PURCHASING POWER PARITY AND EXCHANGE RATE OVERSHOOTING

PURCHASING POWER PARITY AND EXCHANGE RATE OVERSHOOTING: AN ECONOMETRIC INVESTIGATION

by

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ABSTRACT

After the abandoning of fixed exchange rates by most major countries in 1973, it was observed that exchange rates fluctuated disproportionally to relative prices. "The asset market approach to exchange rate determination " has been used to explain the volatility of the exchange rates. The application of "the asset market approach to exchange rate determination " to a large country framework is the subject of this dissertation.

The effect of an increase of nominal money supply on the exchange rate is dampened in a two-country world and overshooting is not a necessary feature of the model. The model has the advantage of examining the effect of real shocks, like an increase in government spending. It can also handle shocks due to changes in foreign variables (nominal or real) which are equally important in a large country setting.

The assumption that both domestic and foreign variables have the same coefficient but opposite signs, which has been used extensively in the theoretical and empirical literature, is relaxed since its imposition could even reverse the signs of the constraint coefficients.

Even within a two-country model, the long-run proportionality between money, prices and exchange rates, that is, purchasing power parity, holds. This is derived as a long-run zero degree homogeneity restriction in money and prices which can be tested. The impact period results, however, are different from those derived in a small country world.

The sample consists of 42 quarterly observations (1973I-1983II) and only the large OECD countries, France, Germany, Japan, the UK and the US are considered. The notion of effective exchange rate is applied. The foreign variables are constructed by aggregating over the major trade partners of each country using trade weights.

It is shown that the reduced form system is quite successful in tracking the actual data and that the model is indeed stable. There is no indication of overshooting except for France, and the restriction implying purchasing power parity cannot be statistically accepted. Finally, the predictive performance of the purchasing power parity is evaluated.

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CHAPTER 1

INTRODUCTION

The world moved to a general system of floating exchange rates after the collapse of the Bretton Woods agreement in 1973 and a revived interest in the theory of purchasing power parity has emerged during the last decade. The experience of the major advanced industrial economies has led many to argue that generalized floating may not be a panacea for international monetary problems. An understanding of the forces influencing currency values is of prime importance to the international financier and investors and to everyone concerned with international finance and trade. Foreign exchange is one of the key factors which determines quoted prices of products and services.

Over the years several competing theories to explain changes in foreign exchange rates have been proposed. One of the major theories, the theory of purchasing power parity, is examined in depth in this thesis. There are two opposing views on the theory of currency depreciation. In the elasticity approach to the balance of trade, a devaluation or currency depreciation is believed to have a small inflationary impact on the devaluing country. On the other hand, the monetary approach to the balance of payments assumes considerable inflation in the short run. In the context of the international economy changes in price levels and changes in exchange rates will offset one another. This is one implication of the neoclassical theory.

The purchasing power parity theory implies that changes in relative prices are reflected in changes in exchange rates. This proposition has been tested with relatively simple models. Recently, the purchasing power parity relationship has been explicitly incorporated into the monetary approach to exchange rate determination and dynamic versions of it have been tested.

The purchasing power parity theory has been used as a long-run proposition or as a steady-state relation. Given that it holds in the long run, useful conclusions can be drawn for the short-run behaviour of exchange rates. Dornbusch's (1976b) paper falls in this category.

Dornbusch's approach is extended here to a large country framework and the extended variable output case of the Dornbusch model is considered. Previous studies have completely neglected feedback responses from abroad. There appears to be no other study in which purchasing power parity is examined within a two-country model. The phenomenon of overshooting, as first conceived by Dornbusch in a small country setting, is not a necessary phenomenon in a large country model.

The model constructed in the present study can examine the effects, not only of changes of money supply, which have commonly been considered in other studies, but also of exogenous real shocks, such as an increase of government expenditures or of energy prices. It can also handle shocks to the foreign variables (nominal or real) and examine their effects on the domestic country.

The thesis is organized as follows. Chapter 2 describes the literature concerning purchasing power parity as a theory of exchange rates. Since the proposition of purchasing power parity is quite old, there is a vast amount of literature to be discussed. However, only the more recent trends in the literature are given close attention. After defining some basic concepts, a survey of recent studies is provided under three headings: price indices and effective exchange rates; policy considerations; and dynamics and lag structure.

Chapter 3 describes the theoretical model. It is a model within the tradition of the asset market approach to exchange rate determination. The small country assumption has been replaced by a two-country model which is more appropriate for explaining the economies of some large industrial countries. Even with a two-country model, the long-run proportionality between money, prices and exchange rates, that is, purchasing power parity, holds. This is derived as a result of the model and it appears as a long-run homogeneity restriction in money and prices which can be tested. The impact period results, however, are different from those obtained with the Dornbusch model.

Chapter 4 discusses some considerations preliminary to estimation. The objective of that chapter is to make the model presented in chapter 3 applicable for empirical implementation. The question of the standard country, the time period, the sample of domestic and rest of the world countries, some reasons for the choice of the price index and the treatment of expectations are discussed.

The sample consists of 42 quarterly observations covering the flexible exchange rate period 1973I-1983II and only the large OECD countries, France, Germany, Japan, the UK and the US are considered. The rest of the world variables are constructed by aggregating over the major trade partners of each country using trade weights. This aggregation allows us to have an effective exchange rate even for the US, by treating the US symmetrically with the other countries.

The estimation method to be used and the statistical criteria to be applied, as well as the various tests performed with the model, are discussed in chapter 5. Zellner's seemingly unrelated regression method is used. All the endogenous variables are expressed in terms of exogenous variables and random errors which are correlated across equations. The model allows us to test for the purchasing power parity and the phenomenon of overshooting or undershooting following a money supply change.

The model is flexible enough to test the proposition that domestic and foreign variables enter the equations with common coefficients but of opposite signs. Though such an assumption has not been made, it can be tested with a log-likelihood ratio test. It is an assumption that has been adopted very extensively in other studies without any *a priori* theoretical reasoning.

Chapter 6 is concerned with the validation of the model by comparing observed historical with actual values. Subsequently, the predictive performance of the purchasing power parity theory is examined, based on simulated values of domestic and foreign prices and exchange rates. Some simulation experiments are performed to evaluate the response of the model to various shocks.

Chapter 7 summarizes the study and makes suggestions for future research.

CHAPTER 2

THE PURCHASING POWER PARITY THEORY OF EXCHANGE RATES: A SURVEY

2.1 INTRODUCTION

Purchasing power parity (P.P.P.) theory can be considered as an extension of the quantity theory of money in an open economy. The monetary approach explains exchange rate movements largely by actual and anticipated movements of relative money stocks. Thus, it stresses one line of causation running from money to domestic prices to exchange rate.

Gustav Cassel (1916, 1922, 1928) is the first economist to place P.P.P. within a systematic framework and it is this framework that has been used extensively even in recent studies. The origins, however, of P.P.P. can be traced back to Ricardo (1970) and Wheatley (1970).

P.P.P. has been used in a variety of contexts and for a variety of purposes: as a tool for assessing exchange rate disequilibria under both floating and fixed exchange rate regimes, for time series as well as comparative static comparisons of purchasing power parities and exchange rates, as a basic relation in aggregate econometric models, as a tool for investigating the movement of internal price ratios, as a test of the commodity arbitrage hypothesis and as a criterion for setting new exchange rates.

The literature of P.P.P. is so large that it is not possible to cover it here. Fortunately, Officer (1976) offers an excellent review article. He examines both the theoretical and empirical studies concerning P.P.P. and various arguments in favour of and against it. The question of productivity bias is particularly emphasized. A historical description of the early controversies that led P.P.P. to emerge as a theory can be found in Myhrman (1976). The book by Lee (1976) can be considered as a reference volume.

Recent trends and particularly P.P.P. within the modern approach to exchange rate determination are not dealt with in these studies. Thus, after discussing some definitions and methodological issues relating to P.P.P., the recent trends of the literature are surveyed here. The problem of choosing the appropriate price index is apparent and a special section is devoted to it. The orientation of P.P.P. towards policy considerations and the dynamic formulation of the theory, which is a very recent development, are then considered.

2.2 DEFINITIONS AND METHODOLOGY

The proposition that national monies tend toward purchasing power parities over real goods and services gives a good starting point to examine the question of whether equilibrium exchange rates between commodities and currencies are established. The definition of P.P.P. between two countries has two versions: the absolute and the relative. According to the absolute version the equilibrium rate of exchange between domestic and foreign currency equals the ratio between domestic and foreign prices. The relative version states that the exchange rate is equal to the product of the exchange rate in a base period and the ratio of the countries' price indices. In other words, the relative P.P.P. relates equilibrium change in the exchange rate to changes in the ratio of domestic to foreign price indices.

The following definitions are required:

a) The balance of payments is defined as the official settlements account of the basic balance.

b) The short-run equilibrium exchange rate[1] is the rate that would exist under a freely floating exchange rate regime.

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[1] By exchange rate we mean the spot exchange rate, unless otherwise stated.

c) The long-run equilibrium exchange rate is the fixed rate that would lead to balance of payments equilibrium over a period that incorporates any cyclical variation in the balance of payments, assuming that there are no trade restrictions and no monetary and/or fiscal intervention by the authorities.

d) P.P.P. refers to the long-run equilibrium exchange rate or the main determinant of it.

e) The short-run equilibrium exchange rate is a function of the long-run equilibrium exchange rate as the former tends to approach the latter.

These definitions indicate that the short-run equilibrium exchange rate is a function of P.P.P. (in its absolute or relative version) and other factors. There are two extreme cases. First, one can define the short-run equilibrium exchange rate at a given time as equal to the P.P.P. at the same time. In this case the short-run equilibrium exchange rate cannot deviate even temporarily from the current value of P.P.P. Second, P.P.P. can be considered merely as one variable in a set of variables within a system of multivariable equations which determines the exchange rate.

In an intermediate case one could express the current short-run equilibrium exchange rate as a function of current and past values of P.P.P. This brings the theory closer to Cassel's formulation, especially when an error term is added. Cassel (1918) considers the short-run equilibrium exchange rate as a function of the current value of P.P.P. and allows also other explanatory variables and an error term to enter his formulation. But he is explicit in showing that the most important explanatory variable is the current value of P.P.P.

Two dimensions of P.P.P. have been indicated above. The absolute, as distinguished from the relative form of P.P.P., and P.P.P. as a theory of exchange rates. A third dimension has to do with the application of P.P.P. as a conversion factor to transfer data from one national currency to another. This application has led to the incorporation of the index number theory in the P.P.P. literature and to intercountry comparisons of gross domestic product and its components[2]. Though the concept of P.P.P. as a conversion factor will not be used here, it is unavoidable that a variety of product-price or factor-cost measures will be used in defining

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[2] See Kravis, Irving and others (1975).

P.P.P., particularly in empirical work. Such measures can be the gross domestic price deflator, the cost-of-living price index, the wholesale price index, wage rates, unit labour costs and unit factor costs. The explicit incorporation of the price indices in the previously given definitions and a formal and rigorous interpretation of the absolute and relative P.P.P. versions are undertaken below[3].

2.2.1 ABSOLUTE PURCHASING POWER PARITY

The purchasing power of money at time t, M_t^P, is defined as the reciprocal of some commodity price index. Assume n commodities in the world. Then the commodity price of money at time t is

$$M_t^P = \frac{1}{\sum_{i=1}^{n} c_i P_t^i} \tag{2.1}$$

where P_t^i is the domestic currency price of a unit of good i and c_i is the weight (importance) assigned to commodity i in constructing the domestic price index. It is evident from (2.1) that M_t^P declines with general

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[3] McKinnon (1979, pp. 119-122) gives a similar interpretation for the absolute and relative versions.

inflation in the prices of commodities.

A similar relationship can be written for some particular foreign country:

$$FM_t^P = \frac{1}{\sum_{i=1}^{n} d_i \; FP_t^i} \tag{2.2}$$

where FM_t^P is the foreign commodity price of money at time t, FP_t^i is the foreign currency price of commodity i and d_i is the foreign weight assigned to commodity i.

According to Cassel (1922), the absolute version of P.P.P. is defined as the ratio of the purchasing power of the two monies at time t. "Our valuation of a foreign currency in terms of our own, therefore, mainly depends on the relative purchasing power of the two currencies in their respective countries... This parity I call purchasing power parity." (pp. 138-140.) Thus, we can define the P.P.P. exchange rate as

$$E^{PPP} = \frac{FM_t^P}{M_t^P} = \frac{\sum_{i=1}^{n} c_i P_t^i}{\sum_{i=1}^{n} d_i FP_t^i} \tag{2.3}$$

This is the definition of the absolute P.P.P. It is the parity ratio of the purchasing powers of the two monies and it is expressed in domestic currency per unit of foreign currency.

Four conditions should be satisfied so that this parity ratio, E^{PPP}, exactly equals the actually quoted spot exchange rate, E:

a) No tariffs or other barriers to trade exist.

b) All goods are perfectly tradeable with zero transportation costs.

c) Within each commodity category in the above equation, the domestic and foreign goods are perfectly homogeneous.

d) The price indices used are the same for both countries, i.e.,

$$c_i = d_i, \quad \text{where } i = 1,2,\ldots,n \tag{2.4}$$

If the first three conditions hold, then the law of one price holds, which implies that perfect commodity arbitrage occurs. According to the previous notation

$$P_t^i = E.FP_t^i \text{ for all } i = 1,2,\ldots,n \tag{2.5}$$

But even when the law of one price holds, nothing guarantees that $E^{PPP} = E$ unless $c_i = d_i$. Therefore, in order to obtain the absolute version of P.P.P., these four strong conditions should hold. This is apparent if one substitutes equations (2.4) and (2.5) into (2.3). These conditions are rather extreme to hold in the short run. Commodity arbitrage among tradeable goods is more likely to hold in the long run.

2.2.2 RELATIVE PURCHASING POWER PARITY[4]

The law of one price in international commodity arbitrage is a strong condition. It forces the relative prices of goods in one country to be the same as those in another country in situations of bilateral comparisons. Thus, what commodity will be chosen to calculate the parity exchange rate is not important. One could write,

for instance, $E = \dfrac{P_t^k}{FP_t^k} = E^{PPP}$, where k can be any single commodity.

Suppose the law of one price is relaxed. Then a measure of commodity purchasing power of money is necessary in each country. Usually, national price

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[4] The relationship between absolute and relative P.P.P. is explained in detail in Officer (1978).

indices of traded goods are used. A price index for tradeable goods should be calculated with equal commodity weights ($c_i = d_i$) across countries. Often each country will publish a domestic consumer price index, a gross national product deflator, a wholesale price index and an export price index. Although international statistical conventions may be such that these indices obey the same classification schemes among countries (e.g., the wholesale price index usually includes agricultural commodities, manufactured goods and industrial materials, and excludes services), the problem of different weights remains.

Another problem is that price indices are always calculated relative to some base year. They cannot, therefore, be used directly, according to equations (2.1) and (2.2), to get the absolute purchasing powers of currencies. Those who use national price indices adopt the following convention:

Let $$PI_1 = \frac{\sum_{i=1}^{n} c_i P_1^i}{\sum_{i=1}^{n} c_i P_0^i}$$

where PI_1 is the domestic price index at time one relative to time zero and

$$FPI_1 = \frac{\sum_{i=1}^{n} d_i \ FP_1^i}{\sum_{i=1}^{n} d_i \ FP_0^i}$$

where FPI_1 is the foreign price index at time one relative to time zero. Even when $c_i = d_i$, the ratio $\frac{PI_1}{FPI_1}$ will not be equal to the absolute P.P.P. exchange rate. For this to be the case, the absolute P.P.P. must hold in the base period (time zero)

$$E_0 = \frac{\sum_{i=1}^{n} c_i P_0^i}{\sum_{i=1}^{n} d_i \ FP_0^i} = E_0^{PPP}$$

where E_0 is the actual exchange at time zero and E_0^{PPP} is the P.P.P. exchange rate at time zero. If $E_0 = E_0^{PPP}$, one can use the actual exchange rate, E_0, and knowledge of subsequent movements in the countries' price indices to compute the relative version of P.P.P., E^{PPP}.

According to the notation previously used,

$$E^{PPP} = \frac{PI_1}{FPI_1} \cdot E_0$$

This is the definition of the relative P.P.P.

In practice, the condition that the exchange rate should be in equilibrium in the base period can be approximated by selecting a stable base year, or a period of time over which the ratio of $\frac{PI}{FPI}$ does not move a great deal.

2.3 RECENT TRENDS IN THE PURCHASING POWER PARITY LITERATURE

A revived interest for the literature of P.P.P. has emerged during the last decade after the collapse of Bretton Woods (1973) and the return of major currencies to a floating regime[5]. Three basic trends are apparent in the recent literature. First is the improvement of existing and the use of new indices, since more data are available. Second, most of the recent articles address directly the question of policy or at least have policy implications. Third, P.P.P. theory has been improved in the sense that dynamic structures have been used.

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[5] Some reasons for the re-emergence of P.P.P. theory in the 1970s are given in Katseli (1979).

2.3.1 PRICE INDICES AND EFFECTIVE EXCHANGE RATES

The problem of choosing the appropriate price index still remains a fundamental one in recent literature. Apart from the question of the choice of base and terminal years, the question of whether to rely on bilateral or multilateral currency relationships has emerged.

In June 1977, the Ford Foundation, in collaboration with the Central Bank of Greece, sponsored a two-day conference on P.P.P. The papers presented there were published by the Journal of International Economics in May 1978. They cover a wide area related to exchange rates and prices. The choice of the appropriate index is addressed in most of these papers.

Frenkel (1978) presents two views. According to the first, only prices of traded goods should be included. Domestic commodity prices are secondary. The second view is that P.P.P. refers to the internal value of the currencies and variations in this value can be measured by general indices reflecting all goods marketed in the country. Those who support the view that only traded goods should be included stress the importance of commodity arbitrage as the mechanism which dominates the relationship between exchange rate and price. Those who support the broader price index stress the importance of equilibrium in the asset markets, as the major mechanism of the relationship between the exchange rate and price.

Proponents of commodity arbitrage argue that only individual commodity prices should be analyzed, and thus no aggregate price index is relevant. Proponents of the asset market approach claim that this approach takes for granted that commodity arbitrage equates traded goods prices, and thus P.P.P. applied only to traded goods becomes a truism. Consequently, proponents of the asset market approach reject the use of a wholesale price index since it gives an excessive weight to traded goods. They claim that even when traded goods prices have been equalized by commodity arbitrage, the exchange rate will still be in disequilibrium because it coordinates purchasing powers of monies in terms of the broad definition of price levels.

According to Kravis and Lipsey (1978), there are three measures appropriate for comparing price level changes The GDP implicit deflator, the wholesale price index and the consumer price index. GDP deflators are the best since they are a general measure of a country's price level. Wholesale price indices have been used extensively but they are biased towards uniformity of price movements. They include a higher proportion of tradeables than the implicit deflators. They often overweight primary products and completely omit highly differentiated products. Consumer price indices are not subjected to these deficiencies, but they provide partial measures of price level adjustments because private consumption is usually only a proportion of GDP.

If emphasis is on money demand, as the monetary approach would suggest, consumer price indices should be used, especially when one is concerned with households. But even the GDP implicit deflators could be used since they have the advantage of taking at least some account of the non-household holders of money.

Regarding the choice among price indices Thygesen (1978) presents four main candidates: indices of export prices, wholesale prices, unit labour costs and consumer prices. The export price indices would be expected to bias the results very strongly in favour of parallel price trends in various countries, when measured with a common numeraire. Parallel export prices cannot constitute evidence in favour of P.P.P. but merely of efficient arbitrage in international commodity markets, i.e., the law of one price. At the statistical level, tnis index is a unit-value rather than a genuine price index and it leaves out completely prices of import-competing goods. At the theoretical level, observation of the law of one price conveys little information about equilibrium in the long-run sense.

The defects of export price indices could be avoided by using unit labour cost indices. Information on P.P.P. as an equilibrium relationship would be more consistent if one could combine data for hourly wages and output per man-hour. However, there are both statistical and theoretical problems with their use. The quality of available statistics is suspect. Indirect labour costs such as payroll taxes and unemployment insurance are largely excluded. For some countries unit labour cost data do not exist at all, while for others they are not published nationally. At the theoretical level, it would be desirable to have information on total factor costs and productivity rather on just the major factor of production.

Brillembourg (1977) attempts to give evidence that a country with an overvalued currency will tend to have a balance of payments deficit. He constructed a relative price index (RPI) that is used to judge the relative overvaluation or undervaluation for 14 industrialized countries for the period 1963-74. His paper considers the question of what is the best proxy for RPI.

If the exchange rate is freely floating one might be able to test for the appropriate RPI by comparing it with the exchange rate which, by definition, equals the equilibrium rate. He performs this test on its dual, which is the balance of payments. Using the wholesale (WPI) and consumer price index (CPI), the following four types of RPIs are constructed:

$$\frac{\text{Domestic CPI}}{\text{Foreign CPI}}, \quad \frac{\text{Domestic CPI}}{\text{Foreign WPI}}, \quad \frac{\text{Domestic WPI}}{\text{Foreign CPI}} \text{ and } \frac{\text{Domestic WPI}}{\text{Foreign WPI}}$$

The foreign price index is not the index of only one country, but a weighted average of many countries' price indices. He uses only two weighting schemes: trade and income weights. Combining the two sets of weights, with the four combinations of CPI and WPI, 8 RPI measures are constructed. These measures are related to the balance of payments. He finds that the results are sensitive to the measure of RPI.

Brillembourg's constructions of RPIs has to do with the notion of effective exchange rate. Officer (1976) suggests that the selection of a standard country requires reexamination. If a unique standard country is to be used in the computation of P.P.P. for a broad group of countries, then the usual choice of the U.S. seems justified. For individual country analysis, however, the optimal standard country would be the one with which the former country's trade and payments links are the strongest. This reasoning suggests that the concept of effective exchange rate be applied to P.P.P. Thus, the standard currency is replaced by an appropriate weighted average of the currencies of the country's main partners in trade and payments.

Rhomberg (1976) examines considerations relevant to the construction of effective exchange rates and compares effective exchange rates constructed by various organizations for various countries. Effective rates have been constructed by the US Treasury, the US Federal Reserve, the IMF (multilateral exchange rate model, or MERM), the UK Treasury and the OECD. The most comprehensive indices are those of the IMF which cover 21 countries. The proper choice of weights for an index of the effective exchange rate depends on its purpose. The use of trade weighted indices is especially inappropriate for primary producing countries. For such countries a separate methodology is developed by Belanger (1976). The Fund's MERM is extended to primary producing countries. As primary commodities are relatively homogeneous, income weighted indices are more reliable indicators of the effect of exchange rates on export receipts, for the primary producing countries. Trade weighted indices are more appropriate for industrial countries that have exports which are more differentiated, and hence less substitutable for similar products of a different origin.

Officer (1980) tests the predictive power of the theory over long time periods spanning the pre-world War I gold standard to the managed float regime of the 1970s. The GDP deflator as the price measure and the effective exchange rate concept are used[6]. The predictive power of the P.P.P. hypothesis rather than its fundamental assumption that monetary changes dominate real wages in the domestic and foreign economies between the base and the current periods is tested. In the base

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6 In view of non-uniform availability of GDP deflators among countries over time, several base periods and associated country samples are used. All samples share the same current period (1975) and intervening period (1966). Intervening periods are similar to the current period in the sense that effective exchange rates and relative prices are computed and compared, thus testing P.P.P. theory. In order to maximize country coverage given data availability, three alternative base periods are selected: 1879, 1905 and 1913.

period exchange rate and relative price are equal. A comparative static test of the theory is devised by comparing how far from the ideal condition of the base period are P.P.P. computations. The main findings are that in multilateral computations, the average forecast error of the theory is in the order of 5-10 per cent for 1966, as the terminating period, and 15-25 percent for 1976 in that role. Considering bilateral computations and a longer time span (over a century) the average forecast error is in the order of 10 per cent and 1-4 per cent for the 1966 and 1975 periods, respectively. Officer accepted the hypothesis that deviations from P.P.P. follow a normal distribution. These deviations could be explained in terms of structural changes in the economies.

The choice between bilateral and effective exchange rates in econometric tests of P.P.P. can affect the results. In the Optimum Currency Area (OPTICA) report, for instance, "conformity to P.P.P. is considerably closer multilaterally than bilaterally." (Thygesen, 1978, p. 306).

2.3.2 POLICY CONSIDERATIONS

The diversity of topics covered in the literature of P.P.P. indicates the central role of P.P.P. in relation to exchange rate problems. They share the common focus of exchange rates and relative prices on their role in the macroeconomic adjustment process. The papers discussed in this section will make clear that P.P.P. has moved from a narrow assertion about the behaviour of prices and exchange rates, to policy oriented questions of intervention strategies and formation of currency blocks.

Dornbusch (1976a) develops three views for the determination of exchange rates and their interaction with macroeconomic equilibrium and aggregate policies. First, a long-run view characterizes exchange rate determination in terms of monetary and real factors which concern relative price structures. Second, there is a "liquidity" or short-run view which emphasizes the role of asset market equilibrium and expectations. Third, there is a policy view which indicates that in the short run nominal disturbances will tend to be transmitted internationally. This latter view analyzes the effectiveness of aggregate policies. A critical ingredient of the

Dornbusch approach is the P.P.P. theory in the narrow sense of goods arbitrage for traded goods. He showed that a flexible rate system is expected to exhibit a lack of homogeneity in the short run. If prices are sticky, monetary changes as much as foreign price disturbances will be transmitted internationally and will destroy the insulating properties of a flexible rate system.

P.P.P. is relevant under both fixed and flexible rates. This is the message in Genberg's paper (1978), which attempted to compare P.P.P. calculations under both regimes. P.P.P. in this context is used as an explanation of both the international transmission of inflation and of movements in a freely floating exchange rate. He concludes that P.P.P. is mainly a long-run phenomenon. In the short run the deviations are smaller and less prolonged under a fixed exchange rate regime.

Two papers presented at the conference on P.P.P. in Athens (1977) are concerned with the role of P.P.P. as a policy guide within the E.E.C. The paper presented by Thygesen (1978) is a summary of the so-called OPTICA report sponsored by the Commission of the European Communities. It is argued that changes in the exchange rates of the European Community member currencies during the period between the early 1960s and the mid-1970s predominantly reflect inflation differentials. In reviewing observed exchange rate developments, the characterization given by Krugman and Dornbusch (1976), that P.P.P. is the focal point of any longer run analysis of the exchange rate, is confirmed. The results are extremely good when wholesale price indices are used to express national inflation rates and P.P.P. is measured in terms of effective exchange rates. These results justify a P.P.P.-based intervention rule as the main criterion for managing the individually or jointly floating European currencies. What the OPTICA report claims is that a P.P.P. rule for adjusting effective rates for European currencies is sufficiently close to a long-run equilibrium to prevent major distortions and is also useful in preventing a repetition of the sudden movements of the actual exchange rates in the mid-1970s.

The paper presented by Vaubel (1978) stresses the role of P.P.P. in the context of optimum currency areas. An operational criterion of the desirability of currency unification is the deviation from relative P.P.P. The criterion is applied to the European Community in 1959-76 and in various subperiods, and the CPI is used. It is shown that the community is a less desirable currency area than other comparable existing currency unions, like the US and Germany. It is possible, however, using P.P.P. as a guide, to identify the member countries which are the most suitable candidates for currency unification.

Until Neihans' (1980) "Dynamic Purchasing Power as a Monetary Rule," the P.P.P. literature used the assumption that the only instrument of monetary policy is the buying and selling of foreign exchange against domestic money. Thus, only the money supply could be varied, and the OPTICA report follows this tradition. But Niehans suggests that "this may be unsatisfactory and that the real problem is the appropriate combination of different policy instruments." (p. 228)

His main contribution is that he introduces the ratio between foreign exchange reserves and domestic securities in the central bank, as another policy instrument. If this ratio is positive the central bank can increase its foreign exchange holdings at the expense of the domestic portfolio, without changing the money supply. The objective, therefore, of a P.P.P.-rule can be attained not by controlling the money supply, but by changing the composition of a constant monetary base. But shifts between foreign and domestic securities are not sufficient to neutralize foreign disturbances. Thus, the problem remains. The satisfactory insulation of the domestic economy against foreign disturbances requires not only variations in the money supply through foreign exchange purchases but a more complex policy. Thus, he concludes we have returned to the familiar Mundell-Fleming problem of selecting the appropriate combination of different policy instruments.

P.P.P. as a feasible policy has been used in an extension of a medium term simulation of the Link system (1980-1990) presented in the 1980 Nobel Lecture[7]. In that lecture a particular simplifying assumption was to treat the exchange rates as exogenous variables and fixed at their 1981 values for the remainder of the decade. L.R. Klein, S. Fardoust and V. Filatov (1981) realized that this assumption is inappropriate for a simulation study aiming at investigating equilibrium properties of a system. The original simulation model is modified by introducing the principle of P.P.P. for treating exchange rates as endogenous variables.

P.P.P. is used in this context to give answers to two questions: first, if it performs

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[7] Klein (1980).

equilibrating functions, and second, if the doctrine of P.P.P. is interesting in its own right as a rule for determining exchange rates in an international model. The results indicate that P.P.P. does not do wonders for the world economy but that it does constitute a convergent dynamic process. Furthermore, it can be used successfully to hold down inflation in the Euro-Link OECD countries that appreciate their currencies relative to the dollar. The endogeneity of the exchange rate in the medium-term projection does not provide firm ground for estimating year by year exchange rate movements. It gives, however, a basis for using P.P.P. as a feasible process that does not upset the stability of the solution in the context of a world model. It is applicable in examining long-run exchange rate movements.

The usefulness of P.P.P. as a policy guide is recognized in Frenkel (1981a), though his empirical findings do not support the theory. The differential speed of adjustment between commodity and asset prices was the most important reason for explaining deviations from P.P.P. during the 1970s. Given the deviations from P.P.P., Frenkel questions what is left for policy purposes. He concludes that as a policy instrument it provides a guide useful for the general trend of exchange rates, particularly when the origins underlying the trend are monetary. In the context of macroeconomic policy it is an important reminder that policies affecting the trend of domestic relative to foreign prices affect the exchange rate in a similar way.

Niehans (1981) goes a step further and shows that even in the case of purely monetary disturbances, there is no reason for the equilibrium exchange rate to correspond to P.P.P., as long as P.P.P. is not corrected for the bias due to the particular type of monetary policy. He proves that the creation of money through purchases of foreign exchange results in an over-valuation of the currency relative to P.P.P., while an increase in domestic debt at a given money supply results in an under-valuation. These results apply to full equilibrium. Only if the increase in debts as a percentage of total domestic assets of the private sector equals the percentage increase in money supply will the exchange rate correspond to P.P.P. In this case the foreign exchange component of the central bank's assets will increase in the same proportion to the domestic component <u>via</u> the increase of the exchange rate.

2.3.3 DYNAMICS AND LAG STRUCTURE

A test for P.P.P. is to calculate a time series of relative P.P.P. during a period when the exchange rate is floating and then compare it with the corresponding time series of the actual floating rate. This procedure was very common in the early tests of P.P.P. theory when floating exchange rate regimes were examined. However, recent studies recognize that there is no need for the relationship to be simultaneous. Allowance for lags is consistent with the theory and improves its explanatory power, if the lags are distributed over time. Despite the extensive research that followed Cassel's original formulation, dynamic considerations were explicitly considered only in the 1970s.

In 1973, Thomas examined an adaptive expectations model that relates expected to actual P.P.P. He presents the following model:

$$E_t = aP_t + \gamma P_t^E$$

$$P_t^E - P_{t-1}^E = b(P_t - P_{t-1}^E)$$

P and P^E stand for the current and expected P.P.P. (ratio of domestic to foreign WPIs) respectively, and the subscript t-1 denotes a one month lag. The current P.P.P. determines the trade balance but the expected P.P.P. represents speculative capital flows. Eleven countries and monthly data for the period 1920-24 are considered. The estimated b came close to zero, indicating a low elasticity of expectations, which is a favourable result for the validity of P.P.P.

Two years later, Hodgson and Phelps (1975) offered evidence on the short-run characteristics of P.P.P. The usual P.P.P. testing in a static form is performed according to the following equation:

$$\ell n\ E_t = a_0 + a_1\ \ell n\ P_t + u_t$$

P_t stands for the ratio of the domestic to foreign price level at time t. a_1 is expected to be positive. P.P.P. will be valid if a_1 is close to unity and the constant term close to zero. A long time is required for forces of adjustment to verify the equation, and the authors take into account that the relation between P.P.P. and the exchange rate is distributed over time. To introduce distributed-lag effects, Hodgson and Phelps employed the following variants of the Rational Distributed-Lag model:

$$\ln E_t = a_0 + a_1 \ln P_t + a_2 \ln E_{t-1} + u_t$$

$$\ln E_t = a_0 + a_1 \ln P_t + a_2 \ln E_{t-1} + a_3 \ln E_{t-2} + u_t$$

Both models are fitted to 14 countries that had used floating rates in the period 1919-1925. In both models movements in P.P.P. explain more than 90 per cent of the movements in exchange rates and the average lag is less than six months for the majority of the countries.

In early studies of P.P.P. theory no distinction between short run and long run was made. Frenkel (1978) emphasizes this distinction. He assumes a long-run P.P.P. relationship. The long-run exchange rate (E^*) is treated as a function of relative prices:

$$\ln E^* = a + b \ln P_t/FP_t$$

A short-run partial adjustment process by which the percentage rate of change of the exchange rate is proportional to the logarithm of the ratio of the long-run value to the actual exchange rate is then considered:

$$\ln E_t - \ln E_{t-1} = \gamma(\ln E_t^* - \ln E_{t-1})$$

Combining the two equations and adding an error term, Frenkel estimates the equation:

$$\ln E_t = a\gamma + b\gamma \ln(P_t/FP_t) + (1-\gamma)\ln E_{t-1} + u_t$$

The long-run elasticity b turns out to be close to unity. The short-run elasticities vary across the exchange rates with the choice of price indices, implying that the speeds of adjustment differ among various price indices.

Transmission lags are quite important. Genberg (1978) suggests that, even in the case of monetary or neutral disturbances, the long run equilibrium real exchange rate might deviate from P.P.P. if the balance of payments is affected by monetary policy rather fast, while the price level is subjected to longer lags. Alternatively, the long-run equilibrium real exchange rate might be close to P.P.P. even in the case of real shocks if these are quickly transmitted across countries and affect the economies symmetrically.

The important issue is not whether P.P.P. holds, but the speed with which it works. The transmission of monetary disturbances between countries is the fastest, taking one to two quarters. The arbitrage mechanism is much slower: empirical evidence suggests that it may take a year. Short-run variations in exchange rates under a floating exchange rate regime do not get offset by movements in relative price levels. However, P.P.P. is a long-run phenomenon. If a simple adjustment for structural changes is allowed, actual rates will come closer to P.P.P. values. Therefore, Genberg concludes, more detailed time series evidence on P.P.P. may be helpful in determining exchange rate levels in the short run, by pointing to empirical regularities which have to be explained by theory.

Niehans (1980) also considers P.P.P. in a dynamic framework. He is concerned with deviations from P.P.P. that may appear during the adjustment process. A temporary overshooting of the exchange rate relative to P.P.P. will have serious consequences for the economies concerned. He writes:

> "After laying dormant for half a century (overshooting was already observed by Cassel), this insight has recently been revived. Model building has finally caught up with intuition. This may fairly be regarded as the most important, if still limited contribution of recent economic theory to the understanding of floating exchange rates." (p. 215)

Niehans assumes that prices satisfy the quantity theory but with a lag. Money supply, in his model, reaches its full effect on prices only after three periods and the initial effect may be negligible. For the home country this is expressed by:

$$P_t = a_0 m_t + a_1 m_{t-1} + a_2 m_{t-2} \qquad (2.6)$$

where P and m are the percentage change of the price level and of the money supply, respectively.

The following conditions are imposed:

$$a_0 + a_1 + a_2 = 1, \quad a_i > 0, \text{ for } i = 0,1,2,\ldots,n$$
$$\text{and } a_0 < a_1 < a_2$$

Time t is measured in units of about four to eight months.

A similar equation can be written for the foreign country (as indicated by bars over the variables):

$$\bar{P}_t = a_0 \bar{m}_t + a_1 \bar{m}_{t-1} + a_2 \bar{m}_{t-2} \qquad (2.7)$$

In the long run the exchange rate is proportional to the ratio of the two money supplies, but the adjustment takes time. Thus, the percentage change in the exchange rate can be written as:

$$E_t = b_0(m_t - \overline{m}_t) + b_1(m_{t-1} - \overline{m}_{t-1})$$

$$+ b_2(m_{t-2} - \overline{m}_{t-2}) + \gamma(\varepsilon_t - \varepsilon_{t-1}) \quad (2.8)$$

The time profile of a's and b's is quite different. While a_0 and perhaps a_1 are expected to be close to zero, the exchange rate will first overshoot its new equilibrium value and then approach the latter faster than prices. This characteristic imposes the following restrictions:

$b_0 + b_1 + b_2 = 1$, $b_0 > 1$, $b_1 < 0$, and b_2 small.

The term $\varepsilon_t - \varepsilon_{t-1}$ captures the effect of expectations about the future trend of money supply. The expectational effect reinforces the overshooting produced by $\overline{m}$.

According to the P.P.P. rule the domestic rate of monetary expansion will be $P_t - \overline{P}_t - E_t = 0$. Given this condition, Niehans solves equations (2.6), (2.7), and (2.8) for the required rate of monetary expansion in terms of past domestic expansion rates, past and present foreign expansion rates, and changes in expectations:

$$m_t = \bar{m}_t + c(\bar{m}_{t-1} - m_{t-1}) - (1 + c)(\bar{m}_{t-2} - m_{t-2})$$

$$+ \frac{\gamma}{a_0 - b_0}(\varepsilon_t - \varepsilon_{t-1}).$$

Once the path of domestic money supply is known, (2.6) and (2.8) can be used to calculate the paths of prices and exchange rates.

Dornbusch's article (1976b) is now considered a classic in the area of exchange rate dynamics. The importance of it is reinforced by the observed large fluctuations in exchange rates. Two assumptions are basically used to explain the volatility of the exchange rates. The first is that the goods market adjusts relatively more slowly than the asset market, and the second is that an initial overshooting occurs as a result of the differential speed of the two markets. In addition, perfect capital mobility and consistent expectations are assumed.

A formal expression for the short-run effect of a monetary expansion on the spot rate is obtained by the money market equation and confirms that in the short run the exchange rate will overshoot. Dornbusch extends the model to replace the assumption of consistent with rational expectations and the assumption of fixed with variable output.

The Dornbusch model has been tested by Bilson (1978), who provides suggestive evidence about the appropriateness of this model for the Deutsch Mark/pound rate. The relative rate of inflation is related to the deviation from P.P.P.

$$Dp_t = 0.020\ (E_{t-1} - p_{t-1}) + .291\ Dp_{t-1} + u_t$$

$$R^2\ (\text{adj}) = .2109; \quad SE = .0067; \quad D.W. = 2.046$$

where D denotes the difference operator and $p = \ell n\ P/FP$. The estimates support the view that prices gradually adjust to exchange rates. It takes 12 months to complete one quarter of the necessary adjustment of prices to an exchange rate change and 27 months to complete one half of the adjustment. Bilson then compared his model with an equilibrium rational expectations version of the monetary approach. His results are in favour of the Dornbsuch model.

Frankel (1979) also extends the Dornbsuch model by incorporating secular inflation rates and tests it against the actual movements of the Deutsch Mark/dollar rate. The model is in accordance with the assumption of sticky prices in goods markets which creates a difference between short-run and long-run effects. The domestic economy is assumed highly liquid when the nominal interest rate is low relative to the expected inflation rate. A capital inflow causes the exchange rate to depreciate until there are sufficient expectations of future appreciation to offset the low interest rate. The overshooting of the exchange rate will be proportional to the real interest differential.

The P.P.P. as an _a priori_ constraint on the reduced form parameters is tested by Driskill (1981). Dornbsuch's model is tested with Swiss-U.S. data for the period 1973-79. Driskill finds that following a monetary shock there is short-run exchange rate overshooting by a factor of about two, and that subsequent exchange rate adjustments to a new long-run equilibrium take longer than two years and exhibit nonmonotonic patterns. His results satisfy P.P.P. as an _a priori_ constraint on the reduced form parameters, but other _a priori_ constraints embedded in Dornbusch's model are rejected. There is, however, empirical verification of the overshooting hypothesis as used by Dornbusch.

Attempts by Dornbusch (1980) and Frankel (1982) to use the monetary approach to explain movements in the mark/dollar exchange rate after February 1978, however, have been unsuccessful, showing insignificant coefficients and a reverse sign on the relative money supply coefficient. Frankel (1983), interprets that as an evidence of the collapse of the explanatory power of the monetary model.

In a recent paper Papell (1983) develops a model based on Dornbusch (1976b) but incorporating the assumption that money supply is endogenous. He considers the effect of an activist monetary policy on the exchange rate overshooting. His main theoretical result is that accommodative monetary policy (with respect to prices) can cause the economy to switch from exchange rate overshooting to undershooting.

The only two-country model from the theoretical point of view is the extension of the Dornbusch model by Bhandari (1981). He shows that the result of overshooting is not a necessary feature of the asset approach to exchange rate determination because of the endogeneity of the rest of the world variables. We proceed in the following chapters with an extension of the Dornbusch model to a two-country world. Our model is different than Bhandari's because it is a variable output model. On the empirical side there is no other paper that deals with P.P.P. in a two-country world.

2.4 CONCLUSIONS

Recent trends in the literature were classified under three headings: index number problems and the evolution of the effective exchange rate literature; policy considerations; and the dynamic formulations of P.P.P. theory.

The problem of the choice of the appropriate price index is apparent. Emphasis has shifted to the use of effective exchange rates for multilateral comparisons. P.P.P. has been used to address policy considerations in a national and international context. Despite the many limitations of the theory it is extensively used as a policy guide in the recent literature.

The dynamic formulation of the theory is a very recent phenomenon. Various lag structures have been used. There is mixed evidence concerning the time required for convergence to the long-run exchange rate.

Dornbusch's article (1976b) falls in the category of dynamic P.P.P. studies. It is one of the first to attempt theoretically to explain deviations from P.P.P. during the 1970s, using the slow adjustment of prices relative to exchange rates. This is in accordance with the monetary approach to the balance of payments which accepts the differential adjustment speeds with which markets clear. The overshooting of the exchange rate has significant consequences for the theory.

Some empirical tests seem to be in accordance with the Dornbusch model. However, these tests give only limited support to the model. An extension of it that will bring it closer to P.P.P. theory and time series testing for many countries should follow. Wider empirical application will give a firmer ground for acceptance or rejection of the theory.

CHAPTER 3

THE THEORETICAL FRAMEWORK

3.1 INTRODUCTION

The aim of this chapter is to present the theoretical framework within which subsequent empirical results will be derived. First, some of the basic assumptions are outlined and the notion of overshooting is discussed. Further assumptions are then introduced as we proceed with the specification of the model which is given in the third section of the chapter. Finally, the reduced form of the model is given, in discrete and stochastic form. P.P.P. is derived as an *a priori* constraint on the reduced form parameters.

3.2 THE NOTION OF OVERSHOOTING

It is by now well established that exchange rates exhibit greater fluctuations than relative prices. During the 1970s real exchange rate variability, or deviations from purchasing power parity, characterized most economies. The overshooting hypothesis, as exemplified by Dornbusch (1976b), was an attempt to explain this pattern of variability.

The model presented here is an extension of Dornbusch. The objective is to test whether purchasing power parity holds in the long run despite the wide fluctuations of the exchange rates in most major countries.

An assumption that is universally employed by the authors who have attempted to test the Dornbusch model is the "small country" assumption[1]. Under this assumption the country is small in the goods import markets and in the securities market. Consequently, the world price of importables and the world yields on international securities are considered given. On the other hand, a large open economy can affect the world variables and hence, the world price of importables and the world yield on international securities are considered endogenous. The large country framework is more appropriate for describing trade between countries of equal economic size, such as many of the European countries.

Existing models tend to give too much emphasis

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1 On the theoretical level, the only two-country model that is within the "asset-market view of exchange rate determination" is that of Bhandari (1981). On the empirical level there is no work based on a two-country model.

to money supply disturbances neglecting shifts in money demand, fiscal and demand disturbances which, of course, are as important as money supply changes. The neglect of demand and fiscal variables in empirical work is, in fact, quite universal. An attempt is made here to include some fiscal variables (e.g., government spending) as determinants of the endogenous variables. Output also varies in this model, affecting money demand, whereas in other models only the fixed output version has been tested.

The assumption of perfect capital mobility is maintained to make things comparable to the rest of the literature. Dornbusch's extended variable output model is tested. An expected inflation term is also added. The main idea is that if there is an exogenous shock (an unanticipated increase in domestic money supply) at time t, the exchange rate will depreciate initially, but during the adjustment process it will appreciate monotonically until it reaches the new equilibrium value at time t + 1. In the same period the domestic price level will increase gradually, since the goods markets adjust more slowly than the money markets, until it reaches the new equilibrium value. At time t + 1, P.P.P. holds.

Domestic and foreign interest rates are allowed to be different in the short run, though perfect capital mobility has been assumed. The older macroeconomic literature ignored the continuous transitional movement in the exchange rate that allows temporary interest differentials to develop and was implicitly confined to describing the new equilibrium at the end of the period when the domestic and foreign interest rates are again equal.

The deviation of the spot exchange rate from the long-run P.P.P. rate during the adjustment process is reflected in the interest rate differential, as determined by interest rate parity.

Even if individual agents cannot observe what money supply changes have occurred or will occur, they can see derivative movements in interest rates and exchange rates. Thus, it does not seem farfetcned to model their behaviour as if they focused their expectations with greater or lesser confidence on what the future money supply will be, with known consequences for the interest and exchange rate. In other words, private expectations are rational in focusing on the supply of (or demand for) domestic money that really does drive nominal interest and exchange rates in the short run.

If the increase of the exchange rate is greater than the initial increase of money supply, then overshooting has occurred. Overshooting occurs in the sense that the immediate effect of a monetary expansion on the exchange rate is greater than the ultimate effect. Overshooting, however, is not necessary as long as real income is allowed to vary when it is different from full employment income. This result differs from Driskill (1981) and Lafrance and Racette (1982), who have tested the fixed income version of the Dornbsuch model. They allow aggregate demand to be different from real income, which is assumed fixed. For our purposes, aggregate demand equals real income but real income is different from full employment income. The new possibility arises because, in the short run, an income expansion raises money demand and may do so sufficiently to actually increase interest rates.

3.3 SPECIFICATION OF THE MODEL

Assume two countries, A and B. Each produces a single final commodity. All considerations of intermediate products, capital formation and the labour market are deliberately suppressed. The model contains a description of the commodity and money markets in each country and the specification of covered interest arbitrage. The bond market is omitted in consequence of Walras' Law. The money markets clear first but the goods markets adjust slowly and the prices respond over time to continuing disequilibrium in the goods markets. Other simplifying assumptions will be introduced in the process of analysis.

