Welche Rolle der Euro im Konzert der wichtigen Währungen tatsächlich spielen wird, entscheidet sich primär an den internationalen Finanzmärkten.*"[278]

The above reasoning suggests that we should investigate international transactions both in current account and capital account, in order to estimate how far the Euro's introduction will change the incumbent structure of payments.

Another question can be proposed in this context: Will the Euro replace the USD as the major foreign exchange vehicle currency, if the structure of payments do not change?

Hartmann's model provides us a key to answer this question. His model justified a structure of exchange with two foreign exchange vehicle currencies, which have different status, i.e., one functions as the major vehicle currency and the other as the second vehicle currency. This structure of exchange reflects the current structure of exchange, in which the USD functions as the major vehicle currency and the DEM as the second vehicle currency.

That the DEM could replace the USD as the vehicle currency in intra-European foreign exchange transactions is based on the low exchange rate volatility between the DEM and other European currencies. This fact suggests that the key determinant of the extent and speed of the Euro's use as a major foreign exchange vehicle under the incumbentstructure of payments will be the transaction cost in foreign exchange markets.[279] Transaction costs is assumed by Hartmann in turn to increase by the exchange rate volatility and decrease by the trading volume. However, the USD predominance indicates that a larger trading volume in the global foreign

[278] Issing, O. (1997), p. 10.
[279] Portes, R., and Rey, H. (1998), p.3.

exchange markets plays a much more important role than a lower volatility for deciding which currency is used as the major foreign exchange vehicle.

In the following chapter we will estimate the prospects of the Euro as the foreign exchange vehicle for two NICs in two steps. We assume in the first step that the incumbentstructure of payments do not change after the Euro's introduction, while in the second step we estimate how far the Euro's introduction will change it. The first step is to measure the Euro's transaction costs in the foreign exchange markets. For this step the author will not directly utilize the historical data of bid-ask spreads in the foreign exchange markets. Instead of that, the author will measure the major international currencies' transaction costs in terms of trading volume and exchange rate volatility and compare them. The author assumes that transaction costs in the foreign exchange market in the future are more determined by the past trading volume and exchange rate volatility than the past transaction costs. The second step is to estimate how the Euro' introduction will influence the structure of payments of the two NICs. We will investigate the current account and capital account factors, which determine the structure of payments in the two NICs and at the same time, the nature of the foreign exchange regime.

6. MAIN FACTORS INFLUENCING RESERVE MANAGEMENT OF NICS: A CASE STUDY FOR TAIWAN AND THAILAND

In this chapter we will examine the main factors influencing reserves management from both intervention-related motives and portfolio-related motives in our two NICs, i.e., Taiwan and Thailand. In 1997 the Asian Crisis appeared, which could be an important disturbing factor for our discussion about reserves management in NICs. On the one hand, it influenced some determinants for NICs' reserve management. An investigation of reserve management in NICs should illustrate to what extent the Asian Crisis influenced these determinants. On the other hand, some of these determinants might play some role for the Asian Crisis' outbreak. An investigation of these determinants could provide an explanation for the Asian Crisis at the same time.

The author tries to give a possible explanation for the Asian Crisis in 6.1 firstly. In fact, this trial provides us a reason for why these two countries are chosen. The empirical data in the subsequent sections, which mainly examine the main factors influencing reserve management in two NICs, can be used to test our possible explanation for the Asian Crisis at the same time.

Section 6.2 analyses the main factors influencing reserve management from intervention-related motives. Monetary reserves are here regarded as being held as transaction balance. The respective choices of intervention currency in the two NICs determine to what extent they hold the Euro in monetary reserves as transaction balance. The choice of intervention currency depends on the choice of foreign exchange vehicle currency and the nature of the foreign exchange rate regime, which depend in turn, at least partly, on current account factors and capital account factors. The subject matter of this section is made up of these issues.

Section 6.3 applies the portfolio theory approach to investigate reserve management from the portfolio-related motives in the two NICs. Monetary reserves are here regarded as being held as idle balance. The different reserve currencies are assumed to have the same money quality. This means that we do not take the differences in transaction costs and non-pecuniary rates of return into consideration. This section also examines the respective scope for

diversifying official foreign exchange reserves and the statistic characteristics of USD and Euro's rate of return.

6.1. An important disturbing factor: The Asian Crisis

This section illustrates firstly the extent of the Asian Crisis. Two NICs should be so chosen such that an explanation of the Asian Crisis will be evident, when we contrast one with the other. Taiwan and Thailand seem to be the best choice for this reason, because they are two extreme examples of the Asian Crisis' spectrum. Secondly, we will point out some crucial deficiencies of the traditional models, which contradict empirical evidences. Finally, the author tries to propose a explanation for the Asian Crisis on the base of empirical evidences and some recent studies.

6.1.1. Extent of the Asian Crisis

To what extent the Asian Crisis has influenced East Asian NICs can be read from the following tables.

Table 6-1: Currency Depreciations in East Asian NICs

	Local currency/USD		
Country	**1997/06/30**	**1998/01/23**	**%**
Hong Kong	7.7468	7.7410	0.07
Indonesia	2,431.9	13,250	-81.65
Korea	889	1,745	-49.05
Malaysia	2.5249	4.5255	-44.21
Philippine	26.375	43.690	-40.00
Singapore	1.4309	1.7629	-18.83
Taiwan	27.812	33.925	-18.02
Thailand	24.7	54.8	-54.93

Source: Perng, F.N. (1998), table 1.

Table 6-2: Stock Market Indices in East Asian NICs

Country	1997/06/30	1998/01/23	%
Hong Kong	15,196.79	8,920.20	-41.30
Indonesia	724.56	450.98	-37.76
Korea	745.40	486.86	-34.68
Malaysia	1,077.30	558.57	-48.15
Philippine	2,809.21	1,704.07	-39.34
Singapore	1,987.95	1,259.83	-36.63
Taiwan	9,030.28	8,085.47	-10.46
Thailand	527.28	422.87	-19.80

Source: Perng, F.N. (1998), table 2.

Table 6-3: GDP Growth in East Asian NICs

Country	1991	1992	1993	1994	1995	1996	1997	1998
Hong Kong	5.06	6.26	6.13	5.40	3.89	4.49	5.26	-5.13
Indonesia	8.93	7.22	7.25	7.54	8.22	7.98	4.75	-13.68
Korea	9.23	5.44	5.49	8.25	8.92	6.75	5.01	-5.84
Malaysia	8.60	7.80	8.35	9.30	9.36	8.60	7.70	-6.70
Philippines	-0.58	0.34	2.12	4.39	4.68	5.85	5.15	-0.54
Singapore	7.11	6.57	12.75	11.38	8.16	7.53	9.01	0.35
Taiwan	7.55	6.76	6.32	6.54	6.03	5.67	6.76	4.90
Thailand	8.11	8.24	8.54	8.61	8.83	5.52	-1.26	-9.40

Source: IMF, World Economic Outlook, WEO Database

Table 6-1 shows, affected by the turmoil, that most currencies of East Asian NICs depreciated over 40 percent against the USD between the end of June 1997 and the end of January 1998. A remarkable exception is the HKD, which appreciated against the USD slightly. Two less outstanding exceptions, i.e., the NTD and the SGD, depreciated by 18.02 and 18.83 percent against the USD in the same period, respectively.

Table 6-2 shows that the stock market indices in most East Asian NICs, including Hong Kong, declined over 30 percent between the end of June 1997 and the end of January 1998. This implies that Hong Kong was also to a certain extent affected by the Asian crisis, but it

prevented its currency from depreciation by taking some measures, which nevertheless injured its own stock market performance. Two exceptions, i.e., Taiwan and Thailand, featured a smaller drop in their stock market indices in the same period. When we take the heavy decline of Thailand's stock market index in the earlier period into account, Taiwan is unquestionable more predominant.

As table 6-3 suggests, before the Asian Crisis East Asian NICs' economies had featured sustained rapid growth. Affected by the crises, the most NICs experienced slower or even negative growth rate. In 1998, one year after the Asian Crisis, only two NICs, i.e., Taiwan and Singapore, maintained their positive GDP growth. Again, Taiwan is the more remarkable example. Taiwan's economy still grew at a rate of 4.9 percent in 1998, with the Thailand's decline of economic growth rate forming a sharp contrast to that of Taiwan.

A theoretical explanation consistent and accepted by most economists for the Asian Crisis is not yet available. Krugman described this situation as follows: „*It seems safe to say that nobody anticipated anything like the current crisis in Asia. True, there were some Asia skeptics - including myself - who regarded the claims of an Asian economic miracle as overstated, and argued that Asia was bound to run into diminishing returns eventually. And some people - again including myself - raised warning flags a year or two before the Thai crisis, noting that the current account deficits of Southeast Asian countries were as high as or higher than those of Latin America in 1994, and arguing that Asian economies had no special immunity to financial crises. But even pessimists expected something along the lines of a conventional currency crisis followed by at most a modest downturn, and we expected the longer-term slowdown in growth to emerge only gradually. What we have actually seen is something both more complex and more drastic: collapses in domestic asset markets, widespread bank failures, bankruptcies on the part of many firms, and what looks likely to be a much more severe real downturn than even the most negative-minded anticipated.*"[280]

In order to provide an explanation of the Asian Crisis at the same time, we will choose two NICs to investigate the main factors influencing their reserve management. These two NICs should be so chosen such that an explanation of the Asian Crisis will be evident, when we contrast one with the other. Taiwan and Thailand seem to be the best choice for this reason,

[280] Krugman, P. (1998), p.1.

because they are two extreme examples at the spectrum of the Asian Crisis. In contrast with Taiwan, Thailand was the starting point of the Asian Crisis and is often regarded as a typical example. As well as other ASEAN countries and South Korea, Thailand belongs to the more afflicted countries in the Asian Crisis. Taiwan, Singapore and Hong Kong were, relatively speaking, less affected by the Asian Crisis. Their currencies depreciated less and they maintained their economic growth. Most importantly, they did not experience drastic reversals of capital flows and financial panic.[281]

6.1.2. First generation models of financial crisis

In the so-called first generation models, a fixed exchange rate regime and a credit expansion resulting from the monetization of budget deficits are assumed. Such a policy mix would be ultimately unsustainable. It would lead to attempts by investors to anticipate an inevitable collapse, which in turn generate a speculative attack on the currency when foreign exchange reserves fall to some critical level. In the end, foreign exchange reserves fall gradually because of successive speculative attacks until the central bank exhausts the remaining foreign exchange reserves, and is forced to a floating rate regime.[282]

Table 6-4: Government Fiscal Balances in East Asian NICs

(% of GDP)

Country	1991	1992	1993	1994	1995	1996	1997
Indonesia	0.45	-0.44	0.64	1.03	2.44	1.26	0.00
Korea	-1.63	-0.50	0.64	0.32	0.30	0.46	0.25
Malaysia	-2.10	-0.89	0.23	2.44	0.89	0.76	2.52
Philippines	-2.10	-1.16	-1.46	1.04	0.57	0.28	0.06
Singapore	8.58	12.35	15.67	11.93	13.07	14.10	9.52
Taiwan	-2.18	-5.34	-3.88	-1.73	-1.09	-1.34	-1.68
Thailand	4.79	2.90	2.13	1.89	2.94	0.97	-0.32

Source: Corsetti, G., Pesenti, P., and Roubini, N. (1998a), table 13

[281] Corsetti, G., Pesenti, P., and Roubini, N. (1998b), p. 2.
[282] Cp. Krugman, P. (1979) and Krugman, P. (1998), p.2.

Table 6-5: Inflation Rates in East Asian NICs

Country	1991	1992	1993	1994	1995	1996	1997
Hong Kong	11.60	9.32	8.52	8.16	8.59	6.30	5.83
Indonesia	9.40	7.59	9.60	12.56	8.95	6.64	11.62
Korea	9.30	6.22	4.82	6.24	4.41	4.96	4.45
Malaysia	4.40	4.69	3.57	3.71	5.28	3.56	2.66
Philippines	18.70	8.93	7.58	9.06	8.11	8.41	5.01
Singapore	3.40	2.32	2.27	3.05	1.79	1.32	2.00
Taiwan	3.63	4.50	2.87	4.09	3.75	3.01	0.90
Thailand	5.70	4.07	3.36	5.19	5.69	5.85	5.61

Source: Corsetti, G., Pesenti, P., and Roubini, N. (1998a), table 14

The first generation models failed to provide an acceptable explanation for the Asian Crisis. Table 6-4 shows that on the eve of the Asian Crisis all countries were more or less in a fiscal balance. Table 6-5 shows that the inflation rates of all NICs were quite low, which implies that the assumption of credit expansion resulting from the monetization of budget deficits is not appropriate for explaining the Asian Crisis. However, this is not a surprising result, since Krugman admitted that his model, which is proposed in the article "A model of balance of payments crises" and regarded as the standard model of the first generation, is subject to limitations. The most serious one for our discussion is that his model is based on a highly-simplified macroeconomic model and the analysis of the factors triggering a balance-of-payments crisis is incomplete.[283]

6.1.3. Second generation models of financial crisis

In first generation models the commitment to the fixed exchange regime is assumed to be state invariant, whereas in second generation models it is state-dependent.[284] A government faces a tradeoff between the fixedness of the exchange rate and the attainment of economic objectives, which are a conceivable part of the government's social welfare function. The government's commitment to a fixed exchange rate is thus constrained by some macroeconomic fundamentals. Speculative attacks on a currency result from either a predicted

[283] Krugman, P. (1979), p. 324.
[284] Flood, R.P. and Marion, N.P. (1998), p.23.

future deterioration in such macroeconomic fundamentals or a shift in market expectations, which alter the government's tradeoff and bring about a self-fulfilling crisis. A currency crisis arises from the fact that defending the pegged exchange rate is more expensive if the market believes that defense will ultimately fail. [285]

Second generation models tried to render an accurate picture of the causes of the two currency crises in the early 1990s. Therefore, we compare the Asian Crisis with the two currency crises in the following. The Asian Crisis is very different from the 1992 ERM Crisis and the 1994 Mexican Peso Crisis in many respects.

As table 6-3 and 6-6 suggests, unlike the afflicted countries of the 1992 ERM Crisis, before the Asian Crisis all of the East Asian NICs' economies had featured sustained rapid growth and did not have any incentive to abandon a fixed foreign exchange rate regime to pursue a more expansionary monetary policy.[286] This can be demonstrated by table 6-5. Table 6-5 displays that the inflation rates were very stable in East Asian NICs before the Crisis. Therefore, there is no evidence for pursuing a relatively more expansionary monetary policy in these countries.

Table 6-6: Unemployment Rates in East Asian NICs

Country	1990	1991	1992	1993	1994	1995	1996
Hong Kong	1.3	1.8	2.0	2.0	1.9	3.2	2.8
Indonesia	2.5	2.6	2.7	2.8	4.4	*7.2*	
Korea	2.4	2.3	2.4	2.8	2.4	2.0	2.0
Malaysia	5.1	4.3	3.7	3.0	2.9	2.8	2.6
Philippines	*8.1*	*9.0*	*8.6*	*8.9*	*8.4*	*8.4*	*7.4*
Singapore	1.7	1.9	2.7	2.7	2.6	2.7	3.0
Taiwan	*1.7*	*1.5*	*1.5*	*1.5*	*1.6*	*1.8*	*2.6*
Thailand	2.2	2.7	1.4	*1.5*	*1.3*	*1.1*	*2.0*

Source: IMF, International Financial Statistics Yearbook, 1998. The data for Indonesia in 1995, Philippines, Taiwan and Thailand from 1993 to 1996 (in italics) are from the Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries.

Like Mexico in 1994, the afflicted countries of the Asian Crisis had current account deficits. However, while the deterioration of the current account balance in the years preceding the

[285] Krugman, P. (1998), p2 and Flood, R.P. and Marion, N.P. (1998), p.13.

1994 Mexican peso crisis was largely due to a fall in private savings, the saving rates in all East Asian NICs were subject to sudden declines and were very high.

