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**Currency Risks in
International Financial Markets**

Clas Wihlborg

**INTERNATIONAL FINANCE SECTION
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PETER B. KENEN
Director

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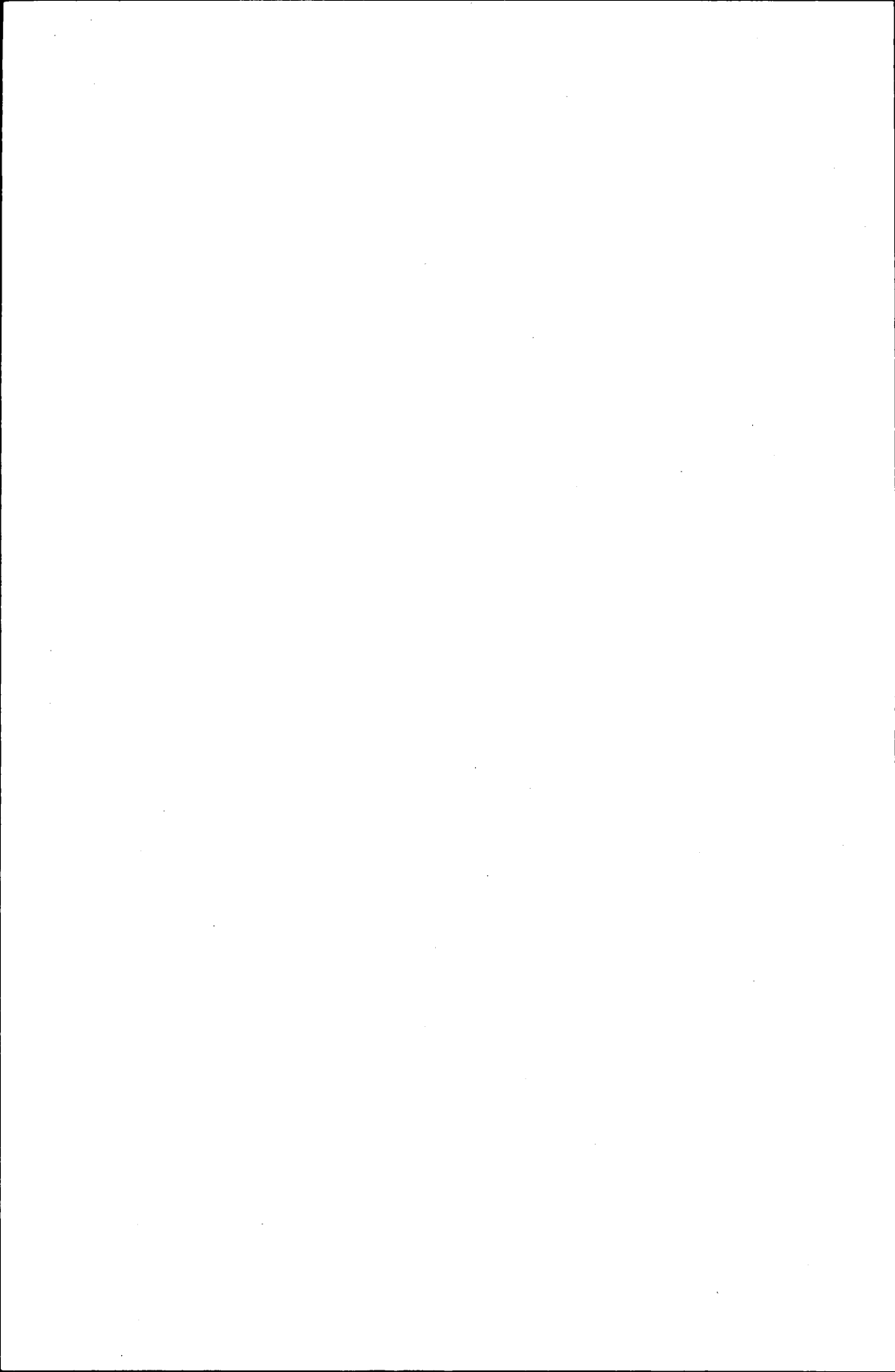
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1 INTRODUCTION

The relative riskiness of holding foreign currency under flexible and fixed exchange-rate regimes has always been a major consideration when the costs and benefits of each regime have been compared. Interest has centered on risk because of its welfare implications and its effect on the efficiency of stabilization policies.