The domestic economy, A, produces a single homogeneous good, and has real aggregate demand AD. Product market equilibrium in which real domestic demand equals real output (Y^A) for country A can be written as[2]:

$$Y^A = AD^A = C^A + I^A + G^A + X^A - IM^A \cdot \frac{EP^B}{P^A} \tag{3.1}$$

Total consumption depends on real disposable income.

$$C^A = C(Y^A); \qquad C_{Y^A} > 0 \tag{3.1a}$$

[2] The superscripts A and B refer to countries A and B. In all cases A corresponds to the domestic and B to the foreign country.

where C_{Y^A} stands for the first derivative of C with respect to Y^A. For simplicity, and following the practice elsewhere in the literature, the relations between disposable and real income and between disposable income and taxes are assumed constant over the sample period.

Investment is a function of real income and the real interest rate, ρ^A

$$I^A = I(Y^A, \rho^A); \quad I_{Y^A} > 0, \quad I_{\rho^A} < 0 \quad (3.1b)$$

Government expenditure, G, can be thought of as an exogenous policy variable.

Finally, the term $X^A - IM^A \cdot EP^B/P^A$ is the difference between exports from and imports into country A, and is a function of real domestic and foreign income and the terms of trade. Foreign income enters the domestic equation because we are concerned with a large country model. Thus,

$$X^A - IM^A \frac{EP^B}{P^A} = X(Y^A, Y^B, T); \quad (3.1c)$$

$$X_{Y^A} < 0, \quad X_{Y^B} > 0, \quad X_T > 0$$

where $T = EP^B/P^A$ stands for the terms of trade. The exchange rate, E, is measured as the domestic currency price of foreign exchange and P^B and P^A stand for the foreign and domestic prices, respectively.

Now, equation (3.1) can be written as

$$Y^A = AD^A = Y^A\left(\frac{EP^B}{P^A},\ Y^A,\ Y^B,\ \rho^A\right) + G^A \qquad (3.2)$$

It is assumed that the terms of trade, domestic income and foreign income affect aggregate demand positively[3], while the real interest rate affects it negatively.

The same analysis applies for country B:

$$Y^B = AD^B = Y^B\left(\frac{P^A}{EP^B},\ Y^B,\ Y^A,\ \rho^B\right) + G^B \qquad (3.3)$$

Given that the income-adjustment mechanism is stable (see footnote 3), one can solve (3.2) for Y^A and

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[3] The terms of trade and the foreign income affect domestic aggregate demand positively. However, though Y^A affects aggregate demand positively through consumption and negatively through imports, it is assumed its ultimate effect on AD is positive. This is the usual macroeconomic assumption because of the stability of the income-adjustment mechanism. Though this stability condition is easily obtained for a small country model, it is more complicated for a two-country model. Details for the stability conditions of the income-adjustment mechanism in a two-country framework are given in Appendix 3A.

(3.3) for Y^B and get

$$Y^A = Y_1^A\left(\frac{EP^B}{P^A}, Y^B, \rho^A\right) + G^A \tag{3.4a}$$

$$Y^B = Y_1^B\left(\frac{P^A}{EP^B}, Y^A, \rho^B\right) + G^B \tag{3.4b}$$

In what follows, the log-linear functional form is used. With the exception of interest rates, all variables are expressed in natural logarithms. This has the advantage of allowing straightforward linearization of equations (3.4a) and (3.4b). The model is written in discrete stochastic form. Lower case letters stand for logarithms of variables except for the interest rate variables and the subscript t indicates time.

Equations (3.4a) and (3.4b) are written as:

$$y_t^A = b_0 + b_1(e_t + p_t^B - p_t^A) - b_2\rho_t^A + b_3'y_t^B$$

$$+ g_t^A + w_t \tag{3.5a}$$

$$y_t^B = b_0' + b_1'(p_t^A - p_t^B - e_t) - b_2' \rho_t^B$$

$$+ b_3 y_t^A + g_t^B + w_t' \tag{3.5b}$$

where w and w' reflect stochastic shifts in aggregate demands. They are assumed to be independent, serially uncorrelated random shocks with zero means and constant (finite) variances.

All coefficients are assumed positive. The coefficients b_0 and b_0' are autonomous components of expenditures in the two countries. The fraction expended by the domestic country on foreign goods is b_3, and b_3' is the analogous fraction for the foreign country. The fractions b_3 and b_3' of aggregate demand in the two countries apply to the home goods of their trading partners.

Next, equation (3.5b) is substituted into (3.5a), and (3.5a) into (3.5b). The resulting equations are:

$$y_t^A = a_0 + a_1(e_t + p_t^B - p_t^A) - a_2\rho_t^A - a_3\rho_t^B$$

$$+ a_4 g_t^A + a_5 g_t^B + a_6 w_t + a_7 w_t' \tag{3.6a}$$

$$y_t^B = a_0' + a_1'(p_t^A - p_t^B - e_t) - a_2'\rho_t^B - a_3'\rho_t^A$$

$$+ a_4'g_t^B + a_5'g_t^A + a_6'w_t' + a_7'w_t \qquad (3.6b)$$

In terms of the structural coefficients of (3.5a) and (3.5b), the reduced form coefficients of (3.6a) and (3.6b) are given by

$$a_0 = \frac{b_0 + b_3'b_0'}{1 - b_3b_3'}, \quad a_1 = \frac{b_1 - b_3'b_1'}{1 - b_3b_3'}, \quad a_2 = \frac{b_2}{1 - b_3b_3'}$$

$$a_3 = \frac{b_3'b_2'}{1 - b_3b_3'}, \quad a_4 = \frac{1}{1-b_3b_3'}, \quad a_5 = \frac{b_3'}{1-b_3b_3'}$$

$$a_6 = \frac{1}{1-b_3b_3'}, \quad a_7 = \frac{b_3'}{1-b_3b_3'}$$

$$a_0' = \frac{b_0' + b_3b_0}{1-b_3b_3'}, \quad a_1' = \frac{b_1' - b_3b_1}{1 - b_3b_3'}, \quad a_2' = \frac{b_2'}{1-b_3b_3'}$$

$$a_3' = \frac{b_3b_2}{1-b_3b_3'}, \quad a_4' = \frac{1}{1-b_3b_3'}, \quad a_5' = \frac{b_3}{1-b_3b_3'}$$

$$a_6' = \frac{1}{1-b_3b_3'}, \quad a_7' = \frac{b_3}{1-b_3b_3'}$$

Since b_3 and $b_3^{'}$ are fractions, $1-b_3b_3^{'} > 0$. Also, $b_1 - b_3^{'}b_1^{'}$ and $b_1^{'} - b_3b_1$ will each be positive if

$b_3^{'} < \frac{b_1}{b_1^{'}} < \frac{1}{b_3}$. In what follows it is assumed that this is the case[4]. Given that b_3 and $b_3^{'}$ are less than unity, the following relations hold:

$$a_2 > a_3^{'}, \quad a_2^{'} > a_3, \quad a_4 > a_5, \quad a_4^{'} > a_5^{'}$$

$$a_4 > a_5^{'}, \quad a_4^{'} > a_5, \quad a_4 = a_4^{'}$$

The interpretation of the cross-equation inequalities is that the variables of country A have a greater impact on the domestic aggregate demand (Y^A) than they have on the foreign aggregate demand (Y^B). The inequalities between parameters of the same equation imply that domestic fiscal policy has a greater impact than foreign fiscal policy.

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[4] These restrictions will be satisfied if b_1 and $b_1^{'}$ are of similar magnitude.

Equations (3.6a) and (3.6b) emphasize the effects of monetary or fiscal policies conducted in any one country. If there is an increase in either domestic or foreign government spending, aggregate demand will increase, although the effect of increased foreign spending must operate *via* increased foreign imports. At a given level of prices, if there is an increase in the domestic nominal money supply, the domestic interest rate decreases and hence aggregate demand increases. Part of the increase of aggregate demand falls on the foreign good *via* increased home imports. The secondary or feedback responses are fractions of the initial responses.

The impact of the relative price term ($e + p^B - p^A$ is the logarithm of the relative home currency price of foreign goods) is ambiguous. If the relative price increases there will be a diversion of home demand toward home goods. As the domestic aggregate demand increases, y^B will be stimulated *via* increased imports. At the same time, foreign demand will be switched towards home goods as well. Therefore, home exports will be stimulated which implies an increase in y^A and a decrease in y^B. However, the standard assumption will be made that the net effect of an increase in $e + p^A - p^B$ is to stimulate home demand and depress foreign demand.

The money markets in each country are in continuous equilibrium. The nominal money supplies (m^A and m^B are the logarithms of nominal money supplies) consists of domestic and foreign exchange components. The domestic components are controlled by the central authorities, while the exchange rate adjusts to hold the foreign exchange components constant. The nominal money supplies can therefore be treated as exogenous variables, while the real money demands depend on the nominal interest rates (r^A and r^B) and real incomes.

The government budget constraint can be ignored since the open market bond sales, which finance the portion of the deficit not covered by money creation, have no repercussions elsewhere in the model. Wealth accumulation that occurs through trade surpluses and wealth effects on the money demand or consumption demand are not considered. The omission of wealth effects can also be partially justified by the short-run nature of the analysis.

Equations (3.7a) and (3.7b) give the conditions for monetary equilibrium in each country[5]:

$$m_t^A - PI_t^A = c_0 + c_1 y_t^A - c_2 r_t^A + u_{2t} \qquad (3.7a)$$

$$m_t^B - PI_t^B = c_0' + c_1' y_t^B - c_2' r_t^B + u_{2t}' \qquad (3.7b)$$

This formulation assumes that currency substitution does not occur. If it did, y^B would affect the domestic money market and y^A the foreign. The actual rather than the expected price index of domestic goods appears in the equations (3.7) since all agents know their own money income.

The stochastic terms u_{2t} and u_{2t}' have properties similar to those of the w's. Notice, however, that u_{2t} (the stochastic error in the money market equation) can be correlated with w_t (the stochastic error in the goods market equation). (Similarly, u_{2t}' can be correlated with w_t'). The reason is the following: The demand for real money balances,

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[5] Equation (3.7a) is the log-linear form of $M_t^A / {}^*PI_t^A = C_0 (Y_t^A)^{c_1} \exp(-c_2 r_t^A)$ where $m_t^A = \ell n\, M_t^A$, $y_t^A = \ell n\, Y_t^A$, $c_0 = \ell n\, C_0$, $PI_t^A = \ell n\, {}^*PI_t^A$ and ${}^*PI_t^A$ is the price index of country A. A similar equation holds for country B.

real output and real bonds are constraint by the overall budget constraint in the economy. This constraint implies that the error terms in these three markets satisfy the adding-up constraint $u_{1t} + u_{2t} + w_t = 0$, where u_{1t} is the error term in the bond market which has been eliminated <u>via</u> Walras' law. Given this adding-up constraint, it is frequently argued that u_{2t} and w_t will be negatively correlated since a stochastic increase in the demand for output is likely to be met in part by a decrease in the demand for real balances. But if u_{1t} is sufficiently strongly negatively correlated with both u_{2t} and w_t, it is possible for u_{2t} and w_t to be positively correlated. Such a positive correlation may result from the transactions role of money. If, for some reason, the demand for goods increases, it will generate additional transactions, which may cause a shift away from bonds into both goods and money. A similar adding-up constraint holds for country B.

PI^A and PI^B stand for the (log) price indices in the home and foreign country, respectively. They are assumed to be multiplicative weighted averages of the price of domestic and foreign goods in each country. Therefore, real balances in (3.7a) and (3.7b) express purchasing power over two goods, which is the essence of the open economy framework. The fixed weight price index is, in fact, the true cost of living index, if the consumer's underlying utility functions are of the Cobb-Douglas type (Samuelson and Swamy, 1974, pp. 566-593). The weights (b_3 and b_3') are the fractions of expenditures associated with the two goods in each country and thus characterize the degree of openness. Hence,

$$PI_t^A = (1-b_3)p_t^A + b_3(p_t^B + e_t) \qquad (3.8a)$$

$$PI_t^B = (1-b_3')p_t^B + b_3'(p_t^A - e_t) \qquad (3.8b)$$

The aggregate demand for goods is a function of the real interest rate while the demand for money is a function of the nominal interest rate. The two rates are related in a Fisherian way by the following relations, one for each country:

$$\rho_t^A = r_t^A - (E_t PI_{t+1}^A - PI_t^A) \qquad (3.9a)$$

$$\rho_t^B = r_t^B - (E_t PI_{t+1}^B - PI_t^B) \qquad (3.9b)$$

where E_t is the conditional expectations operator at time t.

The quantity $E_t PI^i_{t+1} - PI^i_t$ for i = A,B, is the anticipated rate of inflation over the period (t, t+1), held at time t. By the assumption of rational expectations, this equals the conditional expected rate of inflation at time t [6].

The models characterizing the rational expectations monetary literature, e.g., Sargent and Wallace (1975), express the expected rate of inflation as $(E_{t-1} PI_{t+1} - E_{t-1} PI_t)$ rather than $(E_t PI_{t+1} - PI_t)$. Our formulation assumes that the price level is known at the time the consumption and investment decisions embodied in the IS curve must be made. Consumption demand is typically determined (in discrete time) in relation to money demand. The money demand equations (3.7a) and (3.7b) are based on the actual price. Thus, our formulation has the advantage of treating the two demand functions more symmetrically in this respect [7].

Two central elements of the model are the pair of equations describing the adjustment of domestic and foreign prices. The following two equations allow for short-run adjustment in output in response to changes in aggregate demand:

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[6] Burton (1980) and Turnovsky (1980) give a similar specification of the real interest rate.

[7] Turnovsky (1980) has a good discussion on the choice of the time subscript of the conditional expectations operator.

$$P^A_{t+1} - P^A_t = \gamma(y^A_t - \bar{y}^A_t) + u_{3,t+1} \quad (3.10a)$$

$$P^B_{t+1} - P^B_t = \gamma'(y^B_t - \bar{y}^B_t) + u'_{3,t+1} \quad (3.10b)$$

The stochastic disturbances $u_{3,t+1}$ and $u'_{3,t+1}$ reflect real disturbances on the supply side and are assumed to satisfy properties analogous to those of the other terms.

Prices of the domestic good in each country adjust according to the discrepancy between actual and full employment, $\bar{y}$ [8]. Equations (3.10a) and (3.10b) can be rationalized in the following way [9]. These price

[8] An expected inflation term could also be included as an explanatory variable in the determination of actual inflation. For our purposes, however, the omission of that does not change the results in any respect, but it simplifies manipulations. An expected inflation term as a shift variable makes (3.10a) and (3.10b) into equations representing expectations-augmented Phillips curves.

[9] Another rationalization can be given in terms of firms. An elegant formulation along these lines has been worked out by Bilson (1979, pp. 1-37, and especially footnote 16). The output term reflects adjustment of prices to achieve the profit maximizing level of production, $\bar{y}$. If aggregate demand, y, exceeds this level, firms will increase production in the short run to meet the demand and begin to raise their prices more rapidly in order to re-establish their desired operating level. One might conclude that equations (3.10a) and (3.10b) are not very appropriate for the level of an individual firm or price setting unit. The average behaviour implied by these equations is more reasonable under a macroeconomic perspective, in which case there is no homogeneity across firms. At any rate, the objective is not to develop a model that is rich in realistic detail, but rather to show how the price level can be determined by the discrepancy between y_t and $\bar{y}_t$.

adjustment equations are "a combination of a relationship between wage and price inflation, a relation between wage inflation and unemployment as in a Phillips curve, and a relation between unemployment and the departure from potential output, $y - \bar{y}$, as described by Okun's law". (Dornbusch, 1976b, p. 1172)

Since there are no reliable estimates for capacity output, $\bar{y}$, covering the sample period and the sample of countries used, domestic capacity output is defined as a function of a time trend (TIME) representing changes in population, technology, and capital stock and the price of energy relative to the price of domestic output (Buiter, 1978).

$$\bar{y}_t^A = d_0 + d_1 \text{ TIME} \pm d_2(OP_t^A - p_t^A) + z_t \tag{3.11a}$$

$$\bar{y}_t^B = d_0' + d_1' \text{ TIME} \pm d_2'(OP_t^B - p_t^B) + z_t' \tag{3.11b}$$

where OP is the logarithm of the price of energy and z and z' are stochastic terms.

An increase in the price of energy relative to the price of output raises firms' costs and, given the exchange rate, firms reduce production. This effect can be positive or negative, depending on the economy's resource base. If a country is an oil consumer the effect will be negative. If it is an oil producer it will be positive. For a country that is both an oil producer and net importer the net effect is uncertain. Some preliminary estimates on the assumption that capacity output is a function of a time trend and of the price of energy relative to the price of output are presented in Appendix 4A of chapter 4.

The final building block of the model is a joint assumption of uncovered interest arbitrage and exchange rate expectations. This final block stresses one channel of mutual interdependence between the two countries. It results from trade in securities. Another channel results from trade in commodities and is represented by the equations (3.6) to (3.10).

Each country supplies bonds denominated in its own currency in the world market. Since these assets are assumed to be perfect substitutes on a "covered" basis[10] there is only one internationally traded bond. Therefore, net yields on these two assets must be equal.

The assumption of uncovered interest arbitrage results from the assumption of zero profits accruing to covered interest arbitrage and a zero risk premium between domestic and foreign assets. Assuming rational expectations the uncovered arbitrage condition[11] is given by

$$r_t^A = r_t^B + (E_t e_{t+1} - e_t) + v_{2t} \qquad (3.12)$$

where v_{2t} is a stochastic term that satisfies properties analogous to those of the other error terms.

Exchange rate expectations are defined in a way analogous to price expectations. According to (3.12) the equilibrium exchange rate is known to

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[10] Our formulation also assumes that exchange rate expectations held by domestic and foreign residents are the same. This is consistent with perfect substitution between domestic and foreign securities. On the other hand, if domestic and foreign wealth holders are sufficiently different to have divergent exchange rate expectations, it seems that these differences also render domestic and foreign securities less than perfect substitutes. While the analysis of systematically divergent expectations may be of interest, it would lead to considerable complexity of the model and will not be pursued.

[11] Burton (1980) uses a similar arbitrage condition in a small country model for the Canadian economy.

market participants in each country and a fraction of the gap between e_t and $E_t e_{t+1}$ is expected by market participants in each country to be closed each period. The period length is that over which interest rates are defined in (3.12).

If the domestic currency is expected to depreciate, domestic interest rates (denominated in terms of domestic currency) will be higher than foreign interest rates by the expected rate of depreciation. Equation (3.12) represents the case of perfect capital mobility. Capital flows will ensure that (3.12) holds at all times.

3.4 THE MODEL IN REDUCED FORM

In this section, the reduced form of the complete model is derived. The reduced form equations can be used to test for the phenomenon of overshooting following a nominal or real disturbance and of the proposition that P.P.P. holds in the long run *via* the homogeneity restrictions, though the model captures also short-run effects. They are also convenient because the structural equations contain expectation terms which can be handled relatively simply in the reduced form equations under the assumption of rational expectations.

Dornbusch has shown that while expectations formation according to equations (3.9) and (3.12) appears ad hoc, it is actually consistent with perfect foresight. Given the model, the perfect foresight path is the only expectational assumption that is not arbitrary and does not involve persistent prediction errors. The model is presented in stochastic form since the perfect foresight path corresponds to the deterministic equivalent of rational expectations. Alternatively, rational expectations imply that the expectation of an endogenous variable is its mathematical expectation, given the model and the information available when the expectation is formed.

One assumption that has been used extensively in the literature of the "asset market approach to exchange rate determination" is that the exogenous variables follow a random walk. Though the above assumption is not convenient for analyzing shocks due to changes in the policy environment via changes in policy reaction functions, and more complex feedback rules have been suggested, it is adopted here so that the model is consistent with the rest of the literature. It makes all changes unanticipated and thus makes the model correspond to the Dornbusch treatment.

This assumption is important because it implies that the money supply of the current period is also the expected supply for all future periods. Appendix 4B of chapter 4 presents some tests of the assumption of random walk which indicates that for the majority of the exogenous variables the assumption is satisfactory.

Next, the process of finding the reduced form is described briefly. More details are given in Appendix 3B. The money market equations are expressed in terms of p_t^A and p_t^B, using the price indices definitions (3.8a) and (3.8b), and then they are solved with respect to the nominal interest rates:

$$r_t^A = \frac{c_0}{c_2} + \frac{1-b_3}{c_2} p_t^A + \frac{b_3}{c_2} p_t^B + \frac{b_3}{c_2} e_t$$

$$+ \frac{c_1}{c_2} y_t^A - \frac{1}{c_2} m_t^A + \frac{1}{c_2} u_{2t} \qquad (3.13a)$$

$$r_t^B = \frac{c_0'}{c_2'} + \frac{1-b_3'}{c_2'} p_t^B + \frac{b_3'}{c_2'} p_t^A - \frac{b_3'}{c_2'} e_t$$

$$+ \frac{c_1'}{c_2'} y_t^B - \frac{1}{c_2'} m_t^B + \frac{1}{c_2'} u_{2t}' \qquad (3.13b)$$

The real interest rate equations (3.9a) and (3.9b) are also expressed in terms of p_t^A and p_t^B. Substitutions of the nominal interest rates into the real and subsequent substitution of the real interest rates into the goods market equations (3.6a) and (3.6b) yield

$$y_t^A = \delta_0 + \delta_1 p_t^A + \delta_2 p_t^B + \delta_3 e_t + \delta_4 m_t^A$$

$$+ \delta_5 m_t^B + \delta_6 g_t^A + \delta_7 g_t^B + \delta_8 E_t p_{t+1}^A$$

$$+ \delta_9 E_t p_{t+1}^B + \delta_{10} E_t e_{t+1} + \delta_{11} u_{2t}$$

$$+ \delta_{12} u_{2t}' + \delta_{13} w_t + \delta_{14} w_t' \qquad (3.14a)$$

$$y_t^B = \delta_0' + \delta_1' p_t^B + \delta_2' p_t^A + \delta_3' e_t + \delta_4' m_t^B$$

...continued

$$+ \delta_5' m_t^A + \delta_6' g_t^B + \delta_7' g_t^A + \delta_8' E_t p_{t+1}^B$$

$$+ \delta_9' E_t p_{t+1}^A + \delta_{10}' E_t e_{t+1} + \delta_{11}' u_{2t}' $$

$$+ \delta_{12}' u_{2t} + \delta_{13}' w_t' + \delta_{14}' w_t \qquad (3.14b)$$

Expressions for δ's and all subsequent coefficients are given in Appendix 3B. Notice here, however, that $\delta_1 + \delta_2 + \delta_4 + \delta_5 + \delta_8 + \delta_9 = 0$ and that $\delta_1' + \delta_2' + \delta_4' + \delta_5' + \delta_8' + \delta_9' = 0$.

We solve equation (3.12) with respect to the spot exchange rate and substitute equations (3.13a), (3.13b), (3.14a), and (3.14b), into the resulting equation. Thus,

$$e_t = k_0 + k_1 p_t^A + k_2 p_t^B + k_3 m_t^A + k_4 m_t^B$$

$$+ k_5 g_t^A + k_6 g_t^B + k_7 E_t p_{t+1}^A + k_8 E_t p_{t+1}^B$$

$$+ k_9 E_t e_{t+1} + k_{10} u_{2t} + k_{11} u_{2t}'$$

$$+ k_{12} w_t + k_{13} w_t' + k_{14} v_{2t} \qquad (3.15)$$

Again,

$$k_1 + k_2 + k_3 + k_4 + k_7 + k_8 = 0 \qquad (3.15.1)$$

Substitution of (3.15) into (3.14a) and (3.14b) yields

$$\begin{aligned} y_t^A = {} & \phi_0 + \phi_1 p_t^A + \phi_2 p_t^B + \phi_3 m_t^A + \phi_4 m_t^B \\ & + \phi_5 g_t^A + \phi_6 g_t^B + \phi_7 E_t p_{t+1}^A + \phi_8 E_t p_{t+1}^B \\ & + \phi_9 E_t e_{t+1} + \phi_{10} u_{2t} + \phi_{11} u_{2t}' + \phi_{12} w_t \\ & + \phi_{13} w_t' + \phi_{14} v_{2t} \end{aligned} \qquad (3.16a)$$

$$\begin{aligned} y_t^B = {} & \phi_0' + \phi_1' p_t^B + \phi_2' p_t^A + \phi_3' m_t^B + \phi_4' m_t^A \\ & + \phi_5' g_t^B + \phi_6' g_t^A + \phi_7' E_t p_{t+1}^B + \phi_8' E_t p_{t+1}^A \\ & + \phi_9' E_t e_{t+1} + \phi_{10}' u_{2t}' + \phi_{11}' u_t + \phi_{12}' w_t' \\ & + \phi_{13}' w_t + \phi_{14}' v_{2t} \end{aligned} \qquad (3.16b)$$

The following restrictions hold:

$$\phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_7 + \phi_8 = 0 \qquad (3.16a1)$$

$$\phi_1' + \phi_2' + \phi_3' + \phi_4' + \phi_7' + \phi_8' = 0 \qquad (3.16b1)$$

The price equations can be derived from equations (3.10a) and (3.10b), given the definitions of full employment output (3.11a, 3.11b) and equations (3.16a), and (3.16b).

$$\begin{aligned} p^A_{t+1} = {} & \lambda_0 + \lambda_1 p^A_t + \lambda_2 p^B_t + \lambda_3 m^A_t + \lambda_4 m^B_t \\ & + \lambda_5 g^A_t + \lambda_6 g^B_t + \lambda_7 E_t p^A_{t+1} + \lambda_8 E_t p^B_{t+1} \\ & + \lambda_9 E_t e_{t+1} + \lambda_{10} Op^A_t + \lambda_{11} TIME + \lambda_{12} u_{2t} \\ & + \lambda_{13} u'_{2t} + \lambda_{14} w_t + \lambda_{15} w'_t + \lambda_{16} v_{2t} \\ & + \lambda_{17} z_t + \lambda_{18} u_{3,t+1} \qquad (3.17a) \end{aligned}$$

$$\begin{aligned} p^B_{t+1} = {} & \lambda_0' + \lambda_1' p^B_t + \lambda_2' p^A_t + \lambda_3' m^B_t + \lambda_4' m^A_t \\ & + \lambda_5' g^B_t + \lambda_6' g^A_t + \lambda_7' E_t p^B_{t+1} + \lambda_8' E_t p^A_{t+1} \end{aligned}$$

...continued

$$+ \lambda_9' E_t e_{t+1} + \lambda_{10}' Op_t^B + \lambda_{11}' TIME + \lambda_{12}' u_{2t}'$$

$$+ \lambda_{13}' u_{2t} + \lambda_{14}' w_t' + \lambda_{15}' w_t + \lambda_{16}' v_{2t}$$

$$+ \lambda_{17}' z_t' + \lambda_{18}' u_{3,t+1} \qquad (3.17b)$$

The last two equations give the following restrictions:

$$\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 + \lambda_7 + \lambda_8 + \lambda_{10} = 1 \qquad (3.17a1)$$

$$\lambda_1' + \lambda_2' + \lambda_3' + \lambda_4' + \lambda_7' + \lambda_8' + \lambda_{10}' = 1 \qquad (3.17b1)$$

Substitution of (3.15), (3.16a) and (3.16b) into (3.13a) and (3.13b) yields the following interest rate equations:

$$r_t^A = \tau_0 + \tau_1 p_t^A + \tau_2 p_t^B + \tau_3 m_t^A + \tau_4 m_t^B$$

$$+ \tau_5 g_t^A + \tau_6 g_t^B + \tau_7 E_t p_{t+1}^A + \tau_8 E_t p_{t+1}^B$$

$$+ \tau_9 E_t e_{t+1} + \tau_{10} u_{2t} + \tau_{11} u_{2t}' + \tau_{12} w_t$$

$$+ \tau_{13} w_t' + \tau_{14} v_{2t} \qquad (3.18a)$$

$$r^B = \tau_0' + \tau_1' p_t^B + \tau_2' p_t^A + \tau_3' m_t^B + \tau_4' m_t^A$$

$$+ \tau_5' g_t^B + \tau_6' g_t^A + \tau_7' E_t p_{t+1}^B + \tau_8' E_t p_{t+1}^A$$

$$+ \tau_9' E_t e_{t+1} + \tau_{10}' u_{2t}' + \tau_{11}' u_{2t} + \tau_{12}' w_t'$$

$$+ \tau_{13}' w_t + \tau_{14}' v_{2t} \qquad (3.18b)$$

Given the restrictions (3.15.1), (3.16a1) and (3.16b1) we get

$$\tau_1 + \tau_2 + \tau_3 + \tau_4 + \tau_7 + \tau_8 = 0 \qquad (3.18a1)$$

$$\tau_1' + \tau_2' + \tau_3' + \tau_4' + \tau_7' + \tau_8' = 0 \qquad (3.18b1)$$

Equations (3.15), (3.16a), (3.16b), (3.17a), (3.17b), (3.18a) and (3.18b) constitute the model to be estimated. The treatment of the expected variables is explained in the next chapter. Since the error terms are correlated across equations, we estimate the system simultaneously. Then we test for the restrictions (3.15.1), (3.16a1), (3.16b1), (3.17a1), (3.17b1), (3.18a1), and (3.18b1). These restrictions stand for the long-run proportionality of the system with respect to nominal money supply changes. In particular, the restriction $k_1 + k_2 + k_3 + k_4 + k_7 + k_8 = 0$ reflects the long-run zero degree homogeneity of the exchange rate with respect to nominal money supply changes, which implies that money supplies, prices and the exchange rate move proportionately, that is P.P.P. holds in the long run. The coefficient of money supply in the exchange rate equation is indicative of the phenomenon of overshooting. If it is greater than unity, then overshooting occurs.

The model is flexible enough to allow us to test the assumption made in other studies that domestic and foreign variables have common coefficients. Finally, by simulating with the model we can see whether the equations fit the data well, and examine the effects of different shocks on the system. The above tests are the subject of the chapters to follow.

3.5 CONCLUSIONS

The model presented in this chapter is an extension to a two-country world of Dornbusch's small country model based on the asset approach to exchange rate determination. It assumes that asset markets clear relatively faster than goods markets and that perfect capital mobility prevails between the two countries.

The model can be tested in reduced form, with expectations treated within a rational expectations framework. The reduced form allow us to test the long-run P.P.P., the phenomenon of overshooting and the hypothesis that domestic and foreign variables enter the equations with common coefficients, except for signs. Overshooting is not a necessary feature, since we are concerned with a large country model. Some useful dynamics can also be derived by simulating with the model.

APPENDIX 3A

STABILITY CONDITIONS OF THE INCOME-ADJUSTMENT MECHANISM IN A TWO-COUNTRY WORLD

Assume that Y^A tends to increase (decrease) when the aggregate demand for the A country's output (AD^A) is higher (lower) than Y. This implies that the rate of change of Y^A per unit of time is given by

$$\dot{Y}^A = \ell \left[Z^A(Y^A) + IM^B(Y^B) - IM^A(Y^A) - Y^A \right] \tag{3A1}$$

where Z^A stands for the domestic absorption of country A, ℓ is the positive speed of adjustment and $\dot{Y}^A$ is the time derivative. Since the exports of country A are the imports of country B, we write $X^A = IM^B$. Emphasis here is on the income adjustment mechanism. Thus, all the terms are expressed as a function of income ignoring other components, such as the real interest rate and the terms of trade.

A similar expression is written for country B:

$$\dot{Y}^B = \ell' \left[Z^B(Y^B) + IM^A(Y^A) - IM^B(Y^B) - Y^B \right] \tag{3A2}$$

Expanding equations (3A1) and (3A2) around the equilibrium point $\bar{Y}^A$ and $\bar{Y}^B$, and dropping all nonlinear terms, yields

$$\dot{Y}^A = -\ell \left[(1 - Z^A_{Y^A} + IM^A_{Y^A})(Y^A - \bar{Y}^A) - IM^B_{Y^B}(Y^B - \bar{Y}^B) \right] \tag{3A3}$$

$$\dot{Y}^B = -\ell' \left[(1 - Z^B_{Y^B} + IM^B_{Y^B})(Y^B - \bar{Y}^B) - IM^A_{Y^A}(Y^A - \bar{Y}^A) \right] \tag{3A4}$$

The solutions of the last two equations have the following form:

$$Y^A = \bar{Y}^A + a_{11}e^{\lambda 1t} + a_{12}e^{\lambda 2t} \tag{3A5}$$

$$Y^B = \bar{Y}^B + a_{21}e^{\lambda 1t} + a_{22}e^{\lambda 2t} \tag{3A6}$$

where the constants a_{ij} depend on initial conditions at time $t = 0$ and ℓ_1 and ℓ_2 are roots of the following determinantal equation:

$$\begin{vmatrix} -\ell(1-z^A_{Y^A} + IM^A_{Y^A})-\lambda & +\ell IM^B_{Y^B} \\ & \\ \ell' IM^A_{Y^A} & -\ell'(1-z^B_{Y^B} + IM^B_{Y^B})-\lambda \end{vmatrix} = 0 \tag{3A7}$$

Equations (3A5) and (3A6) indicate that Y^A and Y^B will not tend to the equilibrium values $\bar{Y}^A$ and $\bar{Y}^B$ unless the real parts of λ_1 and λ_2, the roots of (3A7), are both negative.

Next, the determinant is expanded and expressed in the following form:

$$\lambda^2 + A_1\lambda + A_2 = 0 \tag{3A8}$$

where

$$A_1 = \ell(1-z^A_{Y^A} + IM^A_{Y^A}) + \ell'(1-z^B_{Y^B} + IM^B_{Y^B}) \tag{3A9}$$

$$A_2 = \ell \ell' \left[(1 - Z^A_{Y^A} + IM^A_{Y^A})(1 - Z^B_{Y^B} + IM^B_{Y^B}) - IM^A_{Y^A}\, IM^B_{Y^B} \right] \qquad (3A10)$$

The real parts of the roots of (3A8) will be negative (Samuelson, 1947, pp. 430-431), if, and only if, $A_1 > 0$ and $A_2 > 0$. Since ℓ and ℓ' are both positive, (3A10) reduces to

$$(1 - Z^A_{Y^A} + IM^A_{Y^A})(1 - Z^B_{Y^B} + IM^B_{Y^B}) - IM^A_{Y^A}\, IM^B_{Y^B} > 0 \qquad (3A11)$$

Since $IM^A_{Y^A} > 0$ and $IM^B_{Y^B} > 0$, it follows that $(1 - Z^A_{Y^A} + IM^A_{Y^A})(1 - Z^B_{Y^B} + IM^B_{Y^B}) > 0$. Thus, the two factors $(1 - Z^A_{Y^A} + IM^A_{Y^A})$ and $(1 - Z^B_{Y^B} + IM^B_{Y^B})$ must have the same sign. Given that $A_1 > 0$, we obtain

$$1 - Z^A_{Y^A} + IM^A_{Y^A} > 0 \qquad (3A12)$$

$$1 - Z^B_{Y^B} + IM^B_{Y^B} > 0 \qquad (3A13)$$

Inequalities (3A11), (3A12), and (3A13) are the necessary and sufficient conditions for the stability of the income adjustment mechanism.

APPENDIX 3B

DERIVATION OF THE REDUCED FORM EQUATIONS

Using the price definitions (3.8a) and (3.8b), the money market equations (3.7a) and (3.7b) and the real interest rate definitions (3.9a) and (3.9b) are written as

$$m_t^A - (1-b_3)p_t^A - b_3(p_t^B + e_t)$$

$$= c_0 + c_1 y_t^A - c_2 r_t^A + u_{2t} \qquad (3B1a)$$

$$m_t^B - (1-b_3')p_t^B - b_3'(p_t^A - e_t)$$

$$= c_0' + c_1' y_t^B - c_2' r_t^B + u_{2t}' \qquad (3B1b)$$

$$\rho_t^A = r^A - (1-b_3)E_t p_{t+1}^A - b_3(E_t p_{t+1}^B$$

$$+ E_t e_{t+1}) + (1 - b_3)p_t^A + b_3(p_t^B + e_t)$$

$$(3B2a)$$

$$\rho_t^B = r^B - (1 - b_3')E_t p_{t+1}^B - b_3'(E_t p_{t+1}^A - E_t e_{t+1}) + (1 - b_3')p_t^B + b_3'(p_t^A - e_t) \tag{3B2b}$$

Equations (3B1a) and (3B1b) are solved with respect to nominal interest rates and give us equations (3.13a) and (3.13b) of the text.

Substitution of (3.13a) into (3B2a) and then into (3.6a) yields

$$y_t^A = \{a_0 - \frac{c_0(a_2+a_3)}{c_2} - \left[a_1 + \frac{(1-b_3)(a_2+a_2c_2)}{c_2} + \frac{a_3b_3'(1 + c_2)}{c_2}\right]p_t^A - \left[-a_1 + \frac{a_2b_3(1+c_2)}{c_2} + \frac{(1-b_3')(a_3+a_3c_2)}{c_2}\right]p_t^B - \left[-a_1 + \frac{(a_2b_3-a_3b_3')(1+c_2)}{c_2}\right]e_t - \frac{a_2c_1}{c_2}y_t^A - \frac{a_3c_1'}{c_2'}y_t^B + \frac{a_2}{c_2}m_t^A + \frac{a_3}{c_2}m_t^B + a_4g_t^A$$

$$+ a_5 g_t^B + (a_2 - a_2 b_3 + a_3 b_3' + a_3 b_3') E_t p_{t+1}^A$$

$$+ (a_3 + a_2 b_3 - a_3 b_3') E_t p_{t+1}^B + (a_2 b_3$$

$$+ a_3 b_3') E_t e_{t+1} - \frac{a_2}{c_2} u_{2t} - \frac{a_3}{c_2} u_{2t}'$$

$$+ a_6 w_t + a_7 w_t' \}/1 + \frac{a_2 c_1}{c_2} \qquad (3B3a)$$

Substitution of (3.13b) into (3B2b) and then into (3.6b) yields

$$y^B = \{a_0' - \frac{(a_2'+a_3')c_0'}{c_2'} - \left[a_1' + \frac{(1-b_3')(a_2'+a_2'c_2')}{c_2'}\right.$$

$$\left. + \frac{a_3' b_3 (1+c_2')}{c_2'}\right] p_t^B - \left[-a_1' + \frac{a_2' b_3' (1+c_2')}{c_2'}\right.$$

$$\left. + \frac{(1-b_3)(a_3'+a_3'c_2')}{c_2'}\right] p_t^A - \left[a_1'\right.$$

$$\left. - \frac{(a_2' b_3' - a_3' b_3)(1+c_2')}{c_2'}\right] e_t - \frac{a_2' c_1'}{c_2'} y_t^B$$

...continued

$$- \frac{c_1 a_3'}{c_2} y_t^A + \frac{a_2}{c_2'} m_t^B + \frac{a_3'}{c_2'} m_t^A + a_4' g_t^B + a_5' g_t^A$$

$$+ \quad (a_2' - b_3' a_2' + a_3' b_3) E_t p_{t+1}^B + (b_3' a_2'$$

$$+ a_3' - a_3' b_3) E_t p_{t+1}^A + (b_3' a_2' + a_3' b_3) E_t e_{t+1}$$

$$- \frac{a_2'}{c_2'} u_{2t}' - \frac{a_3'}{c_2'} u_{2t} + a_6' w_t' + a_7' w_t \} / 1$$

$$+ \frac{a_2' c_1'}{c_2'} \qquad (3B3b)$$

Next, we substitute (3B3b) into (3B3a) and (3B3a) into (3B3b), and after some manipulations we are left with equations (3.14a) and (3.14b) of the model, where the δ coefficients can be expressed in terms of the structural parameters as follows:

$$\delta_0 = \left[(a_0 - \frac{a_2 c_0}{c_2} - \frac{a_3 c_0}{c_2}) / (1 + \frac{a_2 c_1}{c_2}) \right]$$

$$- (\frac{a_3 c_1'}{c_2'}) (a_0' - \frac{a_2' c_0'}{c_0'} - \frac{a_3' c_0}{c_2}) / (1 + \frac{a_2 c_1}{c_2})$$

$$(1 + \frac{a_2' c_1'}{c_2'}) \gtreqless 0$$

$$\delta_1 = -a_2(1-b_3)(1 + \frac{1}{c_2}) - \frac{a_2 a_2' c_1' (1-b_3)}{c_2'}(1 + \frac{1}{c_2}) + \frac{a_3 a_3' c_1'}{c_2'}$$

$$\cdot (1 - b_3)(1 + \frac{1}{c_2}) - a_1(1 + \frac{a_2' c_1'}{c_2'}) - a_3 b_3'(1 + \frac{1}{c_2'}) - \frac{a_3 a_1' c_1'}{c_2'} < 0$$

$$\delta_2 = a_1(1 + \frac{a_2' c_1'}{c_2'}) - a_3'(1 + \frac{1}{c_2}) - \frac{a_3' a_2' c_1'}{c_2'}(1 + \frac{1}{c_2})$$

$$+ \frac{a_3 a_3' b_3 c_1'}{c_2'}(1 + \frac{1}{c_2}) - a_3(1 - b_3')(1 + \frac{1}{c_2'}) + \frac{a_3 a_1' c_1'}{c_2'} \gtrless 0$$

$$\delta_3 = -a_3'(1 + \frac{b_2 c_1'}{c_2'}) + a_1(1 + \frac{a_2' c_1'}{c_2'}) + a_3'(1 + \frac{a_2' c_1'}{c_2'}$$

$$+ \frac{a_3 b_3 c_1'}{c_2'}) + a_3 \left[b_3'(1 + \frac{1}{c_2}) + \frac{a_1' c_1'}{c_2'} \right] \lesseqgtr 0$$

$$\delta_4 = a_2(\frac{1}{c_2} + \frac{a_2' c_1'}{c_2 c_2'}) - \frac{a_3 a_3' c_1'}{c_2 c_2'} \gtreqless 0$$

$$\delta_5 = a_3/c_2' > 0$$

$$\delta_6 = a_4 + \frac{a_2' c_1'}{c_2'} > 0$$

$$\delta_7 = a_5 > 0$$

$$\delta_8 = a_2(1 - b_3) + b_3' a_3 + \frac{a_2 a_2' c_1'(1-b_3)}{c_2'}$$

$$- \frac{a_3 a_3' c_1'(1 - b_3)}{c_2'} \gtreqless 0$$

$$\delta_9 = a_3'(1 + \frac{a_2' c_1'}{c_2'}) + a_3(1 - b_3') - \frac{a_3 a_3' b_3 c_1'}{c_2'} \gtreqless 0$$

$$\delta_{10} = a_3'(1 + \frac{b_2' c_1'}{c_2'}) + a_3 b_3' > 0$$

$$\delta_{11} = -(\frac{a_2}{c_2} + \frac{a_3 a_3' c_1'}{c_2'})/1 + \frac{a_2 c_1}{c_2}$$

$$\delta_{12} = -(\frac{a_3}{c_2} + \frac{a_3 a_2' c_1'}{c_2} /1 + \frac{a_2 c_1}{c_2}$$

$$\delta_{13} = a_6 + \frac{a_3 a_7 c_1'}{c_2'} /1 + \frac{a_3 c_1}{c_2}$$

$$\delta_{14} = a_7 + \frac{a_3 a_6' c_1'}{c_2'} /1 + \frac{a_2 c_1}{c_2}$$

$$\delta_0' = \left[(a_0' - \frac{a_2' c_0'}{c_2'} - \frac{a_3' c_0'}{c_2'})/1 + \frac{a_2' c_1'}{c_2'}) \right]$$

$$- (\frac{a_3' c_1}{c_2})(a_0 - \frac{a_2 c_0}{c_2} - \frac{a_3 c_0'}{c_2'})/(1 + \frac{a_2 c_1}{c_2'})$$

$$\gtreqless 0$$

$$\delta_1' = -a_2'(1 - b_3')(1 + \frac{1}{c_2'}) - \frac{a_2 a_2' c_1 (1-b_3)}{c_2}(1 + \frac{1}{c_2'})$$

$$+ \frac{a_3 a_3' c_1}{c_2}(1 - b_3')(1 + \frac{1}{c_2'})$$

$$- a_3' b_3 (1 + \frac{1}{c_2}) - a_1'(1 + \frac{a_2 c_1}{c_2})$$

$$- \frac{a_1 a_3' c_1}{c_2} < 0$$

$$\delta_2' = a_1'(1 + \frac{a_2 c_1}{c_2}) - a_3(1 + \frac{1}{c_2'}) - \frac{a_3 a_2 c_1}{c_2}(1 + \frac{1}{c_2'})$$

$$+ \frac{a_3 a_3' b_3' c_1}{c_2}(1 + \frac{1}{c_2'}) - a_3'(1 - b_3)(1 + \frac{1}{c_2}) + \frac{a_1 a_3' c_1}{c_2} \gtreqless 0$$

$$\delta_3' = a_3(1 + \frac{b_2 c_1}{c_2}) - a_1'(1 + \frac{a_2 c_1}{c_2}) - a_3(1$$

$$+ \frac{a_2 c_1}{c_2} + \frac{a_3' b_3' c_1}{c_2}) - a_3'\left[b_3(1 + \frac{1}{c_2'})\right.$$

$$\left. + \frac{a_1 c_1}{c_2}\right] \gtreqless 0$$

$$\delta_4' = \frac{a_2'}{c_2'}(\frac{1}{c_2'} + \frac{a_2 c_1}{c_2 c_2'}) - \frac{a_3 a_3' c_1}{c_2 c_2'} \gtreqless 0$$

$$\delta_5' = a_3'/c_2 > 0$$

$$\delta_6' = a_4 + \frac{a_2 c_1}{c_2} > 0$$

$$\delta_7' = a_5' > 0$$

$$\delta_8' = a_2'(1 - b_3') + b_3 a_3' + \frac{a_2 a_2'(1 - b_3) c_1}{c_2}$$

$$- \frac{a_3 a_3' c_1 (1 - b_3')}{c_2} \gtreqless 0$$

$$\delta_9' = a_3(1 + \frac{a_2 c_1}{c_2}) + a_3'(1 - b_3) - \frac{a_3 a_3' b_3' c_1}{c_2} \gtreqless 0$$

$$\delta_{10}' = a_3(1 + \frac{b_2 c_1}{c_2}) + a_3' b_3 > 0$$

$$\delta_{11}' = -(\frac{a_2'}{c_2} + \frac{a_3 a_c' c_1}{c_2})/1 + \frac{a_2' c_1}{c_2'}$$

$$\delta_{12}' = -(\frac{a_3'}{c_2} + \frac{a_2 a_3' c_1}{c_2})/1 + \frac{a_2' c_1'}{c_2'}$$

$$\delta'_{13} = a'_6 + \frac{a'_3 a_7 c_1}{c_2} \Big/ 1 + \frac{a_2 c'_1}{c'_2}$$

$$\delta'_{14} = a'_7 + \frac{a'_3 a_6 c_1}{c_2} \Big/ 1 + \frac{a'_2 c'_1}{c'_2}$$

All the δ and δ' coefficients are divided by the expression

$$(1 + \frac{a_2 c_1}{c_2})(1 + \frac{a'_2 c'_1}{c'_2}) \left[1 - (\frac{b_3 a_2 c_1/c_2}{1+a_2 c_1/c_2}) (\frac{b'_3 a'_2 c'_1/c'_2}{1+a'_2 c'_1/c'_2}) \right]$$

The coefficients of the exchange rate equation (3.15) are given below.

$$k_0 = \frac{c'_0 + c'_1 \delta'_0}{c'_2} - \frac{c_0 + c_1 \delta_0}{c_2}$$

$$k_1 = \frac{-(1-b_3) + c_1 \delta_1}{c_2} + \frac{b'_3 + c_1 \delta'_2}{c'_2}$$

$$k_2 = \frac{-b_3 - c_1 \delta_2}{c_2} + \frac{1-b_3 - c_1 \delta_1}{c'_2}$$

$$k_3 = \frac{1 - c_1 \delta_4}{c_2} + \frac{c_1' \delta_5'}{c_2'}$$

$$k_4 = \frac{c_1' \delta_4'}{c_2'} - \frac{1 + c_1 \delta_5}{c_2}$$

$$k_5 = \frac{c_1' \delta_7'}{c_2'} - \frac{c_1 \delta_6}{c_2}$$

$$k_6 = \frac{c_1' \delta_6'}{c_2'} - \frac{c_1 \delta_7}{c_2}$$

$$k_7 = \frac{c_1' \delta_9'}{c_2'} - \frac{c_1 \delta_8}{c_2}$$

$$k_8 = \frac{c_1' \delta_8'}{c_2'} - \frac{c_1 \delta_9}{c_2}$$

$$k_9 = 1 - \frac{c_1 \delta_{10}}{c_2} + \frac{c_1' \delta_{10}'}{c_2'}$$

$$k_{10} = \frac{c_1' \delta_{12}'}{c_2'} - \frac{c_1 \delta_{11}}{c_2}$$

$$k_{11} = \frac{c_1' \delta_{11}'}{c_2'} - \frac{c_1 \delta_{12}'}{c_2}$$

$$k_{12} = \frac{c_1' \delta_{14}'}{c_2'} - \frac{c_1 \delta_{13}}{c_2}$$

$$k_{13} = \frac{c_1'\delta_{13}'}{c_2'} - \frac{c_1\delta_{14}}{c_2}$$

$$k_{14} = 1$$

All the coefficients of the exchange rate equation are divided by the expression $1 + (b_3 + c_1\delta_3)/c_2 + (b_3' + c_1'\delta_3')/c_2'$ which is positive. However, their signs are ambiguous.