Table 6-7: Saving Rates in East Asian NICs

(% of GDP)

Country	1991	1992	1993	1994	1995	1996	1997
Hong Kong	33.78	33.76	35.67	33.83	31.94	29.95	31.33
Indonesia	31.10	33.41	28.66	29.52	27.65	27.50	27.98
Korea	35.74	34.88	34.91	34.60	35.14	33.60	33.06
Malaysia	23.24	30.06	27.70	33.81	34.65	37.81	39.34
Philippines	17.76	18.16	17.29	20.32	17.16	19.35	18.77
Singapore	46.56	48.35	46.17	50.82	51.05	51.33	51.30
Taiwan	30.26	28.93	28.68	26.99	26.70	25.92	25.43
Thailand	34.83	33.73	34.26	33.89	33.25	33.22	32.64

Source: Corsetti, G., Pesenti, P., and Roubini, N. (1998a), Table 12.

Table 6-8: Real Effective Exchange Rates

(1993 = 100)

Country	1994	1995	1996	1997
Hong Kong	108.2	110.4	116.2	129.9
Indonesia	103.9	110.8	125.5	92.4
Korea	100.4	106.1	106.3	83.2
Malaysia	98.0	98.7	103.2	84.8
Philippines	116.3	117.7	124.0	107.4
Singapore	104.7	106.2	109.7	110.5
Taiwan	98.6	96.8	99.1	92.7
Thailand	98.9	102.3	107.8	81.5
Mexico	80.9	63.9	79.1	87.8
Argentina	95.2	96.4	100.6	107.2
Brazil	126.1	112.1	115.5	124.6
Chile	106.6	107.2	114.0	118.4

Source: Bustelo, P. (1998), table B.12

[286] Krugman, P. (1998), p.2.

Table 6-8 shows that currency overvaluation between 1993 and 1996 was significant only in Indonesia and the Philippines. In addition, the currencies of the most afflicted countries of the Asian Crisis had appreciated less than in Brazil and Chile in the same period.

6.1.4. An explanation based on empirical and theoretical foundations

Comparing the data of Taiwan and Thailand in the above tables, there is no reasonable explanation for why Thailand was afflicted by the Crisis while Taiwan maintained its growth till now. The data in the above tables shows no significant difference between Taiwan and Thailand. This surprising result indicates that the Asian Crisis was not simply the result of deteriorating macroeconomic fundamentals. Moreover, the main problem in Thailand, as well as in other afflicted NICs, was not macroeconomic but structural.[287] With other words, deteriorating macroeconomic fundamentals are rather symptoms than illness itself. However, we can at first find some macroeconomic symptoms and trace back to illness itself. The most remarkable macroeconomic difference between Taiwan and Thailand, as the following table suggests, might be that Taiwan had a current account surplus, while Thailand ran a current account deficit.

Table 6-9: Current Account Balances in East Asian NICs

(% of GDP)

Country	1990	1991	1992	1993	1994	1995	1996
Hong Kong	8.4	6.58	5.26	8.14	1.98	-2.21	0.58
Indonesia	-4.4	-4.4	-2.46	-0.82	-1.54	-4.25	-3.41
Korea	-1.24	-3.16	-1.7	-0.16	-1.45	-1.91	-4.89
Malaysia	-2.27	-9.08	-4.06	-10.11	-11.51	-13.45	-5.99
Philippines	-6.3	-2.46	-3.17	-6.69	-3.74	-5.06	-5.86
Singapore	9.45	12.36	12.38	8.48	18.12	17.93	16.26
Taiwan	6.71	6.70	3.84	3.02	2.55	1.85	3.85
Thailand	-8.74	-8.61	-6.28	-6.5	-7.16	-9	-9.18

Source: Roubini, N. (1998), part 5, p. 25

Note: The data for Taiwan are from IMF, WEO Database, the Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries and author's calculation.

In fact, the more afflicted countries have been those with current account deficits throughout the 1990s. On the other hand, countries with a current account surplus were less affected by the Asian Crisis.

Frankel, J.A. pointed out: "*Statistical evidence suggests that a* large *current account deficit or high level of debt are not highly significant predictors of crises. More important than the magnitude of the current account deficit is how it is financed, and how the funds are used.*"[288] On the basis of this statement the author proposes a explanation for the Asian Crisis, which is inspired mainly by works of Krugman[289], Corsetti, Pesenti, and Roubini[290], Radelet and Sachs[291].

One of the most distinguished phenomena before the Asian Crisis in the afflicted NICs has been the surge in capital inflows, which had its roots in both changes in internal economic policies and world markets.[292]

Internationally, the following factors contributed to the capital flows to emerging markets such as the East Asian NICs:[293]

- financial market liberation in the industrialized countries;
- attractive domestic investment falling short of available savings in the industrialized countries;
- low interest rates in the U.S.A. and Japan; and
- new bond and equity mutual funds, new bank syndicates and increased Eurobond lending.

Domestically, the following factors contributed to the capital inflows to the afflicted East Asian NICs:[294]

- continuing high economic growth, which gave confidence to foreign investors;
- nominal exchange rates effectively pegged to the USD, which reduced the risk premium on debt denominated in the USD;

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[287] Frankel, J.A. (1998), p.2
[288] Frankel, J.A. (1998), p.1.
[289] Krugman, P. (1998) and Krugman, P. (1999).
[290] Corsetti, G., Pesenti, P., and Roubini, N. (1998a).
[291] Radelet, S. and Sachs, J. (1998).
[292] Radelet, S. and Sachs, J. (1998), p. 9.
[293] Radelet, S. and Sachs, J. (1998), p.9.
[294] Radelet, S. and Sachs, J. (1998), p. 9.

- financial deregulation during the 1990s, which was encouraged by the IMF, the OECD, and by Western governments, banks and firms, made it much easier for banks and domestic corporations to tap into foreign capital to finance domestic investments and increased the supply-elasticity of funds from abroad;
- special incentives made by governments, which encouraged foreign borrowing.

The above domestic factors were consistent with the policy goal of providing a large supply of low-cost funds to nationally financial intermediaries and for the domestic corporate sector to support continuing economic growth.

Table 6-10: Foreign Debt in East Asian NICs

(% of GDP)

Country	1991	1992	1993	1994	1995	1996
Hong Kong	14.84	14.99	14.35	18.38	16.60	15.44
Indonesia	68.21	68.74	56.44	60.96	61.54	56.74
Korea	13.51	14.34	14.18	14.32	23.80	28.40
Malaysia	35.48	34.51	40.74	40.40	39.31	40.06
Philippines	71.45	62.29	66.09	62.42	53.21	49.75
Singapore	11.07	9.47	9.45	10.79	9.84	10.74
Taiwan	10.73	9.37	10.44	10.87	10.40	10.07
Thailand	38.38	37.51	34.10	33.31	33.78	50.05

Source: Corsetti, G., Pesenti, P., and Roubini, N. (1998-1), table 23.
Note: The source is the Global Development Finance (GDF) report of the World Bank and IMF-IFS. The data for Hong Kong, Singapore, Taiwan are from the Asian Development Bank. The data for Korea in 1995 and 1996 are from OECD, External Debt Statistics.

Table 6-10 shows that the financing of Thailand's current account deficit relied heavily on external debt.[295] The ratios of Taiwan and Thailand contrast with each other sharply. This contrast is more evident by comparing the ratio of Taiwan with that of Thailand in the following table.

[295] See 6.2.4. for more details.

Table 6-11: Short-Term Debt in East Asian NICs

(% of Foreign Exchange Reserves)

Country	1991	1992	1993	1994	1995	1996
Hong Kong	21.78	18.38	17.09	16.49	14.16	22.35
Indonesia	154.62	172.81	159.70	160.36	189.42	176.59
Korea	81.75	69.62	60.31	54.06	171.45	203.23
Malaysia	19.05	21.12	25.51	24.34	30.60	40.98
Philippines	152.31	119.37	107.68	95.00	82.85	79.45
Singapore	2.67	2.35	2.04	1.75	1.78	2.60
Taiwan	20.21	21.00	23.64	21.76	21.64	21.31
Thailand	71.31	72.34	92.49	99.48	114.21	99.69

Source: Corsetti, G., Pesenti, P., and Roubini, N. (1998a), table 26
Note: The source is the Global Development Finance (GDF) report of the World Bank and IMF-IFS. The data for Hong Kong, Singapore, Taiwan are from the Asian Development Bank. The data for Korea in 1995 and 1996 are from OECD, External Debt Statistics.

Short-term external debt of Thailand, as well as in those of other afflicted NICs, had risen to a high level relative to foreign exchange reserves. By contrast, this ratio in Taiwan, as well as in other less afflicted NICs, was low.

Table 6-12: Short-Term Debt in East Asian NICs

(% of Total)

Country	1991	1992	1993	1994	1995	1996
Hong Kong	46.63	45.89	41.19	30.04	28.36	43.57
Indonesia	18.00	20.52	20.17	18.05	20.87	24.98
Korea	28.19	26.99	25.85	25.47	51.60	50.20
Malaysia	12.14	18.18	26.58	21.13	21.19	27.83
Philippines	15.24	15.93	14.01	14.29	13.38	19.34
Singapore	18.92	19.91	17.87	13.28	14.56	19.81
Taiwan	86.49	86.93	84.99	76.75	72.18	68.44
Thailand	33.13	35.22	53.01	60.67	72.36	41.41

Source: Corsetti, G., Pesenti, P., and Roubini, N. (1998-1), table 24

Table 6-12 illustrates the weight of short-term debt in relation to total foreign debt in East Asian NICs. In some NICs, especially in most ASEAN countries, the capital inflows were

largely intermediated by domestic financial intermediaries, with bond and equity markets relatively underdeveloped. Therefore, a large share of foreign debt was in the form of short-term interbank liabilities denominated in foreign currency.

East Asia NICs' foreign debt, such as those of Thailand and Korea, which was huge in relation to their GDP, was mostly composed of short-term debt and could not be covered by monetary reserves, and was very volatile and easily reversible. In contrast with that, although the share of Taiwan's short-term external debt was high, Taiwan was immune from such risk, since the weight of its foreign debt in relation to GDP was very low.

Table 6-13: Claims on Private Sector in East Asian NICs

(% of GDP)

Country	1991	1992	1993	1994	1995	1996
Hong Kong	1.42	1.34	1.40	1.49	1.55	1.62
Indonesia	0.40	0.41	0.39	0.42	0.44	0.46
Korea	1.03	1.11	1.21	1.29	1.33	1.44
Malaysia	NA	1.13	1.13	1.16	1.27	1.42
Philippines	0.22	0.25	0.32	0.36	0.78	0.54
Singapore	1.07	1.07	1.14	1.14	1.18	1.20
Taiwan	1.09	1.27	1.37	1.47	1.49	1.46
Thailand	0.89	0.98	1.11	1.27	1.39	1.47

Source: IMF, International Financial Statistics Yearbook, 1998 and author's calculation. The data for Taiwan are from the Central Bank of China, Key Financial Indicators, and author's calculation.

As Table 6-13 illustrates, domestic claims on the private sector in most NICs had risen significantly, indicating growing strains in the banking sector. Two exceptions are Indonesia and the Philippines. The short-term debt of the Philippines was also relatively low, which could explain why the Philippines was less influenced than other ASEAN countries by turmoil. Table 6-13 exhibits also that claims on Taiwan's private sector had more weight of GDP than that in Thailand. One noticeable fact is that in contrast with most NICs, Taiwan has traditionally depended mainly on domestic savings to finance its domestic investments.[296] This suggests that the combination of the above two imbalances, i.e., the high level of foreign short-

[296] Shea, J.D. (1998b), p. 13.

term debt and claims on the private sector, could be necessary conditions for the onset of a crisis.[297]

At least part of the claims on the private sector was ultimately financed by commercial banks' offshore borrowing. Financial liberalization made it much easier for banks in the afflicted NICs to channel foreign money into financing domestic investments. After a rapid growth in foreign borrowing, however, most profitable investment opportunities had been seized early on and the problem of overinvestment in non-tradables became serious. Using short-term external debt to finance domestic investment in non-tradables was very dangerous for financial intermediaries. They were therefore exposed to the risk of foreign exchange losses from depreciation. In addition, financial intermediaries in the afflicted NICs financed domestic investment with long payback periods, and they were exposed to the risk of illiquidity.[298]

The overinvestment in non-tradables resulted from overlending and thus from underdeveloped financial systems, which could not keep pace with the high levels of international capital inflows and lacked prudential asset and liability management. Furthermore, in most East Asian NICs the financial intermediaries were perceived as having an implicit government guarantee and their risk capital was usually small. Thus, the financial intermediaries in the afflicted NICs were subjected to severe moral hazard problems. They lent excessively to risky and low-profitability projects.

Thailand's financial intermediaries financed largely investments in real assets and stock. This led to an acceleration of asset prices rather than inflation in general.[299] The overpricing of real assets and stock induced more investments and overly-optimistic beliefs that this sort of circular process would persist unabated in the future. The debtors and financial intermediaries in the afflicted NICs thus downplayed the risk and costs of excessive reliance on short-term foreign debt. That is the reason for why a boom-bust cycle in the asset markets preceded the financial panic and the currency crisis in the Asian Crisis.

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[297] Cp. Radelet, S. and Sachs, J. (1998)., p.18.
[298] Cp. Radelet, S. and Sachs, J. (1998), pp. 10-17.
[299] This could explain why the inflation rates in all NICs were very low before the Asian Crisis.

To a certain extent, the Asian Crisis verifies Krugman's theory, which is proposed in his article, "*The Myth of Asia's Miracle.*"[300] According to this article, Asian growth was based on rapid growth in inputs rather than rather than by gains in efficiency. Since input-driven growth is an inherently limited process, in order to maintain a high rate of growth overinvestment becomes inevitable, given the condition that there is no prudential asset management.

Even after the negative signals by the indicators of profitability, investment rates and capital inflows in the afflicted NICs remained high. On the one hand, in the face of the adverse shocks to profitability, the anticipation of a future bail-out provided the financial intermediaries strong incentives to take on more risk. On the other hand, the international banks, which lent large amounts of funds to domestic financial intermediaries in the afflicted NICs, presupposed that short-term interbank cross-border liabilities would be effectively guaranteed by either a direct government intervention in favor of the financial debtors, or by an indirect bail-out through IMF support programs.[301]

The bubble then burst. After a series of triggering events, real asset prices fell suddenly and sharply. The domestic debtors in the afflicted NICs experienced financial difficulties. Subsequently, domestic financial intermediaries were faced with non-performing loans and became insolvent. Table 6-14 shows non-performing loans in East Asian NICs. Here we can see again the sharp contrast between Taiwan and Thailand.

Table 6-14: Non-Performing Loans in East Asian NICs (as Proportion of Total Lending in 1996)

Hong Kong	3%	**Philippines**	14%
Indonesia	13%	**Singapore**	4%
Korea	8%	**Taiwan**	4%
Malaysia	10%	**Thailand**	13%

Source: 1997 BIS Annual Report; Jardine Fleming.
Corsetti, G., Pesenti, P., and Roubini, N. (1998a) table 21

[300] Krugman, P. (1994).
[301] Corsetti, G., Pesenti, P., and Roubini, N. (1998a), p. 4.

International banks and other creditors finally began to withdraw their credits. A financial panic occurs when the following conditions are fulfilled:[302]

- short-term debts of a borrower exceed its short-term assets;
- no single lender is large enough to supply all of the credit necessary to pay off existing short-term debts; and
- there is no lender of last resort.

The latter two conditions held for most countries as debtors in the world. Table 6-15 illustrates how the first condition is fulfilled in the afflicted NICs.