One important concern is that the costs of financing international trade increase if investors and traders consider it risky to hold foreign currencies, making the international division of labor less efficient. Two other concerns relate to the efficiency of international capital markets. First, an exchange-rate regime may cause welfare losses if real rates of return differ on similar investments in different countries because of the riskiness of holding foreign currencies. Second, an exchange-rate regime may limit the opportunity to diversify portfolios so as to minimize exposure to currency risks.

A particular level of risk need not be inherent in an exchange-rate regime: it may be the deliberate result of central-bank policies. The target of minimizing risk may conflict with other policy considerations. Such a conflict occurs, for example, when the central bank tries to control the real rate of interest on domestic financial assets. The bank's ability to do so is largely determined by the degree of substitutability of domestic and foreign assets. By adopting an exchange-rate regime that increases currency risks, the central bank can decrease the substitutability of assets denominated in different currencies and thereby increase the effectiveness of monetary policy.

There is thus ample reason to study the size and nature of the risks associated with international borrowing and lending under different exchange-rate regimes and to determine the extent to which the risks under these regimes are subject to control by monetary authorities. The purpose of this study is to try to clarify the issues by analyzing (a) how the risks of investing in alternative currencies can be described; (b) how the size and the nature of the risks depend on the exchange-rate regime and on the behavior of the monetary authority under each regime; and (c) how risks and changes in the levels of risk affect the behavior of investors. At issue is whether an investor's response to changes in rates of return or risks somehow depends on the exchange-rate regime.

Chapter 2 states the assumptions of the analysis and clarifies certain concepts that must be understood before the analysis of risk can proceed.

The risk analysis and exchange-rate regimes are described, and a distinction is made between currency risks and country risks. The analysis deals mainly with currency risks, i.e., the risks associated with the choice of currency in which an investment is denominated. Currency risks are then divided into three kinds, inflation risk, exchange-rate risk, and a relative-price risk. Finally, the concept of purchasing power parity is explained.

In Chapter 3, risks are analyzed under assumptions about the relationships between the exchange rate, relative-price levels, and relative prices. It is shown that there is a major difference between the risks faced by investors in the presence of purchasing power parity (PPP) and those faced if there is uncertainty about deviations from PPP. It is also shown that exchange risk depends on how closely the exchange rate is correlated with the terms of trade.

In Chapter 4, some recent models of exchange-rate determination are used to evaluate the importance of the different risks under flexible, adjustable-peg, and fixed-exchange-rate regimes. Each kind of risk can exist under any regime. The models of exchange-rate determination provide certain qualitative results, but these are not sufficient to evaluate completely how risks depend on exchange-rate regimes. Reference must also be made to empirical evidence of actual exchange-rate and price relationships and to the behavior of monetary authorities.

In order to draw conclusions about the effects of risks on trade and international capital markets, it is necessary to determine how investors are likely to respond to changing magnitudes and kinds of risk. In Chapter 5 (and in the Appendix), a simple mean-variance analysis is used to examine the effects of risks on investor choice. Conclusions are then drawn about the effects of risks on the substitutability of assets denominated in different currencies and on the efficiency of markets for assets denominated in particular currencies.

The analysis in Chapters 3, 4, and 5 is based on certain assumptions (presented in Chapter 2) about the assets among which investors can choose. In Chapter 6, however, it is pointed out that structural developments have occurred in international financial markets that may be a response to higher risks. Examples of such developments are the increase in borrowing and lending in multi-currency bonds and in assets with non-rigid nominal rates of interest. The role of forward markets is also discussed in this chapter.

Finally, Chapter 7 summarizes the analysis, and the policy issues raised above are discussed briefly with the analysis of risk as a background.

2 ASSUMPTIONS, PRELIMINARIES, AND DEFINITIONS

2.1 *Assumptions*

The analysis adopts the perspective of an investor in country A and considers his investment opportunities. It is also applicable to many transactions of traders, however, since traders become investors or borrowers whenever the date of payment for goods does not coincide with the date of delivery. The analysis is also applicable to multinational corporations and other investors with activities in several countries, but in such cases it is important to define the "habitat" of the investor. (This will be discussed below under assumption d).