Given that $\delta_1 + \delta_2 + \delta_4 + \delta_5 + \delta_8 + \delta_9 = 0$ and $\delta_1' + \delta_2' + \delta_4' + \delta_5' + \delta_8' + \delta_9' = 0$, it can be easily seen that $k_1 + k_2 + k_3 + k_4 + k_7 + k_8 = 0$.

The coefficients of the two output equations (3.16a) and (3.16b) are given below

$$\phi_0 = \delta_0 + \delta_3 k_0 \qquad \phi_1 = \delta_1 + \delta_3 k_1$$

$$\phi_2 = \delta_2 + \delta_3 k_2 \qquad \phi_3 = \delta_4 + \delta_3 k_3$$

$$\phi_4 = \delta_5 + \delta_3 k_4 \qquad \phi_5 = \delta_6 + \delta_3 k_5$$

$$\phi_6 = \delta_7 + \delta_3 k_6 \qquad \phi_7 = \delta_8 + \delta_3 k_7$$

$$\phi_8 = \delta_9 + \delta_3 k_8 \qquad \phi_9 = \delta_{10} + \delta_3 k_9$$

$\phi_{10} = \delta_{11} + \delta_3 k_{10}$ $\phi_{11} = \delta_{12} + \delta_3 k_{11}$

$\phi_{12} = \delta_{13} + \delta_3 k_{12}$ $\phi_{13} = \delta_{14} + \delta_3 k_{13}$

$\phi_{14} = \delta_3 k_{14}$ $\phi'_0 = \delta'_0 + \delta'_3 k_0$

$\phi'_1 = \delta'_1 + \delta'_3 k_2$ $\phi'_2 = \delta'_2 + \delta'_3 k_1$

$\phi'_3 = \delta'_4 + \delta'_3 k_4$ $\phi'_4 = \delta'_5 + \delta'_3 k_4$

$\phi'_5 = \delta'_6 + \delta'_3 k_6$ $\phi'_6 = \delta'_7 + \delta'_3 k_5$

$\phi'_7 = \delta'_8 + \delta'_3 k_8$ $\phi'_8 = \delta'_9 + \delta'_3 k_7$

$\phi'_9 = \delta'_{10} + \delta'_3 k_9$ $\phi'_{10} = \delta'_{11} + \delta_3 k_{11}$

$\phi'_{11} = \delta'_{12} + \delta'_3 k_{10}$ $\phi'_{12} = \delta'_{13} + \delta'_3 k_{13}$

$\phi'_{13} = \delta'_{14} + \delta'_3 k_{12}$ $\phi'_{14} = \delta'_3 k_{14}$

The two price equations (3.17a) and (3.17b) have the following coefficients:

$\lambda_0 = \gamma\phi_0 - \gamma d_0$ $\qquad$ $\lambda_1 = 1 + \gamma\phi_1 \pm \gamma d_2$

$\lambda_2 = \gamma\phi_2$ $\qquad$ $\lambda_3 = \gamma\phi_3$

$\lambda_4 = \gamma\phi_4$ $\qquad$ $\lambda_5 = \gamma\phi_5$

$\lambda_6 = \gamma\phi_6$ $\qquad$ $\lambda_7 = \gamma\phi_7$

$\lambda_8 = \gamma\phi_8$ $\qquad$ $\lambda_9 = \gamma\phi_9$

$\lambda_{10} = \pm\gamma d_2$ $\qquad$ $\lambda_{11} = \gamma d_1$

$\lambda_{12} = \gamma\phi_{10}$ $\qquad$ $\lambda_{13} = \gamma\phi_{11}$

$\lambda_{14} = \gamma\phi_{12}$ $\qquad$ $\lambda_{15} = \gamma\phi_{13}$

$\lambda_{16} = \gamma\phi_{14}$ $\qquad$ $\lambda_{17} = -\gamma$

$\lambda_{18} = 1$ $\qquad$ $\lambda'_0 = \gamma'\phi'_0 - \gamma' d'_0$

$\lambda'_1 = 1 + \gamma'\phi'_1 \pm \gamma' d'_2$ $\qquad$ $\lambda'_2 = \gamma'\phi'_2$

$\lambda'_3 = \gamma'\phi'_3$ $\qquad$ $\lambda'_4 = \gamma'\phi'_4$

$$\lambda'_5 = \gamma'\phi'_5 \qquad \lambda'_6 = \gamma'\phi'_6$$

$$\lambda'_7 = \gamma'\phi'_7 \qquad \lambda'_8 = \gamma'\phi'_8$$

$$\lambda'_9 = \gamma'\phi'_9 \qquad \lambda'_{10} = \pm\gamma' d'_2$$

$$\lambda'_{11} = \gamma' d'_1 \qquad \lambda'_{12} = \gamma'\phi'_{10}$$

$$\lambda'_{13} = \gamma'\phi'_{11} \qquad \lambda'_{14} = \gamma'\phi'_{12}$$

$$\lambda'_{15} = \gamma'\phi'_{13} \qquad \lambda'_{16} = \gamma'\phi'_{14}$$

$$\lambda'_{17} = -\gamma' \qquad \lambda'_{18} = 1$$

Finally, the coefficients of the interest rate equations (3.15a) and (3.18b) follow:

$$\tau_0 = c_0 + b_3 k_0 + c_1\phi_0 \qquad \tau_1 = 1-b_3 + b_3 k_1 + c_1\phi_1$$

$$\tau_2 = b_3 + b_3 k_2 + c_1\phi_2 \qquad \tau_3 = b_3 k_3 + c_1\phi_3 - 1$$

$$\tau_4 = b_3 k_4 + c_1\phi_4 \qquad \tau_5 = b_3 k_5 + c_1\phi_5$$

$$\tau_6 = b_3 k_6 + c_1\phi_6 \qquad \tau_7 = b_3 k_9 + c_1\phi_7$$

$\tau_8 = b_3 k_8 + c_1 \phi_8$ $\qquad$ $\tau_9 = b_3 k_9 + c_1 \phi_9$

$\tau_{10} = b_3 k_{10} + c_1 \phi_{10}$ $\qquad$ $\tau_{11} = b_3 k_{11} + c_1 \phi_{11}$

$\tau_{12} = b_3 k_{12} + c_1 \phi_{12}$ $\qquad$ $\tau_{13} = b_3 k_{13} + c_1 \phi_{13}$

$\tau_{14} = b_3 k_{14} + c_1 \phi_{14}$ $\qquad$ $\tau'_0 = c'_0 - b'_3 k_0 + c'_1 \phi'_0$

$\tau'_1 = 1 - b'_3 - b'_3 k_2 + c'_1 \phi'_1$ $\qquad$ $\tau'_2 = b'_3 - b'_3 k_1 + c'_1 \phi'_2$

$\tau'_3 = c'_1 \phi'_3 - b'_3 k_4 - 1$ $\qquad$ $\tau'_4 = -b'_3 k_3 + c'_1 \phi'_4$

$\tau'_5 = -b'_3 k_6 + c'_1 \phi'_5$ $\qquad$ $\tau'_6 = -b'_3 k_5 + c'_1 \phi'_6$

$\tau'_7 = -b'_3 k_8 + c'_1 \phi'_7$ $\qquad$ $\tau'_8 = -b'_3 k_7 + c'_1 \phi'_8$

$\tau'_9 = -b_3 k_9 + c'_1 \phi'_9$ $\qquad$ $\tau'_{10} = 1 - b'_3 k_{11} + c'_1 \phi'_{10}$

$\tau'_{11} = -b'_3 k_{10} + c'_1 \phi'_{11}$ $\qquad$ $\tau'_{12} = -b'_3 k_{13} + c'_1 \phi'_{12}$

$\tau'_{13} = -b'_3 k_{12} + c'_1 \phi'_{13}$ $\qquad$ $\tau'_{14} = -b'_3 k_{14} + c'_1 \phi'_{14}$

Notice that all the coefficients of the domestic interest rate equation are divided by c_2. The coefficients of the foreign interest rate equation are divided by c'_2.

CHAPTER 4

SOME PRELIMINARY CONSIDERATIONS FOR EMPIRICAL IMPLEMENTATION OF THE MODEL

4.1 INTRODUCTION

The objective of this chapter is to make the model presented in chapter 3 applicable for empirical implementation. Many of the empirical features of P.P.P. discussed in the survey of the literature are necessary for the estimation. It was argued, for instance, that a GDP implicit deflator is the optimal price measure. Some other ingredients necessary for the empirical implementation of the model need elaboration.

In what follows, the question of the standard country, the time period, the sample of domestic and rest of the world countries, some additional reasons for the choice of the price index and the treatment of the expected variables are discussed.

4.2 THE STANDARD COUNTRY

The usual standard country used in the empirical work concerning P.P.P. is the United States.

Sometimes the United Kingdom or West Germany have been used. However, the selection of any unique standard country has the disadvantage of permitting only tests of models in which variable movements pertain only to the domestic vis-à-vis the standard country. Such bilateral tests are generally weak, since they do not consider all the economies involved in the domestic country's trade and payments.

The optimal standard country should be one with which the domestic country's trade and payments links are the strongest. Thus, the influence of economic developments abroad should be represented by indices for the effective exchange rate, real income, prices, the interest rate, real government spending and nominal money balances in the rest of the world.

Given that the concept of the effective exchange rate is applied to the analysis, the standard currency is replaced by appropriately weighted averages of the currencies of the domestic country's main partners in trade and payments[1].

Let ΓE_A be the multilateral exchange rate for

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[1] The methodology used in this section is due to Pentti Kouri (1978).

currency A (number of units of domestic currency per unit of foreign currency), E_{AB} the exchange rate between currency A and currency B (number of units of currency A per unit of currency B) and W_{AB} the weight of currency B in the multilateral exchange rate for currency A. Then, by definition,

$$FE_A = \Pi_B E_{AB}^{W_{AB}}, \text{ where } \sum_B W_{AB} = 1 \text{ and } W_{AA} = 0$$

A geometric (rather than arithmetic) average is used to construct the multilateral exchange rate because of its properties of reversibility and symmetry; in this case, interchangeability of currencies A and B. Assuming orderly cross rates involving the US dollar,

$$FE_A = \Pi_B (E_{A\$}/E_{B\$})^{W_{AB}} = e.\exp(\ln E_{A\$} - \sum_B W_{AB} \ln E_{B\$})$$

or

$$\ln FE_A = \ln E_{A\$} - \sum_B W_{AB} \ln E_{B\$}$$

According to the previous notation (lower case letters stand for the logarithm of a variable):

$$(fe)_A = e_{A\$} - \sum_B w_{AB} e_{B\$}$$

where \$ denotes the US dollar.

An advantage of this formulation is that (fe) can be calculated from exchange rate data involving the US dollar alone. Another advantage is that there is no standard country which does not receive a test for itself as the domestic country. The dollar, which is the numeraire currency, is treated symmetrically with the other currencies and the US is the subject of its own multilateral exchange rate computations. The multilateral exchange rate for the US will be

$$FE_{\$} = e.\exp(-\sum_B w_{\$B} \ln E_{B\$})$$

or

$$(fe)_{\$} = - \sum_B w_{\$B} e_{B\$}$$

By itself the multilateral exchange rate, FE, has no easy intuitive interpretation. It is a mixture of different currency units and corresponds to no exchange rate quoted on the open market. Only when it is judged with respect to some benchmark data is it a useful concept. Let FE_{A0} be a benchmark multilateral exchange rate for some past data, say 1975. Then the effective nominal exchange rate at period N can be defined as

$$FE_{AN} = FE_A/FE_{A0}$$

This effective exchange rate index measures how country A's nominal exchange rate has changed against the other trading partners relative to some base year (1975). A disadvantage is that this specification does not take competition in third markets into account, third markets being mainly countries with inconvertible currencies -- socialist or less developed -- that cannot be meaningfully included in the multilateral comparison.

The rest of the world prices and interest rate variables are weighted indices of the corresponding variables of the countries that have the strongest trade and financial linkages with the domestic countries. The specification of the rest of the world (foreign) price is as follows:

$$FP_{AN} = \Pi_B P_{BN}^{W_{AB}} = e.\exp(\textstyle\sum_B W_{AB}\ \ln P_{BN})$$

or

$$(fp)_{AN} = \textstyle\sum_B W_{AB}\ p_{BN}$$

where FP_{AN} is the foreign price corresponding to country A, in period N relative to period 0.

The foreign energy price is constructed in a similar way.

The index of the foreign interest rates must be calculated in the same way to allow for the possibility of interest rate parity in the long run. Thus,

$$(fr)_A = \textstyle\sum_B W_{AB} r_B$$

where r_B is the nominal interest rate on short-term government securities in country B.

The income and government spending variables were transformed into real terms by deflating their nominal values by the implicit GDP deflator. The indices of foreign real government expenditure, money supply and real income do not require a weighting scheme, since only the sum of real government expenditures, money supplies and real incomes in all foreign countries is of interest. Magnitudes are expressed in terms of the domestic currency.

P.P.P. theory concerns prices and production within the boundaries of respective countries. Thus, GDP is the preferred concept for the income variable, rather than GNP, since it covers domestic rather than national production. In practice, P.P.P. computations on a GNP basis differ very little from those on a GDP basis.

4.3 THE TIME PERIOD AND THE SAMPLE OF DOMESTIC AND FOREIGN COUNTRIES

The model is tested using the 42 seasonally adjusted quarterly observations over the period 1973I-1983II. This period is one of floating exchange rates though there was some intervention by the central banks of the major countries.

Since a large country model is used, regressions are performed for France, Germany, Japan, the UK and the US in the role of the domestic country. These are the largest noncommunist industrial countries according to the OECD, in terms of gross national products and of participation in world trade. The selection of these countries is in agreement with the theoretical definition of a large country, since a change in some of the domestic exogenous variables will affect the foreign variables.

The selection of the base year deserves particular attention. The base year should be one which involves exchange market stability so that P.P.P. computations (under the ideal conditions of purely monetary changes) would neither give rise to a disequilibrium nor perpetuate one. Exchange rate controls and severe trade restrictions should be absent. If exchange rates are flexible, they should be relatively stable during the period. If these are fixed or managed floating rates, balance of payments deficits or surpluses should be neither large nor persistent. Even more important, expectations of major changes in domestic and/or foreign economies should be absent, or at least occur without a considerable effect on the exchange market.

The above considerations are quite important for the weighting patterns. The weights should be calculated during a period of relative stability in the exchange rate market. In brief, there should be a reasonable approximation to ongoing exchange market equilibrium in the base period.

The base period selected is 1975. The weights are an arithmetic average of the weights calculated for the first quarter of 1973 and the last quarter of 1975.

In 1975 small trade deficits or surpluses were observed and exchange rates were kept relatively stable. Expectations that major changes in economies would seriously affect the foreign exchange market were minimal. After 1976, fluctuations of the exchange rates were excessively high. In addition, data are published with 1975 as a base and thus the selection of the year facilitates computations.

The first observation period of the sample (1973I) was also chosen for calculating the weights, since it is a period of relative stability, despite the fact that it is only the beginning of the flexible exchange rate period. Furthermore, it is the only reasonably stable quarter available before the first oil shock.

During the first quarter of 1973, sixteen months after the formal suspension of gold convertibility, many countries abandoned the attempt to maintain fixed exchange rates against the dollar. In the latter part of 1972, there were already signs that the Smithsonian realignment was beginning to affect the trade balances in real terms of the three major participants -- the U.S., Japan and Germany. There were encouraging movements toward equilibrium in these countries in the first quarter of 1973.

The US trade deficit, which was still at an annual rate of $6.75 billion in the fourth quarter of 1972, was almost halved in the first quarter of 1973. The Japanese trade surplus was cut from an annual rate of $9 billion in the fourth quarter of 1972 to $6 billion in the first quarter of 1973. "There has been a concession at least among the economic authorities in major countries that the set of rates which emerged in the beginning of 1973 was 'about right'"[2].

The weight W_{AB} is taken as proportional to the value of merchandise trade (exports plus imports of country B relative to country A[3]. Ideally, FE_{AN} is

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[2] See the publication of OECD, "Economic Outlook," July 1973, p. 13.

[3] Previous studies have used trade weights to construct foreign indices. Asset weights might make more sense for the foreign interest rate; the effective exchange rate could be constructed using both asset and trade weights. However, data problems render this task impossible.

the hypothetical uniform proportionate change in the value of currency A vis-à-vis all other currencies (all B), from the base to the current period, that would have the same effect on country's A balance of payments as the actual set of exchange rate changes EF_{BN} for all B. Thus, an optimal computation of the effective exchange rate can be achieved, if the weights are obtained from a model with parameters that indicate the effects of changes in the relative values of the currencies of all other countries on each country's balance of payments. Econometric modelling of this kind can yield weights that enable the construction of foreign variables that are closest to the ideal concept. However, such modelling is infeasible, given the necessarily limited scope of this thesis. A trade weighted concept provides an inferior pattern to one derived from a correctly specified and appropriately estimated model but is the best of the the feasible alternative schemes.

Table 4.1 describes the weighting pattern of the foreign variables for each country. A measure of the quality of foreign variables for a given country is the proportion of the country's total world trade accounted for by the countries with some weight in the indices. This measure, called "coverage", has two

TABLE 4.1

WEIGHTING PATTERNS

Country	Coverage[a]	Weighting Pattern
France	(.629, .715)	.008 Austria + .008 Australia + .160 Belgium + .012 Canada + .297 Germany + .148 Italy + .019 Japan + .086 Netherlands + .024 Sweden + .058 Switzerland + .084 UK + .092 USA
Germany	(.648, .719)	.050 Austria + .011 Australia + .126 Belgium + .013 Canada + .192 France + .126 Italy + .025 Japan + .178 Netherlands + .043 Sweden + .056 Switzerland + .061 UK + .115 USA
Japan	(.396, .514)	.003 Austria + .141 Australia + .015 Belgium + .085 Canada + .026 France + .063 Germany + .015 Italy + .021 Netherlands + .011 Sweden + .019 Switzerland + .054 UK + .543 USA
UK	(.543, .612)	.017 Austria + .047 Australia + .069 Belgium + .068 Canada + .119 France + .159 Germany + .055 Italy + .042 Japan + .111 Netherlands + .073 Sweden + .059 Switzerland + .178 USA
USA	(.545, .659)	.003 Austria + .024 Australia + .032 Belgium + .395 Canada + .047 France + .096 Germany + .046 Italy + .194 Japan + .048 Netherlands + .015 Sweden + .018 Switzerland + .076 UK

[a] Trade with countries included in weighting pattern as a proportion of the domestic country's total trade. First entry refers to 1973I and second entry to 1975IV.

entries in Table 4.1. The first refers to 1973I and the second to 1975IV. The coverage is always lower in 1973I than in 1975_{IV}. The major reason is that after the first oil shock industrial countries increased considerably their expenditures on oil imports and consequently there were increased exports to the oil producing countries in 1975. Since only "relative trade" among the sample countries is relevant, there is no bias in the weighting patterns. The oil crisis of the 1970s could not have any significant effect on their relative trade because all countries in the sample are industrial. However, both periods (before and after the oil shock) are used to construct the weights.

4.4 THE PRICE INDEX

Many different price indices have been used in various studies, but it was argued in chapter 2 that the least deficient indices are the CPI and the implicit GDP deflator, with the latter the best, since the CPI is a partial measure of price level adjustments. Here, two theoretical arguments in favour of the implicit deflator and some additional empirical reasons are given.

One theoretical argument is on the production and the other on the consumption side of the economy. On the production side it can be argued that a unit-factor-cost measure is the most appropriate one (Houthakker, 1962, p. 293). Under certain assumptions, a unit-factor-cost concept of P.P.P. is equivalent to a P.P.P. based on price levels that are production weighted averages of commodity prices in each country, implying an implicit price level measure (Officer, 1974, p. 871). However, for equivalence with a CPI concept of P.P.P., which implies the use of household consumption weights in the construction of price levels, additional and more stringent assumptions are required (Officer, 1976, p. 12).

On the consumption side, to the extent that the P.P.P. theory is justified by the existence of arbitrage and substitutability of commodities in consumption, the price concept should be as comprehensive as possible. Thus, an implicit deflator, encompassing all output of the economy, is preferred to a CPI measure which restricts pricing to those goods and services purchased by households.

Furthermore, implicit deflators are more likely to be comparable among countries since they are often constructed within a common accounting framework, in particular the U.N. System of National Accounts. However, their application is of limited extent, since there have not been enough data points for empirical work, particularly on a quarterly basis.

The price index is an important variable in the model. There are two price equations, but also prices enter the other equations of the system as well. Though there were strong reasons to support the use of an implicit GDP deflator measure, the model was estimated initially using the implicit deflator, the CPI and the WPI, three of the most commonly used indices.

Preliminary estimation indicated that the best fit was obtained with the implicit deflator and the worst one with the WPI, for all countries [4]. The CPI performed slightly better than the implicit deflator only for the UK and the US.

Moreover, since the model has some lagged dependent variables, the characteristic equation of the system was derived after estimation [5]. When the implicit deflator price indices were used, the characteristic roots were found stable for all countries except the UK and the US. Hence, the implicit deflator was used for France, Germany and Japan and the CPI for the UK and the US.

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4 This judgement was based on the usual statistics and on some signs not supported by the theory.

5 In chapter 5 the characteristic equations and their roots are given.

4.5 THE TREATMENT OF THE EXPECTED VARIABLES

It was argued in the previous chapter that the assumption of rational expectations is consistent with the model. An ideal treatment of rational expectations in the empirical implementation of the model would be the following:

Given equations (3.15) to (3.18b) one would write down some arbitrary trial solutions for the endogenous variables. Then the method of undetermined coefficients could be applied to eliminate the expected terms and estimate the resulting model subject to the rational expectations cross-equation restrictions, using full information maximum likelihood (FIML). These restrictions would yield estimates of the coefficients of the expected terms (unobservable variables).

The use of the cross-equation restrictions, which are expressed in terms of the structural parameters of the model, implies that the agents know and apply the structure of the economy in forming their expectations.

This procedure has been applied only with very simple models that have only one expected variable and a less complicated structure. In our case, it was not possible to solve, even algebraically, the model after this procedure was applied because the cross-equation restrictions were complicated nonlinear expressions and not in reduced form. Even after some brave assumptions which, in principle, allowed solution of the model (given the restrictions), it was impossible to differentiate by computer such a complicated and space consuming system. In fact, because of the restrictions even an iterative scheme asymptotically equivalent to FIML would require a great deal of computation.

It is the computational requirements of the restricted FIML that have directed so much effort in recent years into the development of alternative procedures. McCallum (1976) has referred to any rational expectation estimation procedure which does not impose the rational expectation restrictions as being only "partially rational". If the restrictions are imposed in the maximum likelihood procedures, they are said to be "fully rational". Following McCallum (1976), use is made of an instrumental method approach to provide consistent estimates of the equations of the model involving expectations which are in fact formed rationally. The expectational variables of the model are expected domestic price, expected foreign price and expected exchange rate[6].

Ordinary least square regressions of domestic price (P), foreign price (FP), and exchange rate (FE) on the predetermined variables of the system are performed. Several combinations of variables, which were used to compute the instrumental variables, were tried as predetermined in the first stage regressions, but here only those that gave the best fit are reported.

The resulting estimates are given in Tables 4.2, 4.3, and 4.4. The previous notation used in the model, in which the superscripts A and B denoted the domestic and foreign variables, is abandoned. Now, the first character in each symbol stands for the country (F for France, G for Germany, J for Japan, E for UK and U for US). The variable name is the last character in each symbol, and it keeps the same meaning as in chapter 3, though the lower case letters are replaced with capital letters. A character X denotes an expected variable. A letter F preceding the character

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6 Estimates of expected prices and exchange rate may also be generated using interest rate term structure and the forward exchange rate as proxies of expected prices and exchange rate. However, forward markets do not exist for some of the countries included in the weighting pattern of Table 4.1. Furthermore, our treatment of the expected variables is more consistent with rational expectations.

TABLE 4.2

FIRST STAGE REGRESSIONS USED TO CREATE INSTRUMENTS FOR DOMESTIC EXPECTED PRICE VARIABLES

Explanatory Variables	ENDOGENOUS FP_t	GP_t	JP_t	EP_t	UP_t
Constant		.7005 (.1738)	.5763 (.1011)	-2.2757 (.7284)	.0685 (.0635)
P_{t-1}	.8906 (.0254)	.8462 (.0391)	.7908 (.0548)	.3665 (.1469)	.9815 (.0523)
P_{t-2}		.1011 (.0789)			
P_{t-3}		-.2326 (.0682)			
M_{t-1}					.1285 (.0404)
M_{t-3}				-.2699 (.0849)	
G_{t-3}				.2354 (.0720)	
OP_{t-2}	-.0046 (.0016)	.0156 (.0083)			
FP_{t-1}				1.1426 (.3455)	-.2353 (.0553)
FM_{t-1}	.0389 (.0095)		.0515 (.0218)		
FM_{t-2}		-.0672 (.0448)			
FM_{t-3}		.1395 (.0404)		1718 (.0557)	
FG_{t-1}					.0442 (.0097
FOP_{t-1}	.0544 (.0120)				.0362 (.0131)
FOP_{t-2}			.0030 (.0027)		
STATISTICS					
$\bar{R}^2$	.9999	.9968	.9969	.9980	.9995
SE	.0061	.0065	.0081	.0011	.0054
DW	1.9225	2.0081	1.9234	1.9468	2.0045
h	.2418	-.0257	.2508	.3875	-.0146

TABLE 4.3

FIRST STAGE REGRESSIONS USED TO CREATE INSTRUMENTS FOR FOREIGN EXPECTED PRICE VARIABLES

Explanatory Variables	ENDOGENOUS				
	FFP_t	GFP_t	JFP_t	EFP_t	UFP_t
Constant	.3191 (.0490)	.1665 (.0193)		.1214 (.0200)	.1153 (.0127)
FP_{t-1}	.6929 (.0309)	.9138 (.0108)	.7894 (.0824)	.9779 (.0044)	.6129 (.0753)
FP_{t-2}			.1921 (.0871)	-.0232 (.0053)	.2256 (.0727)
FM_{t-3}	.0733 (.0189)				
FG_{t-3}	-.0625 (.0277)				
FOP_{t-1}		.0553 (.0075)			
FOP_{t-2}	.0278 (.0054)				
P_{t-1}	.2381 (.0232)		.2200 (.0840)		.3633 (.0742)
P_{t-2}	-.0248 (.0049)	-.0129 (.0048)	-.1965 (.0887)		-.2207 (.0720)
P_{t-3}	-.0963 (.0221)				
M_{t-2}		.0106 (.0039)		.0247 (.0055)	
STATISTICS					
$\bar{R}^2$	.9999	.9999	.9999	.9998	.9998
SE	.0030	.0043	.0069	.0030	.0026
DW	1.9947	1.9403	2.1550	2.0251	1.8092
h	.0166	.2480	-.5546	-.0774	.6641

TABLE 4.4

FIRST STAGE REGRESSIONS USED TO CREATE INSTRUMENTS FOR EXPECTED EXCHANGE RATE VARIABLES

Explanatory Variables	ENDOGENOUS FFE_t	GFE_t	JFE_t	EFE_t	UFE_t
Constant	10.2397 (.8017)		-1.1580 (.4873)	6.9358 (.3756)	.9977 (.2202)
FE_{t-1}		.9930 (.0289)	.7423 (.1108)		.7966 (.0449)
FE_{t-2}	-.0135 (.0093)	-.0529 (.0473)		-.1076 (.0364)	
P_{t-1}	-.2647 (.1365)				
P_{t-2}		.0545 (.0479)		.1174 (.0401)	
P_{t-3}				.0086 (.0026)	
M_t	1.3018 (.1617)	.3246 (.0478)	.1726 (.0083)	.4160 (.0307)	
M_{t-1}		-.3391 (.0441)	-.1246 (.0223)		
OP_t					-.0323 (.0071)
FM_t	-1.4253 (.3171)	-.2876 (.1176)	-.1098 (.0215)	-.4628 (.0534)	-.3700 (.0174)
FM_{t-1}		.3022 (.1092)	.0684 (.0267)		.3485 (.0198)
FOP_{t-1}				-.1429 (.0289)	.0557 (.0115)
STATISTICS					
$\bar{R}^2$	.9848	.9999	.9997	.9992	.9992
SE	.0402	.0010	.0022	.0086	.0044
DW	1.8426	1.8224	1.9533	1.5210	2.0005
h	.4859	0.5563	.1972	1.5150	-.0016

that stands for the variable, denotes a foreign variable. The symbol FE is retained for the effective exchange rate. Again, all variables are in logarithms except for the domestic and foreign interest rates.

The figures in parentheses below the coefficients are their respective standard errors. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom. The standard error of the regression is represented by SE. Dubrin-Watson statistic is reported for all equations. The Durbin h statistic is given for detecting autocorrelation in the presence of lagged dependent variables.

The estimates are quite plausible. The t statistics[7] are reasonably large. Only seven out of eighty-four t statistics are insignificant at the 5 percent level, and then only slightly. The adjusted correlation coefficients are high, indicating respectable goodness-of-fit, and the Durbin h statistic is not at all suggestive of autocorrelation, since at the 5 percent level of significance the critical value of the normal distribution is 1.645.

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[7] We use the term to refer to the (implied) absolute values of the ratios of the parameter estimates to their standard errors.

Thus, the null hypothesis of no serial correlation for any of those equations cannot be rejected.

The expected variables enter the equations of the model with the operator $E_t(E_tP_{t+1}, E_te_{t+1})$. The information set includes period t which implies that when the agents form their expectations they already know the current variables. Thus, current exogenous variables are included among the predetermined variables. Notice that some of them test as significant in the exchange rate equation, but they are dropped from the price equations because they do not add anything to the explanatory power of these equations and they test as insignificant.

These latter results are not surprising, given the slow adjustment of goods prices. The exchange rate is assumed to be determined in the asset market and it includes a greater proportion of future information than do prices. Asset prices depend usually more strongly than goods prices on expectations, and thus they are more sensitive to new information which alters expectations about the future.

The multivariate least squares regressions of P, FP and FE on various sets of predetermined variables of the system yield consistent estimates of $\hat{P}$, $F\hat{P}$ and $\hat{FE}$ which may be used as proxies for the unobservable variables of our system (Wallis, 1980, pp. 66-67, and Revankar, 1980, p. 1360). The variables $\hat{P}$, $\hat{FP}$ and $\hat{FE}$ may not be efficient estimators since they do not make use of the rational expectation restrictions; if FIML estimates of the structural parameters were used, they would provide more efficient estimates. But as long as what we are chiefly interested in is a consistent proxy for the unobservable variables, the regressions outlined are adequate (Begg, 1982, pp. 107-110). The first stage regressions are used to estimate the complete model in the chapter that follows.

4.6 CONCLUSIONS

Given the reduced form of the model, two important questions have to be answered: what variables are to be used as rest of the world variables; and how the expectational variables are to be treated. The first question was answered by aggregating over the major trade partners of each individual country. The effective exchange rate was constructed with trade weights and other foreign variables were treated symmetrically.

The unobservable variables were estimated by the method of instrumental variables. The instruments were determined empirically after some experimentation with different predetermined variables.

The questions of the choice of a standard country, the sample of domestic and foreign coutries and the time period were also examined. The time period is the floating exchange rate period of the 1970s and early 1980s and the domestic countries chosen are the largest five OECD industrial countries.

APPENDIX 4A

TESTING THE CAPACITY OUTPUT ASSUMPTION

Capacity output has been defined in chapter 3 as a function of the price of energy relative to domestic output (RP) and a time trend. The validity of this assumption is tested below with simple ordinary least squares corrected for first-order serial correlation. Output is regressed on a time trend and the price of energy relative to the price of domestic output. Symbols, statistics and the sample period have already been defined in chapter 4. (ρ stands for the first-order autocorrelation coefficient.)

FRANCE:

$$FY_t = \underset{(.0226)}{2.6521} + \underset{(.0008)}{.0052}\,TIME + \underset{(.0352)}{.0156}\,FRP_t$$

$$\bar{R}^2 = .9928; \quad DW = 1.5175; \quad \rho = \underset{(.0865)}{.8216}$$

GERMANY:

$$GY_t = \underset{(.0343)}{2.3377} + \underset{(.0013)}{.0028}\,TIME + \underset{(.0226)}{.0146}\,GRP_t$$

$$\bar{R}^2 = .9841; \quad DW = 1.7527; \quad \rho = \underset{(.0704)}{.8682}$$

JAPAN:

$$JY_t = \underset{(.0182)}{7.2247} + \underset{(.0008)}{.0108}\,TIME - \underset{(.0224)}{.0537}\,JRP_t$$

$$\bar{R}^2 = .9995; \quad DW = 1.8019; \quad \rho = \underset{(.0839)}{.8402}$$

UK:

$$EY_t = -.1364 + \underset{(.0009)}{.0074}\ \text{TIME} - \underset{(.1228)}{.2256}\ ERP_t$$
$$\quad\ (.0181)$$

$$\bar{R}^2 = .7438; \qquad DW = 1.8934; \qquad \rho = \underset{(.1348)}{.5383}$$

US:

$$UY_t = 2.7187 + \underset{(.0013)}{.0059}\ \text{TIME} - \underset{(.0233)}{.0437}\ URP_t$$
$$\quad\ (.0338)$$

$$\bar{R}^2 = .9903; \qquad DW = 1.6373; \qquad \rho = \underset{(.0574)}{.9051}$$

The results are encouraging. The time trend is highly significant for all countries. The price of energy relative to the price of domestic output has a negative and significant coefficient in three of the five countries (significant at the 5 percent level); in the case of France and Germany, the coefficient is positive but insignificant. The fit of the regressions is good and the Durbin-Watson statistics satisfactory.

APPENDIX 4B

TESTING THE ASSUMPTION OF RANDOM WALK

The model assumes that the exogenous variables follow a random walk. Here, this assumption is tested by a procedure used by Driskill and Sheffrin (1981). Each variable is regressed on a constant and on its first lag. It is then regressed on a constant and on its first and second lags, and finally on a constant and on its first, second and third lags. The objective is to see if the coefficient of the first lagged variable is close to unity and if additional lags are significant. The test is useful because it throws some light on the lag structure of the exogenous variables. Symbols, statistics and the sample period have already been defined.

MONEY SUPPLIES

FRANCE: $FM_t = .3000 + .9469\ FM_{t-1}$

$\qquad\qquad(.1633)\ (.0305)$

$\bar{R}^2 = .9559; \quad DW = 1.9277; \quad h = .2272$

$$FM_t = .4102 + .9015\ FM_{t-1} + .0254\ FM_{t-2}$$
$$(.1617)\quad (.0346)\qquad\qquad (.0206)$$
$$\bar{R}^2 = .9601; \quad DW = 2.0263; \quad h = -.0829$$

$$FM_t = .4482 + .8929\ FM_{t-1} + .0203\ FM_{t-2} + .0068\ FM_{t-3}$$
$$(.1741)\quad (.0376)\qquad\qquad (.0135)\qquad\qquad (.0110)$$
$$\bar{R}^2 = .9595; \quad DW = 2.0234; \quad h = -.0741$$

GERMANY: $$GM_t = .2682 + .9573\ GM_{t-1}$$
$$(.1727)\quad (.0295)$$
$$\bar{R}^2 = .9657; \quad DW = 1.8531; \quad h = 0.4535$$

$$GM_t = .4116 + .9039\ GM_{t-1} + .0296\ GM_{t-2}$$
$$(.1839)\quad (.0356)\qquad\qquad (.0207)$$
$$\bar{R}^2 = .9578; \quad DW = 1.9748; \quad h = .0796$$

$$GM_t = .3645 + .9135\ GM_{t-1} + .0354\ GM_{t-2} - .0075\ GM_{t-3}$$
$$(.1966)\quad (.0384)\qquad\qquad (.0238)\qquad\qquad (.0111)$$
$$\bar{R}^2 = .9576; \quad DW = 1.9725; \quad h = .0872$$

JAPAN: $$JM_t = .1789 + .9764\ JM_{t-1}$$
$$(.1791)\quad(.0277)$$
$$\bar{R}^2 = .9688;\quad DW = 1.9429;\quad h = .1786$$

$$JM_t = .2538 + .9496\ JM_{t-1} + .0157\ JM_{t-2}$$
$$(.1883)\quad(.0327)\quad(.0100)$$
$$\bar{R}^2 = .9690;\quad DW = 1.9579;\quad h = 0.1328$$

$$JM_t = .2376 + .9530\ JM_{t-1} + .01791\ JM_{t-2} - .0032\ JM_{t-3}$$
$$(.1990)\quad(.0352)\quad(.01220)\quad(.0102)$$
$$\bar{R}^2 = .9681;\quad DW = 1.9601;\quad h = .1259$$

UK: $$EM_t = .1319 + .9759\ EM_{t-1}$$
$$(.1565)\quad(.0331)$$
$$\bar{R}^2 = .9698;\quad DW = 2.0128;\quad h = -.0403$$

$$EM_t = .1792 + .9550\ EM_{t-1} + .0113\ EM_{t-2}$$
$$(.1701)\quad(.0393)\quad(.0109)$$
$$\bar{R}^2 = .9702;\quad DW = 2.0130;\quad h = -.0413$$

$$EM_t = .1359 + .9686\ EM_{t-1} + .0165\ EM_{t-2} - .0101\ EM_{t-3}$$
$$(.1687)\quad(.0401)\quad(.0126)\quad(.0111)$$
$$\bar{R}^2 = .9698;\quad DW = 2.0083;\quad h = -.0264$$

US:

$$UM_t = .0298 + .9995\ UM_{t-1}$$
$$(.0426)\quad (.0058)$$
$$\bar{R}^2 = .9989; \qquad DW = 1.9827; \qquad h = .0534$$

$$UM_t = .03837 + .9968\ UM_{t-1} + .0015\ UM_{t-2}$$
$$(.0429)\quad (.0066)\quad (.0019)$$
$$\bar{R}^2 = .9992; \qquad DW = 1.9832; \qquad h = .0518$$

$$UM_t = .0671 + .9932\ UM_{t-1} - .0030\ UM_{t-2} + .0044\ UM_{t-3}$$
$$(.0451)\quad (.0068)\quad (.0025)\quad (.0028)$$
$$\bar{R}^2 = .9989; \qquad DW = 2.0064; \qquad h = -.0197$$

GOVERNMENT EXPENDITURES

FRANCE:

$$FG_t = -.0412 + .9486\ FG_{t-1}$$
$$(.0527)\quad (.0737)$$
$$\bar{R}^2 = .8251; \qquad DW = 1.8967; \qquad h = .2882$$

$$FG_t = -.0486 + 1.0557\ FG_{t-1} - .1227\ FG_{t-2}$$
$$(.0478)\quad (.0827)\quad (.0752)$$
$$\bar{R}^2 = .8532; \qquad DW = 1.9455; \qquad h = .1952$$

$$FG_t = -.0414 + 1.0651\ FG_{t-1} - .1571\ FG_{t-2} + .0366\ FG_{t-3}$$
$$(.0507) \quad (.0861) \qquad (.0928) \quad (.0675)$$
$$\bar{R}^2 = .8489; \qquad DW = 1.9557; \qquad h = .1611$$

GERMANY: $$GG_t = .0174 + .7334\ GG_{t-1}$$
$$(.0230) \quad (.1019)$$
$$\bar{R}^2 = .5723; \qquad DW = 2.0965; \qquad h = -.3825$$

$$GG_t = .0182 + .5238\ GG_{t-1} + .2043\ GG_{t-2}$$
$$(.0263) \quad (.1529) \qquad (.1526)$$
$$\bar{R}^2 = .4760; \qquad DW = 2.0871; \qquad h = -.80375$$

$$GG_t = .0094 + 1.0176\ GG_{t-1} - .7625\ GG_{t-2} + .6742\ GG_{t-3}$$
$$(.0133) \quad (.1170) \qquad (.1583) \quad (.1127)$$
$$\bar{R}^2 = .8492; \qquad DW = 1.6959; \qquad h = 1.3534$$

JAPAN: $$JG_t = .0040 + .9642\ JG_{t-1}$$
$$(.0199) \quad (.0451)$$
$$\bar{R}^2 = .9236; \qquad DW = 1.9740; \qquad h = .0834$$

$$JG_t = .0024 + 1.0030\ JG_{t-1} - .0706\ JG_{t-2}$$
$$(.0188) \quad (.0831) \qquad (.0822)$$
$$\bar{R}^2 = .9334; \qquad DW = 1.9801; \qquad h = .0714$$

$$JG_t = -.0023 + 1.0132\ JG_{t-1} + .0333\ JG_{t-2} - .1007\ JG_{t-3}$$
$$\qquad (.0194) \qquad (.0833) \qquad (.1149) \qquad (.0822)$$
$\bar{R}^2 = .9325$; DW = 1.9856; h = .0517

UK: $$EG_t = -.1535 + .8043\ EG_{t-1}$$
$$\qquad (.0760) \qquad (.0987)$$
$\bar{R}^2 = .6878$; DW = 1.9856; h = .0559

$$EG_t = -.1312 + .9151\ EG_{t-1} - .0852\ EG_{t-2}$$
$$\qquad (.0703) \qquad (.1119) \qquad (.0717)$$
$\bar{R}^2 = .7186$; DW = 1.9785; h = .0915

$$EG_t = -.1368 + .8854\ EG_{t-1} - .1390\ EG_{t-2} + .0797\ EG_{t-3}$$
$$\qquad (.0759) \qquad (.1161) \qquad (.0880) \qquad (.0707)$$
$\bar{R}^2 = .6969$; DW = 2.0232; h = -.1024

US: $$UG_t = .0215 + .9872\ UG_{t-1}$$
$$\qquad (.0336) \qquad (.0261)$$
$\bar{R}^2 = .9885$; DW = 2.0863; h = -.2695

$$UG_t = .0278 + .9750\ UG_{t-1} + .0073\ UG_{t-2}$$
$$\qquad (.0354) \qquad (.0322) \qquad (.0112)$$
$\bar{R}^2 = .9877$; DW = 2.0901; h = -.2833

$$UG_t = .0243 + .9770\ UG_{t-1} + .0116\ UG_{t-2} - .0036\ UG_{t-3}$$
$$(.0372)\quad (.0330)\qquad (.0177)\qquad (.0114)$$
$\bar{R}^2 = .9877;$ DW = 2.0957; h = -.3013

ENERGY PRICES

FRANCE:

$$FOP_t = 1.5559 + .6864\ FOP_{t-1}$$
$$(.5336)\quad (.1086)$$
$\bar{R}^2 = .9768;$ DW = 1.7732; h = 1.1079

$$FOP_t = 2.2588 + .5307\ FOP_{t-1} + .0157\ FOP_{t-2}$$
$$(.6134)\quad (.1279)\qquad (.0110)$$
$\bar{R}^2 = .9726;$ DW = 1.6818 h = 1.5947

$$FOP_t = .8828 + .8385\ FOP_{t-1} + .0106\ FOP_{t-2} - .0279 FOP_{t-3}$$
$$(.4730)\quad (.1013)\qquad (.0107)\qquad (.0202)$$
$\bar{R}^2$ - .9792; DW = 1.9456; h = .2147

GERMANY:

$$GOP_t = .7845 + .8500\ GOP_{t-1}$$
$$(.2636)\quad (.0538)$$
$\bar{R}^2 = .8387;$ DW = 2.0995; h = -.3251

$$GOP_t = 3.2187 + .2146\ GOP_{t-1} + .1534\ GOP_{t-2}$$
$$(.4664)\quad (.0993)\qquad (.0238)$$
$\bar{R}^2 = .8244;$ DW = 1.6401; h = 1.4029

$$GOP_t = .1370 + 1.0039\ GOP_{t-1} + .0842\ GOP_{t-2} - .1522 GOP_{t-3}$$
$$(.1943)\quad (.0582)\qquad (.0262)\qquad (.0234)$$
$\bar{R}^2 = .9420;$ DW = 1.8644; h = .4478

JAPAN: $JOP_t = .5246 + .9005\ JOP_{t-1}$

$(.2055) \quad (.0423)$

$\bar{R}^2 = .9526; \quad DW = 2.1273; \quad h = -.4064$

$JOP_t = .6909 + .8493\ JOP_{t-1} + .0179\ JOP_{t-2}$

$(.2517) \quad (.0591) \quad (.0156)$

$\bar{R}^2 = .9514; \quad DW = 2.2560; \quad h = -.8478$

$JOP_t = 1.8500 + .5591\ JOP_{t-1} + .0320\ JOP_{t-2} + .0452\ JOP_{t-3}$

$(.4278) \quad (.0975) \quad (.0138) \quad (.0143)$

$\bar{R}^2 = .9292; \quad DW = 1.7765; \quad h = .8622$

UK: $EOP_t = .2037 + .9671\ EOP_{t-1}$

$(.0592) \quad (.0118)$

$\bar{R}^2 = .9931; \quad DW = 1.7726; \quad h = .7027$

$EOP_t = .2508 + .9427\ EOP_{t-1} + .0154\ EOP_{t-2}$

$(.0618) \quad (.0159) \quad (.0899)$

$\bar{R}^2 = .9933; \quad DW = 1.8819; \quad h = .45776$

$EOP_t = .2738 + .9359\ EOP_{t-1} + .0126\ EOP_{t-2} + .0052\ EOP_{t-3}$

$(.0710) \quad (.0186) \quad (.0080) \quad (.0071)$

$\bar{R}^2 = .9924; \quad DW = 1.8980; \quad h = .3164$

US: $$UOP_t = .3842 + .9317\ UOP_{t-1}$$
$$(.1721) \quad (.0342)$$
$$\bar{R}^2 = .9594; \qquad DW = 1.8254; \qquad h = .5505$$

$$UOP_t = 1.2140 + .7209\ UOP_{t-1} + .0485\ UOP_{t-2}$$
$$(.3491) \quad (.0738) \qquad (.0330)$$
$$\bar{R}^2 = .9486; \qquad DW = 1.8215; \qquad h = .6179$$

$$UOP_t = .4586 + .9006\ UOP_{t-1} + .0380\ UOP_{t-2} - .0215\ UOP_{t-3}$$
$$(.2211) \quad (.0551) \qquad (.0238) \qquad (.0144)$$
$$\bar{R}^2 = .9535; \qquad DW = 1.8180; \qquad h = .5965$$

The above regressions indicate that the assumption of random walk is generally supported by the data. The assumption holds better for money supplies and government expenditures than for energy prices. There are only four cases for which the assumption clearly seems not to hold. These are the cases of Germany's government expenditures and France's, Germany's and Japan's energy prices. Thus, the coefficient of the first lagged variable is close to unity and additional lags are not justified for the majority of the exogenous variables.