Table 6-15: Net Foreign Liabilities of the Banking Sector in East Asian NICs (in billions of USD)

Country	1993	1994	1995	1996	1997
Hong Kong	152.78	183.95	215.00	219.34	218.48
Indonesia	6.00	9.13	12.08	12.52	15.84
Korea	20.88	29.24	43.83	59.47	39.56
Malaysia	-5.53	2.36	2.76	4.25	13.01
Philippines	0.39	0.17	0.92	4.58	3.72
Singapore	84.19	101.40	118.19	116.32	87.33
Taiwan	NA	NA	-9.13	-9.44	-8.14
Thailand	22.22	39.43	69.94	78.05	59.90

Source: BIS: International Banking and Financial Market Developments
Corsetti, G., Pesenti, P., and Roubini, N. (1998a), table 28.

In contrast with other NICs, Taiwan was the only net creditor. The remarkably high level of net liabilities in Hong Kong and Singapore reflects their role as financial centers. The high level of net liabilities in Thailand and Korea made a financial panic more possible in these two countries than other NICs.

We employ the theory about 'bank runs' to explain the emergence of financial panic.[303] In the case of a financial panic, it becomes rational for each creditor to withdraw his credit if the other creditors do the same thing. The dramatic swings in a creditor's expectations about the behavior of other creditors thus trigger a financial panic. In this context, the rational behavior

[302] Radelet, S. and Sachs, J. (1998), p. 3.
[303] See 3.1.3.

of individual creditors in international financial markets led to a self-fulfilling financial panic and a sharp reversal of capital flows in 1997, which was triggered by speculative attacks on the currencies of the East Asian NICs, that in turn created at the same time a vicious circle of competitive devaluations, i.e., a currency crisis.[304]

At last we investigate which triggering events caused the dramatic swings in speculators in foreign exchange markets and creditors' expectations in 1997. Large capital inflows and overinvestment led to macroeconomic pressures in the afflicted NICs. Since 1995 a number of country-specific and global shocks exacerbated these macroeconomic pressures.

On the one hand, a surge in capital inflows in the afflicted NICs prevented their currencies from deprecation even if their domestic inflation was higher than world inflation and at times led to nominal currency appreciation; this in turn led to a real appreciation. This trend was magnified by the fact that they pegged their currencies effectively to the USD. Because the USD appreciated against the JPY and the European currencies beginning in the second half of 1995, cost-competitiveness in the afflicted NICs was thereby deteriorated. In addition, the competitive pressures were enhanced by the surge in new competitors, i.e., China and Mexico. The decline of cost-competitiveness led to deterioration of the current account. On the other hand, overinvestment created a saving-investment gap and in its turn led to large and growing current account deficits, since the earlier current account deficits were not reversed through new investments in tradables.[305]

The export slowdown from the afflicted NICs because of stagnation of the Japanese economy and the fall in the demand in the demand for semi-conductors in 1996 also contributed to the worsening of the current account imbalances in the afflicted NICs between 1996 and 1997.[306]

The above shocks changed speculators and creditors' expectations in 1997, which triggered a currency crisis and caused a rapid reversal of capital flows in Thailand first. The subsequent rational behavior of international financial markets induced the spread of financial panic and

[304] Cp. Bustelo, P. (1998), pp. 12-14.
[305] Cp. Bustelo, P. (1998), p. 12.
[306] Corsetti, G., Pesenti, P., and Roubini, N. (1998a), pp. 4-5.

currency crisis from Thailand to other countries, for example, Indonesia and Korea, which had the same problems as Thailand, particularly in the financial sector.[307]

Initially, the NTD seemed to be immune from the currency crisis for following reasons:

- the NTD experienced a real depreciation in the 1990s;
- Taiwan was running a current account surplus and the level of its monetary reserves was very high; and
- the main importers for Taiwanese products were the U.S.A. and China, which had no stagnation as did the Japanese economy;
- Taiwan was less influenced by the falling demand in the demand for semi conductors in 1996 and the emergence of new competitors, since the composition of its exports was more oriented towards high valued-added, high-tech goods.

Because of the depreciation of the SGD, which started to devalue on the wheel of the deterioration of the Malaysian ringgit, the NTD also plunged into competing devaluations. This is because the composition of Singaporean exports is very close to that of Taiwan.[308]

The main conclusion, at this point, is that the Asian Crisis in Thailand and other more afflicted NICs was the result of overinvestment and overlending in the private sector. The essential element in these countries was a combination of a self-fulfilling financial panic, preceded by currency crisis. The example of Thailand demonstrates this explanation. In contrast with Thailand, Taiwan was less influenced by the Crisis. The crucial element in Taiwan was a currency crisis rather than a financial panic.

Krugman described a 'standard' currency crisis as follows: "*A country will have a pegged exchange rate; for simplicity, assume that pegging is done solely through direct intervention in the foreign exchange market. At that exchange rate the government's reserves gradually*

[307] Cp. Fischer, S. (1998), pp.2-3.
[308] Corsetti, G., Pesenti, P., and Roubini, N. (1998a), pp. 10-11.

decline. Then at some point, generally well before the gradual depletion of reserves would have exhausted them, there is a sudden speculative attack that rapidly eliminates the last of the reserves. The government then becomes unable to defend the exchange rate longer."[309] From our explanation for the Asian Crisis we know that a currency crisis is rather a symptom than an illness. A currency crisis might result from a budget deficit, a current account deficit, a capital flow reverse, or a contagion effect. The sharp contrast between Taiwan and Thailand illustrates the difference between a currency crisis because of the contagion effect and a currency crisis associated with financial panics. A currency crisis resulting from financial panics lead to severe 'disintermediation,' i.e., collapse of the banking system's functions. This can explain that one year after the Asian Crisis Taiwan maintained its economic growth, while other afflicted countries, including Thailand, suffered from negative growth rates.

All the same, both the currency crisis and financial panics are attributed to market inefficency. The behavior of capital flows can be described by a model of multiple equilibria such as Diamond and Dybvig's model and the prisoner's dilemma as well as that of the exchange rate. The Asian Crisis is good evidence against the hypothesis of financial market's market efficiency.[310] It demonstrated the global financial markets' nature of multiple equilibria, while other financial crises before illustrated the exchange rate's nature of multiple equilibria. The financial market's instability resulting from market inefficiency is very costly. It interrupts the real sectors.[311]

In the following sections the author investigates the main factors influencing reserve management and vulnerability to the Asian Crisis in Taiwan and Thailand at the same time.

6.2. Determinants of diversification of monetary reserves as transaction balance: Taiwan and Thailand

An analysis of a central bank's transaction balance is a money quality analysis. We will thus carry out a money quality analysis in this section. Such an analysis has to do with transaction costs and non-pecuniary rates of return.

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[309] Krugman, P. (1979), pp. 311-312.
[310] Filc, W. (2000), p. 4.
[311] Cp. Diamond, D.W., and Dybvig, P. (1983), p. 403, Filc W. (2000), p.10 and Filc, W. (1998), p. 25.

As the previous discussions imply, any analysis about the currency composition of a central bank's transactions balance in a specific country should be based on, on the one hand, an analysis about the choice of foreign exchange vehicle currency in its foreign exchange market and, on the other hand, an investigation about the exchange rate regime in this country. The choice of the foreign exchange vehicle currency is determined by transaction costs, which are in turn influenced by structure of payments. The nature of the foreign exchange regime depends also on the structure of payments and additionally on non-pecuniary rates of return.

Before dealing with the money quality analysis, in 6.2.1 we give an overview about basics on the two NICs' financial system, i.e. Taiwan and Thailand, providing the foundation of further discussions, which serve as a case study for them.

We estimate the perspective of the Euro as a foreign exchange vehicle currency for our two NICs' central banks in 6.2.2 on the one hand. In 6.2.3, the exchange rate regimes in these two NICs will be investigated on the other hand.

The discussion in 2.3 suggests that the structure of payments influences the choice of foreign exchange vehicle currency and exchange rate regime at the same time. In 6.2.4 and 6.2.5 we investigate Taiwan and Thailand's structure of payments for the current account and capital account, respectively, in order to answer whether the introduction of the Euro will change the structure of payments in the two NICs significantly. Subsequently, we can roughly estimate the possibility of the Euro as a major foreign exchange vehicle for the NTD and the THB as well as the future development of the exchange rate regimes in Taiwan and Thailand. Finally, we reach a temporary result in 6.2.6.

6.2.1. Basics on the financial system of Taiwan and Thailand

East Asia had undergone sustained rapid growth since the 1960s. Economic growth has spread from Japan, through the so-called four dragon countries (i.e., Taiwan, Hong Kong, Singapore and South Korea) to China and the tiger countries (i.e., ASEAN countries) with impressive structural changes and substantial amelioration in the standard and quality of living of this region's population. In the past, financial markets in all NICs in this region were heavily regulated. These NICs deregulated their financial systems in the 1980s and 1990s

under the slogan, 'Liberalization and Internationalization'. Nonetheless, they are very different in which approach they adopted to liberalize their financial systems. To a certain extent, such a difference may explain why they are diversely afflicted by the Asian Crisis. Again, approaches followed by Taiwan and Thailand present a striking contrast.

Before the start of major liberalization, the Taiwan and Thailand's financial systems owned many common characteristics. Both the NTD and the THB were officially pegged to the USD, with two governments drawn to intervene in the financial system. Above 80% of domestic banks' asset in these two NICs were kept by state-owned banks. The allocation of credit was completely controlled by credit ration in Taiwan or dictating interest rates in Thailand. A critical difference between these two NICs was that Taiwan financed its investment mainly through domestic savings, while Thailand through capital inflows. Both current account and capital account transactions in two NICs were subject to strict controls.

Since the late 1970s Taiwan has achieved an export surplus without interruption. Therefore, it has been one of the richest countries worldwide in terms of monetary reserves. Because of strict foreign exchange control, it was difficult to transfer capital to other countries. This led to pressure on the money supply. The stock exchange became chaotic in the late 1980s for this reason. The government started comprehensive reform measures in the 1990s, which include the liberalization and deregulation of the financial market to reduce the government's role in the financial system and to open financial markets to greater foreign participation. The process of liberalization can be characterized as gradual and halting.[312]

In 1989 Taiwan abandoned the major parity of the NTD against the USD. The restrictions on starting-up in the banking business were relaxed in 1992. The involvement of foreign banks is limited in the financial market in Taiwan and their market share was only around 5% in 1997.[313]

In 1987 Taiwan implemented major steps in relaxing foreign exchange controls to restrain the steady rise in monetary reserves. The central bank lifted controls on trade account transactions and allowed residents to hold and use foreign exchange. The volume per capital account transaction, for which no permission was required, has increased significantly since

[312] Cp. Dunn, M.H. and Soong, E.S., (1998), p. 153.

then, but direct foreign investments still are subject to approval. As to foreign exchange liberalization, we may say that it was a 'partial liberalization' in terms of the capital account.[314]

There are currently still some restrictive regulations on flows of foreign portfolio capital.[315] Foreign holdings accounted for only about 3 percent of locally-listed shares in 1998.[316] In August 1990, the daily average turnover of Taiwanese stock market amounted to USD 1.431 billion, while at the same time the daily average turnover of the Thai market amounted to only USD 124 million. Thus, the Taiwanese stock market is less vulnerable to shifts of international wealth.

Thailand's economy is also export-promotion-oriented at least since 1980s. Nonetheless, its current account performance was not so impressive as that of Taiwan. The process of liberalization and internationalization in Thailand, for that the main purpose is to attract capital inflows to finance investment, was far deeper than that in Taiwan. In 1990 Thailand transferred from Article XIV status to Article VIII status in the IMF. As a result, financial liberalization proceeded in the 1990s in a very dynamic fashion.

The practice of pegging the THB against the USD was abandoned in 1984. From 1984 to 1997, Thailand's exchange rate regime was officially described as a managed float. The THB was pegged to a basket of currencies, which included currencies of the main trading partners, such as the U.S.A., Japan, Germany and Asian neighbor countries.[317] All kinds of interest rate ceilings were lifted in 1992.[318] The market share of the central bank decreased significantly. The major winners were commercial banks and finance companies. Foreign exchange control was substantially relaxed.

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[313] Dunn, M.H. and Soong, E.S., (1998), pp. 159-160.
[314] Liu, C.Y. and Kuo, S.W.Y. (1990). P. 253.
[315] For example, "*The annual inward and outward remittance quota for foreign naturals is limited to US$5 million each way and the investment cap in the Taiwan market is US$50 million. To protect Taiwan investors against foreign raiders, the SEC stipulated that individual foreign investors must not hold more than a 15% of shares in a listed company or in any kind of beneficial certificates. The total foreign holdings in a listed Taiwan company is limited to 30% of the total shares outstanding.*", Dunn, M.H. and Soong, E.S., (1998), p.163.
[316] Shea, J.D., (1998b), p. 14.
[317] Cp. Menkhoff, L., (1998), p. 224.
[318] Warr, P.G. and Nidhiprabha, B. (1996), p. 204.

More important for capital inflows is the establishment of the Bangkok International Banking Facility (BIBF). Banks operating in the BIBF operated exclusively in borrowing and lending foreign currencies. The government gave these banks special tax breaks for the purpose of encouraging offshore borrowing at a lower rate. Commercial banks and financial companies, which operated in offshore financial markets, financed large enterprises' investments and retail banking activities by borrowing short-term liabilities from banks operating in the BIBF. The result was that a large stock of domestic investment was financed by short-term interbank liabilities, denominated in foreign currency of the banks operating in the BIBF.

As chapter 3 indicates, short-term interbank borrowing and lending are highly volatile, especially between offshore and onshore financial markets. While in normal times short-term interbank liabilities are easily roll-overed, the lender banks may suddenly refuse to roll over them because of an emergence of a specific negative signal. On the other hand, the investments ultimately financed by these short-term interbank liabilities were long-term. Furthermore, denomination in foreign currencies of these liabilities brought banks exposure to foreign exchange risk. These factors made the financial system in Thailand more vulnerable to a financial panic, in a context of persistent current account deficits.

Unlike those in Taiwan, foreign investors were major participants in Thailand stock's market, since their share accounted for 30% of turnover in 1995. From the viewpoint of worldwide institutional investors, the Thai stock market is very small. Thus, they can 'make' the market, because small shifts of international wealth can dramatically change expectations of other investors at such a minor market.[319]

In the above discussions, we indicate that the financial system of Thailand, especially the banking sector and the stock market, became more sensitive to unstable expectations of international investors than that of Taiwan in the process of liberalization and internationalization, even though they had a similar staring point. Why Taiwan and Thailand adopted different approaches to liberalize and internationalize their financial systems, is attributed to different macroeconomic motives. Taiwan deregulated its financial system in order to ease pressure on the money supply resulting from huge accumulation of monetary

[319] Menkhoff, L., (1998), pp. 227-228.

reserves. Thailand attracted capital inflows to finance domestic investment by shaping its financial system more accessible to international investors.

In the early 1990s industrial country's institutional investors (especially in the U.S.A.) poured tens of billions of dollar worth of portfolio investment and interbank lending funds into emerging markets, which included developing countries and NICs. In emerging markets this fact increased the share of the quickly reversed capital flows in the total capital account transactions and made the fluctuations of the capital account balances more volatile. Globalization and deregulation of financial markets in the NICs enhanced this trend.[320] Thailand was a good example for that.

A question thus arises: Should the government play a more active role to prevent its economy from the global financial market's instability?