Four major assumptions concerning the behavior of investors are maintained throughout the analysis:

a. Investors choose their portfolios by maximizing expected utility at a target date. The expected real rate of return on the portfolio enters utility positively, while risk enters negatively. This means that each investment opportunity is evaluated on the basis of its expected real rate of return, the level of risk, and the correlation between its rate of return and the rates of return on alternative investments.

b. The probability distributions of all stochastic variables are assumed to be normal. The main stochastic variables are the anticipated rates of change of exchange rates and of the rates of inflation. The arithmetic mean of the anticipated rate of change is called the expected rate of change. The second moments of the probability distributions are the variances. These variances are used to measure the levels of risk. (The levels of exchange rates and prices are lognormally distributed when the rates of change are normally distributed. The analysis is much simplified and the main points are clear under this assumption, although there are cases in which it is unrealistic.)

c. The nominal rate of interest on each asset is fixed and known with certainty at the time of purchase. If the nominal rates of interest were not fixed, the correlation between nominal rates of interest, expected exchange-rate movements, and expected inflation rates would have to be considered. In Chapter 6, this extension is discussed.

d. At the target date of the investment, the investor switches to his domestic currency, i.e., he can purchase goods and services only by using the domestic currency. It is a simplification to employ the term "domestic" for the currency that is used to buy goods and services. The point is that the investor has to switch to the currency of the country in which he is

going to purchase goods and services. For example, the domestic currency of the multinational firm is not the currency of the country where the head office is located. Rather, the multinational firm has many "domestic" currencies, depending on where commodities and services are to be purchased.

Although the domestic currency is normally the currency of issue in the home country, residents of that country might accept as means of payment more than one currency at current exchange rates. The analysis below could be generalized to cover this case, but it would then be necessary to distinguish between inflation rates in countries and inflation rates in currencies. The price of a commodity in a certain currency would depend on the country in which its price was quoted. The individual who made a future contract in nominal terms in a particular currency would always have to be concerned about both the future exchange rates and the future price level in the country of purchase.

2.2 Description of the Risk Analysis

There are two countries, A and B. An investor in either country has a choice between assets issued in country A or B. The A asset is denominated in the currency of country A and the B asset in the currency of country B. The assets are identical in all respects except for the country of origin and the currency of denomination. In other words, asset characteristics do not depend on the specific firms or municipalities issuing assets.

Since investors are assumed to maximize expected utility, the model must explicitly identify the expected real rate of return and the associated risk for each type of investment. The table below indicates how these variables are defined given the habitat of the investor and the country of origin of the asset.

The nominal interest rates on the assets are known at the time of the investment, according to assumption c. For any investor, the nominal interest rate on the A asset is r_A^N , and the nominal interest rate on the B asset is r_B^N . However, the expected nominal rate of return on any *foreign* investment also depends on the expected rate of change in the exchange rate (\hat{X}), defined in units of A currency per unit of B currency. The expected *real* rates of return on the investments are equal to the nominal rates of return minus the expected rate of inflation in the country of habitat.¹

¹ It is, in fact, an approximation to set the real rate (r) equal to the difference between r^N and \hat{P} . The exact version is the following: $(1 + r) = (1 + r^N)/(1 + \hat{P})$. One term ($r \cdot \hat{P}$) is set equal to 0. Qualitatively, the analysis is not influenced by this approximation.

VARIABLES DEFINING THE CHARACTERISTICS OF ASSETS ISSUED IN DIFFERENT
COUNTRIES FOR INVESTORS WITH DIFFERENT HABITATS

| <i>Investor's Habitat</i> | <i>Investing in Asset of</i> | |
|---------------------------------|--|--|
| | <i>Country A</i> | <i>Country B</i> |
| Country A: | | |
| Expected nominal rate of return | r_A^N | $r_B^N + \hat{X}$ |
| Expected real rate of return | $r_A^N - \hat{P}_A$ | $r_B^N + \hat{X} - \hat{P}_A$ |
| Uncertainty about | \hat{P}_A ; country A characteristics | \hat{P}_A ; \hat{X} ; country B characteristics |
| Country B | | |
| Expected nominal rate of return | $r_A^N - \hat{X}$ | r_B^N |
| Expected real rate of return | $r_A^N - \hat{X} - \hat{P}_B$ | $r_B^N - \hat{P}_B$ |
| Uncertainty about | \hat{P}_B ; \hat{X} ; country A characteristics | \hat{P}_B ; country B characteristics |

DEFINITION OF SYMBOLS:

r^N = nominal rate of return

\hat{X} = expected rate of change in exchange rate

\hat{P} = expected rate of inflation

Subscripts *A* and *B* denote country.

The risks associated with the investments depend in all cases on uncertainty about the inflation rate in the country of habitat. On investments in foreign currencies, there is additional uncertainty about the rate of change of the exchange rate. Finally, depending on which country issues the asset, there is uncertainty about laws, regulations, and property rights. These aspects of investment in a country are called "country characteristics" in the table.