APPENDIX 4C

SOURCES AND USES OF DATA

The data consist of quarterly series and cover the period 1973I-1983II. Unless otherwise noted, all variables were taken in level form from the publication, International Financial Statistics of the International Monetary Fund and from the publication, Main Economic Indicators of the OECD. Variables entered into the regressions are the logarithms of these levels, with the exception of interest rates. Variables that were not seasonally adjusted, have been seasonally adjusted (before taking logarithms), using the adjustment routine incorporated in the TSP computer programme. The base year used is 1975.

EXCHANGE RATE

The spot exchange rate (the domestic currency in terms of US dollars) is used. Exchange rates are averages over the quarter for all countries.

SOURCE: IMF, International Financial Statistics, various issues.

INTEREST RATE

Interest rates that are indicative of a short-run time horizon are adopted. The Treasury Bill Rate (the rate at which short-term government paper is issued or traded in the market) is used for Canada, the UK and the US, while the Call Money Rate (the rate at which short-term borrowings are effected between financial institutions) is used for Belgium, France, Germany, Italy, Japan, the Netherlands and Sweden. The only short-term rate available for Australia, Austria and Switzerland was the short-term government bond yield. Interest rates are averages over the quarter.

SOURCE: IMF, International Financial Statistics, various issues.

EXPORTS AND IMPORTS

Quarterly data in US dollars on overall trade (exports and/or imports) by countries were used. Data are averages over the quarter.

SOURCE: OECD, Statistics of Foreign Trade, various issues.

PRICE OF ENERGY

The price of oil is used as a proxy for the price of energy. Data are averages over the quarter.

SOURCE: OECD, Main Economic Indicators, various issues.

MONEY SUPPLY

Money supply consists of the sum of money and quasi-money. Money equals the sum of currency and private sector demand deposits. Quasi-money consists of the time, savings and foreign currency deposits of residents. All data collected are seasonally adjusted at annual rates.

SOURCE: OECD, Main Economic Indicators, various issues.

GOVERNMENT EXPENDITURES

Data used are based on the United Nations System of National Accounts and are also given in the International Financial Statistics of the IMF, various issues. Data reported there are seasonally adjusted at annual rates, except for those of the UK, which were adjusted accordingly. Quarterly data for Austria, Belgium, Italy, the Netherlands, Sweden and Switzerland were not available. Quarterly interpolation from annual data was performed using a quadratic interpolation formula developed by Gandolfo (1981, pp. 114-118). The resulting data points were also seasonally adjusted at annual rates. Quarterly government expenditure data for France were available only commencing in 1978. The observations before 1978 were constructed by quarterly interpolation from annual data.

SOURCE: IMF, International Financial Statistics, various issues.

GROSS DOMESTIC PRODUCT

Data for the GDP reported in the International Financial Statistics of the IMF and in the Main Economic Indicators of the OECD are based on the UN System of National Accounts. Data reported in those two publications are seasonally adjusted at annual rates, except for those of Italy and the UK, which were adjusted accordingly. GDP data for France were available only commencing in 1978. The observations before 1978 and the GDP variables of Austria, Belgium, the Netherlands, Sweden and Switzerland were constructed by quarterly interpolation from annual data. Only GNP data were available for Germany on a quarterly basis. However, GDP data were obtained by subtracting net factor payments from abroad. Data for Australia, Italy, the UK and Germany are taken from the Main Economic Indicators of the OECD. Data for Austria, Belgium, Canada, France, Japan, the Netherlands, Sweden, Switzerland and the US are taken from the International Financial Statistics of the IMF.

SOURCES: IMF, International Financial Statistics, various issues.

OECD, Main Economic Indicators, various issues.

PRICE DEFLATOR

The implicit GDP price deflators for Australia, Canada, Germany, Italy, Japan, the UK and the US are taken from the Main Economic Indicators of the OECD. The price deflator for France is obtained by dividing quarterly GDP data in current prices by quarterly GDP data in constant prices. The price deflators for Austria, Belgium, the Netherlands, Sweden and Switzerland are constructed as follows. First, we divide annual GDP data in current prices by annual GDP data in constant prices. Then, the annual GDP price deflator data are interpolated by quarterly changes in the consumer price index. GDP data at constant prices and the consumer price index were obtained from the International Financial Statistics of the IMF.

SOURCES: IMF, International Financial Statistics, various issues.

OECD, Main Economic Indicators, various issues.

CONSUMER AND WHOLESALE PRICES

Consumer price indices as reported in line 64 and wholesale price indices as reported in line 63 of the International Financial Statistics of the IMF were used. Consumer and wholesale prices are averages over the quarter.

SOURCE: IMF, International Financial Statistics, various issues.

CHAPTER 5

ECONOMETRIC ESTIMATION OF THE MODEL

5.1 INTRODUCTION

The next task is to estimate the model. The model is estimated as a system of equations using Zellner's seemingly unrelated regression method.

Both restricted and unrestricted estimates of the model are reported and the proposition that P.P.P. holds is tested, using the log-likelihood ratio test. The validity of the assumption that the domestic and foreign coefficients are equal (apart from sign) is subsequently addressed. Conclusions relating to the notion of overshooting can easily be derived from the estimates.

5.2 METHOD OF ESTIMATION

To estimate the model quarterly time series data for France, Germany, Japan, the UK, the US and the countries that enter the foreign aggregates for these five are used for the period 1973I-1983II [1].

[1] See Sources and Uses of Data, Appendix 4C, for more details.

Given the treatment of expectations of the previous chapter, the reduced form equations (3.15), (3.16a), (3.16b), (3.17a), (3.17b), (3.18a), and (3.18b) can be estimated with a single-equation estimation technique. However, Zellner's (1962) seemingly unrelated regression procedure is used for two basic reasons:

First, there is evidence that the errors are strongly correlated across equations. Inspection of the reduced form equations indicates that many error terms are common across equations[2]. Another indication is the correlation among the individual error terms of the structural equations <u>via</u> the adding up constraints $u_{1t} + u_{2t} + w_t = 0$ and $u'_{1t} + u'_{2t} + w'_t = 0$, which were discussed in chapter 3. Furthermore, equations like $r^A_t - r^B_t = E_t e_{t+1} - e_t$, that link the markets between the domestic and the foreign countries (or between the endogenous variables) make the correlation even stronger among the equations.

On the empirical side, preliminary estimation

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[2] The error terms have been carried from the structural to the reduced form equations through the substitutions performed when solving for the endogenous variables.

by ordinary least-squares regression gave rather poor results. The standard errors of individual coefficients were far more satisfactory with Zellner's method, though the differences in the magnitudes of the coefficients were small.

Some equations had to be corrected for first-order serial correlation. The result was that the statistics of the rest of the equations of the system were affected due to the contemporaneous correlation of the errors.

Secondly, Zellner's seemingly unrelated regression procedure is asymptotically equivalent to a maximum likelihood estimation procedure and the log-likelihood ratio can be used to test the restrictions of the model. Since the homogeneity restrictions hold for the whole system, it is reasonable to test for them with a simultaneous equations system method.

Estimation with time series data is frequently subject to the problem of autocorrelation of equation errors. This is particularly true with quarterly data. Corrections for autocorrelation are made wherever it is necessary. However, a word of caution applies here, since the errors are contemporaneously correlated as well. The fact that the DW statistic is low in one equation does not necessarily imply that the source of autocorrelation is in that particular equation. Thus, after considerable experimentation, we end up with the results presented in Tables 5.1, 5.2, 5.3, 5.4, and 5.5.

The correction for autocorrelation substantially improved the results in the case of France. The correction was performed in two stages. First, a simple ordinary least square regression corrected for serial correlation with the Cochrane-Orcutt iterative procedure was performed. Then the estimated first-order autocorrelation coefficient (ρ) was used to transform the variables to quasi-first-differences for the particular equation for which ρ has been estimated. Finally, the whole system was estimated with the seemingly unrelated regression method and the transformed equations to the original form. The transformed equations are the French domestic and foreign output equations and the French exchange rate equation.

In some cases a time trend variable (TIME) was added. It improves the fit considerably and tests as highly significant. Moreover, the DW statistics were substantially improved. The time trend was added to Germany's and the UK's domestic and foreign interest rate equations, Japan's domestic interest rate equation and the US's domestic output and domestic and foreign interest rate equations.

5.3 ESTIMATION RESULTS AND INTERPRETATION

In this section estimates of the model, consisting of equations (3.15), (3.16a), (3.16b), (3.17a), (3.17b), (3.18a), and (3.18b), are given. An attempt also is made to provide an economic rationale for the econometric results.

Tables 5.1, 5.2, 5.3, 5.4, and 5.5 present the model estimation results for France, Germany, Japan, the UK and the US, with no restrictions imposed. The $\bar{R}^2$, DW and SE statistics that appear in the tables have already been defined. The names of the variables have also been defined. All variables contained in the first column of the tables are exogenous. The estimated first-order autocorrelation coefficient is represented by ρ and the value in brackets under it is its corresponding asymptotic standard error. L is the log-likelihood function of the system and χ^2 is the Chi-square statistic of the system. The number in parentheses after χ^2 stands for the degrees of freedom of the system.

TABLE 5.1

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE UNRESTRICTED MODEL FOR FRANCL

Explanatory Variables	ENDOGENOUS						
	FY_t	FFY_t	FR_t	FFR_t	FP_{t+1}	FFP_{t+1}	FFE_t
Constant	.2549 (.0886)	.0942 (.0919)	-.6234 (.5732)	.0402 (.3959)	2.7553 (1.1785)	-.5308 (.4692)	5.0453 (.6818)
FP_t	-.3313 (.2040)	-.0881 (.1756)	-.8175 (.3860)	-.7339 (.2628)	-.2901 (.1767)	-.0195 (.0733)	.4597 (.9076)
FFP_t	-.7837 (.4685)	-1.5577 (.3997)	-3.0772 (.5071)	-2.4466 (.3470)	-.8457 (.3034)	.4868 (.1231)	1.2486 (1.877)
FM_t	.1955 (.1175)	.1707 (.0996)	-.1905 (.1989)	.3368 (.1357)	.0377 (.0935)	-.0129 (.0381)	1.0065 (.4954)
FFM_t	.1672 (.1077)	.7073 (.0877)	.1158 (.1122)	-.0582 (.0765)	-.0139 (.0678)	.0887 (.0344)	-1.2705 (.3751)
FG_t	.8224 (.1160)	-.0727 (.0989)	-.0492 (.1952)	-.2417 (.1326)	.0375 (.1048)	-.0354 (.0409)	.4347 (.4998)
FFG_t	-.1709 (.1595)	-.0037 (.1328)	-.2595 (.2137)	-.2347 (.1441)	-.1186 (.0814)	-.0097 (.0358)	-.4960 (.6552)
FXP_t	.0897 (.1750)	-.0259 (.1494)	1.0376 (.3077)	1.0139 (.2115)	.8469 (.1596)	.0589 (.0680)	-.5674 (.7178)
$FFXP_t$	.6026 (.5201)	.9350 (.4420)	2.8829 (.5382)	1.9554 (.3688)	.8068 (.3114)	.3972 (.1465)	-1.2972 (2.0216)
FXE_t	.0444 (.0309)	.0255 (.0268)	.0341 (.0576)	-.0142 (.0401)	.0026 (.0250)	.0313 (.0099)	.1166 (.1281)
FOP_t					.0404 (.0187)		
$FFOP_t$						.0508 (.0074)	
TIME					.0149 (.0052)	-.0014 (.0020)	
STATISTICS							
$\bar{R}^2$	.9773	.9282	.7715	.8071	.9996	.9999	.8739
DW	1.9040	1.7161	1.1484	1.0578	2.1194	2.4651	1.9587
SE	.0086	.0076	.0130	.0092	.0050	.0021	.0349
	.8342 (.0861)	.7715 (.0995)					.5728 (.1280)

System's Statistics: L = 969.67, $\chi^2(67)$ = 845.64

TABLE 5.2

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE UNRESTRICTED MODEL FOR GERMANY

Explanatory Variables	ENDOGENOUS						
	GY_t	GFY_t	GR_t	GFR_t	GP_{t+1}	GFP_{t+1}	GFE_t
Constant	.9341 (.8636)	1.8402 (.3768)	4.1270 (.9671)	.0712 (.8489)	-.2494 (.3635)	.4448 (.3749)	2.6759 (.4685)
GP_t	-3.3022 (.5640)	-.9794 (.2461)	-2.8125 (.4833)	-2.4498 (.3614)	-.4089 (.1888)	.1142 (.2033)	-.2845 (.3059)
GFP_t	-.1044 (.2857)	-.5083 (.1246)	.3785 (.2590)	.2941 (.2028)	.3191 (.0927)	.7167 (.0785)	.5368 (.1550)
GM_t	.7290 (.0713)	.0200 (.0311)	-.1302 (.0618)	-.0111 (.0467)	.0555 (.0208)	.0082 (.0169)	.1613 (.0387)
GFM_t	.1010 (.1577)	.6409 (.0688)	.0443 (.1408)	.1009 (.1091)	-.0255 (.0500)	-.0125 (.0457)	.0388 (.0855)
GG_t	-.0034 (.0229)	-.0068 (.0099)	.0052 (.0190)	-.0012 (.0138)	.0063 (.0062)	-.0033 (.0048)	-.0081 (.0124)
GFG_t	.4037 (.3145)	.3677 (.1372)	.2383 (.2618)	-.2081 (.1905)	.1470 (.0857)	.0125 (.0656)	-.3003 (.1706)
GXP_t	2.0750 (.4564)	.5046 (.1991)	1.8836 (.3885)	2.2194 (.2887)	1.0919 (.1737)	.0564 (.1976)	-.0143 (.2476)
$GFXP_t$	.0508 (.1029)	.0988 (.0449)	-.06164 (.0858)	.0694 (.0625)	-.0359 (.0275)	-.0081 (.0212)	-.1736 (.0558)
GXE_t	.1871 (.1834)	.0046 (.0800)	-.3051 (.1551)	-.2002 (.1117)	.1420 (.0492)	-.0062 (.0384)	.4185 (.0995)
GOP_t					.0023 (.0056)		
$GFOP_t$						.0322 (.0190)	
TIME			.0065 (.0030)	-.0037 (.0031)	-.0026 (.0013)	.0056 (.1608)	

STATISTICS

$\bar{R}^2$	.9886	.9923	.7053	.7582	.9985	.9998	.9836
DW	1.2529	1.1514	1.2994	1.2896	1.8619	2.4537	1.7510
SE	.0172	.0075	.0143	.0104	.0045	.0035	.0093

System's Statistics: L = 1040.0, $\chi^2(69)$ = 944.01

TABLE 5.3

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE UNRESTRICTED MODEL FOR JAPAN

Explanatory Variables	ENDOGENOUS						
	JY_t	JFY_t	JR_t	JFR_t	JP_{t+1}	JFP_{t+1}	JFE_t
Constant	3.3924	-.4239	1.4471	-2.5366	1.016	.6084	-4.0076
	(.9195)	(.9726)	(1.1985)	(1.2878)	(.9385)	(.5717)	(.1609)
JP_t	-.5910	-.3057	-3.3375	-1.5662	-.3691	-.1556	.1038
	(.4564)	(.4828)	(.4580)	(.6393)	(.3452)	(.2333)	(.0799)
JFP_t	-.3540	-.5437	-1.7798	-.1923	-.3405	.2651	.0138
	(.6806)	(.7200)	(.6414)	(.9533)	(.4507)	(.2958)	(.1191)
JM_t	.9074	.1491	-.1694	.0416	.0662	-.0172	.1385
	(.0501)	(.5308)	(.0475)	(.0702)	(.0356)	(.0219)	(.0878)
JFM_t	-.3662	.4562	-.6949	-.1488	-.2094	-.0761	-.0695
	(.1100)	(.11637)	(.1169)	(.1540)	(.1205)	(.0648)	(.0192)
JG_t	.0895	-.0935	.0722	.0121	-.0722	.0527	.0403
	(.0444)	(.04706)	(.0422)	(.0623)	(.0293)	(.0196)	(.0077)
JFG_t	.3034	.6306	.9631	.2448	.1560	.0669	-.0411
	(.1120)	(.11853)	(.1173)	(.1569)	(.1288)	(.0702)	(.0196)
JXP_t	.1339	.1820	3.7062	1.5265	1.4513	.2434	-.1425
	(.5267)	(.5571)	(.5195)	(.7377)	(.3953)	(.2630)	(.0922)
$JFXP_t$	.2693	-.0411	2.1611	.4609	.4700	.4012	-.0814
	(.6872)	(.7269)	(.6692)	(.9624)	(.4966)	(.3146)	(.1203)
JXE_t	.5266	-.3406	.0953	-.4239	.2052	-.2084	.0651
	(.1946)	(.2058)	(.1835)	(.2726)	(.1311)	(.0846)	(.0340)
JOP_t					.0876		
					(.0164)		
$JFOP_t$						.0214	
						(.0095)	
TIME			.0086		.0111	(.0067)	
			(.0037)		(.0031)	(.0018)	
STATISTICS							
$\bar{R}^2$	.9978	.9803	.8423	.7255	.9977	.9996	.9950
DW	1.6573	1.1991	1.1772	.9099	2.1006	2.4175	1.2485
SE	.0101	.0107	.0949	.0141	.0065	.0043	.0017

System's Statistics: $L = 1091.2$, $\chi^2(68) = 1013.6$

TABLE 5.4

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE UNRESTRICTED MODEL FOR THE U.K.

Explanatory Variables	EY_t	EFY_t	ER_t	EFR_t	EP_{t+1}	EFP_{t+1}	EFE_t
Constant	6.3231 (2.3759)	1.3548 (.9523)	2.4096 (2.6152)	-2.3120 (1.5584)	1.7636 (1.6840)	.8818 (.3946)	7.3490 (.8182)
EP_t	-.3626 (.5821)	-.1104 (.2332)	-.2902 (.4047)	-.0878 (.2432)	.0598 (.2457)	-.0203 (.0513)	.0986 (.2004)
EFP_t	4.5142 (2.5061)	-.2574 (.0045)	-4.6804 (1.8249)	-1.1442 (1.0954)	.7767 (1.1958)	-.1378 (.2443)	.5902 (.8631)
EM_t	.9652 (.2088)	.0575 (.0837)	-.2972 (.1462)	.0739 (.0878)	.1643 (.0887)	-.0162 (.0185)	.3814 (.0719)
EFM_t	-.1587 (.3337)	.8055 (.1337)	-.2850 (.2751)	.1665 (.1646)	-.1301 (.1796)	.01483 (.0378)	-.1735 (.1149)
EG_t	.3075 (.1868)	.0272 (.0748)	.1708 (.1290)	.0081 (.0775)	.2199 (.0780)	.0141 (.0162)	.0711 (.0643)
EFG_t	.1758 (.4968)	-.0442 (.1992)	.1758 (.3747)	-.4267 (.2247)	-.0477 (.2437)	-.0608 (.0495)	-.2880 (.1711)
EXP_t	.6813 (.7496)	.3317 (.3004)	.5848 (.5220)	.3122 (.3137)	.9603 (.3222)	.0844 (.0661)	.0869 (.2581)
$EFXP_t$	-6.2457 (2.5263)	-.9485 (1.0126)	3.9889 (1.7706)	1.1442 (1.0639)	-.7142 (1.1160)	.8501 (.2408)	-1.1816 (.8700)
EXE_t	-.4667 (.3018)	.0846 (.1209)	.5384 (.2078)	.1344 (.1249)	-.0055 (.1257)	.0219 (.0260)	.1318 (.1039)
EOP_t					.0459 (.0559)		
$EFOP_t$						.0185 (.0053)	
TIME			.0218 (.0084)	-.0091 (.0049)	.0084 (.0056)	.0035 (.0013)	
STATISTICS							
$\bar{R}^2$	.9624	.9907	.5943	.7828	.9992	.9999	.9721
DW	1.7362	1.0316	.9632	.9068	1.6383	2.2459	1.3128
SE	.0234	.0094	.0161	.0097	.0097	.0020	.0080

System's Statistics: L = 998.30, $\chi^2(69)$ = 943.15

TABLE 5.5

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE UNRESTRICTED MODEL FOR THE U.S.

Explanatory Variables	ENDOGENOUS						
	UY_t	UFY_t	UR_t	UFR_t	UP_{t+1}	UFP_{t+1}	UFE_t
Constant	-2.1045 (1.9372)	2.0660 (.4816)	-9.2068 (1.7052)	-3.3314 (1.0073)	1.1854 (.6772)	-.1892 (.4290)	4.0139 (.2764)
UP_t	-.0871 (1.0042)	-.8528 (.6045)	.1584 (.8524)	-.8695 (.4503)	.6304 (.3087)	.1951 (.2063)	.7579 (.3470)
UFP_t	-.0659 (1.1784)	1.1267 (.7135)	-1.3256 (.9996)	-.1671 (.5271)	-.6879 (.3521)	.0959 (.2120)	-.6534 (.4095
UM_t	.2807 (.2051)	-.0962 (.1079)	.6161 (.1759)	-.0659 (.0963)	.0508 (.0656)	.0379 (.0409)	.2604 (.0619)
UFM_t	.7546 (.1606)	.7875 (.0934)	.1851 (.1367)	.1759 (.0730)	.0915 (.0489)	.0365 (.0304)	-.2429 (.0536)
UG_t	.1358 (.1959)	-.0298 (.1170)	-.1148 (.1664)	-.2850 (.0881)	-.1622 (.0589)	-.0814 (.0351)	-.0696 (.0671)
UFG_t	-.7514 (.1768)	.0229 (.1026)	-.1932 (.1505)	-.2597 (.0804)	.0143 (.0535)	-.0303 (.0318)	-.0226 (.0588)
UXP_t	.5332 (1.068)	1.5378 (.6473)	.6783 (.9059)	1.5742 (.4775)	.1820 (.3377)	-.1640 (.2247)	.9253 (.3715)
$UFXP_t$	-.3698 (1.1949)	-2.4031 (.7248)	1.2910 (1.10136)	.2740 (.5342)	.4944 (.3545)	.8266 (.2095)	.8973 (.4160)
UXE_t	-.3132 (.1678)	-.2607 (.1013)	.1536 (.1424)	-.0648 (.0751)	.0258 (.0507)	-.0082 (.2970)	.0604 (.0581)
UOP_t					.0313 (.0103)		
$UFOP_t$						.0157 (.0131)	
TIME	-.0168 (.0074)		.0352 (.0066)	-.0153 (.0039)	.0584 (.0027)	-.0011 (.0017)	
STATISTICS							
$\bar{R}^2$	.9637	.9954	.8465	.9239	.9997	.9999	.9796
DW	.9759	1.5986	1.9416	1.1875	2.4797	1.4102	1.9172
SE	.0132	.0080	.0111	.0059	.0039	.0023	.0045

System's Statistics: L = 1125.0, $\chi^2(70)$ = 967.74

The equations generally fit the data very well. The poorest fit appears to be in the interest rate equations for all countries considered, which is not surprising, given the continuous intervention of central banks to adjust interest rates during the sample period[3]. The DW statistics are satisfactory, except only for the domestic and foreign interest rate equations of Japan and the UK, and the domestic output equation of the US, for which there was no room for additional improvement owing to a very poor fit of the above five equations when a correction for auto-correlation was applied. Therefore, only the French domestic and foreign output equations and the French exchange rate equations were corrected for autocorrelation.

Money supplies (either domestic or foreign) are the most significant variables for all countries and in most equations, which is in accordance with the literature of the modern approach to exchange rate determination and with the monetarist nature of the model. However, overshooting is not the case, as it is in the

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3 An additional reason could be the validity of the maintained hypothesis of interest rate parity.

rest of the literature, in which only small country models have been tested. Only in the case of France, the coefficients of domestic and foreign money supply in the exchange rate equation are slightly greater than unity, indicating that overshooting can occur either from an increase in domestic or foreign money supply.

Particularly, surprising is the case of Germany, for which previous studies have given a rather high money supply coefficient. In our case, however, there is clearly undershooting. This is in accordance with the theory.

Government expenditure variables have been completely neglected in previous empirical work. An inspection of the estimates presented here indicates that, although they are not as significant as money supplies, they fit well into the model and improve its explanatory power. This is in accordance with Dornbusch's (1982, p. 112) suggestion that fiscal and monetary disturbances should be present in any model based on the asset market approach for determining the exchange rate.

A feature that may look puzzling is that, in some cases, the coefficient of a foreign variable is more significant than the coefficient of the corresponding domestic variable. But in fact, this is not surprising, given that the western industrial economies have become more open to foreign trade in the last twenty years and that the model allows for the endogeneity of foreign variables. McKinnon's analysis (1982, pp. 320-24) supports strongly the above point. "The world money supply exploded in 1971-72 and again in 1977-78 (well before the two oil crises of 1973 and 1979). Even for the US itself this measure of changes in the world money supply explains the great (dollar) price inflations of 1973-74 and 1979-80 much better than does any American monetary aggregate... Growth in the world money supply is a better predictor of American price inflation than is US money growth."

The signs of some coefficients are not as expected. In particular, the French foreign government expenditure, the German price level, government expenditure, expected exchange rate and foreign expected price and the UK foreign government expenditure variables enter with negative signs in the equations for French foreign aggregate demand, the German exchange rate, aggregate demand, interest rate and foreign price and the UK foreign aggregate demand, respectively.

Furthermore, the UK expected exchange rate enters with a positive sign in the UK foreign interest rate equation. Notice, however, that all of the above coefficients are insignificant at any conventional test level. One should also be aware that a high degree of multicollinearity is present in most of the equations which include money, prices and expected prices, both domestic and foreign.

Domestic expected price enters with a negative sign in the exchange rate equations for France, Germany, and Japan, but the coefficients are insignificant. The importance of expected domestic prices is reduced because domestic prices already include a portion of the potential influence of domestic expected prices on the exchange rate. Interventions in the exchange markets and the participation of European countries in the EEC could be additional reasons for the above result.

The rest of the coefficients can be explained directly with the model. Some channels not apparent in a small country model, or in a model without any expectations, are explained below. The interpretation should take into account the short-run nature of the analysis.

In the Mundell-Flemming model an increase in the domestic price level unambiguously increases interest rates. Given the dynamics already described (overshooting is not a necessary phenomenon), an increase of the domestic price level can be accompanied by either depreciating or appreciating currency. Interest rate parity implies that low interest rates are associated with appreciating currencies, and *vice versa*. Thus, both a positive and a negative coefficient of the domestic price variable in the domestic interest rate equations are equally acceptable.

The expected exchange rate affects positively the French and the UK foreign prices. This can be justified again with the help of the interest rate parity condition. An increase of the expected exchange rate (expected depreciation) implies a decrease of the foreign interest rate, which will stimulate foreign aggregate demand, and thus cause the foreign price level to increase. The same reasoning, but in the opposite direction, justifies the negative sign of the expected exchange rate in the UK domestic price equation.

The expected exchange rate enters with a negative sign in the UK and the US aggregate demand equations. When there is a depreciation, aggregate demand usually expands. But when there is an expectation of depreciation, domestic interest rates will increase and aggregate demand will decrease. The same argument, but in the opposite direction, applies to the positive sign of the expected exchange rate in the German and the UK foreign aggregate demand equations.

Foreign expected price has a negative sign in the Japanese, the UK and the US foreign aggregate demand equations. A possible explanation is that, as foreign expected price increases, the expected exchange rate appreciates, which leads to an increase of the foreign interest rate and hence to a decrease of foreign aggregate demand.

The effect of money supply on the interest rate is not clear. In the standard IS-LM macroeconomic framework, an increase of money supply leads to an unambiguous decrease of the interest rate. The ambiguity arises for two reasons in the present model: First, there is the Fisher effect; the increase of money supply creates inflationary expectations which can force the interest rate to increase. Second, output is not fixed at the full employment level, and in the short-run output expansion may raise money demand sufficiently that the interest rate may actually increase. Consequently, it is not inconsistent for some countries to have positive and some negative coefficients of money supply in their interest rate equations.

5.4 TESTING WITH THE MODEL

The validity of P.P.P. can be tested by imposing the long-run homogeneity restrictions. Tables 5.6, 5.7, 5.8 and 5.9 and 5.10 represent the estimated model for France, Germany, Japan, the UK and the US, respectively, when the long-run homogeneity restrictions implied by the model have been imposed. Thus, equations (3.15), (3.16a), (3.16b), (3.17a), (3.17b) (3.18a), and (3.18b) are estimated, by the method of seemingly unrelated regression, subject to the restrictions (3.15.1), (3.16a1), (3.16b1), (3.17a1), (3.17b1), (3.18a1), and (3.18b1). The imposition of the restrictions changes some coefficients considerably and some of the signs are reversed. However, overshooting does not occur even in the restricted model in which P.P.P. has been imposed except for France.

The restrictions are tested using the log-likelihood ratio principle. Table 5.11 presents the log-likelihood functions for both the unrestricted form

TABLE 5.6

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE RESTRICTED MODEL FOR FRANCE
(HOMOGENEITY RESTRICTIONS IMPOSED)

Explanatory Variables	ENDOGENOUS						
	FY_t	FFY_t	FR_t	FFR_t	FP_{t+1}	FFP_{t+1}	FFE_t
Constant	.0282 (.0102)	.2578 (.0639)	.0625 (.4768)	.4581 (.3202)	-.1474 (.2062)	-.3666 (.0792)	3.0865 (.3920)
FP_t	-.2424 (.1966)	.0374 (.1658)	-.4477 (.3483)	-.5320 (.2316)	-.2351 (.1848)	-.0204 (.0740)	.0303 (.8044)
FFP_t	-.2711 (.4563)	-1.1386 (.3716)	-2.6026 (.4638)	-2.1627 (.3099)	-.4551 (.2997)	.4760 (.1239)	.5040 (1.732)
FM_t	.1447 (.1173)	.1096 (.1004)	-.1215 (.1999)	.2598 (.1335)	.0947 (.0921)	-.0166 (.0341)	1.0930 (.4841)
FFM_t	.2114 (.1112)	.6484 (.0856)	-.0072 (.0988)	-.1204 (.0658)	.1048 (.0464)	.0643 (.0246)	0.9913 (.3826)
FG_t	.8365 (.1171)	-.0451 (.1025)	.0486 (.1970)	-.1628 (.1305)	-.0246 (.0993)	-.0316 (.0326)	.3878 (.4964)
FFG_t	-.1176 (.1518)	.1665 (.1137)	.0269 (.1641)	-.0880 (.1088)	-.1594 (.0838)	.0176 (.0354)	-1.1063 (.5301)
FXP_t	.0208 (.1883)	.0440 (.1530)	.8340 (.2994)	.9010 (.2007)	1.0774 (.1260)	.0617 (.0544)	-.8531 (.7267)
$FFXP_t$	.1365 (.4590)	.2989 (.3496)	2.3552 (.4827)	1.6543 (.3215)	.5044 (.3170)	.4090 (.1499)	.2170 (1.6430)
FXE_t	.0383 (.0324)	.0081 (.0264)	.0040 .0582	-.0327 (.0394)	.0141 (.0239)	.0302 (.0100)	-.0474 (.1247)
FOP_t					-.0058 (.0185)		
$FFOP_t$						.0257 (.0077)	
TIME					.0015 (.0005)	-.0007 (.0003)	
STATISTICS							
$\bar{R}^2$	.9700	.9281	.7509	.7980	.9996	.9999	.8166
DW	1.8363	1.6319	1.1394	1.0271	1.9729	2.3747	2.0528
SE	.0095	.0078	.0136	.0094	.0053	.0021	.0358
ρ =	.9697 (.0381)	.7600 (.1015)					.6828 (.1140)

System's Statistics: L = 958.05, χ^2 (60) = 832.66

TABLE 5.7

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE RESTRICTED MODEL FOR GERMANY
(HOMOGENEITY RESTRICTIONS IMPOSED)

Explanatory Variables	ENDODENOUS GY_t	GFY_t	GR_t	GFR_t	GP_{t+1}	GFP_{t+1}	GFE_t
Constant	.2272 (.8497)	1.4901 (.3765)	1.9924 (.8419)	1.6814 (.5482)	-1.0954 (.2845)	.1132 (.2299)	2.7771 (.4373)
GP_t	-2.7427 (.5341)	-.7022 (.2366)	-2.4907 (.5184)	-2.0659 (.3262)	-.7283 (.2086)	.1233 (.2045)	-.3646 (.2749)
GFP_t	-.6789 (.1282)	-.7929 (.0568)	.0137 (.1945)	-.0585 (.1750)	.5547 (.0856)	.6949 (.0782)	.4190 (.0066)
GM_t	.8042 (.0664)	.0573 (.2944)	-.0910 (.0654)	.0454 (.0421)	-.0923 (.0222)	.0095 (.0170)	.1505 (.0342)
GFM_t	.3686 (.1076)	.7735 (.0477)	.4300 (.0997)	.0331 (.0570)	-.0008 (.0432)	.0366 (.0262)	.0005 (.0554)
GG_t	-.0060 (.0242)	-.0081 (.0107)	.0031 (.0223)	-.0023 (.1269)	.0084 (.0072)	-.0034 (.0049)	-.0077 (.0124)
GFG_t	-.1917 (.1738)	.0727 (.0770)	-.3926 (.1819)	-.2669 (.1278)	.2202 (.0717)	-.0568 (.0527)	-.2149 (.0894)
GXP_t	2.0921 (.4830)	.5131 (.2140)	2.0797 (.4487)	2.0054 (.2583)	1.3127 (.19424)	.0984 (.1997)	-.0167 (.2486)
$GFXP_t$	.1566 (.0966)	.1512 (.0428)	.0582 (.0901)	.0702 (.0523)	-.0429 (.0289)	.0056 (.0201)	-.1887 (.0497)
GXE_t	-.0670 (.1517)	-.1212 (.0672)	-.5380 (.1478)	-.2694 (.0093)	.1852 (.0488)	-.0296 (.0379)	.4549 (.07807)
GOP_t					-.0028 (.0067)		
$GFOP_t$						.0314 (.0188)	
TIME			-.00010 (.0019)	.0044 (.0020)	-.0069 (.0009)	.0024 (.0010)	
STATISTICS							
$\bar{R}^2$	.9872	.9912	.5936	.7969	.9980	.9998	.9835
DW	1.0308	1.0978	.9914	1.3107	1.5461	2.5351	1.8334
SE	.0183	.0081	.0168	.0095	.0052	.0036	.0094

System's Statistics: $L = 1022.2$, $\chi^2(62) = 900.37$

TABLE 5.8

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE RESTRICTED MODEL FOR JAPAN (HOMOGENEITY RESTRICTIONS IMPOSED)

Explanatory Variables	ENDOGENOUS						
	JY_t	JFY_t	FR_t	JFR_t	JP_{t+1}	JFP_{t+1}	JFE_t
Constant	3.3901 (.8937)	-.7416 (.9673)	1.0547 (.8629)	-2.1618 (1.2749)	1.1469 (.6339)	-.8000 (.4098)	-4.1218 (.17300)
JP_t	-.5952 (.2213)	-.8925 (.2396)	-3.8469 (.3078)	-.8737 (.3157)	-.4669 (.2627)	-.3951 (.1837)	-.10707 (.0428)
JFP_t	-.3599 (.3948)	-1.3587 (.4273)	-2.4597 (.5179)	.7694 (.5632)	-.5207 (.3972)	.1550 (.2629)	-.2791 (.0764)
JM_t	.9073 (.0496)	.1386 (.0537)	.1771 (.0482)	.0539 (.0708)	.0623 (.3570)	-.0077 (.0229)	.1347 (.0096)
JFM_t	-.3663 .1095	.4413 (.1185)	-.6985 (.1073)	-.1313 (.1562)	-.2260 (.1131)	.0393 (.0656)	-.0747 (.0212)
JG_t	.0895 (.0444)	-.0898 (.0480)	.0743 (.0428)	.0077 (.0633)	-.0698 (.0293)	.0445 (.0204)	.0416 (.0085)
JFG_t	.3033 (.1119)	.6225 (.1211)	.9483 (.1081)	.2543 (.1596)	.1663 (.1220)	-.0504 (.0724)	-.0440 (.0216)
JXP_t	.1390 (.2204)	.8851 (.2385)	4.3112 (.3470)	.6968 (.3144)	1.5394 (.3087)	.4771 (.2085)	.1102 (.0426)
$JFXP_t$	.2752 (.3944)	.7860 (.4269)	2.8711 (.5002)	-.5151 (.5626)	.6206 (.4080)	.7037 (.2570)	.2159 (.0763)
JXE_t	.5268 (.1941)	-.3197 (.2101)	.1147 (.1870)	-.4485 (.2769)	.2062 (.1317)	-.1798 (.0888)	.0725 (.0375)
JOP_t					-.0086 (.0165)		
$JFOP_t$						.0276 (.0105)	
TIME			.0080 (.0009)		.0020 (.0010)	.0002 (.0006)	
STATISTICS							
$\bar{R}^2$	.9978	.9794	.8344	.6527	.9977	.9996	.9938
DW	1.6575	1.2057	1.2428	.9778	2.1106	2.5693	1.4227
SE	.0101	.0109	.0972	.0144	.0066	.0046	.0019

System's Statistics: $L = 1074.1$, $\chi^2(61) = 979.41$

TABLE 5.9

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE RESTRICTED MODEL FOR THE U.K.
(HOMOGENEITY RESTRICTIONS IMPOSED)

Explanatory Variables	ENDOGENOUS						
	EY_t	EFY_t	ER_t	EFR_t	EP_{t+1}	EFP_{t+1}	EFE_t
Constant	1.6627 (1.5041)	.3996 (.5736)	-2.1567 (1.0251)	.1070 (.6311)	.7213 (.6271)	-.1590 (.1513)	5.8280 (.5146)
EP_t	.2604 (.5592)	.0146 (.2132)	-.2284 (.3748)	-.1971 (.2313)	.0249 (.2287)	.0313 (.0547)	.3019 (.1913)
EFP_t	3.8322 (2.6642)	-.3943 (1.0161	-3.0445 (1.7317)	-1.6891 (1.0737)	1.3959 (1.1001)	-.0571 (.2637)	.3676 (.9116)
EM_t	.5065 (.0961)	.9489 (.0646)	-.1606 (.1234)	-.0427 (.0904)	-.0850 (.0762)	-.0212 (.0201)	.2317 (.0329)
EFM_t	.5560 (.1695)	-.0344 (.0366)	.0007 (.1514)	-.0427 (.0904)	-.1103 (.1237)	.0869 (.0259)	.0597 (.0579)
EG_t	.7176 (.0861)	.1094 (.0328)	.0819 (.1069)	-.0132 (.0624)	.1591 (.0661)	.0245 (.0774)	.2049 (.0294)
EFG_t	-.7505 .3415	-.2300 (.1302)	-.0845 (.2649)	-.1984 (.1604)	-.0385 (.1946)	-.1433 (.0414)	-.5903 (.1168)
EXP_t	-.5034 (.6097)	.0939 (.2325)	.5460 (.4512)	.4894 (.2747)	1.0547 (.2863)	.0071 (.0167)	-.2996 (.2086)
$EFXP_t$	-4.6517 (2.6101)	-.6287 (.9955)	2.886 (1.7241)	1.3562 (1.0664)	-1.2256 (1.0735)	.9451 (.2691)	-.6613 (.8931)
EXE_t	-.1220 (.2851)	.1537 (.1087)	.5147 (.1951)	.09656 (.1200)	-.0417 (.1184)	.0368 (.0287)	-.0193 (.0975)
EOP_t					-.0546 (.0545)		
$EFOP_t$						.0078 (.0054)	
TIME			.0002 (.0026)	-.0007 (.0015)	.0018 (.0016)	-.0005 (.0004)	
STATISTICS							
$\bar{R}^2$	.9570	.9904	.5036	.7713	.9992	.9999	.9685
DW	1.4052	.9954	.7587	.9270	1.5581	1.7705	1.2387
SE	.0251	.0095	.0160	.0099	.0096	.0022	.0085

System's Statistics: L = 986.10, $\chi^2(62)$ = 918.75

TABLE 5.10

SEEMINGLY UNRELATED REGRESSION ESTIMATES OF THE RESTRICTED MODEL FOR THE U.S. (HOMOGENEITY RESTRICTIONS IMPOSED)

Explanatory Variables	ENDOGENOUS						
	U_t	UFY_t	UR_t	UFR_t	UP_{t+1}	UFP_{t+1}	UFE_t
Constant	.2455 (1.0416)	1.5690 (.4282)	-3.3261 (1.0143)	.5557 (.5727)	-.8933 (.3599)	-.1992 (.2032)	3.5466 (.2629)
UP_t	1.4838 (1.0993)	-.2821 (.5541)	1.3465 (1.0298)	-.4784 (.5538)	.9919 (.3419)	.3199 (.2051)	1.2945 (.3402)
UFP_t	-2.5336 (1.2696)	.4120 (.6415)	-3.7438 (1.1886)	-1.2256 (.6387)	-.9434 (.3813)	-.0835 (.2078)	-1.3254 (.3938)
UM_t	.5402 (.1873)	.0547 (.0790)	.6403 (.1817)	-.1398 (.1021)	.2188 (.0668)	.0675 (.0385)	.4023 (.0485)
UFM_t	.2804 (.1577)	.6788 (.0786)	-.3294 (.1481)	-.0748 (.0799)	-.0005 (.0503)	.0052 (.0292)	-.3451 (.0482)
UG_t	.4508 (.2102)	.0915 (.1038)	.1021 (.1979)	-.2236 (.1071)	-.0652 (.0639)	-.0528 (.0347)	.0449 (.0637)
UFG_t	-.1277 (.1530)	.1801 (.0669)	.4890 (.1475)	.0650 (.0823)	.0405 (.0511)	.0126 (.0278)	.1252 (.0411)
UXP_t	-1.6915 (1.1362)	.8214 (.5588)	-1.2828 (1.0705)	.7960 (.5801)	-.1492 (.3636)	-.3293 (.2170)	1.5989 (.3431)
$UFXP_t$	1.9206 (1.2982)	-1.6850 (.6540)	3.3693 (1.2162)	1.1227 (.6541)	.8560 (.3902)	1.0057 (.2109)	1.5725 (.40161)
UXE_t	.0203 (.1778)	-.1463 (.0866)	.4264 (.1679)	.0348 (.0912)	.0928 (.0552)	.0189 (.0291)	.1679 (.0532)
UOP_t					.0263 (.0107)		
$UFOP_t$						.0145 (.0119)	
TIME	.0003 (.0015)		.0041 (.0015)	.0037 (.0009)	-.0019 (.0006)	-.0006 (.0004)	
STATISTICS							
$\bar{R}^2$	.9497	.9949	.7490	.8767	.9996	.9999	.9745
DW	.8064	1.3049	1.4275	.6960	2.3910	1.3879	2.3795
SE	.0155	.0083	.0143	.0075	.0045	.0023	.0051

System's Statistics: L = 1096.3, $\chi^2(63) = 910.29$

TABLE 5.11

TESTING WITH THE MODEL

Countries	LOG-LIKELIHOOD FUNCTIONS			LRS	
	No Restrictions Imposed	Homogeneity Restrictions Imposed	Equality of Domestic and Foreign Coefficients Imposed	Test of Homogeneity Restrictions	Test of Equality of Domestic and Foreign Coefficients
France	969.67	958.05	826.98	23.24	281.38
Germany	1040.00	1022.20	874.02	35.60	339.96
Japan	1091.20	1074.10	907.26	34.20	367.88
UK	998.30	986.10	885.25	24.40	226.10
US	1125.00	1096.30	979.47	57.40	291.06
CRITICAL VALUES				$\chi^2(.05,7) \cong 14.07$	$\chi^2(.05,28) = 41.3$

of the model and the form in which the homogeneity restrictions are imposed. The likelihood ratio statistic (LRS) is computed as the difference between the unrestricted and the restricted log-likelihood functions multiplied by negative two:

$$\text{Calculated LRS} = -2(L_{REST} - L_{UNREST})$$

The calculated values of the LRS for the test of homogeneity restrictions are presented in the fourth column of Table 5.11. The calculated LRS has (asymptotically) a χ^2 distribution with seven degrees of freedom and a critical value of 14.07 at the 5 percent level of significance.

The calculated LRSs are all much greater than the critical value, and hence the restrictions are rejected. The rejection of the homogeneity restrictions implies that P.P.P. does not hold.

The rejection of P.P.P. indicates that monetary models that impose directly the assumption of P.P.P. are likely to be misspecified, especially if they are intended to apply to recent experience. As argued in earlier chapters previous empirical evidence is mixed as far as the assumption of P.P.P. is concerned.

Some reasons suggested for the failure of the P.P.P. doctrine were, among others, the omission of real variables among the explanatory variables, the lack of any feedback effects from the rest of the world and the use of bilateral tests. However, it is evident from the rejection of the restrictions in the present study that P.P.P. is unlikely to hold even in a large country framework with a multilateral exchange rate.

A theoretical explanation for the rejection of P.P.P. can be given in terms of what Frenkel (1981b) calls new information or "news". The central insight of the modern approach to exchange rate determination is the notion that the exchange rate can be analyzed within a framework that is appropriate for the analysis of asset prices. A key characteristic of the price of an asset is its strong dependence on expectations. This latter characteristic implies that during periods that are dominated by "news," which induces frequent changes in expectations, asset prices exhibit large fluctuations. Since, by definition, "news" cannot be predicted on the basis of past information and the exchange rates are viewed as asset prices, by and large the fluctuations of the exchange rates are unpredictable.

Commodity price indices are not expected to reveal such a degree of volatility. As it is well known, changes in commodity prices are serially correlated while changes in exchange rates are not (Frenkel, 1981b). The stickiness exhibited by commodity prices need not reflect any market imperfection, rather, it may reflect the cost of price adjustment or the results of a confusion between permanent and transitory shocks.

The slow adjustment of commodity prices, in addition to the fact that they are less sensitive to changes in expectations imply that when there are frequent and significant changes in expectations, as was the case during the 1970s, exchange rates adjust immediately while commodity prices do not. Given this perspective, the volatility of exchange rates and the associated deviations from P.P.P. are less surprising; they reflect the volatile character of the 1970s, which were characterized by a number of major real shocks, including the oil embargo, supply shocks, shifts in demands for money, commodity booms and shortages, and differential productivity growth. Furthermore, frequent changes in expectations occurred in the 1970s, owing to the great uncertainty about the future course of political and economic events.