Even given that the global financial markets feature multiple equilibria as indicated in 6.1.4., some economists find that a more active role from government is questionable, since the social and economic costs might be excessive.[321] Before we can reach a final answer to the above question, the author cites some statements from a standard textbook for bank management:

"*The key entailment of this theory of bank regulation is that the potential for deregulation is* inextricably *bound up with the span of the safety-net. Deregulation, beyond the elimination of redundancies, requires pari passu shrinkage of safety-net that warranted the regulation in the first place. This tradeoff is inescapable, and deregulation rhetoric that ignores the tradeoff is just that.*"[322]

The high degree of the capital account's liberalization in Thailand, associated with a safety net, led to severe moral hazard problems and a currency crisis with financial panics, while a partial liberalization of capital account in Taiwan, also associated with a safety net, resulted in no serious problems. We may interpret a government's more active role as one that should create a political environment, such as matching the span of a safety net with the degree of deregulation, which can effectively reduce the global financial market's instability resulting

[320] Cp. Filc, W. (1998), pp. 24-29.
[321] Reisen, H. (1996), p. 73.
[322] Greenbaum, S. and Thakor, A. (1995), p. 506.

from market inefficiency. A complete creation of such an environment can be achieved by international cooperation.[323] Through international cooperation, the interconnected financial markets can converge towards rules that ensure transparency and disclosure and reduce information asymmetry between transaction counterparts, which do not share religious, ethnic, cultural and historic backgrounds. These rules could be called 'global standard', which are likely determined by the economy with a dominant international currency and a dominant financial market. When the Euro can get a dominant status in the hierarchy of international currency, it will play a determinative role in shaping global standard for the NICs, of course including Taiwan and Thailand.[324]

In the following sections, we investigate the financial system of Taiwan and Thailand more detailed and propose the money quality analysis about their central banks' transaction balance.

6.2.2. Foreign exchange markets: transaction costs, trading volume and exchange rate volatility

In this section we try to answer the following question: Will the Euro replace the USD as the major foreign exchange vehicle currency, if the structure of payments do not change?

Transaction costs determine the choice of foreign exchange vehicle currency. Chapter 5 illustrates that transaction costs increase with exchange rate volatility and decrease with trading volume. In order to estimate the Euro's perspective as a foreign exchange vehicle currency for our two NICs, the author utilizes thus the historical data of the Euro and other international currencies' trading volume and exchange rate volatility to reach a reasonable assessment of their transaction costs on the foreign exchange market. The author will not directly utilize the historical data of bid-ask spreads in the foreign exchange market. Because the author assumes that transaction costs in the foreign exchange market in the future are more determined by the past trading volume and exchange rate volatility than the past transaction costs. Such a procedure implies also that for our investigation the relevant financial market as a sufficient condition for international currency use is the foreign exchange market.

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[323] Filc, W. (1998), p. 29.
[324] Kaji, S. (1999).

Estimating the Euro's transaction costs in terms of trading volume proceeds in two steps.

- Firstly, the Euro's role in relation to the USD in the global foreign exchange market is estimated.
- Secondly, the Euro's role of the in the foreign markets in Taiwan and Thailand is estimated.

The main purpose of the first step is to check whether the Euro will become a rival to the USD as a major foreign exchange vehicle currency in the global markets and to predict the global trend. The second step aims to estimate whether the Euro will become a major foreign exchange vehicle currency for the NTD and the THB.

The procedure used here to estimate the Euro's trading volume in the global market is provided by Hartmann and McCauley[325] and revised by the author. In order to estimate the actual status of the Euro and its limit at the same time, two scenarios are assumed:

- a full EMU, which include all member countries of EMS; and
- an EMU including all member countries of EMS except the United Kingdom.

The first scenario indicates the limit of the Euro's potential. The second scenario describes the Euro's actual status more properly than the first. However, all of them overstate the Euro's importance as a foreign exchange vehicle in the global market.

Why we use the statistics for all EMS countries except the United Kingdom rather than for the 11 EMU countries to estimate the actual status of the Euro is explained as follows:

- BIS's Central Bank Survey lacks a detailed breakdown about the turnover of individual currencies against other currencies.

- The United Kingdom, Sweden, Denmark and Greece are members of EMS, but did not join EMU. Except for the GBP, the local currencies of the latter three countries have only negligible turnover and their inclusion in EMU will not influence our result significantly.

For our estimate, it is useful to decompose trading volume into three components:[326]

- the first one being pure intra-EMU trading,
- the second one is turnover between EMU currencies and the currencies of the rest of the world (ROW), and
- the third one is intra-ROW trading.

The first component is simply erased by EMU. Reducing the first component from individual currencies' total turnovers, we get their total turnovers after EMU.

[325] Cp. Hartmann, P. (1996), table 9 and 10, McCauley, R.N. (1997), table 4.
[326] Hartmann, P. (1996), p. 20.

Table 6-16: Full EMU and Foreign-Exchange Turnover in April 1998

(Daily average in billions of USD and percentage)

	Actual turnover against					with monetary union	
Currency	USD	DEM	**All EMS**	Total	%	**Total less all EMS**	**%**
USD	-	413.1		1741	87.86%	1741	93.61%
DEM	413.1	-	107	602.7		495.7	
FRF	82.6	13.9	*18.5*	102.6		*84.1*	
ECU	22.7	4.3	*5.4*	28.2		*22.8*	
Other EMS currencies	254.4	47.3	*64.4*	320.5		*256.1*	
GBP	159.4	41.6	*48.3*	211.9		*163.6*	
All EMS currencies	932.2	107.1	*243.6*	1265.9	63.88%	*1022.3*	54.97%
JPY	363.3	33.3		407.2	20.55%	407.2	21.89%
CHF	108.7	25.3		138.8		138.8	
CAD	66.6	730		68.7		68.7	
AUD	55.7	451		57.9		57.9	
Currencies of other reporting countries	87.6	2.7		93.5		93.5	
Residual	126.7	20		190.3		190.3	
Total (full EMU)	1741	602.7		1981.6	100%	*1859.85*	100%

Source: BIS, Central Bank Survey, 1998 and author's calculations

Note: 1. Because the table reports the turnover for which a given currency appears on one side of a transaction, each transaction is counted twice. The total is therefore divided by two and set to 100 percent. Estimates are shown in italics. 2. Estimated EMS totals for ECU and other EMS currencies are calculated as the currency total less the sum of its trading against USD, against JPY in Tokyo and against CHF in Zurich. The FRF (or GBP) EMS total is estimated as the total less the sum of its trading against USD, against JPY in Tokyo, against CHF in Zurich, and against JPY, CHF, CAD, AUD and Residual in Paris (or London).

Table 6-17: Full EMU except GBP and Foreign-Exchange Turnover in April 1998

(Daily average in billions of USD and percentage)

	Actual turnover against					with monetary union	
Currency	USD	DEM	**EMS except GBP**	Total	%	**Total less all EMS except GBP**	**%**
USD	-	413.1		1741	87.86%	1741	91.32%
DEM	413.1	-	65.4	602.7		537.3	
FRF	82.6	13.9	*17*	102.6		*85.6*	
ECU	22.7	4.3	*5.4*	28.2		*22.8*	
Other EMS currencies	254.4	47.3	*62.4*	320.5		*258.1*	
All EMS currencies except GBP	772.8	65.5	*150.2*	1054	53.19%	*903.8*	47.40%
GBP	159.4	41.6		211.9		211.9	
JPY	363.3	33.3		407.2	20.55%	407.2	21.36%
CHF	108.7	25.3		138.8		138.8	
CAD	66.6	730		68.7		68.7	
AUD	55.7	451		57.9		57.9	
Currencies of other reporting countries	87.6	2.7		93.5		93.5	
Residual	126.7	20		190.3		190.3	
Total (full EMU except GBP)	1741	602.7		1981.6	100%	*1906.55*	100%

Note: 1. Because the table reports the turnover for which a given currency appears on one side of a transaction, each transaction is counted twice. The total is therefore divided by two and set to 100 percent. Estimates are shown in italics. Components may not sum to the totals. 2. Estimated EMS totals for ECU and other EMS currencies are calculated as the currency total less the sum of its trading against USD, against JPY in Tokyo, against CHF in Zurich and against GBP in London. The FRF EMS total is estimated as the total less the sum of its trading against USD, against GBP in London, against JPY in Tokyo, against CHF in Zurich, and against GBP, JPY, CHF, CAD, AUD and Residual in Paris.

Source: BIS, Central Bank Survey, 1998 and author's calculations

Our estimate in Table 6-16 and 6-17 shows the following results:

- The first thing notable about the tables is that the USD is used on one side of 87.86% of all transactions, while all EMS currencies appear on one side of 63.88% of all foreign exchange transactions.

- With full EMU, the Euro will appear on one side of 54.97% of all foreign exchange transactions, which is smaller than the share of all EMS currencies, i.e., 63.88%. The share of the USD will rises to 93.61%.

- With a full EMS without the GBP, the Euro will appear on one side of 47.40% of all foreign exchange transactions. The share of the USD rises to 91.32%.

Some conclusions can be drawn from the above results:

- Firstly, comparing the relative economic importance of the U.S.A. and the Euro area, we can assert that the USD dominates foreign exchange markets more than it should. This implies that USD turnovers contain much vehicle volume.

- Secondly, EMU's direct impact increases the dominance of the USD. This can be attributed to the elimination of pure intra-EMU trading. This effect has to do with the role of the DEM as a foreign exchange vehicle for EMS currencies, and of course EMU currencies. In contrast, practically all USD vehicle transactions remain since they happen in the form of non-Intra-EMU transactions. The Euro turnovers therefore contain very little vehicle as volume when inherited from the DEM.[327]

- Thirdly, the inclusion of the GBP in EMU influences the Euro's share significantly, but does not change the fact that the Euro will be used as a less important foreign exchange vehicle than the USD.

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[327] "*For example, a bank having French francs (FRF) and needing Belgian francs (BEF) usually exchanges its FRF against DEM and the DEM against BEF. Therefore, joining BEF, DEM, and FRF into one currency implies a double reduction in intra-European trading.*" Hartmann, P. (1996), p.22.

The USD will still remain the most important foreign exchange vehicle in the visible future. The Euro, in contrast, will be used as a second major foreign exchange vehicle.

As a second step, the Euro's trading volume in the foreign exchange markets in Taiwan and Thailand is estimated. Only one scenario here is investigated, i.e., the full EMU, which indicates the limit of the Euro's potential.

Table 6-18: Foreign Exchange Turnover in Taiwan and Thailand in April 1998 (Daily average in millions of USD and percentage)

	Local currency against			
Currency	**Taiwan**	**%**	**Thailand**	**%**
USD	1592	92.61%	2485	96.58%
DEM	17	0.99%	6	0.23%
FRF	5	0.29%	1	0.04%
ECU	-		0	
Other EMS currencies	3	0.17%	2	0.08%
GBP	5	0.29%	4	0.16%
All EMS currencies	30	1.75%	13	0.51%
JPY	63	3.66%	63	2.45%
CHF	2	0.12%	4	0.16%
CAD	3	0.17%	0	0.00%
AUD	3	0.17%	1	0.04%
Residual	26	1.51%	7	0.27%
Total	1719	100.00%	2573	100.00%

Source: BIS, Central Bank Survey, 1998 and author's calculations

The above table illustrates the following facts:

- The trading volume of the USD against the TWD and the THB dominates that of the other currencies. This fact is due to the role of the USD as the most important and perhaps the only foreign exchange vehicle currency for the two NICs.

- The shares of all EMS currencies in total trading volume in two markets respectively are trivial.

Knowing the current strength of the USD in America and Asia, which can be derived from the great turnover of the USD against currencies of other reporting countries and residual in table 6-16 and 6-17, we certainly cannot expect that the Euro could be used as a major foreign exchange vehicle by our two NICs.

As the second part of this section, we measure the candidate currencies' exchange rate volatility. The rate of exchange of currency i's exchange rate against the local currency, i.e., the NTD and/or the THB, is defined as

$$E_i^t = \ln e_i^t - \ln e_i^{t-1},$$

where

E_i^t = rate of change of the exchange rate of currency i against the local currency.

e_i^t = exchange rate of currency i in relation to the local currency in period t.

We use its standard deviation to measure exchange rate volatility. In order to estimate the Euro's exchange rate volatility, two scenarios are assumed:

- First, the Euro is assumed to be a hard currency, while the DEM is used as its proxy.

- Second, the Euro is assumed to be a weak currency, while the ITL is used as its proxy.

The USD's exchange rate volatility against two local currencies, i.e., the NTD and/or the THB, is also calculated, since the USD is the Euro's major competitor. In addition, the JPY's exchange rate volatility is calculated, because for both NICs Japan is the most important importer and the most importance source of trade imbalance and the JPY is therefore also a candidate as the foreign exchange vehicle currency for our two NICs.

The author utilities the monthly average exchange rate of the above currencies against the NTD and/or the THB from the beginning of 1980 to the end of 1996.[328] The choice of sample period is somewhat arbitrary. A long enough period is necessary to avoid having the results dominated by particular episodes of currency movement. The decline of the USD dominated the 1970s, but starting in 1980 there were extended periods of dollar strength and weakness.[329] The investigated period ended in 1996; the year before the Asian Crisis.

The results are shown in the following table. For both the NTD and the THB, the USD's exchange rate volatility is significantly lower than other candidate currencies. Combing this fact with the estimates in terms of trading volume, we reach a conclusion that the USD's transaction costs will be lower than other currencies, including the Euro's two proxies, on the foreign exchange markets in Taiwan and Thailand. This means that the USD will remain being the most important foreign exchange vehicle for both Taiwan and Thailand.

Table 6-19: Exchange Rate Volatility of Major International Currencies against the NTD and/or the THB

(as percentage)

	USD	JPY	DEM	ITL
NTD	1.2045	2.9217	2.8870	2.8244
THB	1.2298	2.8544	2.8297	2.7957

Source: Author' calculation. The data for exchange rates, NTD/USD, are from National Statistics Database, Taiwan. The data for exchange rates, THB/USD, JPY/USD, DEM/USD, and ITL/USD are from IMF, International Financial Statistics, various issues.

The above facts are attributed to the fact that the TWD and the TBH are surrounded by foreign exchange markets, which use the USD as the most important foreign exchange vehicle currency.

Obviously, the above estimate makes use of some simplifications.[330] As indicated in chapter 5 and beginning of this section, it is assumed that the international structure of payments remains unchanged after the Euro's introduction. This assumption means also that there are no

[328] Because monthly average exchange rates of the NTD against the USD are not available, its end of period rates will be used as the proxy.
[329] Masson, P.R. and Turtelboom, B.G. (1997), p. 209.
[330] Hartmann, P. (1996), p.22.

qualitative changes in the structure of exchange outside of the Euro area, although the volumes in EMU-ROW currency pairs all switch to the Euro. That is to say, we make no prediction about whether a liquid CAD/EUR, NTD/EUR or THB/EUR market will be established.

In the long run such qualitative changes in the structure of exchange outside of the Euro area will be introduced through EMU. Concrete predictions about them are difficult, because we do not know when critical volume is reached such that qualitative changes happen.[331] Nonetheless, in the ensuing subsections we will estimate the direct impact from the Euro on the structure of payments in the two NICs, in order to access whether such a direct impact will be a great shock shifting the incumbent structure of exchange.

6.2.3. Nature of exchange rate regime

The foreign exchange rate system for the NTD was officially changed nominally from a fixed rate system to a floating rate system in 1979. In reality, until 1985 the exchange rate for the NTD against the USD fluctuated between 36 and 40 NTD per USD. After the global exchange-rate realignment in 1985, which aimed at reducing global trade imbalances, Taiwan was under pressure from the U.S.A. to appreciate the NTD along with Japan and other major European countries, because it had run the largest trade surplus with the U.S.A. among the Asian NICs. The NTD then appreciated 54 percent against the USD between early 1986 and mid-1989.[332] In 1989 Taiwan abandoned the major parity of the NTD against the USD, which "*was determined daily at the Foreign Exchange Center by a panel of general managers of the five authorized foreign exchange banks in accordance with the amount of US dollars bought and sold on the market during the previous day,*"[333] and the fluctuation limit. Since Taiwan is not a member of IMF, it does not notify the IMF about its exchange rate regime. If it did, the NTD be would classified as independently floating since 1989.[334]

From 1961 to 1980, Thailand's exchange rate remained at roughly 20 THB per USD. Successive devaluations in the early 1980s, whose objectives were to reduce the existing

[331] Hartmann, P. (1996), p.23.
[332] Kwan, C.H. (1994), p. 27-28.
[333] Emery, R.F. (1988), p. 384.
[334] Kwan, C.H. (1994), p. 64.

balance of payments deficits, raised this rate to 27 THB to the USD by the end of 1984.[335] From 1984 to 1997, Thailand's exchange rate regime was officially described as a managed float. The THB was pegged to a basket of currencies, the composition of which was secret. Because of the stability of the THB/USD rate, it was obvious that the USD was a major component of the basket.