It is desirable to distinguish uncertainty about country characteristics from uncertainty about inflation rates and exchange rates, since assets issued in any major European country can be denominated in many currencies. Risks associated with uncertainty about inflation rates or exchange rates are thus called "currency risks." Risks that depend solely on the country of issue are called "country risks."

In order to take country risks into account, it would be necessary to extend the range of alternatives in the table to assets issued in one country but denominated in the other country's currency. In section 2.4, however, it is argued that country risks and currency risks are largely independent. Country risks are therefore neglected in the analysis.

It is important to note that the analysis in Chapter 3 is explicitly partial. The variables are identified on which an investor is expected to base his decision to invest a certain proportion of his wealth in the domestic cur-

rency and certain proportions in foreign currencies. These variables are the expected real rates of return and the variances of these returns, since investors are assumed to be risk-averse maximizers of expected utility (assumption a). Investors individually take as given nominal interest rates, the expected rate of inflation, and the expected rate of change of the exchange rate. They must then evaluate the variances of, and the correlation between, real rates of return on domestic and foreign investments. The analysis in Chapter 3 proceeds by identifying whether it is the variance of the exchange rate, of the inflation rate, of deviations from PPP, or of a relative price that constitutes the risk on an investment in a particular currency. No attempt is made to derive the market relationships between risks and relative rates of return. It must also be noted that the relationships among the exchange rate, the inflation rates, and the terms of trade are simply assumed.

Once the variables on which the risks on alternative investments depend are identified, it is natural to extend the analysis in two ways. First, in Chapter 4, a few models of exchange-rate determination are studied in order to ascertain the risks on foreign and domestic investments given the particular assumptions employed by different models. The second extension, in Chapter 5, develops the market-equilibrium consequences of the risks. It asks, for example, how changes in the levels of risk affect relative demands and therefore equilibrium rates of return, and how the level of risk affects the response of investors to changing relative rates of return.

The interdependence among risks, returns, and the relative demand for domestic and foreign assets is analyzed within a simple two-asset mean-variance model. This model is in equilibrium when the outstanding supplies of foreign and domestic assets are willingly held.

2.3 *Definitions of Exchange-Rate Regimes*

I distinguish between four exchange-rate regimes: (a) fixed exchange rates without bands, (b) fixed exchange rates with bands, (c) adjustable pegs, and (d) flexible exchange rates.

a. A fixed exchange rate is a rate *known* to be fixed for the foreseeable future. Regime (a), the fixed rate without bands, cannot exist between countries with independent central banks. If there is no band within which the exchange rate can fluctuate, and if the rate is known forever, we have in effect a currency area similar to the one within a single country. The fixed rate without bands highlights the monetary-policy aspect of the choice of exchange-rate regime. Since regime (a) necessitates a common monetary policy, any difference between the rates of return on assets

denominated in the two currencies will induce capital flows. Thus, common monetary policies must be carried out, and common inflation rates will result. In other words, the correlation between inflation rates must be close to 1 under regime (a), and the variances of the inflation rates must be similar. It follows, of course, that there can be no difference in the risks associated with holding a "foreign" currency and the domestic currency, just as no greater currency risk is incurred by holding dollars in California instead of in New York. (For political or other reasons, however, the California investment may differ from the New York investment.)

b. As soon as there are bands within which a fixed rate can fluctuate, we have a qualitatively different regime from the point of view of the issues studied here. Uncertainty about the future exchange rate enters the picture. Even a band as narrow as 1 per cent can lead to considerable uncertainty for short-term investors. A maximum change in the exchange rate of 1 per cent over one month implies an annualized rate of change of 12 per cent, while the same maximum change over a ten-year-period implies an annualized rate of change of the magnitude of 0.1 per cent. Clearly, the longer the time horizon of an investment, the less important is the band relative to rates of return. Therefore, the longer the time horizon, the more this exchange-rate regime approaches the one without bands.

Under regime (b), there must be at least an implicit agreement on monetary policies in participating countries. In the short run, however, there is some monetary independence and inflation rates and variances of inflation rates need not be identical. But, again, the correlation between inflation rates must approach 1 over the long run, and the variances of the inflation rates must be similar.