An empirical explanation can also be given in terms of the US dollar. The US dollar exchange rate and price index enter partially (with some weight) all of the constructed indices for other countries. Although this study does not involve bilateral comparisons of the domestic country with the US, US variables still play a significant role. In bilateral comparisons Frenkel (1981a) has shown that when P.P.P. is tested with reference to the US dollar it is rejected emphatically. On the other hand, it appears to hold when, for instance, one uses Germany as the standard country to examine P.P.P. for France. Inspection of the LRSs of Table 5.11 indicates that P.P.P. for the US is strongly rejected, and that the US LRS is much bigger than the LRSs of the European countries. If a 1 percent test level is adopted, the critical value of the χ^2 statistic is 18.48, and the homogeneity restrictions for France and the UK are only barely rejected.

What accounts for the vast differences in the performance of P.P.P. among the various currencies? One argument can be made in terms of changes in commercial policies, which have been more stable within Europe than between Europe and the US. The same applies to the degree of intra-European flexibility of exchange rates and the institutional agreements within Europe. Another argument can be made in terms of the general presumption that, because of transportation costs, P.P.P. is expected to hold better among the neighbouring European countries than between any one of these countries and the US.

It is a common practice of model builders using the monetary approach to exchange rate determination to assume that each explanatory variable is specified in difference form (for example, the logarithmic differences between French and the US money supplies). Hence, a given increase in each domestic variable will have the same effect on the endogenous variable as an equivalent decrease in the corresponding foreign variable. Here it is argued that the empirical tests of the Dornbusch model are inappropriate and misleading because the explanatory variables are specified in difference form. Such linear difference constraints are especially dangerous because the specification bias, which in general results from the restrictions, often leads to a sign reversal in a constrained coefficient. A reversal can be more liekly, ceteris paribus, the stronger the direct correlation between the relevant domestic and foreign variables (Haynes and Stone, 1981).

The specification of explanatory variables in a difference form is an attempt by researchers to increase the efficiency of coefficient estimates by reducing multicollinearity at the cost of (one hopes minimal) bias and to facilitate the manipulations of model building. However, since the specification of the explanatory variables in difference form can result in substantial bias the appropriateness of the restrictions should be formally tested. Our estimates indicate that, in spite of the presence of multicollinearity, it is still possible to derive meaningful results without imposing these constraints.

The model used is flexible enough to test the above assumption of symmetric coefficients. The third column of Table 5.11 gives the values of the log-likelihood functions when the assumption of equality of coefficients has been imposed, and the fifth column gives the corresponding LRS for each country[4]. LRSs far exceed the χ^2 critical value of 41.3 at the 5 percent test level. Thus, the assumption of the equality of the coefficients of the domestic and foreign variables cannot be accepted. This is in accordance with the findings of Driskill and Sheffrin (1981), the only study that addresses this question.

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4 All restrictions were also tested with an F-test and similar conclusions were found to hold.

5.5 CONCLUSIONS

The method and the results of estimation of the model were presented for five large OECD countries. The results were not surprising, except perhaps for what they imply about the phenomenon of overshooting: with the exception of France, there were no indications of overshooting. The restrictions that imply the validity of P.P.P. were not supported by the results. Finally, the assumption used by various writers that domestic and foreign variables enter the equations with coefficients that are equal but of opposite sign was strongly rejected.

The results of a simulation based on the estimated model are provided in the next chapter, the aim being to see how well the model as a whole tracks the actual historical data over time. Simulated values of some of the endogenous variables allow us to calculate the real exchange rate and to examine how it behaves dynamically.

CHAPTER 6

SIMULATION RESULTS AND THE FORECASTING ERROR OF PURCHASING POWER PARITY

6.1 INTRODUCTION

A historical simulation -- that is, one in which solutions of the model are computed over the sample period -- is performed to test whether the system of equations, when solved dynamically, fits the data well. The dynamic structure of the model is more complicated than that of any of the individual equations of which it is composed. Thus, a comparison of actual data series with the simulated series for the various endogenous variables is a useful way to evaluate the entire model.

The simulated values of some of the endogenous variables are then used to calculate the real exchange rate, which is a measure of the predictive power of the P.P.P. theory for a given domestic country and a given period (relative to the base period). Finally, some additional simulation experiments are performed to examine the dynamic response of the system to various exogenous shocks.

6.2 HISTORICAL SIMULATION

The Gauss-Seidel interative technique is used to solve the model in dynamic simulation experiments. The estimated coefficients, the actual exogenous variables and the observed lagged values of endogenous variables of 1973I are used as inputs to the historical simulation experiments. Since there is a lag of one period, the simulation is started in 1973II. The simulation for France is started in 1973III because the estimated model was corrected for first-order serial correlation.

A common practice in evaluating how accurately the model reproduces all the data series of the endogenous variables is to report the deviation of historical simulation values from actual values, expressed either in absolute units or percentage terms, on a quarter-to-quarter basis throughout the sample period.

The following statistical criteria are applied in analyzing the forecasting ability of the model[1]:

(1) Coefficient of Correlation between actual and simulated series (CC).

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[1] A detailed discussion of the statistical measures used in this chapter for evaluating the model is given in Pindyck and Rubinfeld (1981, pp. 362-366).

(2) Root-Mean-Square Error:

$$RMSE_i = \sqrt{1/n \sum_{t=1}^{n} (Y^s_{it} - Y^a_{it})^2}$$

(3) Mean Absolute Error:

$$MAE_i = 1/n \sum_{t=1}^{n} \left| Y^s_{it} - Y^a_{it} \right|$$

(4) Mean Error: $ME_i = 1/n \sum_{t=1}^{n} (Y^s_{it} - Y^a_{it})$

(5) Regression Coefficient of Actual on Predicted Values (RCAP).

(6) Theil's Inequality Coefficient:

$$U_i = RMSE_i \cdot \left[\sqrt{1/n \sum_{t=1}^{n} (Y^s_{it})^2} + \sqrt{1/n \sum_{t=1}^{n} (Y^a_{it})^2} \right]^{-1}$$

where n = length of simulation period;

Y^s_{it} = model simulation value of the i^{th} variable in period t;

Y^a_{it} = actual value of the i^{th} variable in period t.

The correlation and regression coefficients, CC and RCAP, should be close to unity. Zero values of ME_i indicate that there is no bias, in the sense that the model does not tend to overestimate or underestimate the variables in question. If ME_i has a positive value the model overestimates the variable, and vice versa. Values of MAE_i and $RMSE_i$ close to zero indicate a high degree of simulation accuracy. The problem with the ME_i measure is that it may be close to zero if large positive errors cancel out large negative errors. However, this is not true with the MAE_i and the $RMSE_i$.

The values of U_i must be between 0 and 1; if $U_i = 0$, $Y^s_{it} = Y^a_t$ for all t and the fit is perfect. Values of U_i less than 0.4 have generally been considered reasonable in other applications. The numerator of the inequality coefficient can be decomposed into three components:

$$U^M_i = (\bar{Y}^s_i - \bar{Y}^a_i)^2/MSE_i$$

$$U^S_i = (S_{is} - S_{ia})^2/MSE_i$$

$$U_i^C = \left[2(1 - CC)S_{is}S_{ia}\right]/MSE_i$$

$$U_i^M + U_i^S + U_i^C = 1$$

where $\bar{Y}_i^s$, $\bar{Y}_i^a$, S_{is}, S_{ia} are the means and standard deviations of the series Y_{it}^s and Y_{it}^a, respectively, and MSE stands for the Mean-Square-Error.

The proportions, U^M, U^S and U^C are the fractions of error due to bias, differences of variation and differences of covariation, respectively. For any value of $U > 0$, we would like U^M to be close to zero. The ideal result would be $U^M = U^S = 0$ and $U^C = 1$. Roughly speaking, systematic bias in the model can be inferred from values of U^M above 0.1 and 0.2.

Theil (1966) has also proposed another decomposition of the inequality coefficient into the fraction of error due to bias (U^M), the difference of the regression coefficient from unity, known as the regression proportion (U^R), and the residual variance, known as the disturbance proportion (U^D):

$$U_i^R = (S_{is} - CC_{ia})/MSE_i$$

$$U_i^D = \left[(1 - CC^2)S_{ia}^2\right]/MSE_i$$

$$U_i^M + U_i^R + U_i^D = 1$$

For any value of $U > 0$, the ideal distribution of inequality over the three sources is $U^M = U^R = 0$ and $U^D = 1$.

Summary statistics of the historical simulation for all endogenous variables are presented in Tables 6.1 and 6.2. The model converged to a solution for every country in every period, and gave results which were close to observed values[2]. The symbols for the variables are the same as those used in previous chapters.

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[2] The stability of the model can also be verified by computing the characteristic equations and their roots for every country. There is a lagged dependent variable in both domestic and foreign price equations. Furthermore, the domestic price variable depends on the lagged foreign price variable and the foreign price variable on the lagged domestic price variable. Given the estimated coefficients of the price variables in the domestic and foreign price equations, the determinant of the coefficient matrix of the lagged price variables is formed and is equated to zero. (This methodology has been explained in Appendix 3A.) The expansion of the coefficient matrix results in the following second-order characteristic equations and their roots:

Six selected summary measures are reported in Table 6.1. On the whole, the summary measures indicate that the predictive performance of the model is quite good. Based on Theil's inequality coefficient, all variables perform well, having values of U much less than .1, except for GR, JR and EY, which have values .13, .16 and .16, respectively. The values of ME are less than .001. The same applies for the magnitudes of RMSE and MAE. The correlation coefficient is also very high for all variables.

Table 6.2 presents the decomposition of the simulation error. With regard to bias, all variables have values of less than .01 and the disturbance proportion (U^D) is close to unity, except for JR, which is .5. The other statistical measures indicate similar patterns and lead to the conclusion that the tracking ability of the model is quite satisfactory[3].

France: $K^2-.1966K-.1577 = 0$. Hence $K_1=.5074$, $K_2= -.3108$
Germany: $K^2-.3080K-.3296 = 0$. Hence $K_1=.7484$, $K_2= -.4404$
Japan: $K^2+.1040K-.1509 = 0$. Hence $K_1=.3399$, $K_2= -.4439$

UK: $K^2 + .0780K+.0075 = 0$. Hence $K_1,K_2= -.0390\pm.0773i$ and $M = .0866$

US: $K^2-.7764K +.1946=0$. Hence $K_1,K_2=.3632\pm.2505i$ and $M = .4412$

Where M is the absolute value of the complex roots. Therefore, the model is stable for all countries.

[3] Figures showing actual and simulated values can be found at the end of this chapter.

TABLE 6.1

SUMMARY STATISTICS FOR HISTORICAL SIMULATION [a]

VARIABLES	CC	RMSE	MAE	ME	RCAP	U
FP	.9998	.0052	.0039	-.00007	1.000	.0005
FFP	1.0000	.0022	.0017	.00005	1.000	.0002
FFE	.9828	.0452	.0362	.00238	1.008	.0046
FR	.8838	.0142	.0110	-.00020	1.012	.0634
FFR	.9005	.0101	.0082	-.00042	1.024	.0556
FY	.9853	.0123	.0096	-.00069	1.016	.0022
FFY	.9918	.0346	.0276	-.00137	1.003	.0043
GP	.9993	.0048	.0039	-.00019	1.000	.0005
GFP	.9999	.0036	.0028	.00002	1.001	.0004
GFE	.9928	.0094	.0075	-.00001	1.001	.0010
GR	.7569	.0199	.0152	.00081	.8155	.1334
GFR	.8034	.0148	.0122	.00045	.8075	.0767
GY	.9479	.0192	.0159	.00040	.9605	.0039
GFY	.9977	.0101	.00885	.00020	1.001	.0013
JP	.9990	.0070	.0057	-.00009	.9988	.0007
JFP	.9998	.0043	.0032	.00010	1.000	.0004
JFE	.9977	.0018	.0013	.00002	.9988	.0002
JR	.6466	.0280	.0227	-.00064	.4721	.1653
JFR	.7985	.0166	.0129	.00051	.8543	.0899
JY	.9979	.0078	.0063	-.00016	1.001	.0005
JFY	.9951	.0101	.0084	-.00008	1.001	.0014
EP	.9997	.01006	.0083	.00007	.9999	.0010

...continued

TABLE 6.1 (continued)

VARIABLES	CC	RMSE	MAE	ME	RCAP	U
EFP	1.000	.0020	.0016	-.00001	1.000	.0002
EFE	.9883	.0082	.0066	-.00005	.9994	.0008
ER	.7133	.0191	.0157	-.00068	.7220	.0844
EFR	.9074	.0097	.0079	-.00017	.9832	.0543
EY	.9432	.0243	.0188	-.00027	.9585	.1668
EFY	.9963	.0109	.0079	.00001	1.001	.0015
UP	.9999	.0035	.0028	-.00006	.9993	.0003
UFP	1.0000	.0024	.0019	-.00001	.9999	.0002
UFE	.9887	.0053	.0043	.00003	.9844	.0005
UR	.9390	.0109	.0086	.00016	.9908	.0614
UFR	.9656	.0062	.0054	.00003	.9690	.0324
UY	.9855	.0131	.0106	.00010	.9999	.0023
UFY	.9974	.0093	.0078	.00057	.9985	.0014

[a] The units in which the variables are measured in subsequent tables and figures are those defined in previous chapters, but we repeat them here for convenience. The price variables are logarithms of price indices. Exchange rates (domestic in terms of foreign currency) are logarithms of indices constructed by appropriately weighted averages of the currencies of the domestic country's main partners in trade and payments. Interest rates are in percentage form. Income variables are logarithms of real income expressed in terms of the domestic currency. The base period is 1975. The construction of the foreign variables is explained in more detail in chapter 4. The above discussion applies for Tables 6.1 and 6.2 and Figures 6.1 to 6.30. The variables of Tables 6.3 to 6.9 are in percentage form.

TABLE 6.2

DECOMPOSITION OF SIMULATION ERROR

VARIABLES	U^M	U^S	U^C	U^R	U^D
FP	.00019	.00014	.9997	.000009	.9998
FFP	.0054	.00001	.9994	.000003	.9994
FFE	.00278	.01885	.9784	.001978	.9952
FR	.00021	.07287	.9269	.000470	.9993
FFR	.00175	.07657	.9217	.002340	.9959
FY	.00305	.03157	.9654	.008505	.9884
FFY	.00158	.00737	.9910	.000471	.9979
GP	.00153	.00034	.9981	.000001	.9985
GFP	.00005	.00601	.9939	.004998	.9950
GFE	.00001	.00427	.9957	.000026	1.0000
GR	.00166	.01129	.9870	.064140	.9342
GFR	.00093	.00006	.9990	.093690	.9054
GY	.00044	.00165	.9979	.01479	.9848
GFY	.00041	.00201	.9976	.000154	.9994
JP	.00019	.00001	.9998	.000560	.9992
JFP	.00062	.00134	.9980	.000773	.9986
JFE	.00011	.00028	.9996	.000292	.9996
JR	.00052	.12350	.8759	.472900	.5266
JFR	.00094	.01121	.9879	.048610	.9504
JY	.0004	.00232	.9972	.000247	.9993
JFY	.00004	.00488	.9951	.000070	.9999

TABLE 6.2 (continued)

VARIABLES	U^M	U^S	U^C	U^R	U^D
EP	.00005	.00011	.9998	.000006	.9999
EFP	.00001	.00004	1.0000	.000004	1.0000
EFE	.00004	.0053	.9946	.000013	.9999
ER	.00127	.00025	.9985	.132900	.8658
EFR	.00032	.03360	.9661	.001358	.9983
EY	.00012	.00228	.9976	.014860	.9850
EFY	.00002	.00283	.9971	.000105	.9999
UP	.00028	.00169	.9980	.002320	.9974
UFP	.00001	.00002	1.0000	.000099	.9999
UFE	.00004	.00084	.9991	.010810	.9892
UR	.00024	.02305	.9767	.000645	.9991
UFR	.00002	.00018	.9998	.013880	.9861
UY	.00006	.00723	.9927	.000001	.9999
UFY	.00375	.00020	.9960	.000556	.9958

The above statistics indicate that there are no great differences across countries; the same pattern is apparent for all. The price variables have an exceptionally good fit. The fit of the exchange rate variables is also satisfactory. One might expect a higher volatility of exchange rates. However, the volatility is not as substantial as one might anticipate, since the effective exchange rate is used, and not the actual bilateral exchange rate. Similar conclusions hold for the output variables. Interest rate variables give the poorest performance, compared to the other variables of the system, but their simulation statistics are still quite respectable. The major reason is that interest rates were very volatile and also were the major target of most central banks in the 1970s and early 1980s.

6.3 THE FORECASTING ERROR OF PURCHASING POWER PARITY

As discussed in chapter 5, the restrictions implying P.P.P. were not accepted. The simulated values of exchange rates and domestic and foreign prices can be used to form a measure of the predictive power of the P.P.P. theory[4]. The P.P.P. theory predicts,

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[4] This section is adapted from Officer (1980).

under ideal conditions, that the ratio of the exchange rate (in this case effective, EF) to relative prices (RP) in the two countries (EF_t/RP_t) will equal unity for any period t [5].

A measure of the predictive power of the P.P.P. theory for a given domestic country and given period t is

$$\ln(EF_t/RP_t) = \ln\left[(EF_t/RP_t)/1\right],$$

the proportionate deviation of EF_t/RP_t from unity (its predicted value under P.P.P.), that is, the proportionate forecasting error of P.P.P.

By definition, in the base period $EF_{1975} = RP_{1975} = 1$. Therefore,

$$\ln(EF_t/RP_t) = \Delta\ln(EF_t/RP_t) \equiv \ln(EF_t/RP_t) - \ln(EF_{1975}/RP_{1975})$$

is also the proportionate change in EF_t/RP_t since the base period. The closer it is to zero, the higher the predictive power of the P.P.P. theory. If $\ln(EF_t/RP_t)$ is positive (negative) the domestic currency is

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[5] The terminology of real exchange rate has been used for the ratio of bilateral exchange rate to relative prices. In the present context, the ratio EF_t/RP_t can be called the "effective real exchange rate".

overvalued (undervalued) according to the P.P.P. theory by $100[\ln(EF_t/RP_t)]$ per cent[6].

The reader should not confuse the above definition with a widely held proposition that countries with a deficit (surplus) in the balance of payments usually have overvalued (undervalued) currencies. According to the definition of the P.P.P. theory, if $100[\ln(EF_t/RP_t)]$ is, say, 5 it means that the domestic currency exchanges for 5 per cent more units of foreign currency in the current period than is justified by the price level movements in the domestic country and abroad since the base period.

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6 An alternative measure of the degree of overvaluation (undervaluation) of the currency could be $100[(EF_t - RP_t)/RP_t]$. However, it is an asymmetric measure since $100[(EF_t - RP_t)/RP_t] \neq 100[(RP_t - EF_t)/EF_t]$. It suffers also from the defect that while there is no upper bound for currency overvaluation there is a lower bound (100 percent) for undervaluation. In contrast, $100[\ln(EF_t/RP_t)]$ is unbounded in both directions and $100[\ln(EF_t/RP_t)] = -100[\ln(EF_t/RP_t)]$.

As an indicator of the overall predictive performance of the P.P.P. theory, the degree of overvaluation (undervaluation) of the currency, $100[\ln(EF_t/RP_t)]$, is presented in Table 6.3 for each country and each time period. The relative price is constructed as the difference between the logarithms of the foreign and domestic price (P - FP), while $\ln EF_t$ corresponds to the already defined series FE_t. The base period is again 1975. The constructed series enter Table 6.3 with the symbol RE (real exchange rate) and the letter denoting the corresponding country.

There is a tendency for the par values to move away from the values of 1975 as the 1980s are entered. Only for the US is this not the case. The US currency is overvalued for most of the period after 1975, but in the latter quarters it is undervalued. The French franc is overvalued by 13.1 per cent in 1983II, compared to the base period; the German mark is undervalued by 11.7 per cent, and the Japanese yen by 7.8 per cent. The English pound is also undervalued in the 1980s, by as much as 6 per cent in some quarters, though in 1983 there is a tendency for smaller forecast errors than in previous periods. Korteweg (1980, p. 18) also draws similar conclusions as far as the size of deviations from P.P.P.

TABLE 6.3

FORECASTING PERCENTAGE ERRORS OF PURCHASING POWER PARITY

	FRE	GRE	JRE	ERE	URE
732	——	3.75040	-1.97797	1.45980	-.906725
733	-2.17746	1.85973	-1.51986	1.14786	-.634357
734	-.611205E-01	1.65233	-.753469	1.62046	-.427181
741	1.60348	1.48004	-.575331E-01	1.31075	-.996476
742	2.34282	1.36940	.362820	1.25487	-.520440
743	3.52927	1.59189	.789814	1.68515	-.568843
744	3.14156	1.55578	.526609	1.16765	-.622214
751	1.27262	.678490	.708099	.806137	-.276780
752	.613803E-01	.247137	.490344E-01	-.280307	.173135
753	-1.91412	-.367462	-.118935	.209630	.193370
754	.557030	-.551699	-.633193	-.709270	-.968612E-01
761	-.264240	-.876045	-.770829	-.648720	.573018E-01
762	.351682	-1.90681	-.322663	-.545565	.108872
763	.104113	-2.49311	-.368681	-.381970	.264648
764	2.14045	-3.33138	-.602426	-.348165	.468611
771	2.73574	-3.64879	-.593480	-.381848	.235039
772	2.63742	-3.85814	-.998449	-.600697	.331930
773	3.27335	-4.41138	-1.18557	-.931186	.478696
774	2.97507	-4.70095	-1.29829	-1.21782	.538812
781	3.39262	-5.32109	-1.75089	-1.73971	.686880
782	3.10259	-5.60908	-2.15634	-1.18615	.954796
783	3.51852	-5.85278	-2.86633	-1.44349	1.10274
784	2.69234	-6.12570	-3.25597	-1.60675	1.42076
791	3.44000	-6.87072	-2.80948	-2.03149	1.25675
792	2.80082	-7.01761	-3.37105	-2.51686	.951904
793	2.97959	-7.62487	-3.35275	-3.55568	.745538
794	2.55549	-8.03744	-3.75940	-3.82791	.606169
801	.880481	-8.05491	-3.79105	-4.15288	.107693
802	2.87920	-7.98575	-4.12052	-4.58102	-.265735
803	1.98278	-8.17655	-4.45189	-5.65687	.270080
804	2.25570	-8.34202	-4.92521	-6.03696	-.132205
811	4.39697	-8.31112	-5.42112	-6.18342	-.289869
812	5.16956	-8.50954	-5.88960	-5.78539	-.666300
813	8.00618	-8.77168	-6.29806	-5.64700	-1.39483
814	6.48479	-9.28591	-6.06560	-4.92963	-1.36934
821	8.75378	-9.63811	-6.76137	-5.56051	-1.27045
822	8.32773	-9.93969	-6.61345	-5.24063	-1.75927
823	10.3333	-10.4492	-6.90207	-5.30521	-1.96566
824	12.6090	-10.6608	-6.60301	-5.17105	-1.99834
831	11.3902	-11.1090	-7.51975	-4.21009	-1.66743
832	13.1268	-11.7665	-7.88588	-3.71053	-1.86663

is concerned[7]. Therefore, movements in real exchange rates have been large, which implies that exchange rate changes were not matched by relative price movements.

6.4 SOME POLICY SIMULATION RESULTS

The most common simulation experiment performed in other studies is one involving an increase in the nominal money supply. Then the dynamic pattern of the exchange rate is examined. Money supply turned out to be the most significant variable for all countries also in this study. However, the model is flexible enough to allow also some experiments with real government expenditures and oil prices. In addition, the large country framework gives the opportunity to examine the effect of a change in a domestic policy variable on the rest of the world, something ignored by other studies. The effect of a change in a foreign policy variable on the domestic economy can also be examined.

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[7] Data developed by Korteweg indicate that the average change in the real exchange rate for sixteen industrial countries between March 1973 and the end of 1979 was 6.8 per cent.

The above issues can be explored with either a temporary or a permanent shock (one that persists during the whole sample period). The temporary shocks provide an indication of the speed with which the system adjusts. This section presents and discusses the results of the following hypothetical experiments.

(1) A temporary increase of domestic money supply.

(2) A permanent increase of domestic money supply.

(3) A permanent increase of energy prices.

(4) A temporary increase of foreign money supply.

(5) A temporary increase of domestic government expenditures.

(6) A temporary increase of foreign government expenditures.

The magnitude of the shock is 10 per cent of the relevant exogenous variable in each of the above experiments. The temporary shocks occur in the first quarter of the simulation period. The results of the simulation experiments for all five countries are presented in Tables 6.4 to 6.9 in terms of percentage differences of the endogenous variables from the control values provided by the historical test simulation[8].

A temporary increase of money supply is absorbed relatively fast in all countries except Germany. The effect of the French domestic money supply on the exchange rate is what the original Dornbusch model predicts; initially the exchange rate depreciates in our experiment, and then monotonically appreciates. Depreciation takes place for all countries in the impact period. However, the adjustment process is characterized by subsequent appreciation or depreciation for Germany, Japan, the UK and the US.

The change of domestic money supply affects the rest of the world significantly. Although the effect of domestic money supply on the foreign price is smaller than its effect on the domestic price, the foreign price adjusts much more slowly than the domestic one. Similar observations hold for the permanent increase of the domestic money supply. Overshooting does not occur in any of the above cases. The effects of money supply on the rest of the endogenous variables have already been discussed.

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8 Tables 6.4 to 6.9 can be found at the end of this chapter.

A permanent increase of energy prices increases domestic and foreign prices and depreciates the currencies in all cases. Interest rates generally decline. However, this is not the case for the Japanese foreign interest rate. Notice also that in the impact period the German domestic and foreign interest rates increase and in all subsequent periods they decline. The effect of the permanent energy price increase on both domestic and foreign output is negative for all cases except the domestic UK output variable.

An increase of the foreign money supply has significant effects on the domestic economies concerned. Exchange rates react in exactly the opposite direction to the effect of an increase of domestic money supply, except for GFE. They appreciate in the impact period and subsequently depreciate. In the case of Japan and the UK the adjustment after the impact period is oscillatory. The French exchange rate initially overshoots by an amount of 8.5 per cent. This implies that the volatility of the exchange rate may be equally due to foreign disturbances. Foreign output increases by a considerable amount initially, and subsequently decreases for all countries. US domestic output is affected even more than the foreign output. The effect of foreign money supply on French, Japanese and UK output is generally negative.

Real domestic government spending is equally important domestically and abroad. The exchange rate appreciates in the impact period, except for the case of Germany, for which the effect is very small. There can be either appreciation or depreciation in subsequent periods. Appreciation also occurs due to an increase in foreign real government spending for all countries. The domestic price level adjusts rather slowly to an increase of foreign government spending. Domestic output increases after a rise of domestic government spending, except for France and the UK. In the case of Japan the impact multiplier is negative but small. A domestic fiscal expansion also affects foreign output positively. Similar conclusions hold for the increase of foreign government spending as far as domestic output is concerned.

6.5 CONCLUSIONS

In conclusion, it can be said that the historical simulation indicates that the model tracks the data very well. Furthermore, the model appears stable. The summary statistics indicate that the system of equations performed well for all countries.

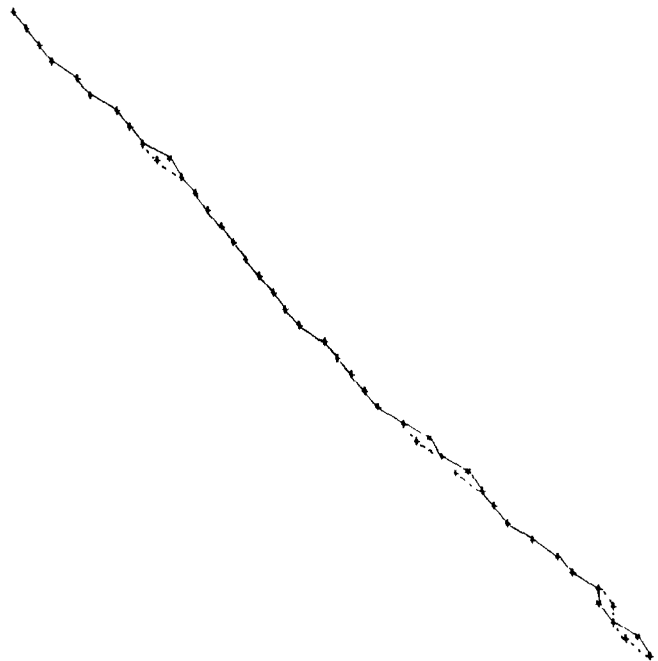
The simulation experiments indicate that adjustments are rather fast for all countries, and that in every case, the rest of the world is quite important. The "large country" assumption is more suitable than the "small country" one, for explaining the economies of the countries examined. An increase in a domestic policy variable has generally significant effects on the rest of the world.

It was found in the third section of this chapter that the prediction of P.P.P. that exchange rate changes are matched by relative price movements does not hold for the flexible exchange rate period of the 1970s and early 1980s.

FIGURE 6.1: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF FP

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
733	4.401	4.401	-.136E-03
734	4.429	4.424	.508E-02
741	4.437	4.440	-.239E-02
742	4.465	4.469	-.457E-02
743	4.496	4.497	-.168E-02
744	4.528	4.530	-.198E-02
751	4.572	4.557	.145E-01
752	4.594	4.596	-.157E-02
753	4.615	4.613	.174E-02
754	4.639	4.638	.680E-03
761	4.665	4.662	.315E-02
762	4.687	4.689	-.264E-02
763	4.708	4.710	-.249E-02
764	4.735	4.733	.206E-02
771	4.747	4.760	-.136E-01
772	4.776	4.772	.413E-02
773	4.798	4.801	-.281E-02
774	4.818	4.822	-.338E-02
781	4.837	4.842	-.433E-02
782	4.864	4.860	.367E-02
783	4.889	4.888	.685E-03
784	4.911	4.909	.241E-02
791	4.939	4.934	.519E-02
792	4.953	4.956	-.266E-02
793	4.982	4.984	-.138E-02
794	5.012	5.012	-.401E-03
801	5.051	5.045	.557E-02
802	5.084	5.089	-.484E-02
803	5.110	5.110	.177E-03
804	5.131	5.140	-.922E-02
811	5.158	5.159	-.575E-03
812	5.184	5.190	-.587E-02
813	5.220	5.219	.341E-03
814	5.262	5.255	.724E-02
821	5.293	5.288	.517E-02
822	5.325	5.319	.629E-02
823	5.332	5.345	-.129E-01
824	5.352	5.355	-.270E-02
831	5.383	5.377	.581E-02
832	5.408	5.404	.438E-02



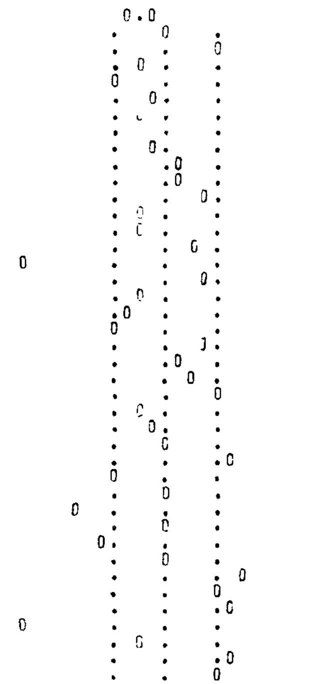
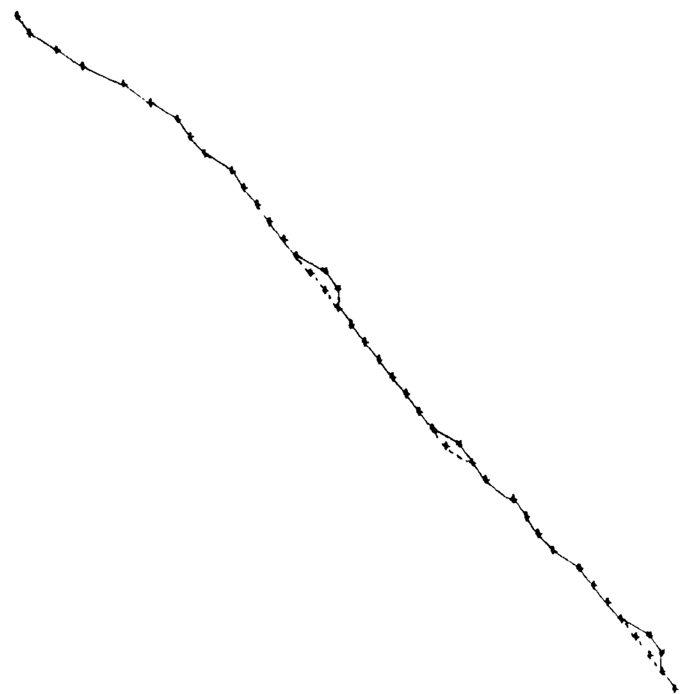


FIGURE 6.2: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF FFP

	ACTUAL	FITTED	RESIDUAL
733	4.379	4.378	.469E-03
734	4.401	4.401	.677E-03
741	4.424	4.425	-.119E-02
742	4.461	4.462	-.139E-02
743	4.502	4.502	.660E-03
744	4.540	4.539	.107E-02
751	4.571	4.571	.928E-03
752	4.594	4.598	-.403E-02
753	4.614	4.615	-.108E-02
754	4.634	4.635	-.120E-02
761	4.650	4.653	-.273E-02
762	4.672	4.672	.431E-03
763	4.690	4.688	.207E-02
764	4.710	4.708	.219E-02
771	4.730	4.728	.193E-02
772	4.749	4.744	.379E-02
773	4.765	4.762	.245E-02
774	4.778	4.778	-.129E-03
781	4.795	4.795	-.365E-03
782	4.809	4.808	.100E-02
783	4.821	4.825	-.428E-02
784	4.840	4.839	.101E-02
791	4.857	4.857	.332E-03
792	4.873	4.873	.122E-03
793	4.889	4.891	-.265E-02
794	4.914	4.912	.197E-02
801	4.934	4.931	.302E-02
802	4.958	4.957	.164E-02
803	4.984	4.980	.347E-02
804	4.999	5.001	-.236E-02
811	5.021	5.020	.559E-03
812	5.039	5.040	-.109E-02
813	5.062	5.064	-.215E-02
814	5.079	5.085	-.688E-02
821	5.105	5.107	-.177E-02
822	5.123	5.124	-.122E-02
823	5.144	5.140	.333E-02
824	5.159	5.157	.143E-02
831	5.172	5.170	.199E-02
832	5.183	5.183	.617E-04



PLOT OF RESIDUALS(0)

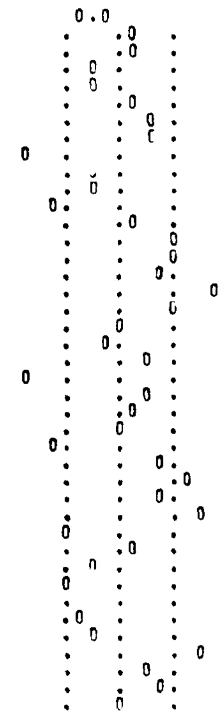
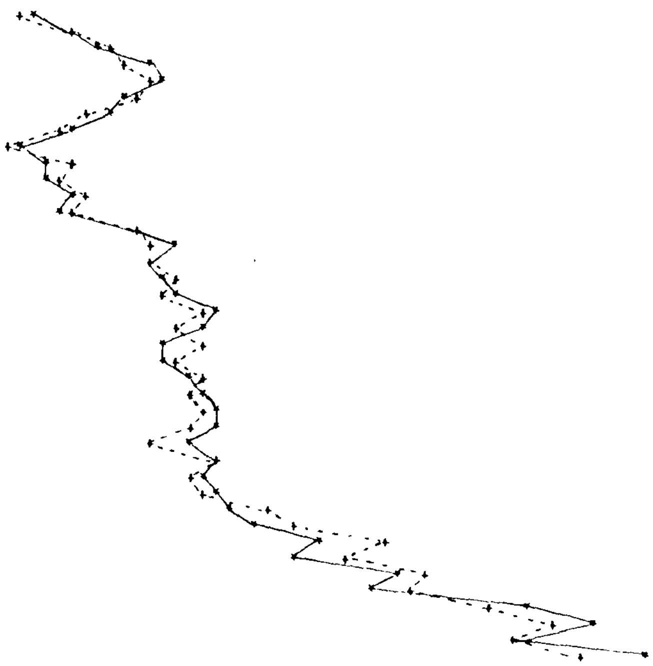


FIGURE 6.3: PLOT OF ACTUAL (—) AND SIMULATED (---) VALUES OF FFE

	ACTUAL	FITTED	RESIDUAL
733	4.547	4.509	.381E-01
734	4.615	4.606	.863E-02
741	4.645	4.674	-.289E-01
742	4.735	4.701	.345E-01
743	4.759	4.745	.148E-01
744	4.684	4.721	-.375E-01
751	4.676	4.629	.462E-01
752	4.612	4.585	.276E-01
753	4.525	4.496	.291E-01
754	4.569	4.612	-.445E-01
761	4.563	4.581	-.179E-01
762	4.606	4.618	-.113E-01
763	4.592	4.611	-.185E-01
764	4.715	4.708	.636E-02
771	4.779	4.744	.351E-01
772	4.740	4.734	.627E-02
773	4.753	4.775	-.217E-01
774	4.775	4.766	.911E-02
781	4.832	4.817	.144E-01
782	4.828	4.779	.482E-01
783	4.761	4.810	-.490E-01
784	4.746	4.777	-.309E-01
791	4.906	4.820	-.136E-01
792	4.818	4.800	.187E-01
793	4.839	4.813	.266E-01
794	4.845	4.799	.461E-01
801	4.796	4.732	.642E-01
802	4.846	4.840	.554E-02
803	4.814	4.798	.160E-01
804	4.834	4.819	.144E-01
811	4.869	4.922	-.538E-01
812	4.909	4.971	-.629E-01
813	5.005	5.118	-.113
814	4.971	5.054	-.831E-01
821	5.153	5.182	-.299E-01
822	5.111	5.172	-.606E-01
823	5.372	5.286	.856E-01
824	5.467	5.400	.675E-01
831	5.347	5.343	.431E-02
832	5.556	5.450	.106



PLOT OF RESIDUALS(0)

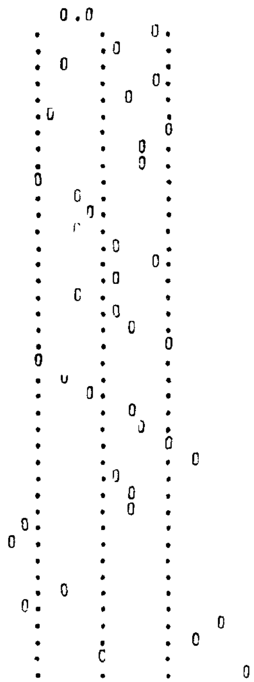
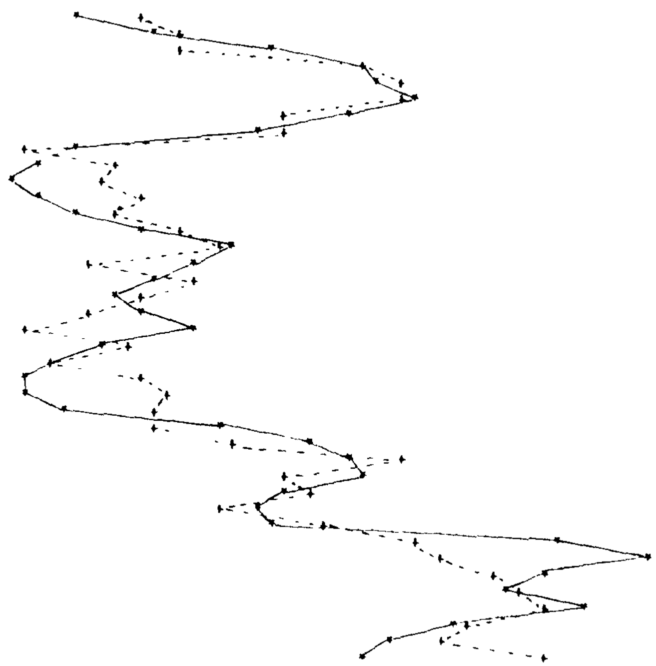


FIGURE 6.4: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF FR

	ACTUAL	FITTED	RESIDUAL
733	.7704E-01	.8756E-01	-.105E-01
734	.9174E-01	.9619E-01	-.445E-02
741	.1120	.9657E-01	.154E-01
742	.1276	.1282	-.569E-03
743	.1293	.1335	-.425E-02
744	.1354	.1337	.215E-02
751	.1240	.1129	.111E-01
752	.1092	.1128	-.367E-02
753	.7825E-01	.6844E-01	.981E-02
754	.7064E-01	.8394E-01	-.133E-01
761	.6579E-01	.813[illegible]E-01	-.155E-01
762	.7087E-01	.8837E-01	-.175E-01
763	.7664E-01	.8298E-01	-.634E-02
764	.8907E-01	.947[illegible]E-01	-.564E-02
771	.1055	.1028	.278E-02
772	.9862E-01	.7997E-01	.187E-01
773	.9182E-01	.9665E-01	-.482E-02
774	.8421E-01	.8903E-01	-.481E-02
781	.8824E-01	.8048E-01	.777E-02
782	.9702E-01	.6811E-01	.289E-01
783	.8210E-01	.8649E-01	-.439E-02
784	.7223E-01	.7169E-01	.539E-03
791	.6807E-01	.8927E-01	-.212E-01
792	.6722E-01	.9255E-01	-.253E-01
793	.7431E-01	.9109E-01	-.168E-01
794	.1017	.9172E-01	.994E-02
801	.1179	.1052	.127E-01
802	.1241	.1347	-.106E-01
803	.1263	.1138	.125E-01
804	.1147	.1174	-.267E-02
811	.1088	.1017	.715E-02
812	.1116	.1206	-.902E-02
813	.1626	.1364	.261E-01
814	.1775	.1406	.369E-01
821	.1599	.1513	.864E-02
822	.1523	.1552	-.294E-02
823	.1660	.1601	.596E-02
824	.1445	.1461	-.160E-02
831	.1324	.1400	-.766E-02
832	.1281	.1599	-.318E-01



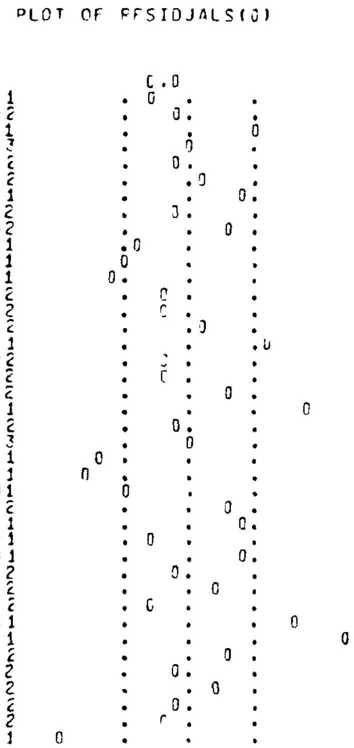
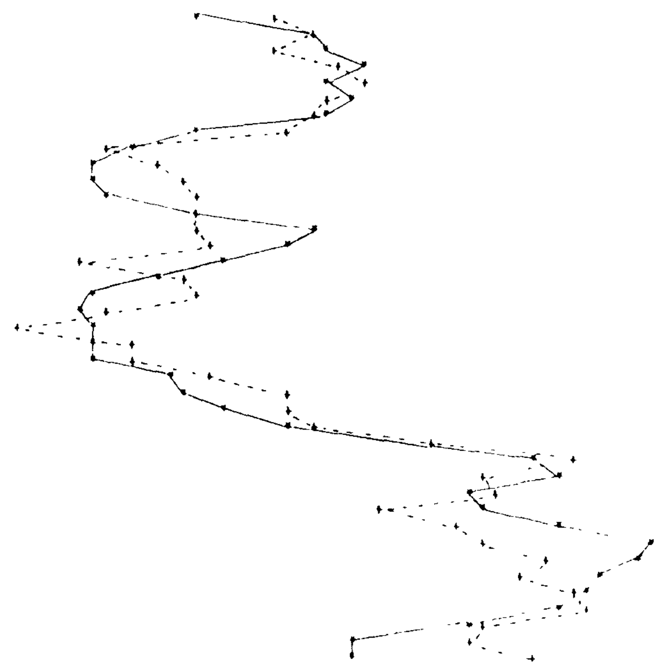


FIGURE 6.5: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF FFR

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
733	.7194E-01	.8267E-01	-.107E-01
734	.8714E-01	.8851E-01	-.138E-02
741	.8391E-01	.7723E-01	.668E-02
742	.938[illegible]E-01	.9087E-01	.295E-02
743	.8971E-01	.9568E-01	-.597E-02
744	.9366E-01	.8910E-01	.456E-02
751	.8886E-01	.8779E-01	.107E-02
752	.7270E-01	.8521E-01	-.124E-01
753	.6416E-01	.6044E-01	.372E-02
754	.5927E-01	.6711E-01	-.884E-02
761	.5941E-01	.708[illegible]E-01	-.124E-01
762	.6051E-01	.7214E-01	-.116E-01
763	.7331E-01	.7315E-01	.153E-03
764	.8785E-01	.732[illegible]E-01	.146E-01
771	.8430E-01	.7451E-01	.979E-02
772	.7573E-01	.570[illegible]E-01	.187E-01
773	.6704E-01	.7139E-01	-.435E-02
774	.5904E-01	.7263E-01	-.136E-01
781	.5771E-01	.607[illegible]E-01	-.301E-02
782	.5972E-01	.4879E-01	.109E-01
783	.5874E-01	.6417E-01	-.543E-02
784	.5873E-01	.6367E-01	-.491E-02
791	.6901E-01	.7387E-01	-.486E-02
792	.7116E-01	.8502E-01	-.139E-01
793	.7537E-01	.8375E-01	-.838E-02
794	.8524E-01	.8739E-01	-.215E-02
801	.1028	.1036	-.834E-03
802	.1162	.1223	-.612E-02
803	.1204	.1092	.113E-01
804	.1087	.1114	-.266E-02
811	.1097	.9672E-01	.130E-01
812	.1195	.1072	.123E-01
813	.1319	.1100	.219E-01
814	.1306	.1181	.125E-01
821	.1251	.1150	.101E-01
822	.1243	.1214	.293E-02
823	.1208	.1237	-.297E-02
824	.1090	.1093	-.312E-03
831	.9356E-01	.1082	-.146E-01
832	.9359E-01	.1164	-.228E-01