Warr and Nidhiprabha's regression analysis confirmed this conjecture. They found also that the share of the USD within the basket might have increased since the basket system's introduction.[336] The estimated weights in 1997 were the USD, 80-82 percent; the JPY, 11-13 percent; the DEM, 6-8 percent; and other currencies, 0-3 percent.[337] The weight of the USD in the basket was so high that the exchange rate regime in Thailand before the Asian Crisis can be characterized as being pegged to the USD. This conclusion is also supported by Frankel and Wei.[338] The THB effectively fluctuated between 25.2 and 25.5 THB per USD.

Because of the discrepancy between official and actual exchange rate policy, it is necessary to measure what is the nature of the exchange rate regime in Taiwan and Thailand. We utilize exchange rate elasticity, which is developed by BIS,[339] to carry out this measurement. Exchange rate elasticities are estimated as coefficients in the regression

$$(6.2.3\text{-}1)\quad LC/USD = a + b\left(DEM/USD\right) + g\left(JPY/USD\right) + u,$$

where LC = Local currency, and all variables are percentage changes.

Unlike estimates in the foregoing section, we do not use the ITL as a weak Euro's proxy, since the ITL is not a pegging currency. The regression is estimated over three sub-periods for Taiwan and Thailand respectively and the sample period extends from 1980 to 1999 June. We divide the sample period according to the time point, at which there is structural change in the foreign exchange rate of the local currency against the USD. The NTD appreciated dramatically beginning from early 1986, while THB/USD rose significantly at the end of 1984.

[335] Warr, P.G. and Nidhiprabha, B. (1996), pp. 205-206.
[336] Warr, P.G. and Nidhiprabha, B. (1996), pp. 215-216.
[337] 倪成彬 (1998), p. 51.
[338] Frankel, J.A. and Wei S.J. (1993).
[339] BIS (1999), p. 119.

As reference, the Asian Crisis happened in the second half of 1997. The author uses monthly average exchange rates to achieve the regression. Because monthly average exchange rates of the NTD against the USD are not available, its end of period rates will be used as the proxy. The results of the regression are illustrated in the following tables. An elasticity close to zero indicates a high co-movement with the USD.

Table 6-20: Exchange Rate Elasticities in Taiwan

	1980/01-1985/12	1986/01-1997/06	1997/07-1999/06
DEM/USD	-0.0190	0.0696	-0.1473
JPY/USD	0.0730	0.0731	0.5282

Source: The data for exchange rates, NTD/USD, are from National Statistics Database, Taiwan. The data for exchange rates, DEM/USD, and JPY/USD are from IMF, International Financial Statistics, various issues, and author's calculation.

Table 6-21: Exchange Rate Elasticities in Thailand

	1980/01-1984/12	1985/01-1997/06	199707-1999/06
DEM/USD	-0.1113	0.0890	0.6578
JPY/USD	0.0776	0.1092	0.6644

Source: IMF, International Financial Statistics, various issues, and author's calculation.

As the above tables indicate, in the first sub-period the USD was clearly the only currency to which the NTD and the THB were pegged. In the second sub-period, the figure did not change significantly. This result is consistent with Frankel and Wei's study[340] and supports our explanation for the Asian Crisis. The policy of pegging to the USD in Thailand ensured the stability of the nominal exchange rate of the THB against the USD. The changes in the nominal and actual exchange rate of the USD against the JPY and the European currencies had therefore the consequence of affecting the real exchange rate of the THB.

For a more detailed story in the second sub-period, we examine table 6-8. The rapid appreciation of the USD relative to most world currencies after the spring of 1995 contributed to a very rapid real appreciation of the THB. Table 6-8 illustrates also that in several NICs, a large part of the real appreciation occurred after 1995. The real appreciation of the THB was partly the cause of large and growing current account imbalances. In contrast with that, as

[340] Frenkel, J.A. and Wei, S.J. (1994).

table 6-8 shows, because of political factors[341] the NTD experienced a real depreciation in the same period, which was to a certain extent the cause of Taiwan's current account surplus.

The Asian Crisis officially seemed to have no influence on the exchange rate regime in Taiwan, while Thailand was forced to abandon 'Basket pegging,' and adopted a more flexible exchange rate system. However, Table 6-20 and 6-21 depict another figure, showing that ever since the Asian Crisis movements in both the NTD and the THB tended to be more correlated with the JPY. This fact is attributed to both the NTD and the THB having a tendency to co-move closely with whichever currency is depreciating, be it "the USD or the JPY."[342] The THB tended to be more correlated with the DEM at the same time. This means that under the incumbent structure of payments a move to more Euro-pegging seems to be unlikely for Taiwan, while it may be possible for Thailand. All these facts suggest a situation, which McCauley has correctly predicted: "*Recent currency and banking instability in Southeast Asia raises the question of whether dollar anchoring is a thing of the past. When the dust settles, greater flexibility in exchange-rate systems is likely.*"[343] Some observers interpret this trend as an alarming example of the USD-order's decline.[344]

To what extent Taiwan or Thailand will move to an exchange rate regime that is more correlated to the Euro depends on the structure of payments and political factors. An investigation about the political factors will be ignored in this dissertation. This means that we will not take the non-pecuniary rate of return into consideration in our money quality analysis. In the ensuring subsections, we examine the current account and capital account factors, i.e., the structure of payments, which influence the choice of the pegging currencies in Taiwan and Thailand respectively.

6.2.4. Current account factors

This subsection examines the Euro's direct impact on the structure of payments of the current account, which influences the choice of foreign exchange vehicle currency and the nature of exchange rate regime in the two NICs at the same time. We utilize historical data to

[341] In 1996, China threatened Taiwan with missile maneuvers during the presidential race.
[342] Bis (1999), p. 113.
[343] McCauley, R.N. (1997), p. 31.
[344] Portes, R. and Rey, H. (1998), p. 5.

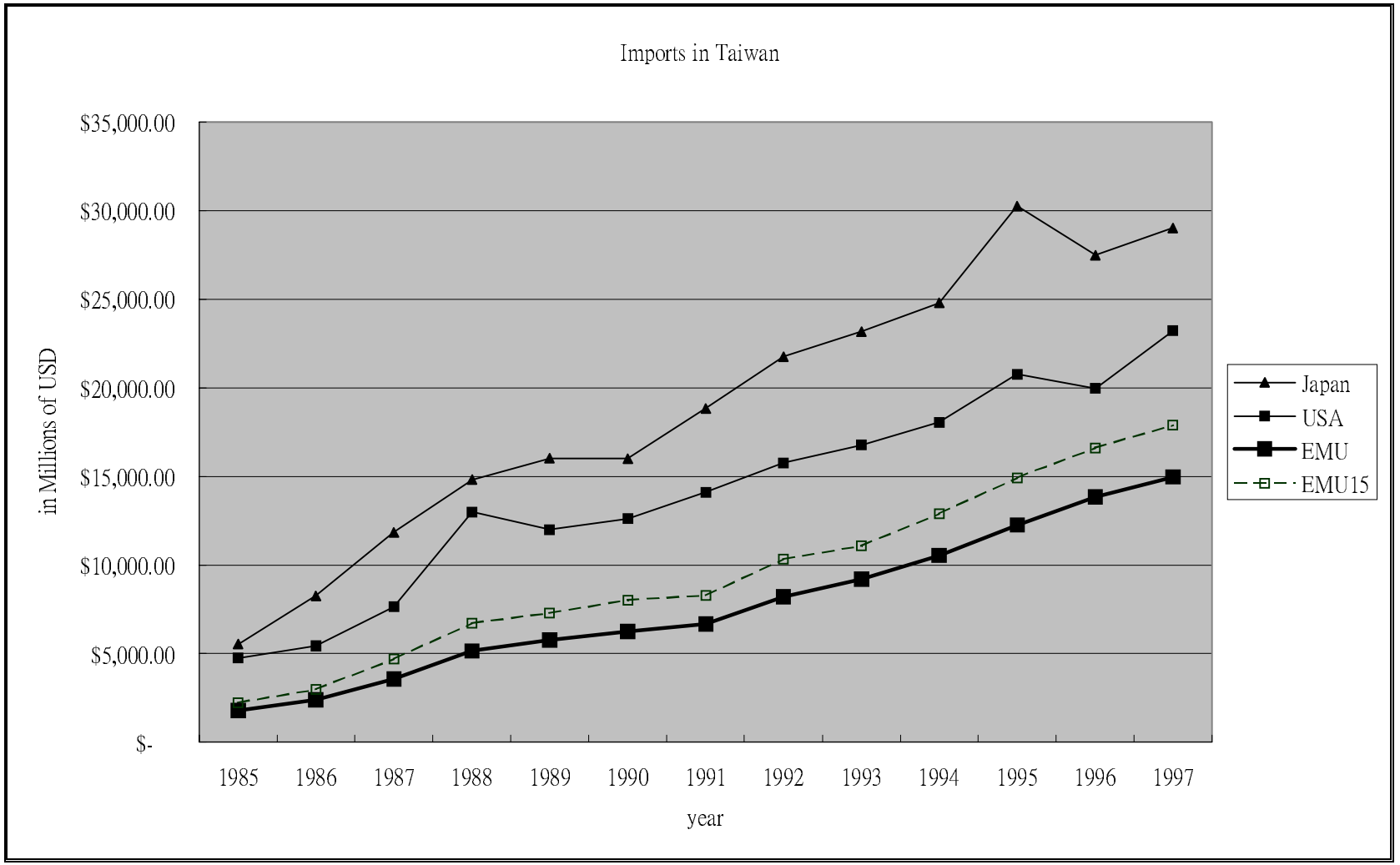
estimate the Euro's perspective as a current account transaction vehicle currency for Taiwan and Thailand.

In estimating the Euro's perspective as a current account transaction vehicle currency, two scenarios are also assumed here:

- a full EMU, which include 15 member countries of EU, and
- an actual EMU, which include 11 member countries.

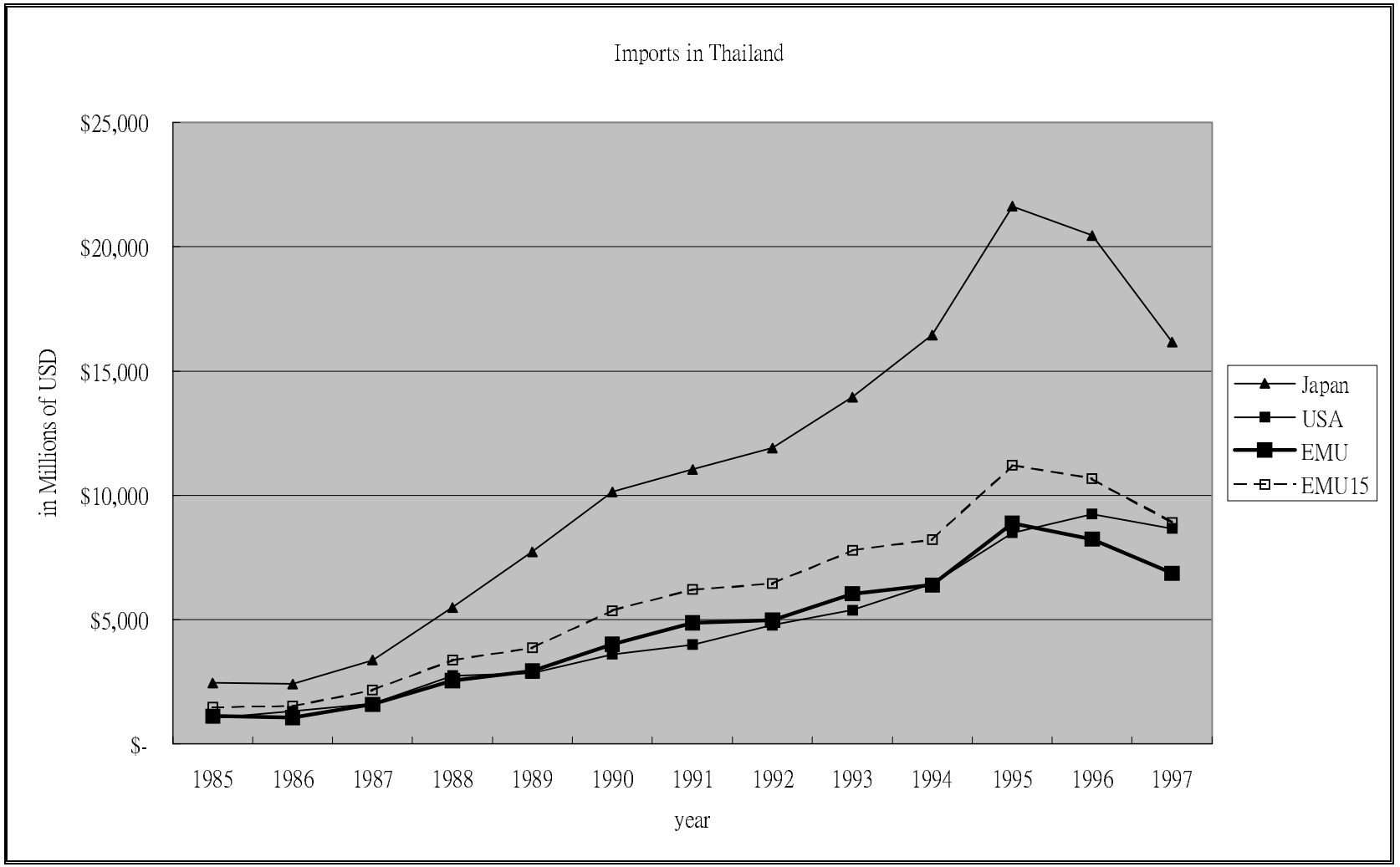
The first scenario indicates the limit of the direct impact of the EMU on the structure of current account payments. The second scenario describes the Euro's actual status.