c. An adjustable peg can be described as a regime under which the exchange rate may fluctuate within a band and discrete adjustments of the exchange rate can be made too. With this regime, there is no restriction on the monetary policies of different countries and on the correlation between the inflation rates. The less policies are coordinated and the more inflation rates diverge, however, the more often and the larger must be the discrete adjustments. A feature of this regime that distinguishes it from a flexible rate is that uncertainty about the peg is a necessary part of the regime. Central banks typically decide to adjust the peg in secret in order to avoid massive short-term capital movements. Were the adjustments to be announced ahead of time, nominal interest rates would have to respond immediately with a corresponding change. In addition, along the lines of prevailing theories of stabilization policy, large adjustments are made in order to change the relationship between real wages and profits. If announcements of impending adjustments were made,

firms and individuals would anticipate the changes and possibly nullify the desired effects. (A technical problem of measuring risks arises under this regime. Variances of normal distributions were identified with risks above. Under this regime, however, the distribution of anticipated changes of the exchange rate may at times approach a binomial distribution; anticipations are such that either the peg is not adjusted or it is adjusted by a large amount [see Schilling, 1970]. I argue below, however, that the assumption of a normal distribution still provides the right direction of change in magnitudes.)

d. The flexible-exchange-rate regime may be dirty or clean, i.e., with or without central-bank intervention. The key feature of this regime is that the exchange rate can change continuously without fixed rules. Monetary policies may or may not be coordinated between countries, and inflation rates may or may not be similar. The main point is that monetary policies and inflation rates are independent. The correlation between inflation rates may be high or low, and the variances of inflation rates may be of similar magnitudes or very far apart. However, it can be argued that the longer the time horizon, the more likely it is that the correlation between inflation rates will be low. The fact that central banks are independent makes it extremely unlikely that they will carry out identical policies at all times.

When three of the exchange-rate regimes are compared in terms of the nature and magnitudes of risks (fixed rates without bands are excluded), flexible rates are at one extreme and fixed rates with bands at the other. The fixed rate requires coordinated monetary policies and highly correlated inflation rates except in the very short run. The flexible rate implies that monetary policies and inflation rates are independent but not necessarily uncorrelated. The adjustable peg can be viewed as a mixture of these two regimes. In the short run, when the peg is believed to hold, it is like a fixed regime. In the long run, it is like a flexible regime since monetary policies are independent and inflation rates need not be correlated. The most specific feature of an adjustable peg is that there can at times be expectations that the exchange rate will remain fixed and at times expectations that it will change by a large amount.

2.4 Definitions of Risks: Distinguishing Currency Risks from Country Risks

With the development of the Eurocurrency markets, it has become desirable to distinguish between country risks and currency risks. It can be argued that country risks to some extent depend on exchange-rate regimes or in some way may increase because of attempts to lower cur-

rency risks. When country risks are carefully defined, however, the grounds for such arguments become very weak.

Currency risks. Currency risks are divided into three categories, inflation risk, exchange-rate risk, and a relative-price risk.

Inflation risk is the variance of the real rate of return caused by the variance of the inflation rate of the currency in which the investment is denominated. Inflation risk is symmetric: investors in all countries are affected by it, as we shall see below.

Exchange-rate risk, or exchange risk, is the variance of the rate of return caused by the variance of the rate of change of the exchange rate *without* corresponding changes of the inflation rates, i.e., by the variance of the rate of change of deviations from PPP. We shall see that this is an asymmetrical risk specific to foreign investments.

When exchange-rate changes are correlated with relative-price changes between goods produced domestically and abroad, we have relative-price risk. It is caused by the variance of a relative price and therefore depends on the consumption bundle of the investor and not on the habitat.

This clear distinction between risks associated solely with currencies and risks that depend solely on the consumption bundle is difficult to maintain in all cases. However, it seems desirable to distinguish risks that depend on uncertainty about nominal variables—inflation rates and the exchange rate viewed as the relative price of currencies—from risks that depend on real variables, i.e., relative prices.

Country risks. Country risks are divided into political risk, default risk, and “real capital” risk.

Countries can be regarded as more or less risky to lend to when investors are uncertain about future regulations and laws regarding taxes, exchange controls, moves toward socialism, etc. Basically, these political risks depend on uncertainty about the extent of property rights.

Uncertainty about exchange controls is a critical link between uncertainty about property rights and exchange-rate regimes. Some have argued that exchange controls are more likely to be imposed under fixed and pegged exchange rates than under floating rates. But central banks may consider short-term exchange-rate fluctuations under a flexible regime to be just as serious as fluctuations of the balance of payments under a fixed-rate regime. They may therefore opt to control capital flows under either regime. Economists disagree about whether a flexible rate *can* be stabilized by controls, but controls have certainly been recommended by some (see, e.g., Cooper, 1976). On the other side, McKinnon (1976), for example, has argued that free, short-term capital movements are necessary for a smoothly functioning flexible-rate regime.

Default risk on a country level has been discussed lately in connection