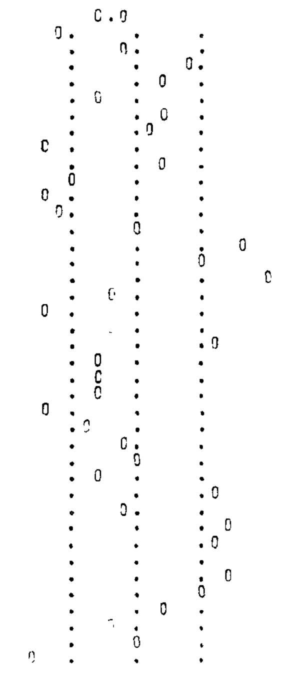
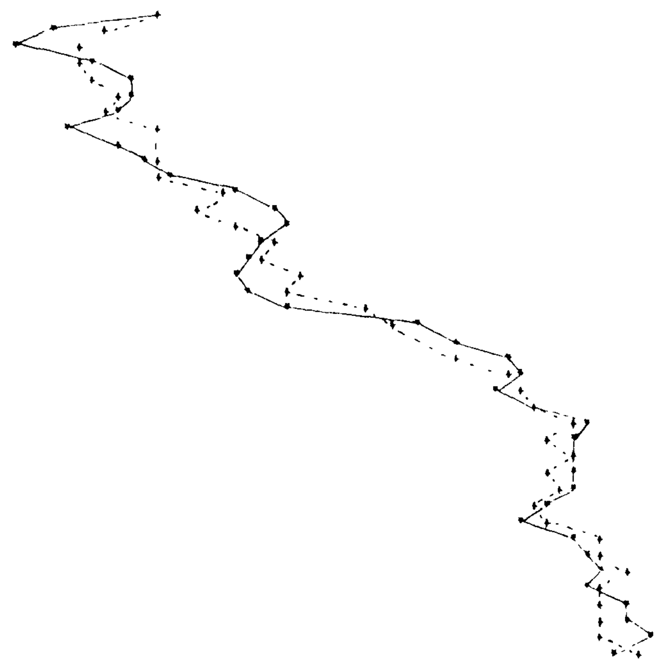


FIGURE 6.6: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF FY

PLOT OF RESIDUALS(O)

	ACTUAL	FITTED	RESIDUAL
733	2.689	2.696	.230E-02
734	2.653	2.671	-.184E-01
741	2.639	2.663	-.243E-01
742	2.667	2.662	.517E-02
743	2.678	2.664	.134E-01
744	2.681	2.673	.761E-02
751	2.675	2.669	.636E-02
752	2.653	2.683	-.305E-01
753	2.674	2.676	-.187E-02
754	2.686	2.690	-.407E-02
761	2.693	2.689	.377E-02
762	2.714	2.710	.397E-02
763	2.728	2.703	.251E-01
764	2.735	2.717	.179E-01
771	2.727	2.728	-.417E-03
772	2.719	2.725	-.588E-02
773	2.714	2.738	-.244E-01
774	2.721	2.734	-.122E-01
781	2.734	2.760	-.259E-01
782	2.779	2.770	.912E-02
783	2.792	2.793	-.115E-02
784	2.811	2.796	.148E-01
791	2.815	2.813	.202E-02
792	2.807	2.816	-.889E-02
793	2.823	2.821	.182E-02
794	2.839	2.833	.591E-02
801	2.833	2.825	.803E-02
802	2.834	2.836	-.127E-02
803	2.835	2.826	.919E-02
804	2.834	2.831	.391E-02
811	2.824	2.823	.958E-03
812	2.817	2.827	-.103E-01
813	2.834	2.844	-.102E-01
814	2.841	2.845	-.409E-02
821	2.846	2.855	-.923E-02
822	2.838	2.843	-.485E-02
823	2.854	2.846	.862E-02
824	2.854	2.842	.115E-01
831	2.862	2.844	.174E-01
832	2.851	2.859	-.852E-02



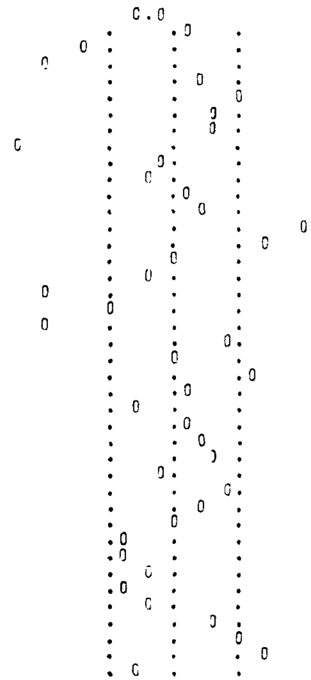
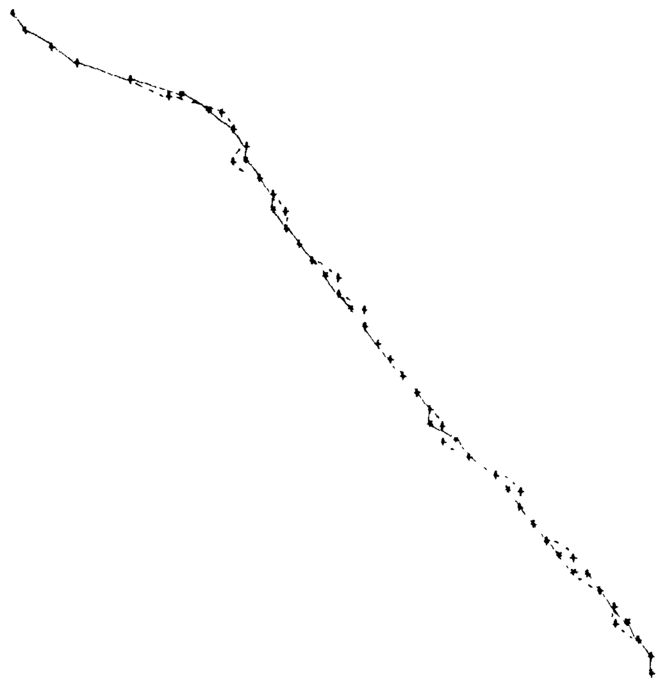


FIGURE 6.7: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF GP

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
732	4.432	4.433	-.529E-03
733	4.442	4.444	-.160E-02
734	4.460	4.460	-.212E-03
741	4.476	4.480	-.334E-02
742	4.527	4.516	.649E-02
743	4.565	4.556	.939E-02
744	4.580	4.591	-.113E-01
751	4.599	4.596	.312E-02
752	4.605	4.608	-.271E-02
753	4.610	4.603	.665E-02
754	4.614	4.614	.337E-03
761	4.628	4.631	-.336E-02
762	4.632	4.636	-.436E-02
763	4.640	4.641	-.109E-02
764	4.651	4.650	.646E-03
771	4.660	4.659	.932E-03
772	4.666	4.672	-.616E-02
773	4.679	4.673	.516E-02
774	4.687	4.692	-.473E-02
781	4.701	4.697	.345E-02
782	4.703	4.704	-.835E-03
783	4.716	4.714	.223E-02
784	4.726	4.729	-.368E-02
791	4.737	4.731	.617E-02
792	4.742	4.749	-.669E-02
793	4.742	4.751	-.860E-02
794	4.765	4.756	.882E-02
801	4.772	4.773	-.256E-03
802	4.797	4.794	.328E-02
803	4.806	4.810	-.400E-02
804	4.811	4.812	-.108E-02
811	4.823	4.825	-.259E-02
812	4.835	4.835	.180E-03
813	4.845	4.854	-.891E-02
814	4.856	4.859	-.353E-02
821	4.873	4.868	.471E-02
822	4.877	4.881	-.447E-02
823	4.894	4.886	.822E-02
824	4.903	4.899	.435E-02
831	4.911	4.909	.177E-02
832	4.907	4.907	.313E-03



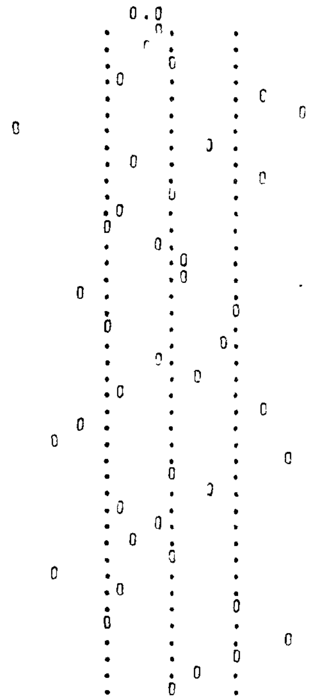
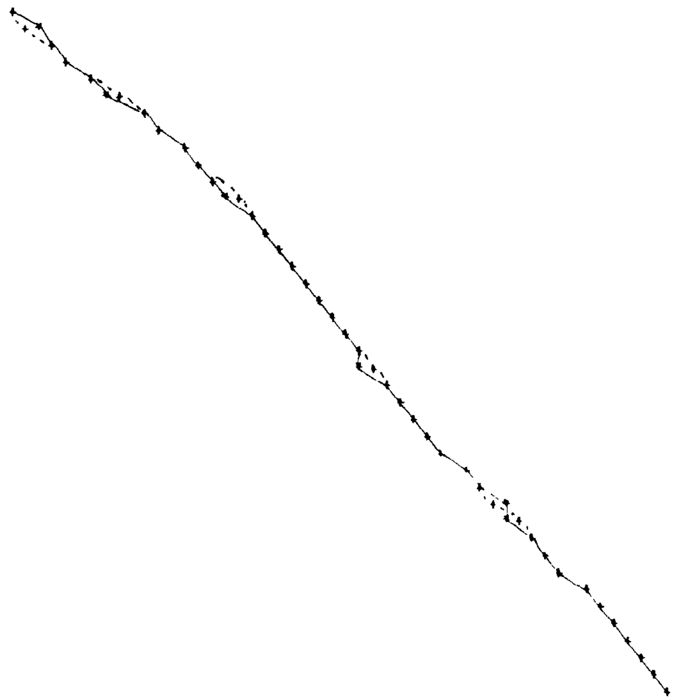


FIGURE 6.8: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF GFP

	ACTUAL	FITTED	RESIDUAL
732	4.350	4.350	-.104E-03
733	4.373	4.374	.441E-02
734	4.404	4.400	.392E-02
741	4.425	4.426	-.558E-03
742	4.455	4.458	-.310E-02
743	4.491	4.495	-.380E-02
744	4.531	4.532	-.277E-03
751	4.565	4.566	-.563E-03
752	4.592	4.594	-.242E-02
753	4.616	4.619	-.246E-02
754	4.638	4.641	-.288E-02
761	4.659	4.662	-.339E-02
762	4.685	4.684	.148E-02
763	4.706	4.705	.160E-02
764	4.729	4.726	.296E-02
771	4.749	4.746	.295E-02
772	4.773	4.766	.656E-02
773	4.792	4.786	.572E-02
774	4.806	4.805	.129E-02
781	4.822	4.824	-.205E-02
782	4.842	4.842	-.215E-03
783	4.848	4.859	-.113E-01
784	4.877	4.877	.282E-03
791	4.896	4.897	-.144E-02
792	4.914	4.917	-.325E-02
793	4.935	4.939	-.378E-02
794	4.960	4.960	-.555E-03
801	4.985	4.984	.135E-02
802	5.009	5.009	.109E-03
803	5.039	5.035	.389E-02
804	5.055	5.058	-.322E-02
811	5.081	5.081	-.797E-03
812	5.100	5.105	-.529E-02
813	5.130	5.129	.101E-02
814	5.151	5.153	-.154E-02
821	5.181	5.175	.575E-02
822	5.202	5.195	.738E-02
823	5.221	5.215	.637E-02
824	5.236	5.235	.118E-02
831	5.253	5.255	-.223E-02
832	5.270	5.272	-.194E-02



PLOT OF RESIDUALS(0)

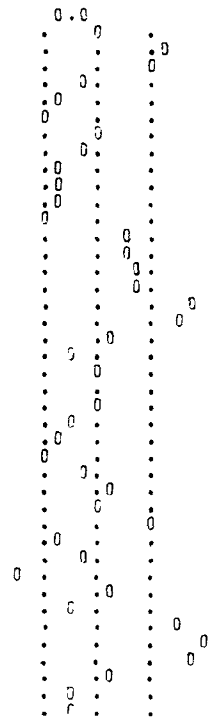
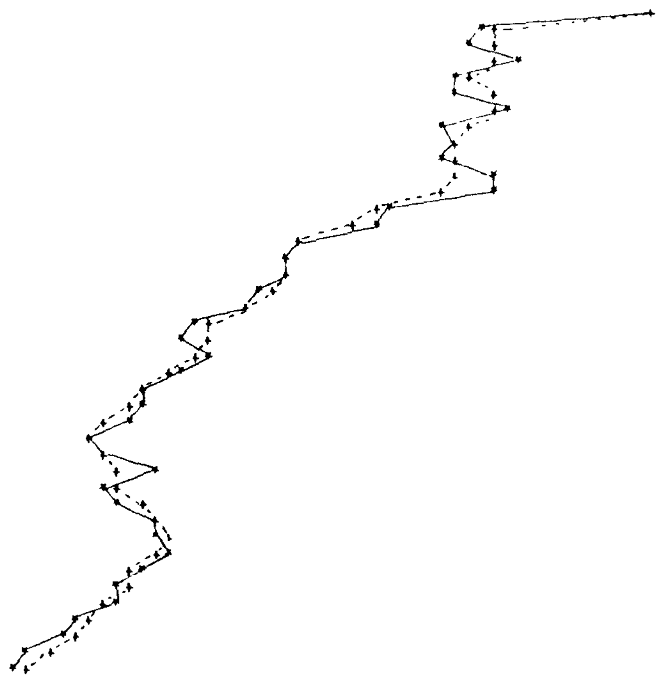


FIGURE 6.9: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF GFE

	ACTUAL	FITTED		RESIDUAL
732	4.700	4.698		.112E-02
733	4.617	4.624		-.720E-02
734	4.611	4.624		-.135E-01
741	4.641	4.623		.171E-01
742	4.605	4.615		-.994E-02
743	4.609	4.625		-.166E-01
744	4.629	4.623		.614E-02
751	4.598	4.612		-.141E-01
752	4.605	4.609		-.333E-02
753	4.602	4.610		-.829E-02
754	4.626	4.609		.180E-01
761	4.626	4.602		.239E-01
762	4.574	4.571		.307E-02
763	4.571	4.560		.114E-01
764	4.537	4.537		-.117E-03
771	4.524	4.529		-.501E-02
772	4.529	4.526		.326E-02
773	4.514	4.519		-.468E-02
774	4.506	4.506		.311E-03
781	4.483	4.490		-.740E-02
782	4.480	4.488		-.838E-02
783	4.489	4.483		.532E-02
784	4.481	4.472		.816E-02
791	4.457	4.457		.240E-03
792	4.462	4.451		.106E-01
793	4.452	4.442		.101E-01
794	4.438	4.438		.894E-04
801	4.439	4.443		-.377E-02
802	4.465	4.448		.175E-01
803	4.443	4.448		-.445E-02
804	4.445	4.459		-.114E-01
811	4.467	4.468		-.110E-02
812	4.467	4.472		-.487E-02
813	4.475	4.463		.115E-01
814	4.461	4.456		.472E-02
821	4.450	4.451		-.127E-02
822	4.445	4.443		.199E-02
823	4.426	4.433		-.736E-02
824	4.424	4.429		-.538E-02
831	4.407	4.417		-.398E-02
832	4.398	4.405		-.680E-02

PLOT OF RESIDUALS(0)

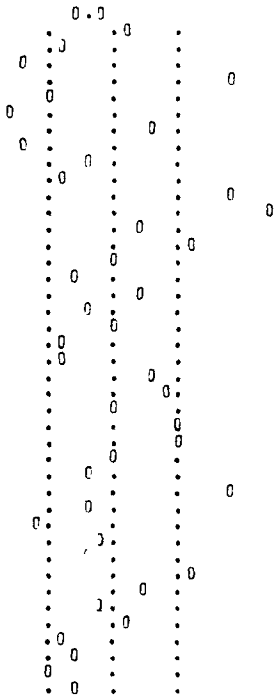
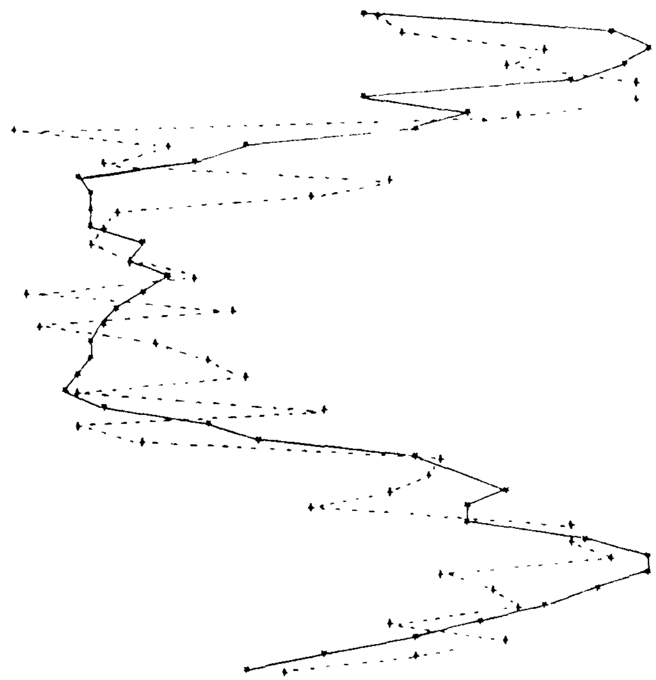


FIGURE 6.10: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF GR

	ACTUAL	FITTED	RESIDUAL
732	.7570E-01	.7777E-01	-.207E-02
733	.1106	.8028E-01	.303E-01
734	.1170	.1016	.154E-01
741	.1131	.9576E-01	.173E-01
742	.1066	.1153	-.872E-02
743	.7496E-01	.1153	-.404E-01
744	.9033E-01	.9764E-01	-.730E-02
751	.8313E-01	.2381E-01	.593E-01
752	.5744E-01	.4699E-01	.105E-01
753	.5034E-01	.3684E-01	.135E-01
754	.3338E-01	.7844E-01	-.451E-01
761	.3564E-01	.6822E-01	-.326E-01
762	.3590E-01	.3817E-01	-.227E-02
763	.3613E-01	.3695E-01	-.823E-03
764	.4211E-01	.3431E-01	.780E-02
771	.4105E-01	.4067E-01	.398E-03
772	.4616E-01	.5028E-01	-.412E-02
773	.4307E-01	.2647E-01	.166E-01
774	.3978E-01	.5706E-01	-.173E-01
781	.3719E-01	.2830E-01	.885E-02
782	.3484E-01	.4454E-01	-.966E-02
783	.3503E-01	.5219E-01	-.172E-01
784	.3293E-01	.5881E-01	-.258E-01
791	.3112E-01	.3371E-01	-.259E-02
792	.3795E-01	.6914E-01	-.312E-01
793	.5304E-01	.3247E-01	.205E-01
794	.6016E-01	.4259E-01	.176E-01
801	.8337E-01	.8590E-01	-.247E-02
802	.8514E-01	.8467E-01	.470E-03
803	.9607E-01	.7832E-01	.177E-01
804	.9023E-01	.6793E-01	.222E-01
811	.9036E-01	.1048	-.145E-01
812	.1077	.1049	.282E-02
813	.1171	.1122	.486E-02
814	.1164	.8604E-01	.304E-01
821	.1094	.9375E-01	.157E-01
822	.1026	.9897E-01	.360E-02
823	.9207E-01	.7961E-01	.125E-01
824	.8341E-01	.9606E-01	-.126E-01
831	.6929E-01	.8275E-01	-.135E-01
832	.5847E-01	.6330E-01	-.484E-02



PLOT OF RESIDUALS(0)

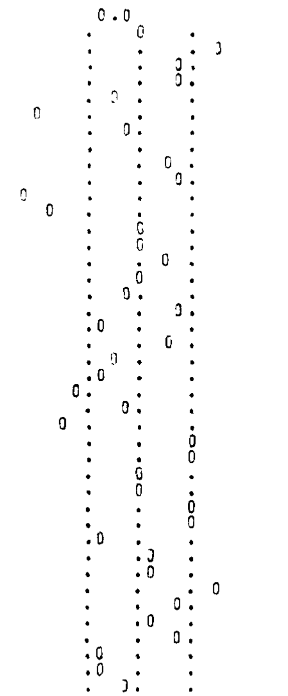
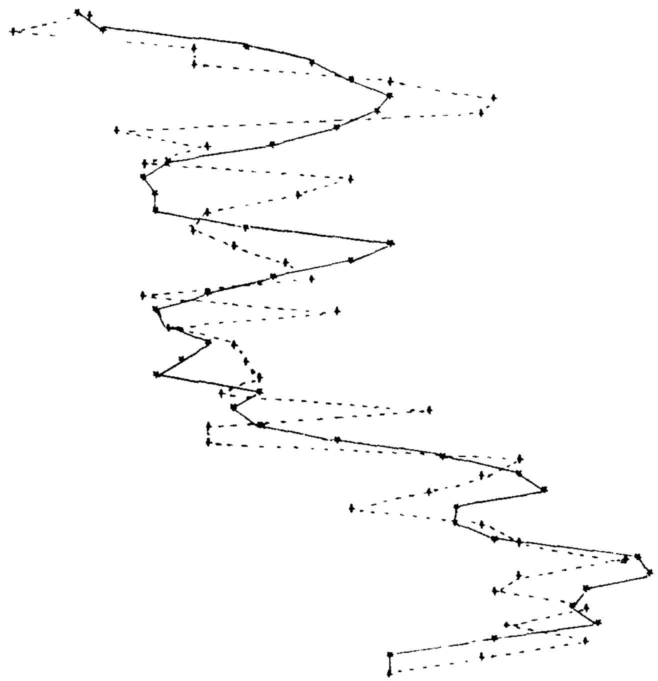


FIGURE 6.11: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF GFR

	ACTUAL	FITTED	RESIDUAL
732	.5423E-01	.5646E-01	-.218E-02
733	.5944E-01	.451[illegible]E-01	.143E-01
734	.7964E-01	.7188E-01	.776E-02
741	.8952E-01	.7319E-01	.163E-01
742	.9693E-01	.1020	-.509E-02
743	.1021	.116[illegible]	-.159E-01
744	.100[illegible]	.1171	-.163E-01
751	.950[illegible]E-01	.6[illegible]5[illegible]E-01	.345E-01
752	.8483E-01	.7415E-01	.107E-01
753	.6343E-01	.6405E-01	.544E-02
754	.6570E-01	.9594E-01	-.302E-01
761	.6583E-01	.8890E-01	-.230E-01
762	.6717E-01	.7536E-01	-.821E-02
763	.7997E-01	.7248E-01	.749E-02
764	.1019	.780[illegible]E-01	.237E-01
771	.9621E-01	.8726E-01	.895E-02
772	.8543E-01	.9042E-01	-.494E-02
773	.7457E-01	.6416E-01	.104E-01
774	.6694E-01	.9411E-01	-.271E-01
781	.6921E-01	.6946E-01	-.242E-03
782	.7439E-01	.7938E-01	-.501E-02
783	.7005E-01	.7969E-01	-.963E-02
784	.6757E-01	.8270E-01	-.152E-01
791	.8162E-01	.7575E-01	.587E-02
792	.7945E-01	.1087	-.292E-01
793	.8161E-01	.7563E-01	.598E-02
794	.9466E-01	.7504E-01	.196E-01
801	.1098	.1214	-.116E-01
802	.1228	.1153	.746E-02
803	.1251	.1077	.174E-01
804	.1121	.9644E-01	.156E-01
811	.1113	.1154	-.410E-02
812	.1185	.1218	-.327E-02
813	.1398	.1370	.279E-02
814	.1417	.1220	.197E-01
821	.1317	.1187	.130E-01
822	.1306	.1326	-.200E-02
823	.1336	.1208	.128E-01
824	.1189	.1319	-.130E-01
831	.1020	.1166	-.145E-01
832	.1028	.1032	-.460E-03



PLOT OF RESIDUALS(0)

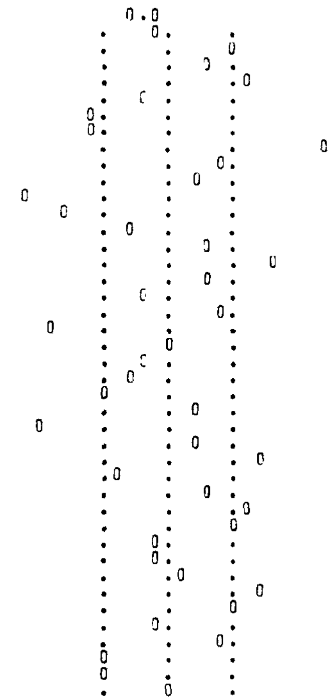
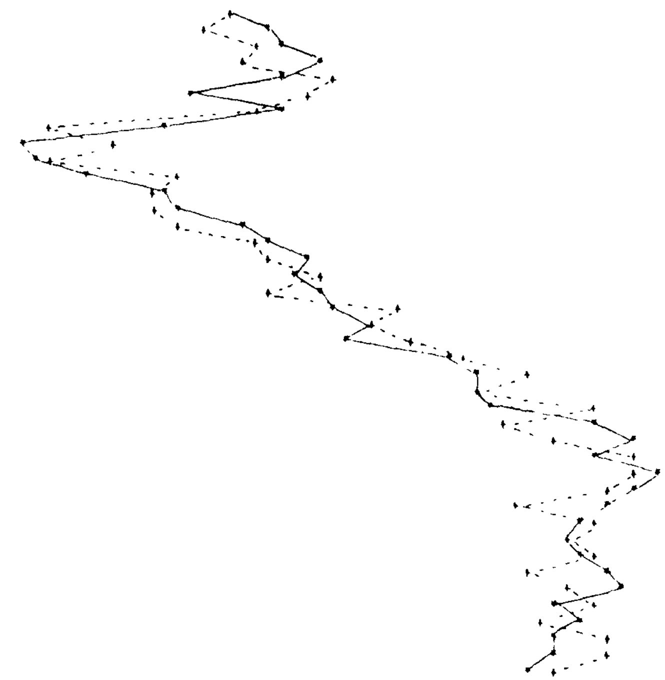


FIGURE 6.12: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF GY

PLOT OF RESIDUALS(O)

	ACTUAL	FITTED	RESIDUAL
732	2.381	2.38[illegible]	-.171E-02
733	2.393	2.374	.187E-01
734	2.397	2.391	.576E-02
741	2.41[illegible]	2.38[illegible]	.260E-01
742	2.397	2.41[illegible]	-.206E-01
743	2.364	2.407	-.389E-01
744	2.39[illegible]	2.391	.679E-02
751	2.361	2.32[illegible]	.409E-01
752	2.314	2.345	-.318E-01
753	2.31[illegible]	2.32[illegible]	-.270E-02
754	2.33[illegible]	2.365	-.314E-01
761	2.36[illegible]	2.358	.495E-02
762	2.36[illegible]	2.35[illegible]	.101E-01
763	2.387	2.36[illegible]	.207E-01
764	2.39[illegible]	2.391	.461E-02
771	2.40[illegible]	2.39[illegible]	.121E-01
772	2.403	2.412	-.862E-02
773	2.41[illegible]	2.39[illegible]	.130E-01
774	2.41[illegible]	2.438	-.228E-01
781	2.43[illegible]	2.427	.324E-02
782	2.42[illegible]	2.44[illegible]	-.233E-01
783	2.45[illegible]	2.460	-.661E-02
784	2.46[illegible]	2.47[illegible]	-.154E-01
791	2.46[illegible]	2.46[illegible]	.112E-02
792	2.468	2.503	-.351E-01
793	2.50[illegible]	2.47[illegible]	.286E-01
794	2.514	2.487	.276E-01
801	2.50[illegible]	2.51[illegible]	-.137E-01
802	2.52[illegible]	2.51[illegible]	.102E-01
803	2.515	2.507	.322E-02
804	2.50[illegible]	2.47[illegible]	.277E-01
811	2.49[illegible]	2.50[illegible]	-.349E-02
812	2.494	2.491	.341E-02
813	2.495	2.50[illegible]	-.678E-02
814	2.50[illegible]	2.49[illegible]	.269E-01
821	2.50[illegible]	2.49[illegible]	.166E-01
822	2.487	2.50[illegible]	-.144E-01
823	2.49[illegible]	2.48[illegible]	.113E-01
824	2.48[illegible]	2.504	-.151E-01
831	2.49[illegible]	2.50[illegible]	-.177E-01
832	2.47[illegible]	2.48[illegible]	-.795E-02



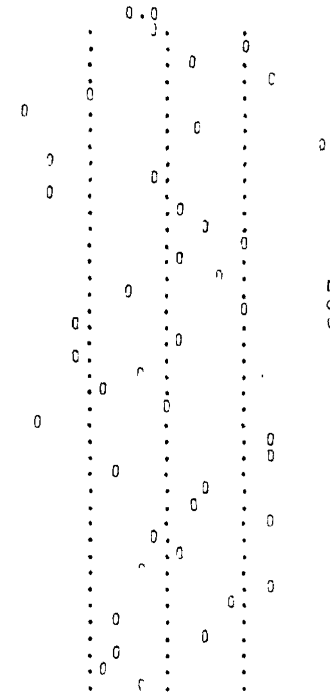
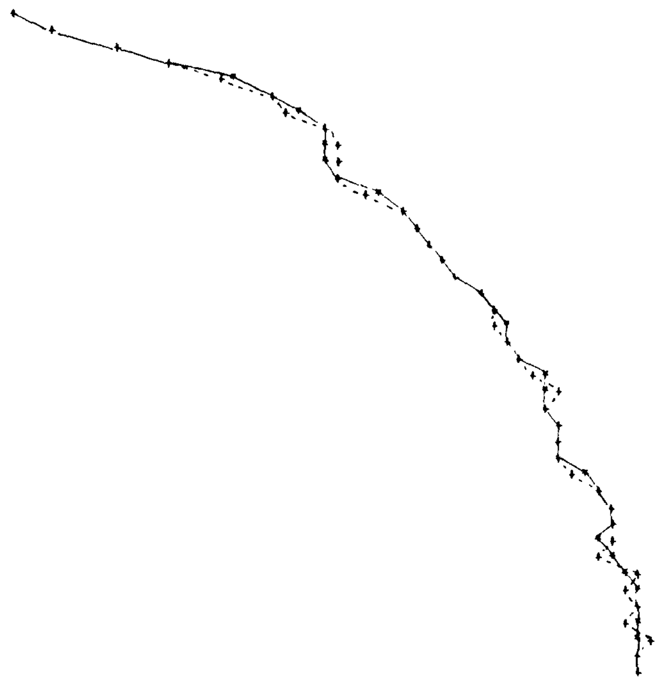


FIGURE 6.13: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF JP

	ACTUAL	FITTED	RESIDUAL
732	4.293	4.295	-.170E-02
733	4.333	4.329	.359E-02
734	4.385	4.388	-.295E-02
741	4.437	4.440	-.243E-02
742	4.498	4.490	.823E-02
743	4.527	4.537	-.997E-02
744	4.559	4.549	.100E-01
751	4.577	4.582	-.551E-02
752	4.582	4.587	-.527E-02
753	4.585	4.595	-.104E-01
754	4.594	4.597	-.293E-02
761	4.627	4.613	.144E-01
762	4.652	4.653	-.739E-03
763	4.671	4.668	.291E-02
764	4.678	4.682	-.426E-02
771	4.692	4.690	.150E-02
772	4.706	4.705	.120E-02
773	4.724	4.720	.485E-02
774	4.733	4.735	-.207E-02
781	4.743	4.740	.267E-02
782	4.749	4.757	-.756E-02
783	4.761	4.756	.539E-02
784	4.782	4.773	.896E-02
791	4.784	4.799	-.147E-01
792	4.791	4.785	.571E-02
793	4.796	4.798	-.175E-02
794	4.798	4.796	.241E-02
801	4.799	4.802	-.267E-02
802	4.818	4.804	.140E-01
803	4.832	4.835	-.340E-02
804	4.843	4.839	.406E-02
811	4.842	4.847	-.497E-02
812	4.837	4.846	-.956E-02
813	4.849	4.838	.115E-01
814	4.857	4.864	-.695E-02
821	4.866	4.862	.360E-02
822	4.865	4.867	-.159E-02
823	4.873	4.862	.109E-01
824	4.868	4.881	-.127E-01
831	4.870	4.874	-.401E-02
832	4.870	4.871	-.191E-02



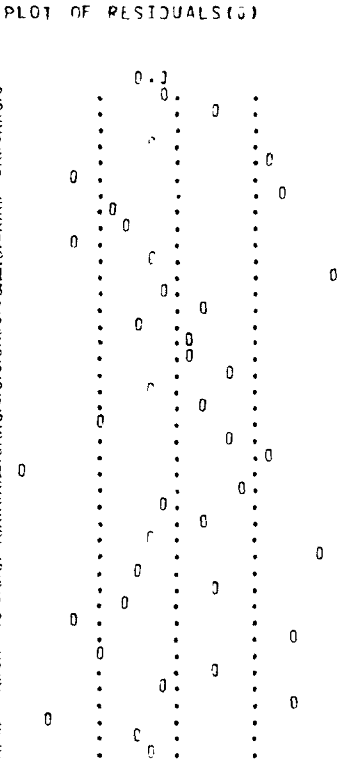
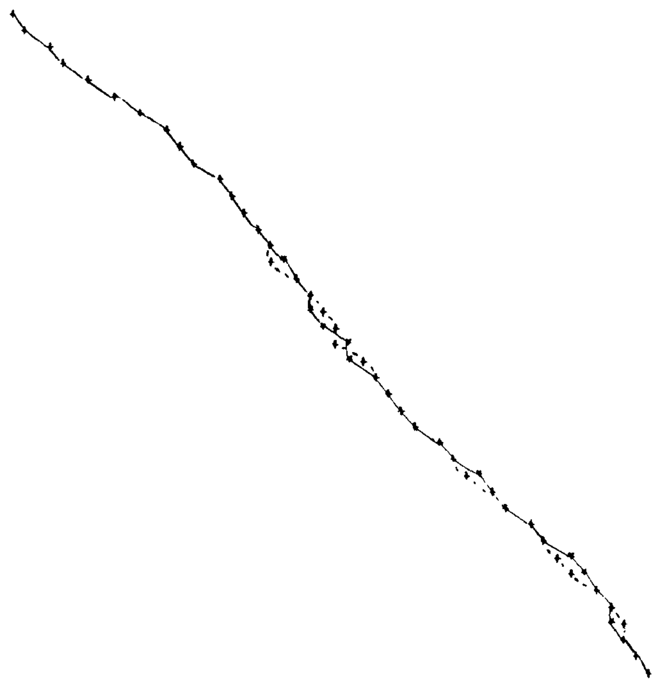


FIGURE 6.14: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF JFP

	ACTUAL	FITTED	RESIDUAL
732	4.380	4.384	-.331E-02
733	4.406	4.404	.189E-02
734	4.431	4.429	.234E-02
741	4.457	4.456	.776E-03
742	4.485	4.487	-.212E-02
743	4.522	4.523	-.938E-03
744	4.558	4.552	.645E-02
751	4.582	4.585	-.313E-02
752	4.609	4.610	-.107E-02
753	4.631	4.629	.218E-02
754	4.657	4.649	.772E-02
761	4.671	4.673	-.182E-02
762	4.689	4.691	-.272E-02
763	4.707	4.704	-.171E-02
764	4.722	4.723	-.102E-02
771	4.739	4.734	.374E-02
772	4.756	4.755	.124E-02
773	4.772	4.775	-.502E-02
774	4.785	4.792	-.672E-02
781	4.802	4.805	-.239E-02
782	4.825	4.822	.320E-02
783	4.839	4.839	-.334E-03
784	4.862	4.864	-.238E-02
791	4.884	4.882	.131E-02
792	4.904	4.901	.312E-02
793	4.923	4.926	-.278E-02
794	4.947	4.950	-.307E-02
801	4.971	4.972	-.916E-03
802	4.996	4.992	.335E-02
803	5.023	5.024	-.560E-03
804	5.031	5.043	-.120E-01
811	5.077	5.065	.907E-02
812	5.091	5.090	.107E-02
813	5.122	5.109	.137E-01
814	5.137	5.132	.500E-02
821	5.153	5.154	-.103E-02
822	5.170	5.171	-.112E-02
823	5.184	5.186	-.193E-02
824	5.202	5.193	.298E-02
831	5.213	5.213	-.528E-05
832	5.227	5.224	-.552E-02



PLOT OF RESIDUALS(0)

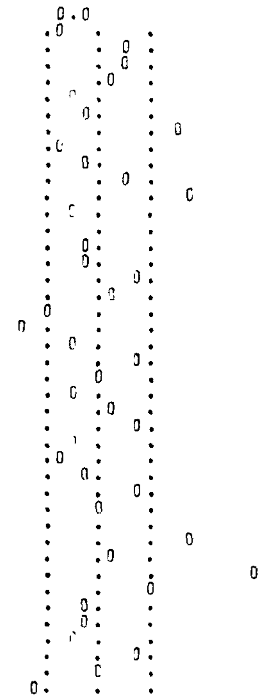
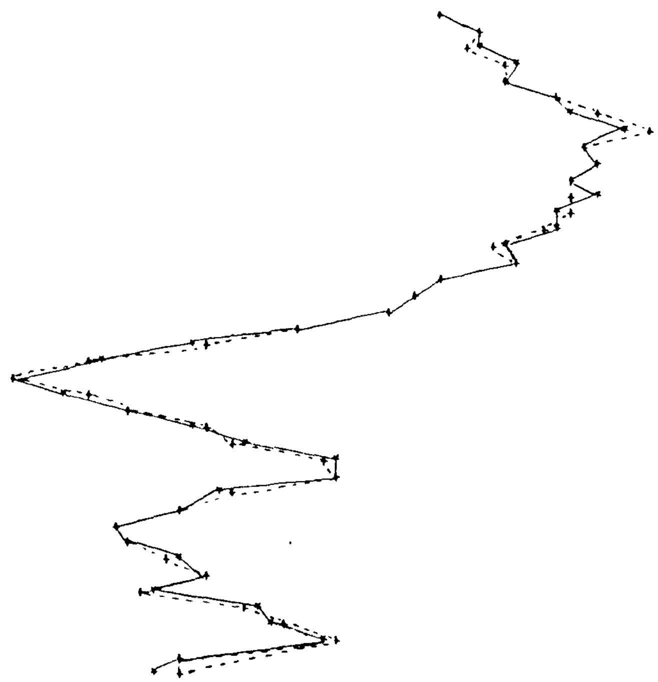


FIGURE 6.15: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF JFE

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
732	4.582	4.583	-.154E-03
733	4.583	4.583	.690E-04
734	4.588	4.587	.662E-03
741	4.595	4.593	.239E-02
742	4.595	4.593	-.774E-03
743	4.60.	4.601	-.142E-02
744	4.603	4.606	-.260E-02
751	4.610	4.614	-.485E-02
752	4.604	4.604	.588E-03
753	4.606	4.607	-.974E-03
754	4.603	4.602	.108E-02
761	4.607	4.603	.429E-02
762	4.601	4.602	-.138E-02
763	4.600	4.598	.184E-02
764	4.593	4.591	.217E-02
771	4.595	4.595	.466E-03
772	4.582	4.562	-.159E-03
773	4.573	4.578	-.444E-03
774	4.575	4.574	.624E-03
781	4.562	4.561	.371E-03
782	4.545	4.546	-.101E-02
783	4.530	4.528	.237E-02
784	4.517	4.517	.204E-03
791	4.524	4.529	-.480E-02
792	4.536	4.535	.123E-02
793	4.545	4.546	-.390E-03
794	4.552	4.552	.372E-03
801	4.567	4.566	.101E-02
802	4.568	4.566	.137E-02
803	4.549	4.551	-.165E-02
804	4.542	4.543	-.741E-03
811	4.533	4.532	.543E-03
812	4.535	4.534	.188E-03
813	4.543	4.540	.233E-02
814	4.547	4.547	.518E-03
821	4.533	4.537	.229E-02
822	4.555	4.554	.192E-02
823	4.559	4.558	-.511E-03
824	4.565	4.566	-.392E-03
831	4.542	4.543	-.871E-03
832	4.538	4.542	-.433E-02



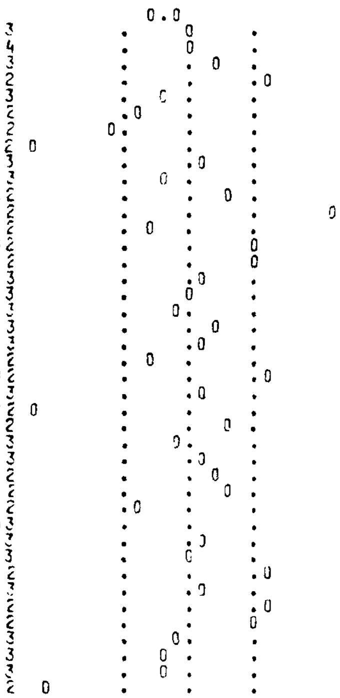
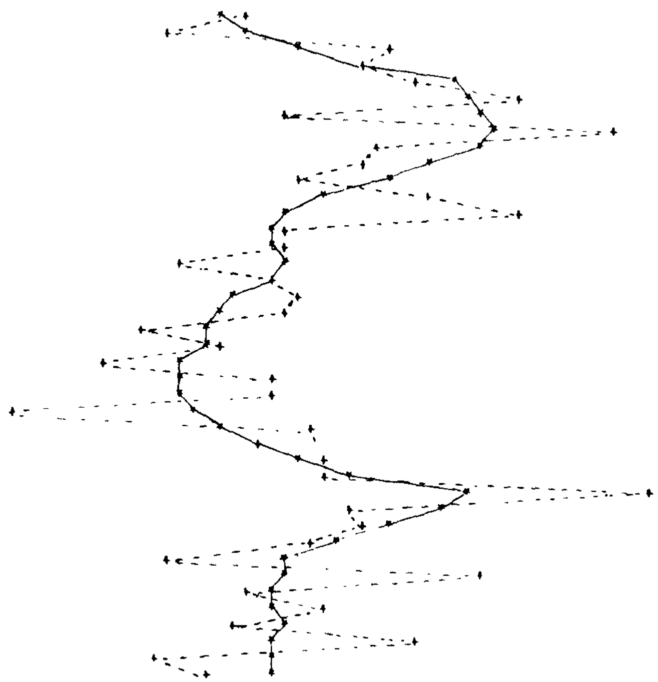


FIGURE 6.16: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF JR

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
732	.5192E-01	.6153E-01	-.961E-02
733	.6200E-01	.3910E-01	.229E-01
734	.7661E-01	.1013	-.247E-01
741	.9599E-01	.9332E-01	.267E-02
742	.1208	.1088	.120E-01
743	.1231	.1378	-.147E-01
744	.1268	.7179E-01	.550E-01
751	.1309	.1646	-.337E-01
752	.1286	.9730E-01	.313E-01
753	.1140	.9281E-01	.212E-01
754	.1016	.7459E-01	.270E-01
761	.8236E-01	.1122	-.299E-01
762	.7092E-01	.1384	-.675E-01
763	.6977E-01	.7166E-01	-.229E-02
764	.6932E-01	.6997E-01	-.655E-03
771	.6995E-01	.4136E-01	.286E-01
772	.6902E-01	.6965E-01	-.633E-03
773	.5572E-01	.7449E-01	-.188E-01
774	.5309E-01	.7323E-01	-.202E-01
781	.4931E-01	.3189E-01	.174E-01
782	.4741E-01	.5436E-01	-.695E-02
783	.4147E-01	.1939E-01	.221E-01
784	.4239E-01	.6715E-01	-.248E-01
791	.4301E-01	.6637E-01	-.234E-01
792	.4431E-01	-.7069E-02	.514E-01
793	.5174E-01	.7923E-01	-.274E-01
794	.6251E-01	.6390E-01	-.139E-02
801	.7585E-01	.8439E-01	-.854E-02
802	.9187E-01	.8417E-01	.770E-02
803	.1261	.1768	-.507E-01
804	.1172	.9219E-01	.251E-01
811	.1018	.9556E-01	.622E-02
812	.8527E-01	.7808E-01	.714E-02
813	.7201E-01	.3656E-01	.354E-01
814	.7048E-01	.1292	-.587E-01
821	.6963E-01	.6123E-01	.842E-02
822	.6612E-01	.8185E-01	-.157E-01
823	.7251E-01	.5562E-01	.169E-01
824	.6922E-01	.1081	-.389E-01
831	.6354E-01	.2394E-01	.356E-01
832	.6632E-01	.4759E-01	.197E-01



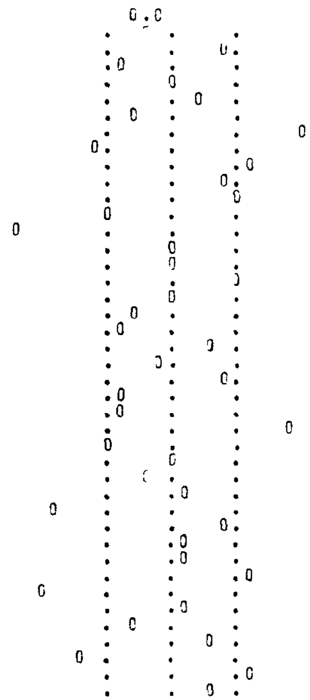
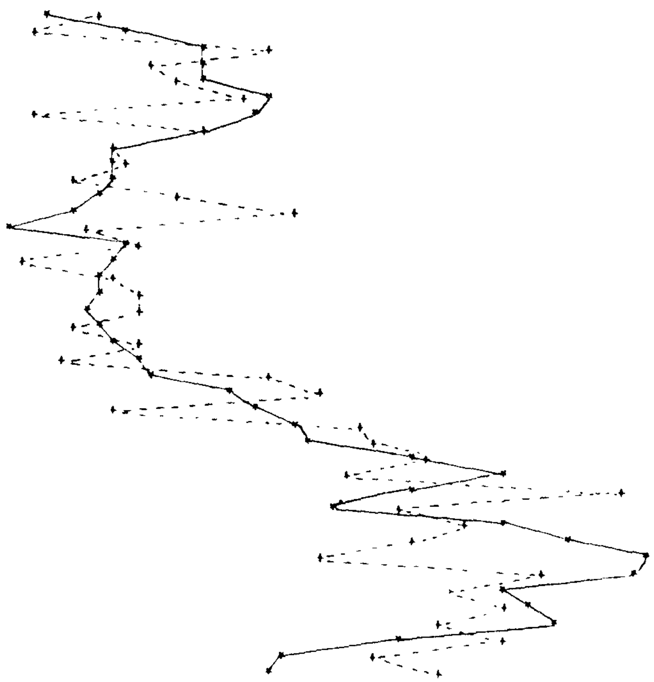


FIGURE 6.17: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF JFR

	ACTUAL	FITTED	RESIDUAL
732	.5560E-01	.6397E-01	-.837E-02
733	.6813E-01	.5395E-01	.142E-01
734	.9078E-01	.903[illegible]E-01	-.955E-02
741	.7388E-01	.7279E-01	.711E-02
742	.8113E-01	.7568E-01	.451E-02
743	.9003E-01	.8523E-01	.479E-02
744	.8857E-01	.5347E-01	.351E-01
751	.8028E-01	.8122E-01	-.942E-03
752	.6715E-01	.6603E-01	.115E-02
753	.6536E-01	.6758E-01	-.222E-02
754	.6694E-01	.5955E-01	.739E-02
761	.6480E-01	.7539E-01	-.106E-01
762	.6067E-01	.9407E-01	-.334E-01
763	.5016E-01	.6310E-01	-.129E-01
764	.6722E-01	.7017E-01	-.294E-02
771	.6627E-01	.5508E-01	.132E-01
772	.6372E-01	.6612E-01	-.240E-02
773	.6392E-01	.7037E-01	-.641E-02
774	.6244E-01	.6926E-01	-.682E-02
781	.6503E-01	.6055E-01	.454E-02
782	.6685E-01	.7030E-01	-.347E-02
783	.7113E-01	.5850E-01	.126E-01
784	.7262E-01	.9107E-01	-.184E-01
791	.8343E-01	.9956E-01	-.151E-01
792	.8855E-01	.6534E-01	.232E-01
793	.9497E-01	.1044	-.940E-02
794	.9554E-01	.1055	-.993E-02
801	.1133	.1150	-.173E-02
802	.1261	.1018	.243E-01
803	.1131	.1450	-.319E-01
804	.9957E-01	.1106	-.110E-01
811	.1271	.1209	.629E-02
812	.1356	.1129	.228E-01
813	.1484	.9921E-01	.492E-01
814	.1471	.1333	.138E-01
821	.1272	.1176	.371E-02
822	.1303	.1268	.347E-02
823	.1344	.1167	.181E-01
824	.1100	.1273	-.173E-01
831	.9215E-01	.1059	-.138E-01
832	.9055E-01	.1165	-.260E-01