Figure 6-1: Imports in Taiwan (by nationality)



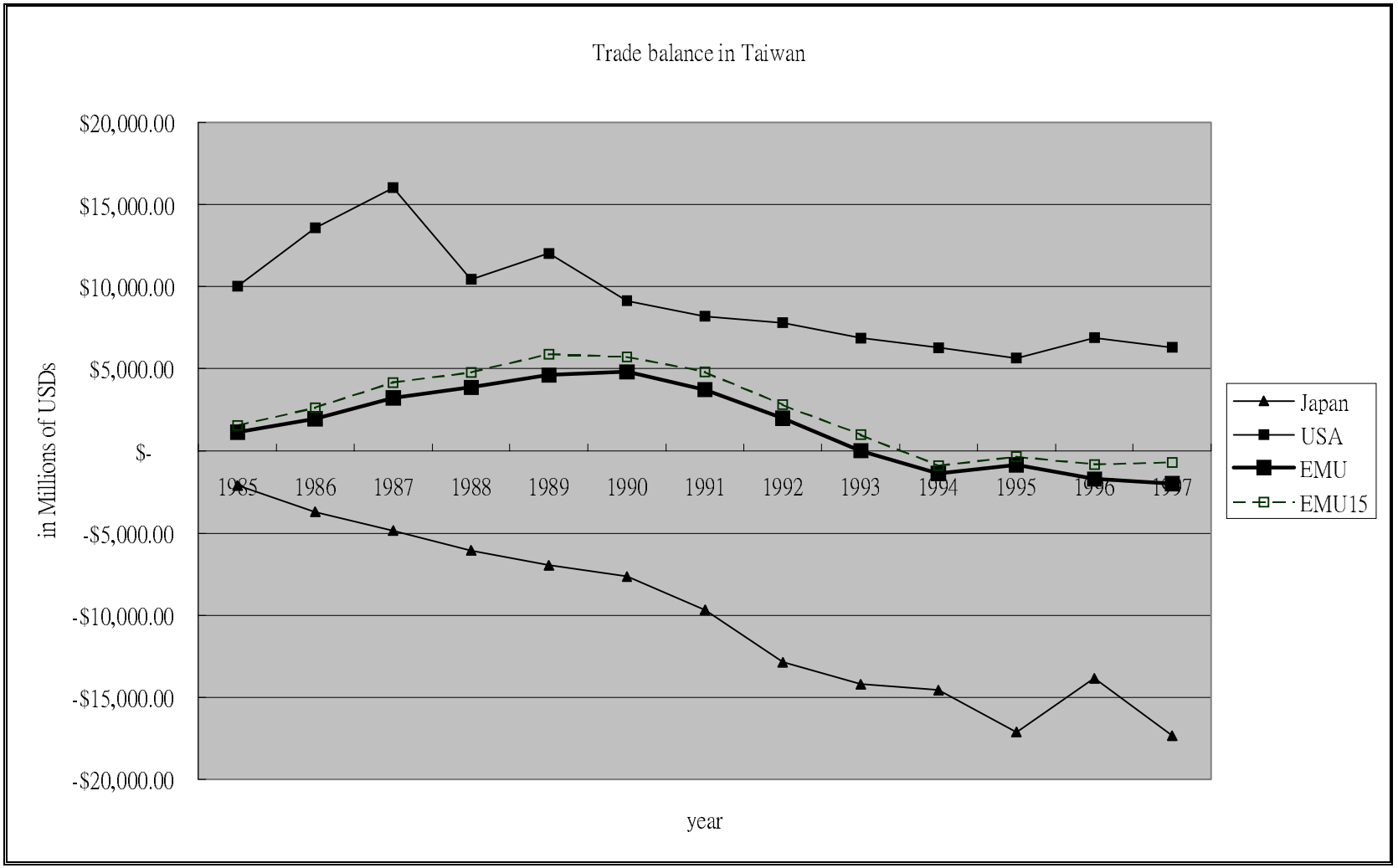
Source: Monthly statistics of exports and imports, Taiwan Area, The Republic of China, various issues and author's calculation.

Figure 6-2: Imports in Thailand (by nationality)



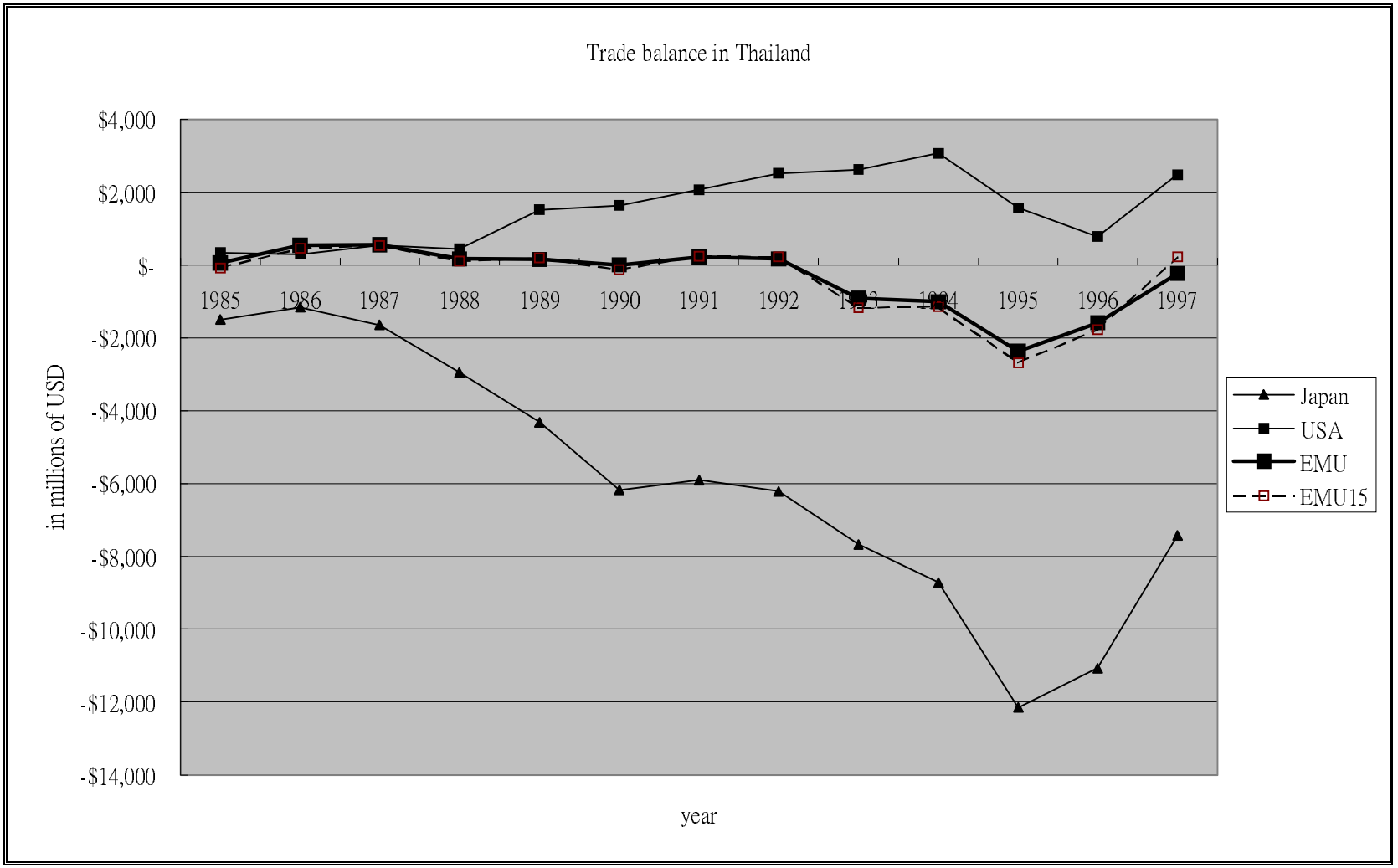
Source: IMF, Direction of Trade Statistics Yearbook, 1983 and 1998, and author's calculation

Figure 6-3: Trade Imbalances in Taiwan (by nationality)



Source: Monthly statistics of exports and imports, Taiwan Area, The Republic of China, various issues and author's calculation.

Figure 6-4: Trade Imbalances in Thailand (by nationality)



Source: IMF, Direction of Trade Statistics Yearbook, 1983 and 1998, and author's calculation.

For central banks, which cover the payments' gap of their country's residents by changing the volume of monetary reserves, the transaction vehicle for the residents' payments is the most important determinant for their choice of foreign exchange vehicles and their intervention currencies. For governments, which want to choose an optimal exchange rate regime to minimize exchange rate risk of their residents' payments, the transaction vehicle for the residents' payments is the most important determinant for their choice of pegging currencies.

Because the data of current account payments' sources by nationality is not available, we use that for trade account payments as its proxy. The sources of gross payments of the trade account by nationality for Taiwan and Thailand are identified in figure 6-1 and 6-2, respectively. They indicate that:

- the most important importer for both Taiwan and Thailand is Japan; and
- there is no significant difference between the two assumed scenarios. The EMU is a less important importer both for Taiwan and Thailand.

Moreover, figure 6-3 and 6-4 indicate that:

- the largest trade deficit of Taiwan and Thailand results from trades with Japan;
- the trades between the EMU and both of the two NICs were in balance, and there is no significant difference between the two assumed scenarios.

All these facts indicate that the Euro's introduction cannot significantly change the structure of payments that determines the choice of intervention currencies for the two central banks and the choice of pegging currency for the two governments. This assertion is subject to limitation. Chapter 2 has already indicated that the importer's currency is not necessarily the quotation currency or the transaction vehicle currency for the trade participants. An investigation of the quotation currencies or the international transaction vehicles might be more appropriate for our purpose. "*Unfortunately, up-to-date global figures on the currency of invoicing and payment are not available.*"[345]

All the same, Kwan's study[346] shows that "*The bulk of the Asian countries' current account transactions continue to be denominated in dollars.*" Why does the USD rather than the JPY

[345] Eichengreen, B. and Frankel, J.A. (1996), p. 358.
[346] Kwan, C.H. (1994), p. 195,

continue to be the preferred quotation currency for Asian countries? Frankel and Wei[347] gave some reasons:

- Firstly, since short-term financial markets are not well-developed in Japan, the JPY is a less convenient currency in which to finance trade.

- Secondly, the huge trading firms, which conduct a large percentage of Japanese trade, are more able to diversify and hedge claims and liabilities in a foreign currency than would be a small exporter or importer.

- Thirdly, trade in primary products is usually invoiced in USD. Such products occupy a large share of Japan's trade in East Asia.

- Finally, Japan is not the center of Asian countries' trade strategies. Each Asian country faces numerous, small Asian partners, and a single, very large American partner. The USD is therefore the dominant quotation currency.[348]

Therefore, it may be a reasonable assumption that the USD will continue to dominate Taiwan and Thailand's structure of current account payments.

Table 6-22: Current Account Balances in Taiwan and Thailand (in millions of USD)

	1990	1991	1992	1993	1994	1995	1996
Current Account balance							
Taiwan	10,923	12,468	8,550	7,042	6,498	5,474	10,923
Thailand	-7,281	-7,572	-6,304	-6,364	-8,086	-13,554	-14,692
Trade Account Balance							
Taiwan	14,807	15,683	12,718	11,450	11,849	13,235	17,543
Thailand	-6,751	-5,889	-4,161	-4,297	-3,726	-7,969	-9,488

[347] Frenkel, J.A. and Wei, S.J. (1994)., pp. 309-311.
[348] Bénassy-Quéré, A. (1996), p. 21.

Source: IMF, International Financial Statistics Yearbook, 1998.

Regarding the Asian Crisis, table 6-9 indicates that Taiwan had a current account surplus, while Thailand ran a current account deficit. The current account imbalance in Thailand stemmed mainly from large trade deficits as indicated in table 6-22.

What caused the current account deficit in Thailand? Making use of the national income accounting identity, the main causes of the current account deficit can be identified. The national income accounting identity is the following well-known equation:

(6.2.4-1) $Y = C + I + G + (X - M)$,

where

Y = Gross national product
C = Consumption of the private sector
I = Investment
G = Government consumption
X = Exports
M = Imports.

We define

(6.2.4-2) $X - M = CA$,

where CA is the current account balance. Therefore,

(6.2.4-3) $Y = C + I + G + CA$,

On the other hand, the gross national product is distributed into C, consumption of the private sector, S, domestic savings, and T, net tax revenue collected by the government.

(6.2.4-4) $Y = C + S + T$.

Savings from the government, S^g, and the private sector, S^p, constitute domestic savings.

(6.2.4-5) $S = S^g + S^p$.

Therefore,

(6.2.4-6) $Y = C + S^p + S^p + T$.

It is apparent that

(6.2.4-7) $CA = S^p - I + (S^g + T - G)$.

We define

(6.2.4-8) $Def = G - T - S^g$,

where Def is government deficit. Therefore,

(6.2.4-9) $CA = S^p - I - Def$.

Following the above equation, a current account deficit may be caused by:

- firstly, a fall in savings of the private sector;
- secondly, an increase in investment; and
- thirdly, an increase in government deficit.

Table 6-4 and Table 6-7 indicate that the first and the third causes did not exist in Thailand. This means that current account deficit in Thailand was only due to an increase in investment, which was not inputted in tradables and was financed by short-term foreign debt.

6.2.5. Capital account factors

In the following, the author analyzes the source of foreign debt by nationality, in order to estimate the Euro's perspective as the capital account transaction vehicle currency for Taiwan

and Thailand. Because of unavailability of the data, consolidated international claims of BIS banks are used as a proxy for foreign debt.

Again, two scenarios are assumed:

- a full EMU, which include 15 member countries of the EU, and
- an actual EMU, which include 11 member countries.

The first scenario indicates the limit of the Euro's direct impact on the structure of capital account payments in Taiwan and Thailand. The second scenario describes the Euro's actual status. We accept the same assumption as that of the last subsection whereby the most important determinant for the choice of foreign exchange vehicles and pegging currencies is the structure of payments.

Table 6-23: Consolidated International Claims of BIS Reporting Banks on Taiwan

(in % of total) (by nationality of reporting banks)

	U.S.A.	Japan	EMU	EMU15	Others
1994	12.12	25.66	31.14	45.86	3.56
1995	12.49	14.36	39.74	54.95	5.41
1996	14.23	12.00	43.63	56.03	6.18
1997	8.35	13.42	47.61	59.17	7.94
1998	5.84	10.22	48.36	64.55	7.09

Source: BIS, Consolidated International Banking Statistics, various issues and author's calculation.

Table 6-24: Consolidated International Claims of BIS Reporting Banks on Thailand

(in % of total) (by nationality of reporting banks)

	U.S.A.	Japan	EMU	EMU15	Others
1994	6.13	60.28	16.04	23.11	2.00
1995	6.52	58.65	18.42	22.91	2.11
1996	7.20	53.49	21.87	26.33	2.54
1997	4.30	56.38	24.07	28.09	2.40
1998	3.33	55.06	29.07	33.43	2.43

Source: BIS, Consolidated International Banking Statistics, various issues and author's calculation.

Table 6-23 and 6-24 identify the sources of capital account payments by nationality and their relative importance for Taiwan and Thailand respectively. We employ the consolidated international claims of BIS reporting banks as the proxy of total external debt because of data unavailability. The above two tables illustrate the following facts:

- Firstly, there are significant differences between the two scenarios, but these differences do not influence the results.

- Secondly, the most important source of foreign debt for Taiwan is EMU, while for Thailand it is Japan.[349]

- Finally, the share of EMU for both Taiwan and Thailand respectively has steadily increased during the investigated period. In contrast, the share of U.S.A. and Japan has declined respectively for both NICs during the same period.

According to the structure of capital account payments, it seems that the appropriate capital account transaction vehicle currency for Taiwan could be the Euro, while for Thailand it is the JPY. The possibility of the Euro as the capital account transaction vehicle currency for both NICs seems to be increasing. This assertion is subject to, again, a limitation. A more appropriate proxy for the relative importance of the Euro as a capital account transaction vehicle currency could be its share in foreign debt. Unfortunately, detailed data for the currency composition of external debt in the two NICs are not available. In addition, we cannot find any reasonable assumption about the currency composition of capital account transactions in our two NICs. For this reason we cannot reach a determinative conclusion in this subsection.

6.2.6. Results of the money quality analysis

[349] Filc also has noted this phenomen: Japan's dominant role in Thailand's capital inflows and its economic weaknes, the JPY's depreciation also contributed to the Asian Crisis. Cp. Filc, W. (2000), p.8.

In order to answer whether the central banks in Taiwan and Thailand should diversify their monetary reserves held as transaction balances from the USD to the Euro, the author has investigated the following issues:

- firstly, the Euro's perspective as a foreign exchange vehicle under the incumbent structure of payments;

- secondly, the nature of the exchange rate regime in Taiwan and Thailand under the incumbent structure of payments; and

- finally, the main factors influencing the structure of payments, which in turn affects the choice of foreign exchange vehicle currencies and the choice of pegging currencies, in the two NICs respectively.

With other words, we carry out a money quality analysis in this section, which takes the candidate currencies', i.e., the Euro and the USD, transaction costs into consideration, while their non-pecuniary rates of return are ignored.. In the concrete, transaction costs determine the choice of foreign exchange vehicle, while non-pecuniary rates of return influence the choice of pegging currency partially.

Regarding the factors influencing transaction costs, we investigate the major international currencies' trading volume and exchange rate volatility. We utilize the Euro and the USD's trading volume and exchange rate volatility to estimate the Euro's perspective as a foreign exchange vehicle under the incumbent structure of payments. The discussions about the first issue demonstrate that the USD will continue to be the most important foreign exchange vehicle for both Taiwan and Thailand.

