

**ACTUARIAL RESEARCH CLEARING HOUSE
1999 VOL. 1**

Currency Risk Models in Insurance: A Mathematical Perspective

July 27, 1998

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Abstract

In this paper we consider a general two-country model of exchange rate dynamics in which interest rates are stochastic. Special cases of this model are also illustrated in which the interest rates are constant in each country and when interest rates are Gaussian in each country. Uncertainty in this global economy consists of the exchange rate between the two countries and the noise in interest rates in each local economy. This model provides an important tool for actuaries dealing with global risk which includes valuation of currency derivatives (forwards, futures, options and swaps), frequency/severity claims model with exchange rate risk in the claim size, valuation of individual insurance contracts written in foreign currency, and valuation of general interest sensitive claims in foreign currency. Typical examples of practical importance include marine insurance, health insurance, and life insurance. The simple case of the model for which interest rates are constant in each local economy is used to explain and analyse the "Siegel paradox" which we describe because it has confused some readers of the 1970 era currency risk literature. We illustrate the model with the calculation of forward prices, currency options, and a simple life insurance contract (which could also be interpreted as a property/casualty contract).