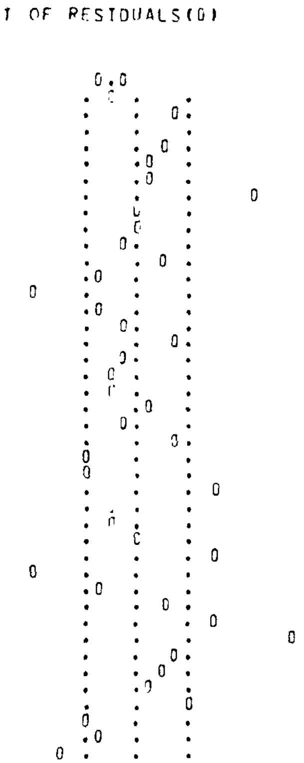
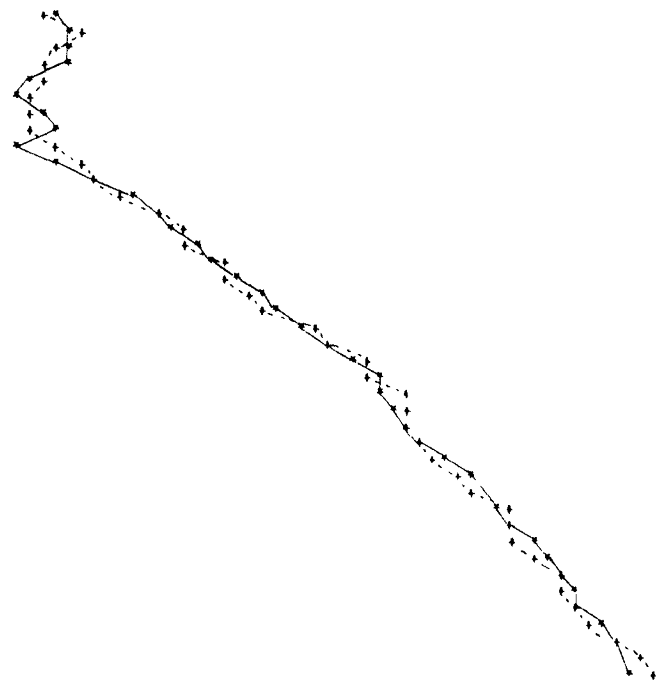


FIGURE 6.18: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF JY

	ACTUAL	FITTED	RESIDUAL
732	7.290	7.286	.250E-02
733	7.301	7.305	-.430E-02
734	7.298	7.294	.385E-02
741	7.300	7.287	.129E-01
742	7.280	7.289	-.936E-02
743	7.274	7.281	-.704E-02
744	7.285	7.279	.600E-02
751	7.292	7.277	.150E-01
752	7.271	7.290	-.194E-01
753	7.294	7.312	-.175E-01
754	7.314	7.318	-.375E-02
761	7.336	7.329	.666E-02
762	7.357	7.353	.382E-02
763	7.364	7.366	-.186E-02
764	7.374	7.372	.267E-02
771	7.389	7.393	-.450E-02
772	7.404	7.395	.875E-02
773	7.418	7.406	.121E-01
774	7.420	7.418	.183E-02
781	7.442	7.444	-.237E-02
782	7.453	7.458	-.491E-02
783	7.472	7.473	-.125E-02
784	7.481	7.477	.376E-02
791	7.486	7.500	-.143E-01
792	7.493	7.496	-.327E-02
793	7.497	7.500	-.227E-02
794	7.506	7.506	.650E-03
801	7.522	7.517	.437E-02
802	7.535	7.530	.482E-02
803	7.538	7.535	.329E-02
804	7.552	7.557	-.490E-02
811	7.564	7.559	.562E-02
812	7.577	7.564	.124E-01
813	7.587	7.578	.895E-02
814	7.594	7.591	.298E-02
821	7.596	7.594	.200E-02
822	7.596	7.600	-.366E-02
823	7.614	7.606	.793E-02
824	7.621	7.625	-.347E-02
831	7.634	7.639	-.571E-02
832	7.632	7.644	-.124E-01



PLOT OF RESIDUALS(0)

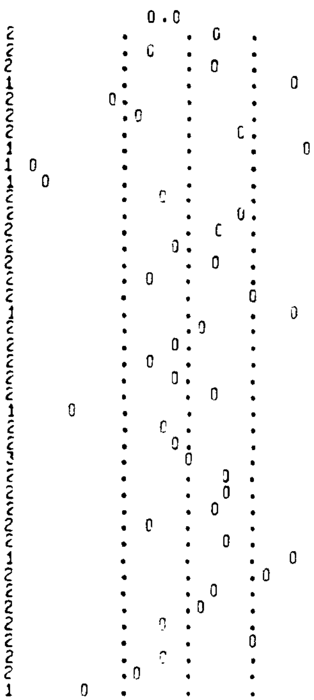
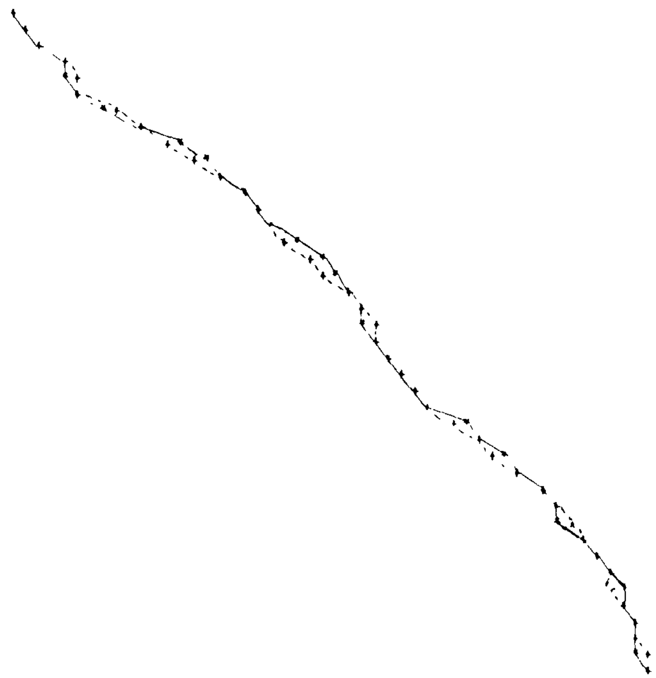


FIGURE 6.19: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF EP

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
732	4.266	4.271	-.515E-02
733	4.289	4.290	-.105E-02
734	4.325	4.318	.749E-02
741	4.363	4.361	.202E-02
742	4.373	4.388	-.151E-01
743	4.404	4.403	.119E-02
744	4.452	4.459	-.628E-02
751	4.507	4.513	-.579E-02
752	4.590	4.571	.181E-01
753	4.639	4.617	.219E-01
754	4.677	4.680	-.301E-02
761	4.71[illegible]	4.715	-.529E-02
762	4.737	4.746	-.878E-02
763	4.766	4.761	-.133E-01
764	4.817	4.809	.791E-02
771	4.867	4.85[illegible]	.134E-01
772	4.898	4.880	.172E-01
773	4.92[illegible]	4.919	.127E-02
774	4.939	4.946	-.664E-02
781	4.954	4.969	-.149E-01
782	4.972	4.974	-.257E-02
783	4.995	5.001	-.504E-02
784	5.017	5.021	-.381E-02
791	5.045	5.05[illegible]	-.574E-02
792	5.072	5.085	-.126E-01
793	5.144	5.124	.200E-01
794	5.177	5.168	.951E-02
801	5.220	5.207	.130E-01
802	5.267	5.262	.501E-02
803	5.295	5.302	-.571E-02
804	5.319	5.325	-.571E-02
811	5.340	5.360	-.206E-01
812	5.377	5.372	.559E-02
813	5.403	5.409	-.695E-02
814	5.431	5.425	.627E-02
821	5.454	5.441	.131E-01
822	5.467	5.461	.584E-02
823	5.479	5.47[illegible]	.398E-02
824	5.491	5.494	-.275E-02
831	5.494	5.50[illegible]	-.845E-02
832	5.504	5.5[illegible]4	-.457E-02



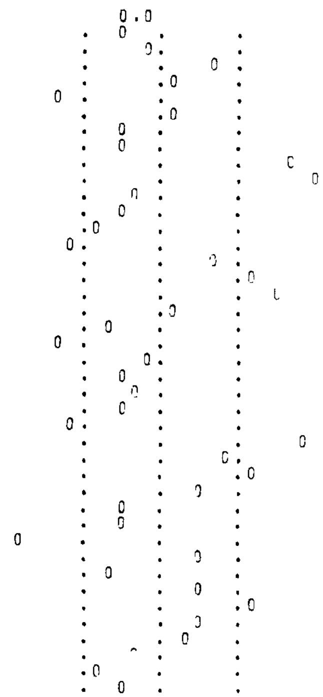
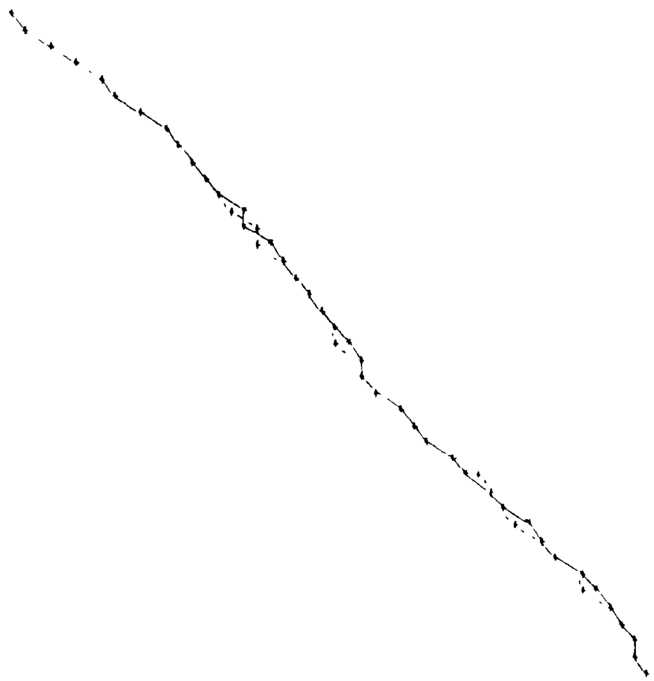


FIGURE 6.20: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF EFP

	ACTUAL	FITTED	RESIDUAL
732	4.382	4.385	-.313E-02
733	4.407	4.404	.315E-02
734	4.437	4.437	-.979E-03
741	4.464	4.465	-.106E-02
742	4.492	4.494	-.191E-02
743	4.521	4.519	.216E-02
744	4.552	4.549	.432E-02
751	4.571	4.575	-.193E-02
752	4.594	4.593	.706E-03
753	4.614	4.615	-.114E-02
754	4.635	4.636	-.128E-02
761	4.657	4.654	-.811E-03
762	4.671	4.672	.680E-03
763	4.687	4.690	-.334E-02
764	4.707	4.704	.322E-02
771	4.726	4.726	-.119E-03
772	4.746	4.742	.463E-02
773	4.767	4.763	-.309E-03
774	4.775	4.778	-.200E-02
781	4.791	4.791	-.135E-02
782	4.804	4.805	.139E-02
783	4.821	4.822	-.114E-03
784	4.835	4.837	-.134E-02
791	4.853	4.854	-.193E-02
792	4.877	4.877	-.237E-03
793	4.894	4.894	.156E-02
794	4.917	4.919	-.105E-02
801	4.947	4.942	.507E-02
802	4.971	4.972	-.207E-02
803	4.991	4.991	.132E-03
804	5.017	5.014	-.770E-03
811	5.034	5.037	.871E-03
812	5.059	5.066	-.129E-02
813	5.084	5.087	.118E-02
814	5.104	5.104	-.226E-03
821	5.121	5.120	.918E-03
822	5.139	5.140	-.128E-02
823	5.154	5.155	.254E-02
824	5.172	5.173	-.163E-02
831	5.181	5.185	-.341E-02
832	5.195	5.193	.197E-02



PLOT OF RESIDUALS(O)

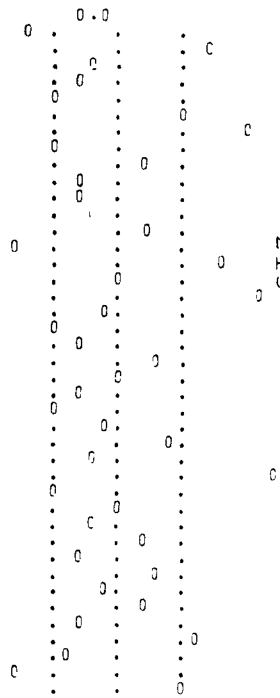
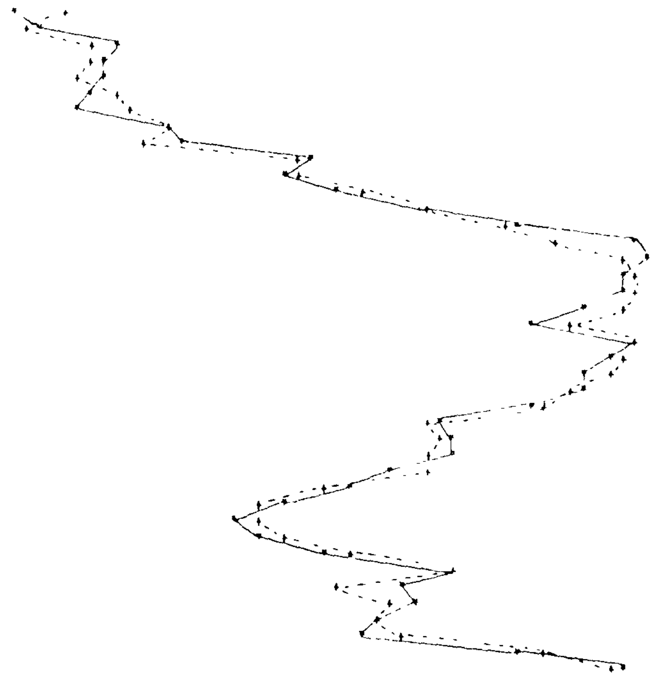


FIGURE 6.21: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF EFE

	ACTUAL	FITTED	RESIDUAL
732	4.55[illegible]	4.57[illegible]	-.162E-01
733	4.5[illegible]	4.5[illegible]	.508E-02
734	4.58[illegible]	4.57[illegible]	.729E-02
741	4.57[illegible]	4.577	.175E-02
742	4.58[illegible]	4.57[illegible]	.930E-02
743	4.57[illegible]	4.583	-.664E-02
744	4.57[illegible]	4.587	-.127E-01
751	4.60[illegible]	4.5[illegible]	.213E-02
752	4.60[illegible]	4.59[illegible]	.129E-01
753	4.63[illegible]	4.[illegible]37	.185E-02
754	4.6[illegible]	4.[illegible]	-.520E-02
761	4.66[illegible]	4.65[illegible]	-.967E-02
762	4.67[illegible]	4.67[illegible]	-.106E-02
763	4.70[illegible]	4.[illegible]	.403E-02
764	4.72[illegible]	4.71[illegible]	.232E-01
771	4.737	4.7[illegible]	.943E-02
772	4.73[illegible]	4.7[illegible]	-.154E-02
773	4.72[illegible]	4.73[illegible]	-.297E-02
774	4.71[illegible]	4.7[illegible]	-.128E-01
781	4.70[illegible]	4.7[illegible]	-.897E-02
782	4.7[illegible]	4.73[illegible]	.297E-02
783	4.72[illegible]	4.723	-.559E-03
784	4.71[illegible]	4.724	-.504E-02
791	4.71[illegible]	4.71[illegible]	.129E-02
792	4.70[illegible]	4.70[illegible]	-.393E-02
793	4.67[illegible]	4.673	.292E-02
794	4.68[illegible]	4.676	.517E-02
801	4.68[illegible]	4.67[illegible]	.583E-02
802	4.66[illegible]	4.67[illegible]	-.135E-01
803	4.65[illegible]	4.6[illegible]	.730E-02
804	4.63[illegible]	4.6[illegible]	.771E-02
811	4.61[illegible]	4.62[illegible]	-.792E-02
812	4.62[illegible]	4.63[illegible]	-.103E-01
813	4.645	4.65[illegible]	-.705E-02
814	4.68[illegible]	4.679	.491E-03
821	4.665	4.64[illegible]	.156E-01
822	4.67[illegible]	4.6[illegible]	.707E-02
823	4.66[illegible]	4.658	.143E-02
824	4.657	4.66[illegible]	-.781E-02
831	4.70[illegible]	4.70[illegible]	-.553E-02
832	4.7[illegible]	4.72[illegible]	.331E-02



PLOT OF RESIDUALS(0)

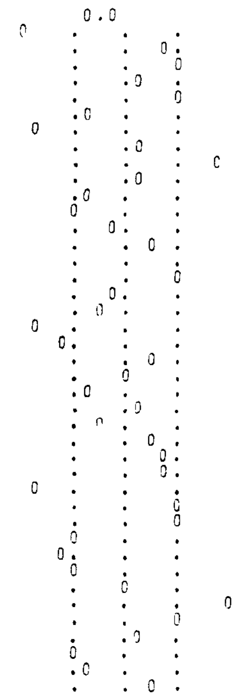
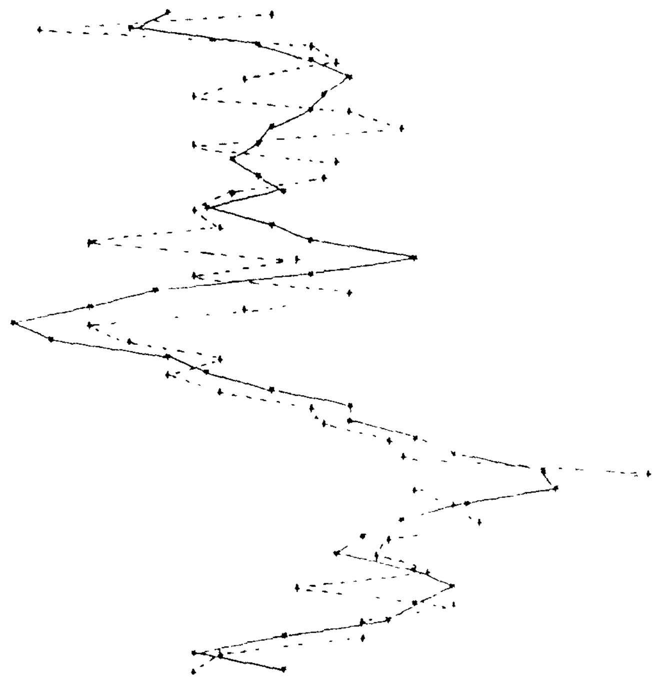


FIGURE 6.22: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF ER

	ACTUAL	FITTED	RESIDUAL
732	.818[illegible]E-01	.1044	-.225E-01
733	.7573E-01	.557[illegible]E-01	.200E-01
734	.1027	.1121	-.939E-02
741	.1117	.1183	-.652E-02
742	.120[illegible]	.1001	.206E-01
743	.1163	.876[illegible]E-01	.293E-01
744	.112[illegible]	.120[illegible]	-.876E-02
751	.1054	.1316	-.262E-01
752	.1009	.8777E-01	.130E-01
753	.9664E-01	.1194	-.223E-01
754	.1021	.116[illegible]	-.146E-01
761	.1271	.[illegible]721E-01	.982E-02
762	.9104E-01	.[illegible]E-01	.237E-02
763	.1043	.920[illegible]E-01	.119E-01
764	.1132	.6613E-01	.469E-01
771	.1347	.1096	.250E-01
772	.112[illegible]	.8917E-01	.236E-01
773	.794[illegible]E-01	.1214	-.419E-01
774	.657[illegible]E-01	.9853E-01	-.328E-01
781	.5059E-01	.6757E-01	-.170E-01
782	.594[illegible]E-01	.739[illegible]E-01	-.145E-01
783	.8347E-01	.949[illegible]E-01	-.115E-01
784	.906[illegible]E-01	.828[illegible]E-01	.789E-02
791	.1058	.945[illegible]E-01	.113E-01
792	.120[illegible]	.11[illegible]	.741E-02
793	.1203	.1147	.660E-02
794	.1339	.1302	.358E-02
801	.14[illegible]	.131[illegible]	.114E-01
802	.1615	.1835	-.219E-01
803	.1644	.1341	.308E-01
804	.1465	.1441	.239E-02
811	.1324	.1487	-.163E-01
812	.122[illegible]	.1284	-.592E-02
813	.1193	.1256	-.631E-02
814	.1359	.1367	-.812E-03
821	.1427	.1109	.316E-01
822	.134[illegible]	.1434	-.922E-02
823	.1294	.1246	.478E-02
824	.1064	.1233	-.168E-01
831	.897[illegible]E-01	.9401E-01	-.428E-02
832	.1066	.8920E-01	.174E-01



PLOT OF RESIDUALS(0)

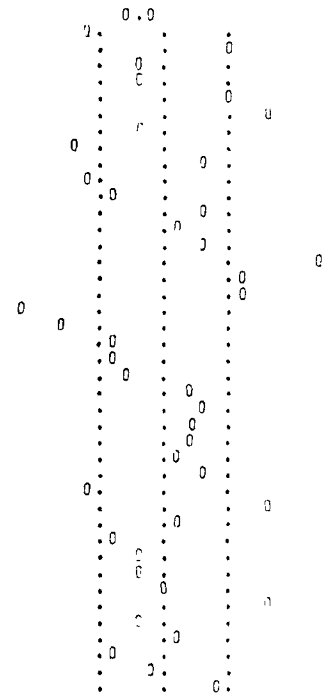
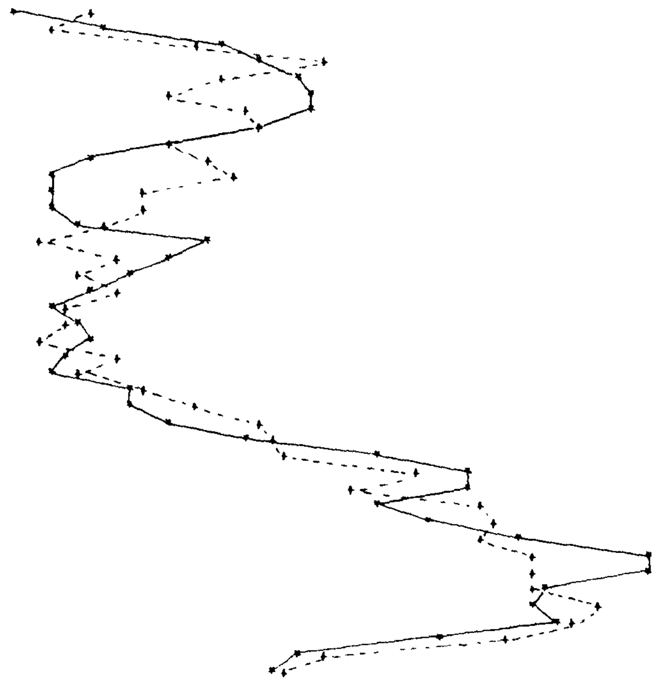


FIGURE 6.23: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF EFR

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
732	.5593E-01	.664[illegible]E-01	-.104E-01
733	.6823E-01	.614[illegible]E-01	.680E-02
734	.8285E-01	.7954E-01	.332E-02
741	.8793E-01	.955[illegible]E-01	-.760E-02
742	.9190E-01	.8294E-01	.897E-02
743	.9358E-01	.7590E-01	.177E-01
744	.9467E-01	.8592E-01	.875E-02
751	.881[illegible]E-01	.8706E-01	.111E-02
752	.7591E-01	.766[illegible]E-01	-.713E-03
753	.6600E-01	.8078E-01	-.148E-01
754	.6113E-01	.845[illegible]E-01	-.233E-01
761	.6083E-01	.7226E-01	-.114E-01
762	.6102E-01	.7187E-01	-.109E-01
763	.6427E-01	.6789E-01	-.366E-02
764	.8091E-01	.5882E-01	.221E-01
771	.7646E-01	.6948E-01	.698E-02
772	.714[illegible]E-01	.6431E-01	.710E-02
773	.6584E-01	.6876E-01	-.291E-02
774	.613[illegible]E-01	.6294E-01	-.156E-02
781	.6361E-01	.6256E-01	.105E-02
782	.6570E-01	.5945E-01	.625E-02
783	.629[illegible]E-01	.6955E-01	-.659E-02
784	.607[illegible]E-01	.6448E-01	-.373E-02
791	.711[illegible]E-01	.7263E-01	-.152E-02
792	.711[illegible]E-01	.7991E-01	-.879E-02
793	.766[illegible]E-01	.8774E-01	-.110E-01
794	.862[illegible]E-01	.8950E-01	-.326E-02
801	.1032	.9037E-01	.129E-01
802	.1135	.1078	.574E-02
803	.114[illegible]	.985[illegible]E-01	.156E-01
804	.1025	.1162	-.137E-01
811	.1094	.1169	-.739E-02
812	.1207	.1165	.423E-02
813	.1373	.1224	.149E-01
814	.1368	.1229	.139E-01
821	.1237	.1224	.132E-02
822	.1222	.1306	-.840E-02
823	.125[illegible]	.1265	-.156E-02
824	.1103	.1198	-.957E-02
831	.9301E-01	.9509E-01	-.203E-02
832	.892[illegible]E-01	.9038E-01	-.118E-02



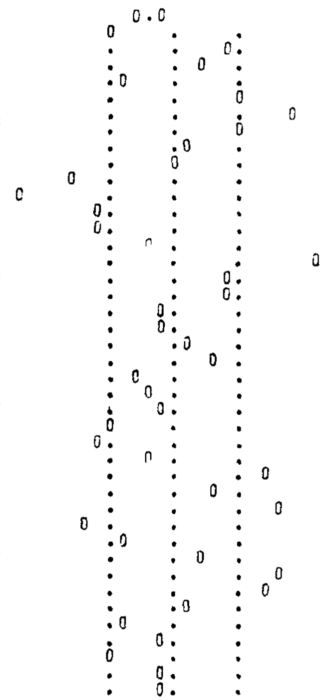
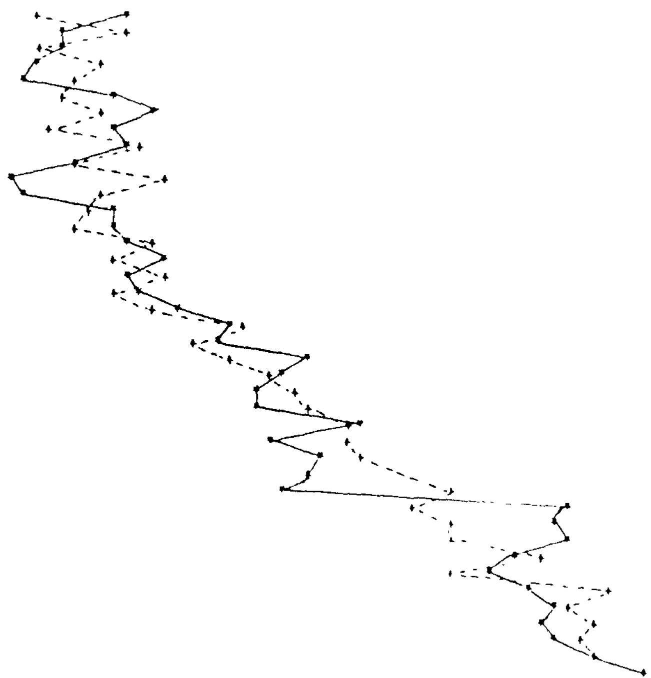


FIGURE 6.24: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF EY

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
732	-.4440E-01	-.78[illegible]E-01	.342E-01
733	-.663[illegible]E-01	-.4546E-01	-.209E-01
734	-.6934E-01	-.7688E-01	.754E-02
741	-.7593E-01	-.5403E-01	-.219E-01
742	-.8163E-01	-.6478E-01	-.169E-01
743	-.5045E-01	-.6995E-01	.195E-01
744	-.3407E-01	-.5557E-01	.215E-01
751	-.465[illegible]E-01	-.7396E-01	.274E-01
752	-.4554E-01	-.3761E-01	-.793E-02
753	-.6452E-01	-.6074E-01	-.377E-02
754	-.8729E-01	-.2671E-01	-.606E-01
761	-.8323E-01	-.5286E-01	-.304E-01
762	-.4613E-01	-.5960E-01	.135E-01
763	-.4885E-01	-.6257E-01	.137E-01
764	-.4127E-01	-.3406E-01	-.721E-02
771	-.3023E-01	-.4954E-01	.193E-01
772	-.4124E-01	-.292[illegible]E-01	-.120E-01
773	-.3726E-01	-.4744E-01	.102E-01
774	-.2155E-01	-.3430E-01	.128E-01
781	-.44[illegible]5E-02	-.1424E-02	-.301E-02
782	-.1031E-01	-.1667E-01	.637E-02
783	.2404E-01	-.4055E-02	.281E-01
784	.1755E-01	.1035E-01	.721E-02
791	.6291E-02	.1906E-01	-.128E-01
792	.5880E-02	.2339E-01	-.175E-01
793	.4393E-01	.3928E-01	.465E-02
794	.1115E-01	.3982E-01	-.287E-01
801	.2833E-01	.4277E-01	-.144E-01
802	.2659E-01	.2394E-01	.265E-02
803	.1357E-01	.7657E-01	-.630E-01
804	.1209	.6597E-01	.548E-01
811	.1155	.7880E-01	.360E-01
812	.1213	.776[illegible]E-01	.443E-01
813	.1022	.111[illegible]	-.945E-02
814	.9267E-01	.792[illegible]E-01	.145E-01
821	.1087	.1364	-.276E-01
822	.1177	.1224	-.466E-02
823	.112[illegible]	.132[illegible]	-.203E-01
824	.1175	.1273	-.974E-02
831	.1346	.1334	.117E-02
832	.151[illegible]	.13[illegible]	.161E-02



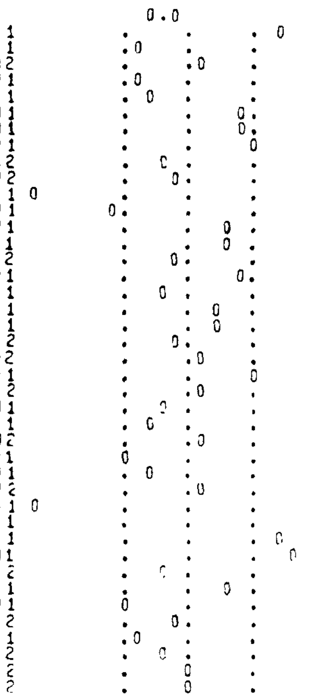
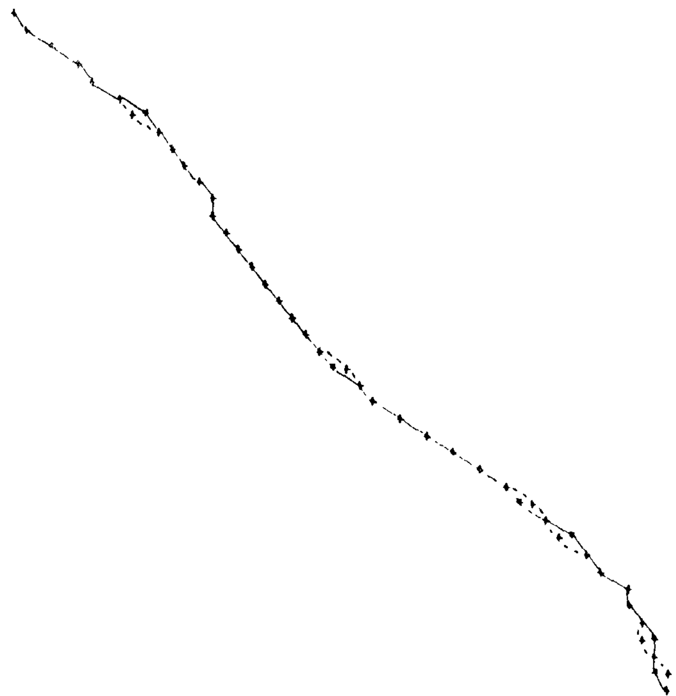


FIGURE 6.25: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF UP

	ACTUAL	FITTED	RESIDUAL
732	4.401	4.398	.311E-02
733	4.422	4.423	-.106E-02
734	4.447	4.448	-.103E-02
741	4.475	4.477	-.944E-03
742	4.502	4.506	-.456E-02
743	4.531	4.533	-.219E-02
744	4.561	4.556	.472E-02
751	4.581	4.581	-.909E-03
752	4.594	4.597	-.242E-02
753	4.614	4.611	.308E-02
754	4.632	4.627	.515E-02
761	4.644	4.643	.684E-03
762	4.654	4.655	-.985E-03
763	4.667	4.666	.183E-02
764	4.683	4.680	.634E-03
771	4.700	4.698	.114E-02
772	4.719	4.718	.146E-02
773	4.732	4.735	-.321E-02
774	4.745	4.748	-.306E-02
781	4.763	4.769	-.562E-02
782	4.787	4.789	-.151E-02
783	4.803	4.811	-.207E-02
784	4.835	4.833	.149E-02
791	4.857	4.859	-.164E-02
792	4.884	4.884	.472E-02
793	4.921	4.916	.383E-02
794	4.950	4.952	-.153E-02
801	4.990	4.986	.422E-02
802	5.024	5.016	.726E-02
803	5.040	5.046	-.571E-02
804	5.069	5.072	-.340E-02
811	5.096	5.091	.512E-02
812	5.117	5.119	-.141E-02
813	5.144	5.140	.442E-02
814	5.161	5.162	-.351E-03
821	5.170	5.175	-.527E-02
822	5.183	5.185	-.196E-02
823	5.200	5.195	.527E-02
824	5.204	5.205	-.106E-02
831	5.205	5.214	-.867E-02
832	5.221	5.221	.149E-04



PLOT OF RESIDUALS(0)

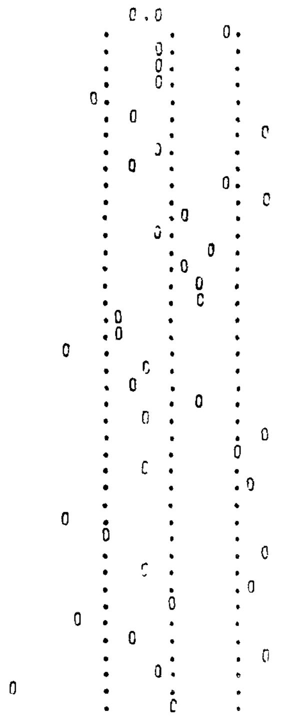
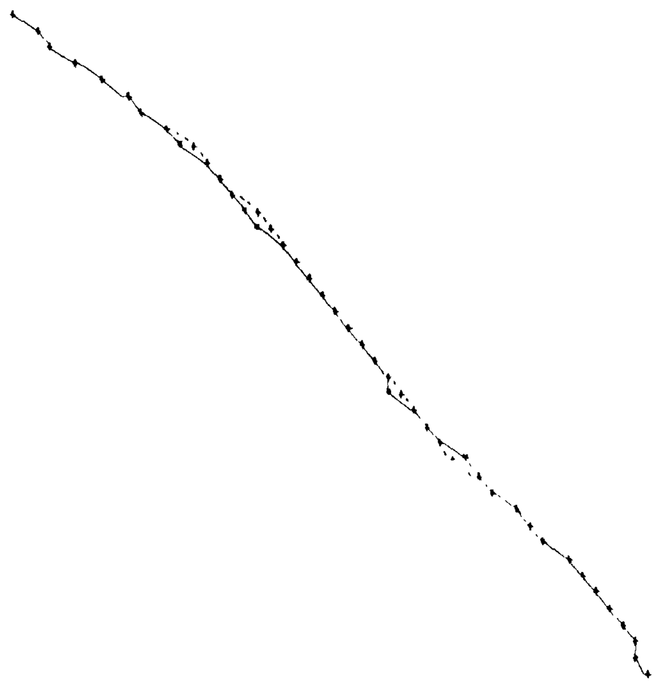


FIGURE 6.26: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF UFP

	ACTUAL	FITTED	RESIDUAL
732	4.359	4.358	.363E-03
733	4.385	4.386	.232E-03
734	4.411	4.411	.145E-03
741	4.452	4.449	.271E-02
742	4.482	4.484	-.200E-02
743	4.514	4.515	-.124E-02
744	4.547	4.546	.110E-02
751	4.573	4.577	-.398E-02
752	4.593	4.595	-.213E-02
753	4.625	4.624	.853E-03
754	4.650	4.648	.175E-02
761	4.670	4.671	-.992E-03
762	4.690	4.692	-.190E-02
763	4.706	4.711	-.467E-02
764	4.729	4.728	.175E-02
771	4.754	4.749	.504E-02
772	4.774	4.770	.413E-02
773	4.791	4.790	.168E-02
774	4.808	4.806	.192E-02
781	4.822	4.823	-.108E-02
782	4.839	4.840	-.853E-03
783	4.858	4.858	.105E-03
784	4.872	4.876	-.437E-02
791	4.889	4.894	-.503E-02
792	4.909	4.910	-.127E-02
793	4.932	4.931	.129E-02
794	4.956	4.954	.155E-02
801	4.981	4.979	.273E-02
802	5.007	5.005	.272E-02
803	5.031	5.029	.178E-02
804	5.054	5.052	.125E-02
811	5.078	5.076	.237E-02
812	5.101	5.100	.664E-03
813	5.124	5.124	.379E-03
814	5.147	5.149	-.157E-02
821	5.165	5.169	-.205E-02
822	5.184	5.184	.292E-03
823	5.203	5.201	.177E-02
824	5.219	5.217	.181E-02
831	5.226	5.230	-.416E-02
832	5.236	5.240	-.334E-02



PLOT OF RESIDUALS(0)

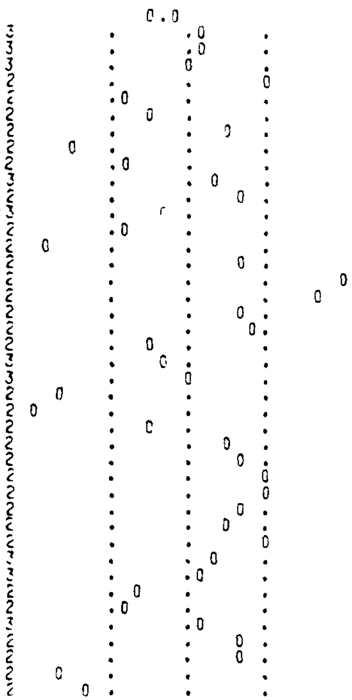
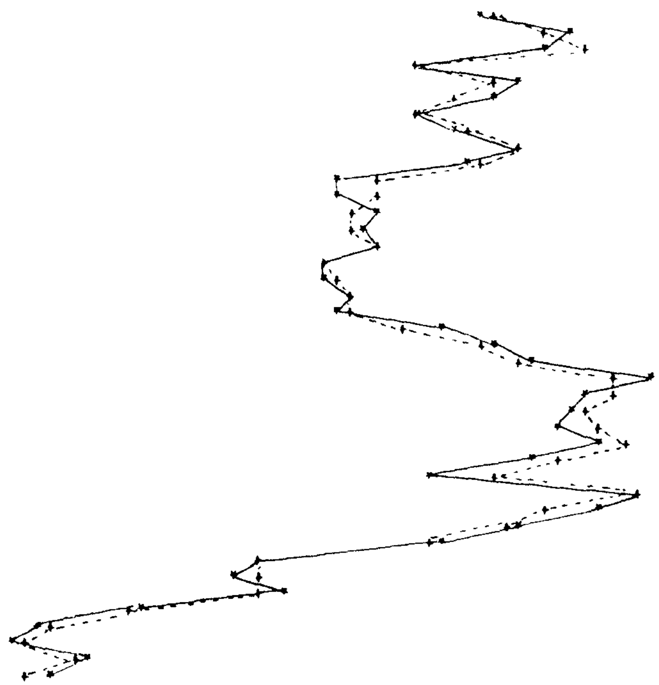


FIGURE 6.27: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF UFE

	ACTUAL	FITTED	RESIDUAL
732	4.622	4.627	-.516E-02
733	4.643	4.636	.701E-02
734	4.637	4.645	-.728E-02
741	4.610	4.609	.631E-03
742	4.631	4.625	.576E-02
743	4.626	4.618	.767E-02
744	4.609	4.608	.910E-03
751	4.614	4.615	-.826E-03
752	4.631	4.630	.110E-02
753	4.619	4.623	-.368E-02
754	4.592	4.601	-.870E-02
761	4.592	4.601	-.944E-02
762	4.599	4.595	.448E-02
763	4.599	4.594	.445E-02
764	4.601	4.601	.304E-03
771	4.590	4.589	.111E-02
772	4.590	4.591	-.105E-02
773	4.595	4.596	-.364E-03
774	4.593	4.595	-.177E-02
781	4.613	4.605	.743E-02
782	4.625	4.621	.403E-02
783	4.634	4.632	.185E-02
784	4.659	4.652	.751E-02
791	4.645	4.652	-.679E-02
792	4.643	4.646	-.263E-02
793	4.641	4.647	-.620E-02
794	4.647	4.652	-.516E-02
801	4.635	4.638	-.344E-02
802	4.611	4.625	-.137E-01
803	4.656	4.655	.636E-03
804	4.648	4.638	.101E-01
811	4.631	4.627	.384E-02
812	4.615	4.612	.258E-02
813	4.576	4.576	-.331E-03
814	4.570	4.575	-.509E-02
821	4.581	4.575	.589E-02
822	4.549	4.546	.260E-02
823	4.527	4.531	-.377E-02
824	4.522	4.524	-.256E-02
831	4.538	4.535	.323E-02
832	4.530	4.524	.619E-02



PLOT OF RESIDUALS(0)

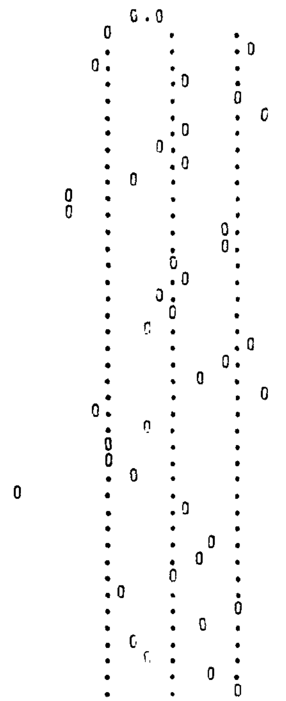
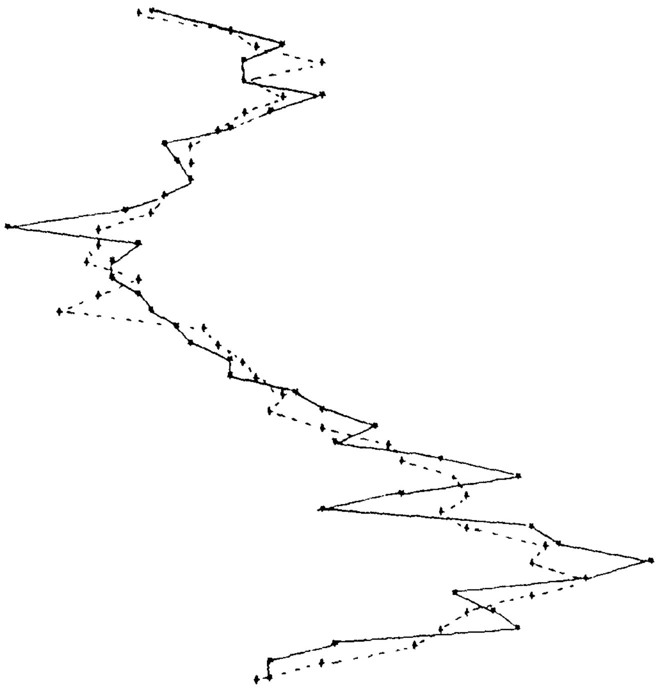


FIGURE 6.28: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF UR

	ACTUAL	FITTED	RESIDUAL
732	.549[illegible]E-01	.5177E-01	.314E-02
733	.7123E-01	.704[illegible]E-01	.861E-03
734	.8134E-01	.7522E-01	.616E-02
741	.7326E-01	.9047E-01	-.172E-01
742	.7399E-01	.7278E-01	.121E-02
743	.891[illegible]E-01	.8272E-01	.647E-02
744	.8031E-01	.7223E-01	.808E-02
751	.7204E-01	.6698E-01	.510E-02
752	.571[illegible]E-01	.611[illegible]E-01	-.399E-02
753	.592[illegible]E-01	.635[illegible]E-01	-.530E-02
754	.614[illegible]E-01	.6366E-01	-.226E-02
761	.5578E-01	.5553E-01	.251E-03
762	.481[illegible]E-01	.5460E-01	-.641E-02
763	.2340E-01	.4259E-01	-.192E-01
764	.5015E-01	.4277E-01	.737E-02
771	.4596E-01	.4079E-01	.517E-02
772	.4498E-01	.506[illegible]E-01	-.571E-02
773	.5209E-01	.4379E-01	.830E-02
774	.5306E-01	.3391E-01	.191E-01
781	.6030E-01	.6619E-01	-.590E-02
782	.6240E-01	.5730E-01	-.490E-02
783	.6988E-01	.7231E-01	-.243E-02
784	.7100E-01	.7629E-01	-.529E-02
791	.8524E-01	.8287E-01	.237E-02
792	.9112E-01	.792[illegible]E-01	.119E-01
793	.1012	.899[illegible]E-01	.112E-01
794	.9341E-01	.1044	-.110E-01
801	.1159	.107[illegible]	.852E-02
802	.1310	.1179	.132E-01
803	.1084	.120[illegible]	-.119E-01
804	.8962E-01	.1159	-.263E-01
811	.1346	.1206	.140E-01
812	.1399	.1387	.117E-02
813	.1599	.135[illegible]	.241E-01
814	.1464	.1459	.416E-03
821	.1180	.1359	-.178E-01
822	.1255	.1215	.395E-02
823	.1333	.1149	.184E-01
824	.941[illegible]E-01	.1102	-.160E-01
831	.7783E-01	.9073E-01	-.129E-01
832	.786[illegible]E-01	.7767E-01	.932E-03



PLOT OF RESIDUALS(0)