With respect to the Euro's perspective as a pegging currency for our two NICs, the author utilizes exchange rate elasticity to measure what is the nature of the exchange rate regime in Taiwan and Thailand from 1980 to 1999. The East Asian NICs have traditionally adopted a policy of USD-pegging. The Asian Crisis introduced some more flexibility to their foreign exchange regime. Our regressions depict that ever since the Asian Crisis movements in both the NTD and the THB tended to be more correlated with the JPY. The THB also tended to be

more correlated with the DEM at the same time. These facts mean that under the incumbent structure of payments a move to more Euro-pegging seems to be unlikely for Taiwan , while it may be possible for Thailand.

To what extent the introduction of the Euro influences the structure of payments in the two NICs will be a determinant for their choice of foreign exchange vehicle currencies and exchange rate regime. With some reasonable assumptions we can reach some temporary conclusions about these issues.

- The USD will still dominate the structure of current account payments in the two NICs.

- According to the structure of capital account payments, it seems that the appropriate capital account transaction vehicle currency for Taiwan could be the Euro, while for Thailand it is the JPY. Moreover, the possibility of the Euro as the capital account transaction vehicle currency for both NICs seems to be increasing. Because of a lack of detailed data, a final conclusion cannot be made here.

All these facts point out that the Euro's introduction cannot be regarded as a big shock leading to qualitative changes in the structure of payments in the two NICs. This means that in the visible future the Euro's emergence will not significantly change our estimates about the foreign exchange vehicle and the nature of exchange rate regime.

In conclusion, the Euro's emergence will not change the fact that the USD will continue to be the major currency of transaction balances of the central banks in Taiwan and Thailand. Moreover, the Euro will only to an insignificant extent influence the share of the USD in Taiwan and Thailand's transaction balances.

6.3. Determinants of diversification of monetary reserves as idle balance: Taiwan and Thailand

In order to answer the question about diversification of monetary reserves as idle balance in the two NICs, this section carries out an analysis of the portfolio approach, which is based on the basic ideas of the Tobin-Markowitz model. Such an analysis assumes that reserve

currencies have the same money quality. Differences in transaction costs and non-pecuniary rates of return are thus ignored.

Firstly, we try to find the scope for diversifying monetary reserves in the two NICs. The measures of the optimal level of monetary reserves discussed in 4.1 will be applied to estimate this scope. We then employ historical data to estimate rates of return on the USD and the Euro and their statistical characteristics. Which factors influence them will also be identified. What the statistical characteristics of the USD and Euro's rates of return imply for diversifying monetary reserves as idle balance in the two NICs will be given as a conclusion to this section. At the same time, as in other sections in this chapter, the relevant factors for the Asian Crisis are also investigated.

6.3.1. Scope for diversifying monetary reserves

Table 6-25 presents the development of official foreign exchange reserves from 1991 to 1997 in Taiwan and Thailand. In absolute terms, Taiwan's reserve position was much stronger than Thailand's. In fact, since the late 1980s Taiwan's reserve holdings have always been top five in size in the world. While Taiwan's official foreign exchange reserves retained its high level, Thailand's official foreign exchange reserves grew much faster and doubled during the same period from 1991 to 1996.

Table 6-25: Foreign Exchange Reserves in Taiwan and Thailand (in billion of USD)

Country	1991	1992	1993	1994	1995	1996	1997
Taiwan	82.4	82.3	83.6	92.5	90.0	88.0	83.5
Thailand	17.3	20.0	24.1	28.9	35.5	37.2	25.7

Source: The data for Taiwan are from the Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries. The data for Thailand are from IMF, International Financial Statistics Yearbook, 1998.

However, to measure the adequacy of official foreign exchange reserves in absolute terms is not usually appropriate. A common international criterion is that for official foreign exchange reserves to be sufficient, they must finance about three to four months of imports. As table 6-

26 shows, the level of official foreign exchange reserves in the two NICs far exceeded such criterion significantly.

Table 6-26: Official Foreign Exchange Reserves in Taiwan and Thailand (as months of imports)

Country	1991	1992	1993	1994	1995	1996	1997
Taiwan	16.4	14.4	13.7	13.7	11.1	10.8	9.3
Thailand	6.1	6.6	7.1	7.2	6.7	7.0	5.6

Source: The data for Taiwan are from the Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries. The data for Thailand are from IMF, International Financial Statistics Yearbook, 1998, and author's calculation.

Because of the increasing importance of capital movements in the world balance of payments, the above criterion seems to be not appropriate any more for measuring the adequacy of official foreign exchange reserves. At least, it did not correctly measure Thailand's vulnerability to sudden capital outflows, most of which were the withdrawal of short-term interbank debt. When capital flows are especially made of easily reversible short-term debt, the need for official foreign exchange reserves may far exceed what the above criterion suggests. The percentage of short-term debt in relation to official foreign exchange reserves should serve as a better measure.[350] In 1996 it was 96.69% in Thailand and 21.31% in Taiwan, respectively.[351] Such a contrast demonstrates the vulnerability of Thailand's economy.

Chapter 3 illustrates that the fluctuations of foreign exchange rates can not be explained on the basis of fundamental economic factors. Thus, the percentage of short-term debt in relation to official foreign exchange reserves might also not be an appropriate measure. The author has suggested that the optimal level of monetary reserves should be thus a positive function of the actual or potential volume of foreign exchange market transactions by the central bank. The percentage of daily average turnover in the foreign market in relation to official foreign exchange reserves should serve as a more appropriate measure. In 1998 it was 9.05% in Thailand and 1.84% in Taiwan.[352] Again, there is a sharp contrast between the two NICs.

[350] Cp. 李榮謙 (1997), p. 537.
[351] See table 6-11.
[352] Source: BIS, Central Bank Survey. The data for Taiwan are from the Asian Development Bank, Key Indicators of Developing Asian and Pacific Countries and the author's calculation. The data for Thailand are from IMF, International Financial Statistics and the author's calculation.

The level of Taiwan's reserve holdings is unquestionably very high, both in absolute terms and relative terms, and far exceeds the need suggested by various theories. Because of capital flow controls, intervention is the main policy implemented in response to foreign market pressures. Taiwan needs more monetary reserves for this purpose than countries with deeper financial liberalization. Due to the partial nature of liberalization, the exchange rate's movement is not able to bring the current account back into equilibrium and leads to further accumulation of monetary reserves.

A high level of monetary reserves can also be explained on the one hand by the use of monetary reserves in Taiwan not limited to being a shock absorber against trade flow fluctuations and unexpected capital outflows. The central bank in Taiwan can use its reserve holdings to actively intervene in the foreign exchange markets, in order to manage the exchange rate of local currencies. By doing so, it can increase the welfare of Taiwan as indicated in chapter 2.[353] On the other hand, it could reflect some special factors influencing reserve management in Taiwan.

Jia-Dong Shea, the previous vice-governor of the central bank in Taiwan, described these factors as the following: "*Taiwan has abundant foreign exchange reserves, but it is also faced with the constant threat of the PRC. Furthermore, we have no safety net. We consider that it will be quite difficult for us to obtain international assistance in an emergency in the event of an economic crisis, since we are not a member of the IMF, the World Bank, or other international organizations.*"[354] However, abundant monetary reserves have not prevented Taiwan from being influenced by rapid changes of expectations prevailing on the foreign exchange markets. As with other NICs, it has experienced a currency crisis, but to a less extent. Theoretically, it should have been immune from a currency crisis. Furthermore, during the Asian Crisis, the central bank in Taiwan spent more than 7 billion USD for intervention in 3 months. This fact might suggest that the scope for diversifying official foreign exchange as idle balance in Taiwan seems to be more limited than it appears. However, at least one thing is certain, that Taiwan has more scope for diversifying its reserve holding than Thailand.

[353] See. 2.2.
[354] Shea, J.D. (1998a), p.6.

In contrast with Taiwan, the fast growth of Thailand's monetary reserves resulted mainly from rapid capital inflows that were even larger than the current account deficit. If the central bank in Thailand had not used a significant portion of the inflow of hard currencies to build up their monetary reserves, the appreciation of the TBH against hard currencies would have been much stronger than what happened. The central bank in Thailand built up its reserve holdings partly also because a strong reserve position can enhance Thailand's international creditworthiness. Because of its source, Thailand's monetary reserves were adequate in relation to imports, but could not cover its short-term foreign debt. This in turn limits the scope of the central bank in Thailand for diversifying its monetary reserves.

6.3.2. Statistical characteristics of rates of return on reserve currencies

As for the second part of the empirical study, we apply the portfolio selection theory to monetary reserves as idle balance. The assumptions, on which such an analysis is based, are already listed in 4.8. In summary, we take only a pecuniary rate of return into consideration. According to the portfolio selection theory and the discussions in chapter 3 and 4, the main factor determining diversification of monetary reserves as idle balance is the covariance and/or correlation coefficient of reserve currencies. For this reason, they are calculated at the same time. As with estimating the Euro's exchange rate volatility, two scenarios are assumed here: In the first one, the DEM is used a hard Euro's proxy, while in the second one the ITL is used as a weak Euro's proxy.

Again, the author uses the monthly average exchange rate of the above three currencies against the JPY from the beginning of 1980 to the end of 1996. The reason for the choice of this sample period is already given in 6.2.2. In order to take the point of view of Taiwan and Thailand, the author uses the JPY as the reference currency, because for both NICs Japan is the most important importer and the most importance source of trade imbalance.

According to standard textbooks of multinational financial management,[355] the total pecuniary rate of return on an investment can be decomposed into three separate elements: dividend/interest income, capital gains (losses), and currency gains (losses). The rate of return on an investment in currency i is therefore defined as

$$(6.3.2\text{-}1)\quad r_i^t = \left[1 + \frac{B_i^t - B_i^t + C_i^t}{B_i^t}\right]\left(1 + E_i^t\right) - 1,^{356}$$

where

r_i^t = expected rate of return on currency i

B_i^t = price of interest-earning asset in currency i

C_i^t = coupon income of currency i

E_i^t = rate of change of the exchange rate of currency i in relation to the reference currency.

Term E_i is the amount of currency i's appreciation (depreciation) relative to the reference currency, when it is positive (negative). It is computed as the fractional increase (decrease) in the reference currency value of currency i:

$$(6.3.2\text{-}2)\quad E_i^t = \frac{e_i^t - e_i^{t-1}}{e_i^{t-1}},^{357}$$

where

e_i^t = exchange rate of currency i in relation to the reference currency in period t.

Equation (6.2.4-1) ignores the inflation rate. This is justified that an international investor takes only the nominal rate of return into consideration, since the fluctuations in the rates of return stem mainly from unexpected fluctuations on the rates of exchange and prices of interest-earning assets, while the inflation rate is relatively stable.[358] We assume that the only interest-earning assets of central banks are treasury bills in reserve currencies, because they are the most liquid instruments in financial markets. Furthermore, we assume that central banks do not take fluctuations in prices of treasury bills into consideration, since as a rule they do not

[355] Here we use Shapiro, A.C. (1992) as an example.
[356] Shapiro, A.C. (1992), pp. 395-396.
[357] Shapiro, A.C. (1992), pp. 84-85.
[358] Ben-Bassat, A. (1984), p. 10.

run a risk to attain capital gains. Therefore, we define the rate of return on reserve currency i for a central bank as

(6.3.2-3) $r_i = (1 + r_F(i))(1 + E_i) - 1,$

where

$r_F(i)$ = treasury bills rate of currency i.

Such a definition for the rate of return on reserve currency is evidently based on the submartingale model, according to which "*the expected value of a future exchange rate is the present exchange rate, adjusted for the difference in yields that can be earned in each of the two currencies.*"[359]

Another way to describe the movements of exchange rate is the martingale model. It means that the current exchange rate is the best predicator of any future exchange rate.[360] According to the martingale model, we redefine the rate of return on an investment in currency i as

(6.3.2-4) $r_i = E_i$.

The statistical characteristics of the rates of return on the USD and the two Euro proxy currencies based on the above two models respectively are then set out in the following two tables.

[359] Giddy, I.H. and Dufey, G. (1975), p. 11.
[360] Hiner, A. (1983), p. 105.

Table 6-27: Statistical Characteristics of Rates of Return based on the Submartingale Model

	r(USD)	r(DEM)	r(ITL)
Mean	3.36	2.70	5.56
Standard Deviation	36.11	30.11	34.14
Covariance			
r(USD)	1304.17		
r(DEM)	482.56	906.87	
r(ITL)	687.56	857.23	1165.44
Correlation Coefficients			
r(USD)	1		
r(DEM)	0.44	1	
r(ITL)	0.56	0.83	1

Source: IMF, International Financial Statistics, various issues and author's calculation.
Note: The treasury bills rates p.a. of reserve currencies are recalculated into monthly rates, in order to be combined with the monthly exchange rates so as to get the monthly rates of return. Finally the monthly rate of return are recalculated into rates of return p.a. The above statistical characteristics are calculated in terms of the rates of return p.a.

Table 6-28: Statistical Characteristics of Rates of Return based on the Martingale Model

	r(USD)	r(DEM)	r(ITL)
Mean	-3.83	-3.36	-7.63
Standard Deviation	35.28	29.90	34.22
Covariance			
r(USD)	1244.48		
r(DEM)	472.85	894.31	
r(ITL)	669.78	854.45	1170.71
Correlation Coefficient			
r(USD)	1		
r(DEM)	0.45	1	
r(ITL)	0.55	0.84	1

Source: IMF, International Financial Statistics, various issues and author's calculation.

The first observation is that the expected rates of return on the three reserve currencies are different, but not so significantly as we expect for both cases. It is even an more astonishing fact that the USD's expected rate of return is higher than that of the DEM in the case of the submartingale model. The U.S.A. has run a great current account deficit for quite a long time. This assumes to lead to foreign economic agents holding huge assets denominated in USD and its expected rate of return will decrease. In contrast with the U.S.A., Germany's current account deficit is relatively small and it even had a current account surplus before 1990.

In order to solve this quiz, we carry out six two-variable regressions for the expected rates of return on the three reserve currencies based on either the submartingale and/or martingale model respectively over the same period. The independent variables are current account balances and overall balances. Because capital account balances of a country influence the foreign economic agents' asset holdings in its local currency as well as current account balances, we also use the sum of them, i.e., overall balances, as an independent variable for our regressions. The results are reported in the table 6-29 and 6-30.

As we expect, all slope parameters are positive in two cases. This means that expected rates of return increase by a current account surplus or overall surplus. A current account surplus or overall surplus of a country reduces the foreign economic agents' asset holdings in its local currency and increase the expected rate of return. All slope parameters and R^2s of the overall balance are greater than those of the current account balance in two cases. This fact suggests that overall balances explain changes in the expected rates of return better than the current account balance does. We can apply this result to explain the above quiz. The huge capital inflows of the U.S.A. compensated the increase of foreign economic agents' asset holdings in USD caused by a current account surplus and might influence the external value of USD. For this reason, the USD's expected rate of return decreases to a lesser extent than we expect and is greater than that of the DEM according to the submartingale model.

Table 6-29: Determinants of the Expected Rate of Return based on the Submartingale Model

	r(USD)	r(DEM)	r(ITL)
Current Account	0.0926	0.1247	0.1960
Balance	(t=1.7252)	(t=1.2858)	(t=1.0342)
	(R^2=0.1656)	(R^2=0.0992)	(R^2=0.0666)
Overall Balance	0.8274	0.3815	0.7114
	(t=2.3010**)	(t=1.8590*)	(t=2.1648**)
	(R^2=0.2609)	(R^2=0.1873)	(R^2=0.2380)

Source: IMF, International Financial Statistics, various issues and author's calculation.

Note: **, (*) denotes "significant at the 95%, (90%) level."

Table 6-30: Determinants of the Expected Rate of Return based on the Martingale Model

	r(USD)	r(DEM)	r(ITL)
Current Account	0.0633	0.1463	0.2914
Balance	(t=1.2618)	(t=1.5240)	(t=1.4948)
	(R^2=0.0960)	(R^2=0.1341)	(R^2=0.1296)
Overall Balance	0.6525	0.3710	0.8065
	(t=1.9437*)	(t=1.7777*)	(t=2.3533**)
	(R^2=0.2012)	(R^2=0.1740)	(R^2=0.2696)

Source: IMF, International Financial Statistics, various issues and author's calculation.

Note: **, (*) denotes "significant at the 95%, (90%) level."

Another important fact illustrated in table 6-27 and 6-28 is that in both cases the rates of return on the USD have positive covariance and correlation coefficient with those on the two proxy currencies, the DEM and the ITL. There is evidently no great difference between the correlation coefficients based on two different models. This implies that it makes no sense for Taiwan and Thailand to diversify a part of their monetary reserves as idle balance from the USD to the Euro.

It should be noted that the above results are not consistent with many other empirical studies. In many studies concerning the diversification of monetary reserves, the correlation

coefficient between the rates of return on the USD and the DEM is negative.[361] This discrepancy results from the following facts:

- The sample period is different.

- The subject of this dissertation concerns two individual countries respectively, while many other similar studies concern a group of countries. For this reason, the JPY is used as the reference currency in this dissertation, while the SDR or other specific currency basket is used as the reference currency for other studies.

- The rates of return on reserve currencies are defined differently from that in many other studies.

An important assumption behind the above estimates is that the Euro's emergency would not introduce structural changes. This means that the Euro's emergency would not affect the statistical characteristics of rates of returns on the USD and the Euro, or more precisely, the two proxy currencies. Such an assumption seems to be unrealistic in the long run. In the short run it is an unsatisfactory, but acceptable choice.

6.3.3. Results of portfolio selection analysis

As the investigations in 6.3.1 suggest, the scope for diversifying monetary reserves in Taiwan is much larger than that in Thailand. However, in both NICs this scope might be much more limited than it appears, but as chapter 4 indicates, we cannot determine exactly the scope for diversifying monetary reserves in the two NICs. For this reason, we also cannot exactly compute an optimal portfolio for two NICs.

In 6.3.2 an analysis of the portfolio theory approach is applied to this question: Does it make sense to divert a part of monetary reserves as idle balance from the USD to the Euro? In this analysis it is assumed:

- The whole monetary reserves are regarded as idle balance.

[361] For example, Ben-Bassat, A. (1980), Masson, P.R. and Turtelboom, B.G. (1997).

- There are three candidate currencies, the USD, the DEM as the proxy of a hard Euro, and the ITL as the proxy of a weak Euro.

- These three candidate currencies have the same money quality.

- The JYP is chosen as the reference currency because of the role played by Japan for imports and trade imbalances of the two NICs.

- The rates of returns on reserve currencies are calculated according to the submartingale and martingale model respectively.

- There are no structural changes after the emergence of the Euro.

The analysis shows that the USD positively correlates with two proxy currencies respectively for both cases based on either the submartingale and/or martingale model. This result implies that Taiwan and/or Thailand respectively cannot reduce risk at a given rate of return or increase the rate of return at a given risk by diversifying their monetary reserves as idle balance from the USD to the Euro in any case.

7. CONCLUDING COMMENTS

The main question of this dissertation is how the emergence of the Euro will influence the currency composition of Taiwan and Thailand's monetary reserves respectively. The equation proposed in 3.2.2 determines the basic structure of our investigation.

(3.2.2-1) $R_i^T = r_i + R_i^n - C_i$,

where

R_i^T = Total expected rate of return on currency i

r_i = expected pecuniary rate of return on currency i

R_i^n = expected non-pecuniary rate of return on currency i

C_i = Transaction costs of currency i.

This indicates a separation of two different sorts of considerations regarding reserve management. One takes the pecuniary rate of return into account, while the other was the non-pecuniary rate of return and transaction costs. Such a separation is also based on the functions of monetary reserves.

Monetary reserves have four functions:

- financing net imbalances,
- as an instrument to manage foreign exchange rate,
- is used to influence the domestic money supply, and
- is a part of the gross foreign assets held by a central bank and at the same time by an economy as a whole.

The former three functions are intervention-related, while the last is portfolio-related. From these functions we derive the motives for central banks' reserve holding, i.e., the intervention-related motives and the portfolio-related motives.

The former motives are justified by the overshooting behavior of exchange rates, which cannot be explained on the basis of fundamental economic factors and thus by traditional

theories such as the Mundell-Fleming model. We therefore employ a multiple equilibria model proposed by Diamond and Dybvig, and the prisoner's dilemma to explain overshooting.

The latter motives are described by the Tobin-Markowitz model of portfolio selection. In this framework, central banks are assumed to maximize the representative residents' utility. How central banks diversify the portfolio depend both on the mean-variance characteristics of the different reserve currencies, and their utility function.

Equation 3.2.2-1 points out the deficiency of the portfolio-related approach models, such as that of Ben-Bassat or that of Dellas and Yoo, which largely abstract from the existence of foreign exchange transaction costs and reserve currencies' different degree of liquidity. The degree of liquidity is reflected sometimes in transaction costs, but more often in the reserve currency's non-pecuniary rate of return. Differences in transaction costs and non-pecuniary rate of return reflect differences in money quality and lead to a hierarchy of reserve currencies. A higher non-pecuniary rate of return and/or lower transaction costs of a currency indicate its priority in the hierarchy.

Central banks generally require low transaction costs and a very high degree of liquidity in monetary reserves held for the purposes of intervention. Reserve management from portfolio-related motives takes the pecuniary rate of return into account, while reserve management from intervention-related motives takes the non-pecuniary rate of return and transaction costs, i.e., money quality, into account. This is the main source of the absence of systematic portfolio considerations in actual reserve management.

Our empirical study thus follows a simple principle that balances arising from different motives should be separately analyzed. The transaction balance is related to intervention-related motives. An analysis of a central bank's transaction balance is a money quality analysis that has to do with transaction costs and non-pecuniary rates of return. In contrast, the idle balance of monetary reserves is related to portfolio-related motives. We analyze monetary reserves as idle balance on the basis of the Tobin-Markowitz model and take only the pecuniary rate of return into consideration.

The structure of our empirical analysis is determined by the structure of relationships between different dimensions of international currency use depicted in figure 2-1. Such a process is based on an assumption that these dimensions of international use are not independent of each other. On the contrary, traditional international currency theories here ignored this interdependence. They confused necessary conditions, sufficient conditions and promotional mechanisms for international currency use. They do not even decide which dimension of international currency use is their subject matter, although 'international currency' is a concept with several dimensions. They employ indicators chosen from necessary conditions, sufficient conditions or promotional mechanisms to measure a candidate currency's, e.g., the Euro's, status in the hierarchy of international currency. Such a process always leads to inconsistent results.

In the empirical study's first part the author tries to answer the following question: Does it make sense that the central banks in Taiwan and Thailand convert at least a part of their transaction balance of USD into the Euro? An analysis about the currency composition of a central bank's transactions balance in a specific country should be based on, on the one hand, an analysis about how the choice of foreign exchange vehicle currency is determined in its foreign exchange market and, on the other hand, an investigation about the nature of exchange rate regime in this country. The choice of foreign exchange vehicle currency is determined by transaction costs, which are in turn influenced by structure of payments. The nature of foreign exchange regime depends on also the structure of payments and additionally non-pecuniary rates of return.

Foreign exchange vehicle currency theories demonstrate that transaction costs increase by the exchange rate volatility and decrease by the trading volume. The author utilizes the historical data of the Euro and other international currencies' trading volume and exchange rate volatility to reach a reasonable assessment of their transaction costs on the foreign exchange market. The result shows that both in the global markets and in Taiwan and Thailand's local markets the USD dominates the Euro in terms of trading volume. The USD's exchange rate volatility is also significantly lower than that of the Euro. This means that the USD will remain being the most important foreign exchange vehicle for both Taiwan and Thailand under the incumbent structure of payments. Nonetheless, to what extent the Euro's

emergence will influence the structure of exchange depends at last on whether the Euro's emergence is enough of a shock to shift the incumbent structure of exchange.

Traditionally, East Asian NICs have adopted a policy of USD-pegging. The Asian Crisis introduced some more flexibility to their foreign exchange regime. Our empirical study indicates that since the Asian Crisis movements in both the NTD and the THB tended to correlate more with the JPY. This fact is attributed to both the NTD and the THB having a tendency to co-move closely with whichever currency is depreciating, "the USD or the JPY." To what extent Taiwan or Thailand will move to an exchange rate regime that is more correlated to the Euro depends on the structure of payments and political factors. An investigation about the political factors will be ignored.

Regarding current account transactions, some facts indicate that the Euro's introduction is not very likely to change the structure of payments significantly. Based on Frankel and Wei's argument, we accept a reasonable assumption that the USD will continue to dominate Taiwan and Thailand's structure of current account payments.

Regarding capital account transactions, our estimates illustrate that the appropriate capital account transaction vehicle currency for Taiwan could be the Euro, while for Thailand it is the JPY, yet the possibility of the Euro as the capital account transaction vehicle currency for both NICs seems to be increasing. However, this assertion is subject to a limitation. Because of a lack of detailed data, a final conclusion cannot be made about this issue.

In summary, the Euro's introduction taken alone cannot be regarded as a big enough shock to shift the incumbent structure of payments in the two NICs. In the near future the Euro's emergence will not change significantly our estimates about the foreign exchange vehicle and the nature of exchange rate regime for the two NICs. The Euro will also influence the share of the USD in Taiwan and Thailand's transaction balances to an insignificant extent.

As the second part of empirical study, we carry out an analysis of the portfolio-related approach, which is based on the basic ideas of the Tobin-Markowitz model. In this analysis monetary reserves are regarded as being held as idle balance. Before beginning on the portfolio-related analysis, we measure the scope of diversifying the idle balance in the two

NICs, since the relative weight a central bank places on the transaction balance against the idle balance is not a priori determinable. We find that the scope for diversifying monetary reserves in Taiwan is much larger than that in Thailand. However, in both NICs this scope might be much more limited than it appears.

We do not compute optimal reserve portfolios for our two NICs. This is justified by several theoretical arguments. Firstly, Dooly has demonstrated that the portfolio theory is most logically applied to the net foreign asset position of a country, and the idle balance is a part of the gross asset position of a country. Secondly, there is a mis-specification of the portfolio model, whose reasons are identified by Horii. Finally and most seriously, the applicability of the minimum variance portfolio and the market portfolio are questionable. Most previous authors used them as proxies for the optimal portfolio of the central bank, on condition that the utility function of the central bank is not given. The assumption behind the minimum variance portfolio is unrealistic. Some new facts in finance indicate some shortcomings or even the invalidity of the CAPM. This in turn indicates the inapplicability of the market portfolio. All these cannot deny a basic idea of Tobin-Markowitz model: when the returns on different assets are negatively correlated with each other, i.e., the returns on assets tend to move in opposite directions, a rational economic agent should diversify his portfolio.

The main question for portfolio-related analysis is thus whether central banks in Taiwan and Thailand can reduce the risk of their monetary reserves by holding the USD and the Euro at the same time. For this reason, the covariance and correlation coefficient of the Euro with the USD are computed, in order to access whether it makes sense for the two NICs concerned to diversify their currency composition of idle balance from USD to Euro under the influence of the Euro's emergence. Our computation illustrates that the rates of return on the USD are positively correlated with those on the two proxy currencies of the Euro, the DEM and the ITL, for both cases based on the submartingale and/or martingale model. This means that Taiwan and Thailand cannot reduce the risk of their monetary reserves by holding the USD and the Euro at the same time.

In conclusion, our empirical study shows a pessimistic perspective of the Euro as a reserve currency for Taiwan and Thailand.

Nonetheless, the first part of our empirical study is founded on the assumption that the international structure of payments remains unchanged after the Euro's introduction. This assumption seems unrealistic, since in the long run the emergence of Euro will exert influence on the international structure of payments to a certain extent. Such influence can already be perceived from some facts:[362]

- During the first six months of 1999, the amount of Euro-denominated bonds issued exceeded that of USD-denominated bonds issued.
- Outside of Europe, the amount of Euro-denominated bonds issued was 3.5 billion USDs during the first six months after the Euro's emergence.

In addition, our empirical study indicates that the possibility of the Euro as the capital account transaction vehicle currency for both NICs seems to be increasing. The appropriate capital account transaction vehicle currency for Taiwan could be the Euro, since the most important source of foreign debt for Taiwan is EMU. Certainly, the weight of the source country of external debt is not identical with that of its currency used in lending. However, our results do illustrate the relative importance of the Euro area and the USD area for capital account transaction in our two NICs.

When the changes in the international of payments arrive at a critical point, the structure of payments and the nature of exchange rate regimes in our two NICs will thereby be changed. It is then possible for Taiwan and Thailand to use the Euro as their foreign exchange vehicle currency, pegging currency and finally reserve currency.

As to the perspective of the nature of exchange rate regime in Taiwan and Thailand in the long run, we have to take some political factors into consideration. The experience of the Asian Crisis teaches us that the NICs' further development and rapid integration into the world market are dependent on the stability of their exchange rate regimes, which in turn are determined by the stability of exchange rate between international currencies. The relative importance of the USD is surely reduced to some extent by the Euro's emergence. Under these circumstances, stabilizing the exchange rate of local currency against the USD is less recommendable for the NICs than in the past. An exchange regime aimed at keeping a balance

[362] Kaji, S. (1999), pp. 72-73.

between international currencies is in interest of the NICs, including Taiwan and Thailand.[363] This means that the Euro will play a more important role in determining the NICs' exchange rate regime. Some of the EMU's periphery countries have accepted a foreign exchange regime pegging to the Euro.[364] Such a fact could be regarded as a starting point of the Euro's influence on the world monetary system.

The results of the empirical study's second part could not be held in the long run. The statistical characteristics of reserve currencies' rate of returns might change in the process of forming currency blocs. After the Euro area evolves into a currency bloc, the Euro's exchange rate, interest rate and finally rate of return will be more and more independent of those of the USD. Taiwan and Thailand could then reduce the risk of their monetary reserves by holding the USD and the Euro at the same time.

In conclusion, the results of our empirical study are subject to many limitations and might not be valid in the long run, since they are too retrospective and based on many unrealistic assumptions. Nonetheless, These limitations are unavoidable if we want to insist on only utilizing available data and get rid of forecasts without empirical foundations.

In the theoretical and empirical study we have also identified the factors influencing three components of total expected rate of return in equation 3.2.2-1. We choose the foreign exchange market as our relevant financial market. The reserve currency's external stability, or exchange rate volatility, as one necessary condition for international currency use influences its transaction costs in the foreign exchange market. Section 2.4.2 points out that the external stability is a minor image of internal stability. This means that internal stability may also indirectly influence transaction costs in the foreign exchange market. However, we do not investigate through which channels these two necessary conditions mentioned above exert their effect on transaction costs or whether they may have an effect on other components of total expected rate of return in equation 3.2.2-1.

The trading volume is a good measure for the breadth and depth of financial markets, which in turn are one of the sufficient conditions for international currency use. We utilized the

[363] Cp. Collignon, S and Mundschenk, S (1999), pp. 98-104.
[364] See Schrader, A. (1999), table 2.

trading volume and exchange rate volatility to estimate transaction costs of major international currencies in the foreign exchange market. Foreign exchange rate agreements between countries influence the non-pecuniary rate of return of reserve currencies and their prospective as pegging currencies. A positive index of the promotional mechanisms (for example, a current account surplus or overall surplus) increases a reserve currency's expected pecuniary rate of return. In this way the author associates equation 3.2.2-1 with traditional international currency theory.

The 21st century was preceded by the introduction of the Euro, which in turn means a new era with different features of economic problems. For such an important event there are already many important and meaningful empirical investigations and studies. However, in the author's view, the reasonable theoretical foundation for empirical studies is more important, which is the goal the author is still striving for.

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