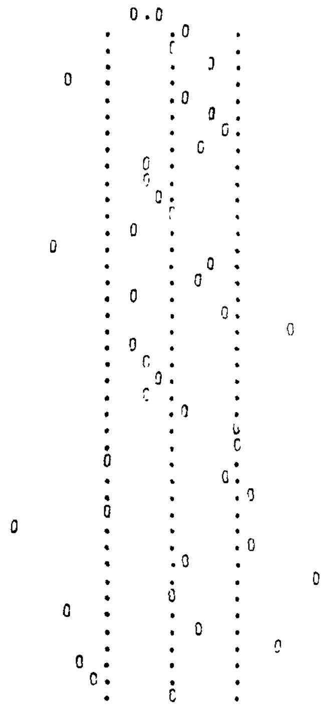
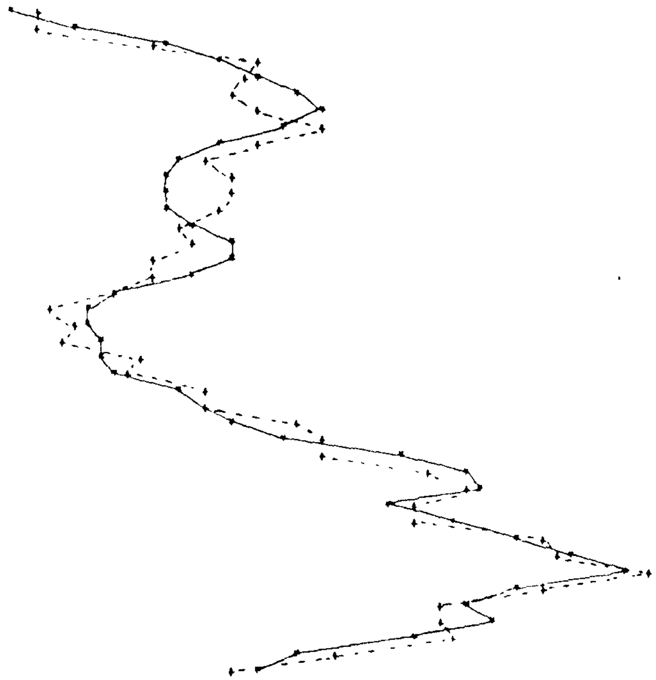


FIGURE 6.29: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF UFR

PLOT OF RESIDUALS(0)

	ACTUAL	FITTED	RESIDUAL
732	.5247E-01	.5603E-01	-.356E-02
733	.6233E-01	.5658E-01	.575E-02
734	.7609E-01	.745[illegible]E-01	.147E-02
741	.8449E-01	.9127E-01	-.678E-02
742	.9074E-01	.8937E-01	.138E-02
743	.9652E-01	.8785E-01	.867E-02
744	.1011	.9104E-01	.101E-01
751	.9446E-01	.1019	-.739E-02
752	.9441E-01	.9054E-01	-.613E-02
753	.7814E-01	.8293E-01	-.485E-02
754	.7703E-01	.8718E-01	-.102E-01
761	.7668E-01	.8684E-01	-.102E-01
762	.7641E-01	.8450E-01	-.809E-02
763	.9177E-01	.7812E-01	.366E-02
764	.8779E-01	.8018E-01	.759E-02
771	.8681E-01	.7558E-01	.112E-01
772	.8001E-01	.7442E-01	.558E-02
773	.6926E-01	.6797E-01	.129E-02
774	.6443E-01	.5946E-01	.502E-02
781	.6365E-01	.6305E-01	.602E-03
782	.6571E-01	.6132E-01	.439E-02
783	.6745E-01	.7309E-01	-.563E-02
784	.6923E-01	.708[illegible]E-01	-.157E-02
791	.7951E-01	.8202E-01	-.251E-02
792	.8334E-01	.8230E-01	.108E-02
793	.8601E-01	.962[illegible]E-01	-.102E-01
794	.9474E-01	.1010	-.626E-02
801	.1133	.1009	.124E-01
802	.1237	.1182	.551E-02
803	.1250	.1235	.147E-02
804	.1110	.1153	-.429E-02
811	.1212	.1159	.534E-02
812	.1319	.1360	-.413E-02
813	.1402	.1365	.364E-02
814	.1481	.1518	-.366E-02
821	.1307	.1349	-.426E-02
822	.1242	.1202	.399E-02
823	.1276	.1188	.876E-02
824	.1148	.1205	-.575E-02
831	.9621E-01	.1027	-.647E-02
832	.9117E-01	.8699E-01	.417E-02



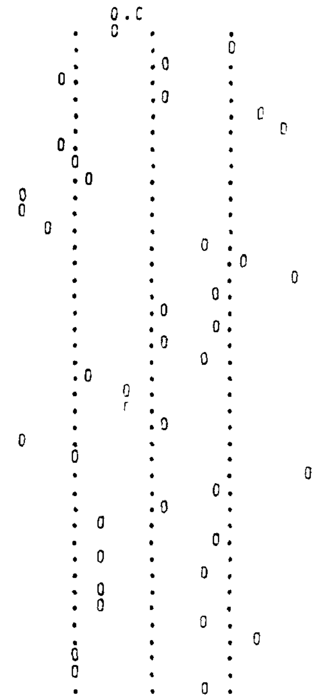
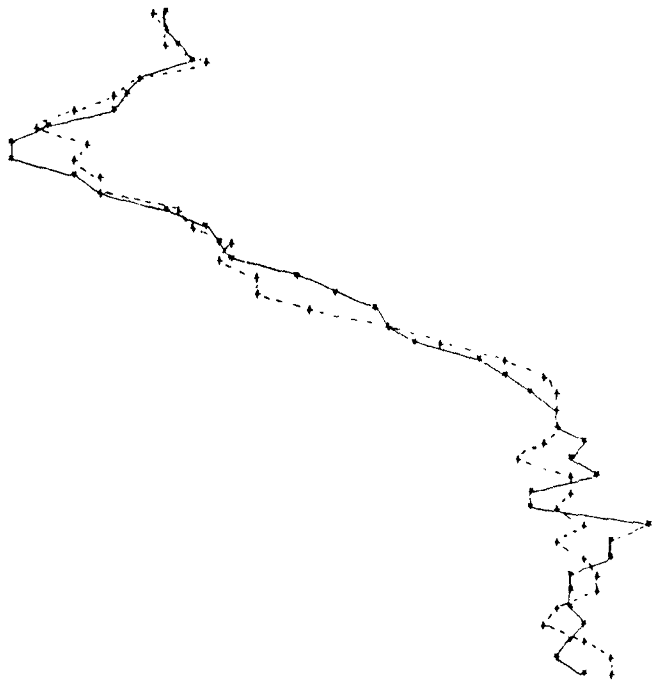


FIGURE 6.30: PLOT OF ACTUAL (—) AND SIMULATED (--) VALUES OF UY

PLOT OF RESIDUALS(U)

	ACTUAL	FITTED	RESIDUAL
732	2.759	2.757	.260E-02
733	2.763	2.759	.392E-02
734	2.763	2.759	.415E-02
741	2.767	2.773	-.584E-02
742	2.745	2.749	-.386E-02
743	2.745	2.740	.522E-02
744	2.74	2.729	.151E-01
751	2.718	2.712	.583E-02
752	2.702	2.729	-.270E-01
753	2.701	2.728	-.266E-01
754	2.726	2.736	-.370E-02
761	2.733	2.737	-.385E-02
762	2.759	2.765	-.633E-02
763	2.773	2.771	.228E-02
764	2.779	2.784	-.508E-02
771	2.785	2.778	.685E-02
772	2.808	2.796	.121E-01
773	2.822	2.795	.269E-01
774	2.837	2.813	.235E-01
781	2.841	2.841	.420E-04
782	2.851	2.861	-.967E-02
783	2.877	2.887	-.959E-02
784	2.885	2.900	-.147E-01
791	2.894	2.906	-.119E-01
792	2.904	2.904	.994E-04
793	2.905	2.907	-.192E-02
794	2.914	2.902	.123E-01
801	2.910	2.892	.181E-01
802	2.920	2.911	.889E-02
803	2.898	2.913	-.150E-01
804	2.896	2.908	-.119E-01
811	2.940	2.917	.233E-01
812	2.926	2.904	.215E-01
813	2.925	2.918	.743E-02
814	2.909	2.920	-.110E-01
821	2.91	2.920	-.993E-02
822	2.911	2.907	.317E-02
823	2.917	2.900	.172E-01
824	2.911	2.916	-.575E-02
831	2.905	2.925	-.201E-01
832	2.915	2.926	-.112E-01



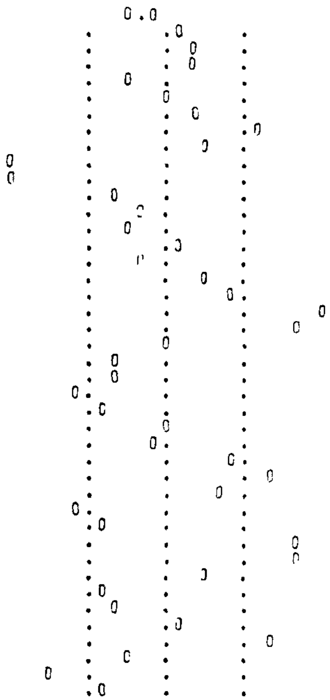


TABLE 6.4

THE PERCENTAGE CHANGES IN ENDOGENOUS VARIABLES DUE TO A TEMPORARY INCREASE OF 10% OF DOMESTIC MONEY SUPPLY

	FY	FFY	FR	FFR	FP	FFP	FFE
3	.403369E-01	.372181E-01	-.358413E-01	.142224	0.	0.	.666325E-01
4	.210503E-02	.548469E-02	.309176E-01	.245701E-01	.658941E-02	-.116970E-02	-.195256E-03
5	.807964E-03	-.590671E-03	.221264E-02	.985609E-03	-.135624E-02	-.503220E-03	-.585656E-03
6	.471816E-03	.243564E-03	.334428E-02	.237952E-02	0.	-.275500E-03	-.228465E-03
7	.239077E-03	.301246E-04	.138614E-02	.937754E-03	0.	-.139263E-03	-.132018E-03
8	.125329E-03	.345243E-04	.774540E-03	.533643E-03	0.	-.720187E-04	-.661901E-04
9	.617007E-04	.156843E-04	.393040E-03	.269368E-03	0.	-.369885E-04	-.339705E-04
10	.239632E-04	.841630E-05	.205300E-03	.140937E-03	0.	-.190570E-04	-.174203E-04
11	.152005E-04	.433381E-05	.106290E-03	.729300E-04	0.	-.982990E-05	-.885176E-05
12	.850936E-05	.227627E-05	.551790E-04	.378650E-04	0.	-.509229E-05	-.471538E-05
13	.439321E-05	.119388E-05	.286220E-04	.196400E-04	0.	-.261055E-05	-.241815E-05
14	.230246E-05	.523855E-06	.148500E-04	.101900E-04	0.	-.135396E-05	-.127368E-05
15	.120723E-05	.311214E-06	.770400E-05	.528600E-05	0.	-.706370E-06	-.657802E-06
16	.622015E-06	.168639E-06	.399600E-05	.274300E-05	0.	-.362618E-06	-.335863E-06
17	.270263E-06	.843829E-07	.207000E-05	.142200E-05	0.	-.191165E-06	-.203037E-06
18	.175733E-06	.280040E-07	.107600E-05	.738000E-06	0.	-.105755E-06	-.112562E-06
19	.872406E-07	0.	.558000E-06	.383000E-06	0.	-.421558E-07	-.454162E-07
20	0.	0.	.290000E-06	.198000E-06	0.	-.209974E-07	-.226644E-07
21	0.	0.	.150000E-06	.103000E-06	0.	-.209293E-07	0.
22	0.	0.	.780000E-07	.540000E-07	0.	0.	0.
23	0.	0.	.410000E-07	.280000E-07	0.	0.	-.223766E-07
24	0.	0.	.210000E-07	.140000E-07	0.	0.	0.
25	0.	0.	.110000E-07	.700000E-08	0.	0.	0.
26	0.	0.	.500000E-08	.300000E-08	0.	-.205899E-07	0.
27	0.	0.	.300000E-08	.200000E-08	0.	0.	0.
28	0.	0.	.200000E-08	.200000E-08	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.

TABLE 6.4 (CONTINUED)

	GY	GFY	GR	GFF	GP	GFP	GFE
2	.276975	.290900E-02	-.666337E-01	-.572316E-02	0.	0.	.182550E-01
3	.631057E-01	.725389E-02	.814296E-01	.707788E-01	.640381E-02	.967227E-03	.206586E-02
4	-.285609E-01	-.354493E-02	-.365135E-01	-.317966E-01	-.291463E-02	-.519404E-04	-.818606E-03
5	.126632E-01	.131015E-02	.156002E-01	.135415E-01	.120390E-02	.299339E-03	.428878E-03
6	-.582636E-02	-.774439E-03	-.723306E-02	-.631204E-02	-.584041E-03	.746790E-04	-.137474E-03
7	.212447E-02	.190869E-03	.291546E-02	.252041E-02	.213558E-03	.120182E-03	.990054E-04
8	-.134192E-02	-.198342E-03	-.148663E-02	-.130466E-02	-.124179E-03	.609367E-04	-.149454E-04
9	.318273E-03	.239121E-05	.503340E-03	.429146E-03	.313232E-04	.575720E-04	.279544E-04
10	-.331803E-03	-.644058E-04	-.335067E-03	-.297925E-03	-.309182E-04	.373407E-04	.368712E-05
11	-.158298E-05	-.190681E-04	.627640E-04	.497420E-04	.803017E-06	.301462E-04	.103473E-04
12	-.114462E-03	-.271923E-04	-.911200E-04	-.828860E-04	-.992814E-05	.213909E-04	.440143E-05
13	-.356013E-04	-.146659E-04	-.736100E-05	-.911900E-05	-.277130E-05	.163979E-04	.476411E-05
14	-.478494E-04	-.134989E-04	-.323000E-04	-.301270E-04	-.410278E-05	.120109E-04	.290351E-05
15	-.260421E-04	-.997328E-05	-.123680E-04	-.122800E-04	-.217861E-05	.905270E-05	.244606E-05
16	-.226406E-04	-.716756E-05	-.144530E-04	-.137100E-04	-.202559E-05	.669529E-05	.169511E-05
17	-.150984E-04	-.515347E-05	-.852600E-05	-.826800E-05	-.133342E-05	.501509E-05	.132142E-05
18	-.118867E-04	-.389733E-05	-.738900E-05	-.706400E-05	-.107323E-05	.370820E-05	.958408E-06
19	-.853850E-05	-.290261E-05	-.508400E-05	-.489900E-05	-.749112E-06	.276939E-05	.744299E-06
20	-.625462E-05	-.215728E-05	-.400000E-05	-.383600E-05	-.599176E-06	.204746E-05	.530051E-06
21	-.448664E-05	-.160453E-05	-.290700E-05	-.279600E-05	-.426290E-06	.154006E-05	.422599E-06
22	-.323372E-05	-.120402E-05	-.221400E-05	-.212500E-05	-.340615E-06	.116078E-05	.295659E-06
23	-.240519E-05	-.869133E-06	-.164000E-05	-.157600E-05	-.233855E-06	.846721E-06	.210948E-06
24	-.169267E-05	-.644414E-06	-.123400E-05	-.118600E-05	-.169701E-06	.658531E-06	.168365E-06
25	-.129761E-05	-.483993E-06	-.920000E-06	-.884000E-06	-.148010E-06	.492111E-06	.125825E-06
26	-.955513E-06	-.348859E-06	-.691000E-06	-.660000E-06	-.105695E-06	.347139E-06	.837827E-07
27	-.695151E-06	-.269030E-06	-.515000E-06	-.496000E-06	-.842337E-07	.264376E-06	.627110E-07
28	-.518550E-06	-.214089E-06	-.387000E-06	-.371000E-06	-.631508E-07	.202463E-06	.626472E-07
29	-.410975E-06	-.160526E-06	-.289000E-06	-.280000E-06	-.420522E-07	.161283E-06	.418130E-07
30	-.268782E-06	-.107651E-06	-.217000E-06	-.210000E-06	-.419065E-07	.100319E-06	.418644E-07
31	-.206026E-06	-.798739E-07	-.162000E-06	-.150000E-06	-.208603E-07	.798564E-07	.209304E-07
32	-.160122E-06	-.802717E-07	-.121000E-06	-.116000E-06	-.207905E-07	.595832E-07	0.
33	-.109533E-06	-.534006E-07	-.900000E-07	-.900000E-07	-.207828E-07	.395402E-07	.210270E-07
34	-.114115E-06	-.537665E-07	-.700000E-07	-.700000E-07	-.207233E-07	.393587E-07	.210474E-07
35	-.603957E-07	-.272147E-07	-.500000E-07	-.500000E-07	0.	.195869E-07	0.
36	-.609068E-07	-.272941E-07	-.380000E-07	-.400000E-07	0.	.194973E-07	.209687E-07
37	-.604613E-07	0.	-.280000E-07	-.300000E-07	-.205785E-07	.194061E-07	0.
38	-.619203E-07	-.274100E-07	-.210000E-07	-.200000E-07	-.205427E-07	.193248E-07	.209055E-07
39	0.	0.	-.160000E-07	-.200000E-07	-.204855E-07	0.	0.
40	-.632366E-07	0.	-.120000E-07	-.200000E-07	0.	0.	0.
41	-.622532E-07	0.	-.900000E-08	0.	0.	0.	0.
42	0.	0.	-.700000E-08	-.100000E-07	0.	0.	0.

TABLE 6.4 (CONTINUED)

	JY	JFY	JR	JFR	JP	JFP	JFE
2	.305368	.248742E-01	-.978622E-01	.240106E-01	0.	0.	.174612E-01
3	-.111620E-01	-.178518E-02	-.109944	-.579970E-01	.884956E-02	-.227188E-02	.835976E-03
4	.545041E-02	.225923E-02	.510998E-01	.184536E-01	-.254159E-02	-.195175E-02	-.268976E-03
5	-.233963E-02	-.513767E-03	-.218992E-01	-.106678E-01	.159562E-02	-.137333E-03	.153906E-03
6	.108811E-02	.396683E-03	.998576E-02	.389315E-02	-.450552E-03	-.276765E-03	-.565367E-04
7	-.472717E-03	-.117910E-03	-.434195E-02	-.201408E-02	.222767E-03	.813405E-05	.290374E-04
8	.226032E-03	.728008E-04	.195789E-02	.796738E-03	0.	-.419889E-04	-.115292E-04
9	-.989418E-04	-.255005E-04	-.858590E-03	-.386678E-03	0.	.553658E-05	.556954E-05
10	.432263E-04	.135009E-04	.384635E-03	.160400E-03	-.218245E-03	-.680527E-05	-.230239E-05
11	-.189241E-04	-.520512E-05	-.169518E-03	-.750110E-04	0.	.154023E-05	.103527E-05
12	.843353E-05	.260421E-05	.756500E-04	.319980E-04	0.	-.118829E-05	-.456331E-06
13	-.367962E-05	-.106904E-05	-.334300E-04	-.146430E-04	0.	.344132E-06	.217262E-06
14	.162463E-05	.489650E-06	.148900E-04	.634900E-05	0.	-.214003E-06	-.869141E-07
15	-.719244E-06	-.201692E-06	-.659300E-05	-.287000E-05	0.	.639484E-07	.434950E-07
16	.291310E-06	.860360E-07	.293200E-05	.125600E-05	0.	-.425126E-07	-.217819E-07
17	-.176582E-06	-.573978E-07	-.129900E-05	-.563000E-06	0.	.211742E-07	0.
18	.560638E-07	.285589E-07	.577000E-06	.249000E-06	0.	0.	0.
19	0.	0.	-.256000E-06	-.111000E-06	0.	0.	.218426E-07
20	0.	0.	.113000E-06	.490000E-07	0.	0.	0.
21	0.	0.	-.500000E-07	-.220000E-07	0.	0.	0.
22	0.	0.	.230000E-07	.100000E-07	0.	0.	0.
23	0.	0.	-.100000E-07	-.400000E-08	0.	0.	0.
24	0.	0.	.500000E-08	.200000E-08	0.	0.	0.
25	0.	0.	-.200000E-08	-.100000E-08	0.	0.	0.
26	0.	0.	.900000E-09	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.

TABLE 6.4 (CONTINUED)

	EY	EFY	ER	EFP	EP	EFP	EFE
2	.498541	.680008E-02	-.125231	.311591E-01	0.	0.	.344576E-01
3	-.623133E-02	.260480E-02	.519792E-01	.138763E-01	.163896E-01	-.155374E-02	-.231922E-02
4	.169217E-01	.121435E-03	-.823432E-02	-.185365E-02	.209839E-02	.532359E-03	.972351E-04
5	-.135763E-02	-.293626E-04	.252180E-03	.404410E-04	-.463285E-03	-.297297E-04	.989723E-05
6	-.283982E-04	.137478E-05	.421400E-04	.107590E-04	0.	-.165728E-05	-.150154E-05
7	.120880E-04	.112471E-06	-.518000E-05	-.114300E-05	0.	.333815E-06	.423978E-07
8	-.738652E-06	-.282786E-07	.900000E-07	.800000E-08	0.	-.221307E-07	0.
9	-.390147E-07	0.	.400000E-07	.800000E-08	0.	0.	0.
10	.117349E-07	0.	-.300000E-08	-.100000E-08	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.

	UY	UFY	UR	UFP	UP	UFP	UFE
2	.685798E-01	-.209753E-01	.415046	-.444193E-01	0.	0.	.382448E-01
3	-.169312E-02	-.141679E-03	-.284266E-01	-.340642E-01	.779113E-02	.586038E-02	.202827E-02
4	-.345848E-03	.217049E-02	-.114710E-01	-.503350E-02	.911893E-03	.208291E-02	-.637339E-03
5	.779188E-04	.165123E-02	-.279802E-02	.297588E-02	-.841320E-03	.377104E-03	-.852018E-03
6	.124722E-03	.757129E-03	.200875E-03	.314175E-02	-.782572E-03	-.128207E-03	-.497486E-03
7	.755212E-04	.232341E-03	.690693E-03	.170280E-02	-.403100E-03	-.164622E-03	-.194634E-03
8	.306122E-04	.211117E-04	.462619E-03	.625243E-03	-.140589E-03	-.941444E-04	-.445804E-04
9	.752285E-05	-.301194E-04	.201575E-03	.122650E-03	-.239894E-04	-.363416E-04	.544066E-05
10	-.513037E-06	-.255633E-04	.563550E-04	-.326400E-04	.975675E-05	-.812817E-05	.126973E-04
11	-.183265E-05	-.128115E-04	.169000E-05	-.475910E-04	.116827E-04	.113018E-05	.612523E-05
12	-.124270E-05	-.440979E-05	-.974400E-05	-.282150E-04	.657068E-05	.237891E-05	.342533E-05
13	-.548001E-06	-.652578E-06	-.740800E-05	-.112310E-04	.248554E-05	.150600E-05	.910579E-06
14	-.144680E-06	.358281E-06	-.348400E-05	-.266500E-05	.538497E-06	.620869E-06	-.216520E-07
15	0.	.422084E-06	-.108800E-05	.251000E-06	-.107417E-06	.170513E-06	-.173193E-06
16	.359229E-07	.133129E-06	-.113000E-06	.702000E-06	-.171466E-06	0.	-.130084E-06
17	0.	.970666E-07	.130000E-06	.460000E-06	-.106843E-06	-.211522E-07	-.643745E-07
18	0.	.321622E-07	.117000E-06	.198000E-06	-.425681E-07	-.210632E-07	-.216331E-07
19	0.	0.	.600000E-07	.540000E-07	0.	0.	0.
20	0.	0.	.210000E-07	.100000E-08	0.	0.	0.
21	0.	0.	.300000E-08	-.100000E-07	0.	0.	0.
22	0.	0.	-.100000E-08	-.700000E-08	0.	0.	0.
23	0.	0.	-.200000E-08	-.400000E-08	0.	0.	0.
24	0.	0.	-.100000E-08	-.100000E-08	0.	0.	0.
25	0.	0.	-.100000E-08	0.	0.	0.	0.
26	0.	0.	0.	.100000E-08	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.

TABLE 6.5

THE PERCENTAGE CHANGES IN ENDOGENOUS VARIABLES DUE TO A PERMANENT INCREASE OF 10% OF DOMESTIC MONEY SUPPLY

	FY	FFY	FR	FFR	FP	FFP	FFE
3	.403369E-01	.372181E-01	-.358413E-01	.142224	0.	0.	.666325E-01
4	.444153E-01	.426585E-01	-.487280E-02	.166593	.636939E-02	-.116970E-02	.677709E-01
5	.493624E-01	.420039E-01	-.219269E-02	.165514	.490079E-02	-.166532E-02	.671938E-01
6	.489272E-01	.422459E-01	.485900E-03	.168420	.466614E-02	-.191429E-02	.677833E-01
7	.504259E-01	.425890E-01	.174631E-02	.170605	.466561E-02	-.203742E-02	.688451E-01
8	.507274E-01	.433834E-01	.248862E-02	.172246	.463222E-02	-.209940E-02	.689026E-01
9	.495724E-01	.443435E-01	.220552E-02	.176253	.463907E-02	-.212992E-02	.692384E-01
10	.471886E-01	.449150E-01	.256377E-02	.179652	.477384E-02	-.216757E-02	.697875E-01
11	.468196E-01	.457023E-01	.279360E-02	.182341	.468871E-02	-.219961E-02	.693949E-01
12	.500163E-01	.454387E-01	.396882E-02	.180765	.484871E-02	-.223016E-02	.701780E-01
13	.500823E-01	.456811E-01	.333560E-02	.181903	.464561E-02	-.222300E-02	.703451E-01
14	.506378E-01	.456906E-01	.367046E-02	.182399	.459815E-02	-.222808E-02	.709989E-01
15	.515035E-01	.458293E-01	.350847E-02	.183361	.469761E-02	-.222650E-02	.713235E-01
16	.529240E-01	.454266E-01	.388625E-02	.183019	.472488E-02	-.222965E-02	.725684E-01
17	.536502E-01	.454325E-01	.381097E-02	.182931	.452291E-02	-.222119E-02	.731021E-01
18	.528566E-01	.456711E-01	.341453E-02	.184605	.461534E-02	-.221265E-02	.737635E-01
19	.527607E-01	.455714E-01	.357425E-02	.185696	.463230E-02	-.221792E-02	.748008E-01
20	.532583E-01	.457955E-01	.345297E-02	.187135	.456015E-02	-.222113E-02	.752855E-01
21	.512722E-01	.455142E-01	.336124E-02	.189074	.464528E-02	-.222932E-02	.769313E-01
22	.491318E-01	.457668E-01	.320634E-02	.191685	.467170E-02	-.224112E-02	.774531E-01
23	.486653E-01	.457931E-01	.345347E-02	.193409	.469000E-02	-.226144E-02	.785832E-01
24	.470402E-01	.460013E-01	.306652E-02	.196717	.468032E-02	-.227558E-02	.795162E-01
25	.475145E-01	.461130E-01	.374185E-02	.197642	.485251E-02	-.230198E-02	.803902E-01
26	.477373E-01	.464212E-01	.362540E-02	.198974	.475887E-02	-.231163E-02	.806323E-01
27	.475643E-01	.466332E-01	.380592E-02	.200016	.479139E-02	-.232221E-02	.812191E-01
28	.462193E-01	.468560E-01	.356606E-02	.202090	.482041E-02	-.232794E-02	.819247E-01
29	.465987E-01	.474764E-01	.373323E-02	.203710	.494996E-02	-.233884E-02	.813775E-01
30	.486659E-01	.473677E-01	.447359E-02	.202401	.479716E-02	-.234850E-02	.824415E-01
31	.466571E-01	.475816E-01	.345818E-02	.205201	.468259E-02	-.233398E-02	.832223E-01
32	.481752E-01	.477286E-01	.422818E-02	.205436	.491695E-02	-.234469E-02	.834279E-01
33	.506231E-01	.474390E-01	.458210E-02	.203872	.485307E-02	-.234177E-02	.844213E-01
34	.532852E-01	.472639E-01	.464169E-02	.202367	.468645E-02	-.232598E-02	.845854E-01
35	.585228E-01	.470691E-01	.514669E-02	.199021	.474565E-02	-.230483E-02	.854386E-01
36	.585466E-01	.473171E-01	.410307E-02	.199729	.457116E-02	-.226623E-02	.859457E-01
37	.596466E-01	.470171E-01	.452050E-02	.198996	.460809E-02	-.225342E-02	.867268E-01
38	.631619E-01	.473579E-01	.437820E-02	.198287	.451575E-02	-.223437E-02	.862895E-01
39	.682570E-01	.470878E-01	.466616E-02	.196521	.439880E-02	-.221947E-02	.872911E-01
40	.718889E-01	.469043E-01	.446790E-02	.195403	.439661E-02	-.219712E-02	.887229E-01
41	.694904E-01	.469669E-01	.379871E-02	.196996	.441946E-02	-.217723E-02	.887720E-01
42	.729674E-01	.467283E-01	.435247E-02	.196326	.433464E-02	-.217785E-02	.900379E-01

TABLE 6.5 (CONTINUED)

	GY	GFY	GR	GFP	GP	GFP	GFE
2	.276975	.290900E-02	-.666337E-01	-.572316E-02	0.	0.	.182550E-01
3	.324739	.102564E-01	.123519E-01	.648457E-01	.640381E-02	.967227E-03	.206910E-01
4	.295447	.696473E-02	-.214250E-01	.356237E-01	.370758E-02	.945306E-03	.200170E-01
5	.325019	.920100E-02	-.560910E-02	.483719E-01	.491530E-02	.124086E-02	.200823E-01
6	.301562	.732907E-02	-.152395E-01	.409981E-01	.412454E-02	.130115E-02	.202316E-01
7	.309345	.772196E-02	-.104615E-01	.453027E-01	.446476E-02	.143510E-02	.204863E-01
8	.319085	.750160E-02	-.122337E-01	.434470E-01	.425201E-02	.148548E-02	.203442E-01
9	.326630	.760103E-02	-.134445E-01	.435810E-01	.423364E-02	.153242E-02	.207313E-01
10	.317458	.767048E-02	-.126691E-01	.448991E-01	.434498E-02	.158208E-02	.209939E-01
11	.322511	.768120E-02	-.129144E-01	.450313E-01	.434415E-02	.161414E-02	.211349E-01
12	.328176	.765691E-02	-.113330E-01	.454543E-01	.437257E-02	.164032E-02	.208186E-01
13	.327588	.750834E-02	-.135220E-01	.439230E-01	.422534E-02	.163815E-02	.208857E-01
14	.326546	.765600E-02	-.130337E-01	.449807E-01	.431049E-02	.165604E-02	.209953E-01
15	.325204	.766861E-02	-.129242E-01	.452887E-01	.433282E-02	.166679E-02	.210326E-01
16	.315273	.767560E-02	-.137438E-01	.453205E-01	.433683E-02	.167295E-02	.211676E-01
17	.314910	.778961E-02	-.130709E-01	.462208E-01	.440783E-02	.168708E-02	.212871E-01
18	.310978	.772854E-02	-.133854E-01	.461840E-01	.439678E-02	.169166E-02	.213556E-01
19	.311678	.776413E-02	-.137015E-01	.464295E-01	.440910E-02	.169728E-02	.215099E-01
20	.302545	.778625E-02	-.134854E-01	.469458E-01	.445466E-02	.170530E-02	.215747E-01
21	.296874	.775603E-02	-.146134E-01	.470123E-01	.445145E-02	.170990E-02	.218596E-01
22	.290417	.783376E-02	-.139749E-01	.482575E-01	.455785E-02	.172695E-02	.221186E-01
23	.288648	.780308E-02	-.137221E-01	.485745E-01	.457814E-02	.173675E-02	.221399E-01
24	.279035	.775359E-02	-.150269E-01	.484272E-01	.456338E-02	.174095E-02	.224198E-01
25	.279761	.792259E-02	-.143217E-01	.496905E-01	.466089E-02	.175884E-02	.225963E-01
26	.275230	.792806E-02	-.141416E-01	.499464E-01	.468085E-02	.176720E-02	.226141E-01
27	.278877	.796110E-02	-.147014E-01	.498896E-01	.466086E-02	.177047E-02	.227145E-01
28	.273515	.800577E-02	-.149784E-01	.503759E-01	.470587E-02	.177738E-02	.229504E-01
29	.271318	.806422E-02	-.141103E-01	.510956E-01	.475975E-02	.178709E-02	.229867E-01
30	.280187	.801877E-02	-.134105E-01	.508076E-01	.470958E-02	.178385E-02	.227130E-01
31	.272289	.799037E-02	-.162105E-01	.496102E-01	.459916E-02	.176804E-02	.230927E-01
32	.282792	.812601E-02	-.134525E-01	.517777E-01	.476248E-02	.178350E-02	.231358E-01
33	.285781	.793122E-02	-.137868E-01	.506020E-01	.465346E-02	.176980E-02	.228564E-01
34	.295024	.789268E-02	-.138365E-01	.500141E-01	.458615E-02	.175534E-02	.226750E-01
35	.307190	.788871E-02	-.129530E-01	.496844E-01	.454016E-02	.173979E-02	.222522E-01
36	.310502	.780939E-02	-.149381E-01	.483585E-01	.441685E-02	.171334E-02	.223121E-01
37	.309689	.789900E-02	-.138070E-01	.494698E-01	.450580E-02	.170976E-02	.223591E-01
38	.315328	.791955E-02	-.137131E-01	.491949E-01	.447227E-02	.169762E-02	.221892E-01
39	.321479	.794509E-02	-.141723E-01	.488494E-01	.443223E-02	.168477E-02	.221480E-01
40	.321608	.796495E-02	-.137435E-01	.490940E-01	.444770E-02	.167758E-02	.220915E-01
41	.318465	.791847E-02	-.146508E-01	.487725E-01	.441408E-02	.166654E-02	.221756E-01
42	.321837	.804185E-02	-.143113E-01	.494848E-01	.446666E-02	.166630E-02	.222706E-01

TABLE 6.5 (CONTINUED)

	JY	JFY	JR	JFP	JP	JFP	JFE
2	.305368	.248742E-01	-.978622E-01	.240106E-01	0.	0.	.174612E-01
3	.297728	.228880E-01	-.208535	-.338077E-01	.884956E-02	-.227188E-02	.184050E-01
4	.303252	.253014E-01	-.158966	-.156108E-01	.646950E-02	-.423007E-02	.182748E-01
5	.312197	.250395E-01	-.180601	-.267316E-01	.797812E-02	-.437442E-02	.182869E-01
6	.312557	.255159E-01	-.170617	-.221369E-01	.743411E-02	-.462401E-02	.183966E-01
7	.319366	.253374E-01	-.176458	-.249216E-01	.757407E-02	-.459525E-02	.183985E-01
8	.330784	.255624E-01	-.173238	-.239481E-01	.749559E-02	-.462035E-02	.182743E-01
9	.334031	.254238E-01	-.173570	-.242591E-01	.725434E-02	-.457297E-02	.181918E-01
10	.327593	.256503E-01	-.174571	-.235683E-01	.720210E-02	-.453355E-02	.195126E-01
11	.328709	.256210E-01	-.176915	-.245516E-01	.741225E-02	-.453598E-02	.185635E-01
12	.327523	.260403E-01	-.175596	-.242781E-01	.740096E-02	-.455384E-02	.186394E-01
13	.325342	.261082E-01	-.177685	-.245020E-01	.739613E-02	-.454661E-02	.187222E-01
14	.322508	.262927E-01	-.178933	-.244149E-01	.737047E-02	-.454462E-02	.189093E-01
15	.323219	.264549E-01	-.180623	-.248416E-01	.752365E-02	-.455847E-02	.190492E-01
16	.317835	.266452E-01	-.182052	-.247650E-01	.749946E-02	-.458101E-02	.192953E-01
17	.320929	.266441E-01	-.183230	-.254656E-01	.747544E-02	-.460362E-02	.192840E-01
18	.310365	.269301E-01	-.184155	-.248762E-01	.746269E-02	-.461771E-02	.196091E-01
19	.306296	.269711E-01	-.187038	-.257002E-01	.765306E-02	-.463335E-02	.197989E-01
20	.303880	.271534E-01	-.187778	-.257311E-01	.762873E-02	-.466467E-02	.199364E-01
21	.294614	.272788E-01	-.190492	-.256464E-01	.760296E-02	-.468023E-02	.203662E-01
22	.283765	.275070E-01	-.194347	-.262940E-01	.780591E-02	-.472881E-02	.207896E-01
23	.275118	.279592E-01	-.197426	-.266391E-01	.778456E-02	-.479246E-02	.212249E-01
24	.267443	.280546E-01	-.200873	-.271291E-01	.799159E-02	-.485405E-02	.216337E-01
25	.272294	.278707E-01	-.202235	-.280635E-01	.817096E-02	-.491123E-02	.215838E-01
26	.278959	.278588E-01	-.200810	-.280013E-01	.812669E-02	-.493391E-02	.214343E-01
27	.281289	.276237E-01	-.199998	-.278661E-01	.815217E-02	-.490850E-02	.213105E-01
28	.284265	.274084E-01	-.199869	-.276964E-01	.791997E-02	-.486951E-02	.212970E-01
29	.290929	.272281E-01	-.199207	-.279919E-01	.813178E-02	-.483997E-02	.210773E-01
30	.291770	.274675E-01	-.197821	-.275112E-01	.791502E-02	-.480092E-02	.210101E-01
31	.278472	.276060E-01	-.200414	-.269028E-01	.791007E-02	-.475922E-02	.215207E-01
32	.277751	.280019E-01	-.203880	-.281268E-01	.806785E-02	-.477269E-02	.217165E-01
33	.273815	.284417E-01	-.204468	-.278743E-01	.805952E-02	-.480956E-02	.219456E-01
34	.276428	.286426E-01	-.205564	-.286182E-01	.825253E-02	-.482412E-02	.219166E-01
35	.282680	.289855E-01	-.203928	-.285343E-01	.804787E-02	-.482088E-02	.217279E-01
36	.282284	.289638E-01	-.203400	-.281545E-01	.826959E-02	-.478616E-02	.217107E-01
37	.279942	.291725E-01	-.205071	-.280118E-01	.801809E-02	-.475488E-02	.219862E-01
38	.288987	.290329E-01	-.204851	-.290247E-01	.822876E-02	-.476012E-02	.216563E-01
39	.293794	.291723E-01	-.202178	-.280829E-01	.801315E-02	-.473550E-02	.215341E-01
40	.295049	.290606E-01	-.202262	-.282855E-01	.802139E-02	-.468981E-02	.214316E-01
41	.284410	.295101E-01	-.204080	-.273547E-01	.799180E-02	-.466378E-02	.2197[illegible]7E-01
42	.284118	.295960E-01	-.207251	-.288555E-01	.820850E-02	-.468802E-02	.220275E-01

TABLE 6.5 (CONTINUED)

	EY	EFY	ER	EFP	EP	EFP	EFE
2	.498541	.680008E-02	-.125231	.311591E-01	0.	0.	.344576E-01
3	.452880	.948509E-02	-.761791E-01	.457636E-01	.163896E-01	-.155374E-02	.328393E-01
4	.514467	.968943E-02	-.836111E-01	.443369E-01	.186524E-01	-.105100E-02	.331471E-01
5	.549701	.978525E-02	-.834150E-01	.443885E-01	.182997E-01	-.106646E-02	.331539E-01
6	.528970	.991090E-02	-.855803E-01	.449455E-01	.183444E-01	-.105987E-02	.337297E-01
7	.542670	.100255E-01	-.855269E-01	.454006E-01	.182357E-01	-.107947E-02	.339973E-01
8	.555462	.101189E-01	-.856048E-01	.455344E-01	.184007E-01	-.107465E-02	.340914E-01
9	.569279	.101343E-01	-.860052E-01	.456709E-01	.181737E-01	-.106823E-02	.343048E-01
10	.519039	.101316E-01	-.872231E-01	.460662E-01	.179521E-01	-.106637E-02	.346169E-01
11	.606483	.100252E-01	-.847711E-01	.457407E-01	.181580E-01	-.107690E-02	.344102E-01
12	.623605	.100028E-01	-.848682E-01	.453145E-01	.175477E-01	-.104383E-02	.342265E-01
13	.675604	.994880E-02	-.841967E-01	.450402E-01	.173077E-01	-.103795E-02	.341357E-01
14	.730103	.986177E-02	-.837219E-01	.447591E-01	.169707E-01	-.102650E-02	.340622E-01
15	.795870	.978160E-02	-.831523E-01	.444750E-01	.168563E-01	-.101668E-02	.340064E-01
16	.815208	.969746E-02	-.832136E-01	.443338E-01	.165272E-01	-.100583E-02	.340652E-01
17	.913479	.966910E-02	-.830125E-01	.442582E-01	.164309E-01	-.100331E-02	.341213E-01
18	.878600	.965734E-02	-.841564E-01	.444967E-01	.162920E-01	-.996662E-03	.344487E-01
19	.865986	.971243E-02	-.850116E-01	.449428E-01	.163934E-01	-.100627E-02	.348071E-01
20	.839182	.976421E-02	-.854473E-01	.452992E-01	.164668E-01	-.101260E-02	.350195E-01
21	.714329	.976728E-02	-.880135E-01	.460913E-01	.163802E-01	-.101480E-02	.356972E-01
22	.737972	.977846E-02	-.878589E-01	.466380E-01	.167069E-01	-.104127E-02	.360598E-01
23	.703587	.981052E-02	-.892574E-01	.471066E-01	.168878E-01	-.103846E-02	.364722E-01
24	.654883	.984988E-02	-.909692E-01	.478509E-01	.169966E-01	-.104975E-02	.370758E-01
25	.643187	.992897E-02	-.912892E-01	.483792E-01	.171281E-01	-.106661E-02	.373011E-01
26	.635878	.100164E-01	-.922980E-01	.488121E-01	.172243E-01	-.106751E-02	.375992E-01
27	.581424	.101766E-01	-.946789E-01	.496588E-01	.171125E-01	-.107451E-02	.381077E-01
28	.574135	.102622E-01	-.949485E-01	.502993E-01	.173692E-01	-.109683E-02	.384651E-01
29	.585740	.103603E-01	-.950446E-01	.505294E-01	.174182E-01	-.109585E-02	.385688E-01
30	.621191	.104713E-01	-.954519E-01	.506934E-01	.174765E-01	-.109155E-02	.387100E-01
31	.527653	.105794E-01	-.995784E-01	.518187E-01	.172938E-01	-.108912E-02	.396371E-01
32	.532421	.107856E-01	-.998792E-01	.528016E-01	.175439E-01	-.113021E-02	.399673E-01
33	.542328	.108362E-01	-.996989E-01	.530636E-01	.176559E-01	-.113130E-02	.400649E-01
34	.583154	.109816E-01	-.994995E-01	.530373E-01	.177239E-01	-.112366E-02	.400783E-01
35	.652367	.109961E-01	-.973334E-01	.524536E-01	.176876E-01	-.111586E-02	.396078E-01
36	.736569	.109378E-01	-.978408E-01	.521030E-01	.173784E-01	-.108747E-02	.397648E-01
37	.649170	.110739E-01	-.101355	.529583E-01	.173272E-01	-.108665E-02	.404877E-01
38	.728050	.111992E-01	-.991641E-01	.531713E-01	.174632E-01	-.112143E-02	.403418E-01
39	.744592	.112714E-01	-.100029	.531230E-01	.173993E-01	-.109667E-02	.404125E-01
40	.771049	.113214E-01	-.997989E-01	.531628E-01	.173516E-01	-.110025E-02	.404477E-01
41	.841972	.111986E-01	-.984036E-01	.527973E-01	.172916E-01	-.109466E-02	.403997E-01
42	.921517	.111020E-01	-.981578E-01	.524306E-01	.172664E-01	-.107738E-02	.403718E-01

TABLE 6.5 (CONTINUED)

	UY	UFY	UR	UFR	UP	UFP	UFE
2	.695798E-01	-.209753E-01	.415946	-.444193E-01	0.	0.	.382449E-01
3	.673802E-01	-.209237E-01	.389776	-.788213E-01	.779113E-02	.586038E-02	.406491E-01
4	.671317E-01	-.186911E-01	.378865	-.841970E-01	.871841E-02	.795046E-02	.401673E-01
5	.670615E-01	-.176379E-01	.377223	-.814618E-01	.784986E-02	.830852E-02	.391251E-01
6	.677795E-01	-.166932E-01	.377241	-.784077E-01	.703546E-02	.813432E-02	.387562E-01
7	.685161E-01	-.166330E-01	.380547	-.769708E-01	.658080E-02	.791131E-02	.387421E-01
8	.689315E-01	-.168083E-01	.381391	-.765949E-01	.644214E-02	.779808E-02	.386741E-01
9	.694846E-01	-.167060E-01	.382346	-.766253E-01	.639724E-02	.772871E-02	.388405E-01
10	.693438E-01	-.165665E-01	.384103	-.769007E-01	.638161E-02	.768403E-02	.391117E-01
11	.696814E-01	-.167069E-01	.385948	-.772926E-01	.639994E-02	.767178E-02	.392467E-01
12	.697395E-01	-.171095E-01	.387340	-.776546E-01	.642012E-02	.767057E-02	.392113E-01
13	.698967E-01	-.171322E-01	.388341	-.779214E-01	.642743E-02	.766324E-02	.393220E-01
14	.695758E-01	-.171983E-01	.390506	-.782539E-01	.642225E-02	.764998E-02	.394777E-01
15	.696597E-01	-.172054E-01	.391840	-.785858E-01	.644001E-02	.765171E-02	.396154E-01
16	.696376E-01	-.171296E-01	.393521	-.789055E-01	.644921E-02	.765114E-02	.398411E-01
17	.700862E-01	-.172969E-01	.395280	-.792476E-01	.645667E-02	.765518E-02	.399150E-01
18	.699536E-01	-.172749E-01	.397105	-.796084E-01	.646021E-02	.765629E-02	.401145E-01
19	.702080E-01	-.172273E-01	.398351	-.799154E-01	.646413E-02	.765512E-02	.402871E-01
20	.700609E-01	-.172106E-01	.400097	-.802248E-01	.646063E-02	.765126E-02	.404533E-01
21	.7017[illegible]5E-01	-.170573E-01	.405024	-.809059E-01	.646956E-02	.765567E-02	.410134E-01
22	.699163E-01	-.167922E-01	.406186	-.814793E-01	.652520E-02	.770182E-02	.4131[illegible]8E-01
23	.695362E-01	-.166139E-01	.407567	-.818090E-01	.652664E-02	.771823E-02	.415538E-01
24	.694867E-01	-.163304E-01	.409053	-.820808E-01	.651302E-02	.771957E-02	.419755E-01
25	.695630E-01	-.163319E-01	.410372	-.823362E-01	.650063E-02	.771879E-02	.420104E-01
26	.698528E-01	-.163792E-01	.411696	-.825880E-01	.648439E-02	.771629E-02	.420894E-01
27	.699970E-01	-.163897E-01	.412982	-.828411E-01	.646967E-02	.771402E-02	.422277E-01
28	.703902E-01	-.163358E-01	.414615	-.831327E-01	.644686E-02	.770494E-02	.424439E-01
29	.707485E-01	-.165078E-01	.415287	-.833542E-01	.642538E-02	.769731E-02	.423936E-01
30	.705300E-01	-.167456E-01	.416712	-.835791E-01	.639179E-02	.767735E-02	.424078E-01
31	.706370E-01	-.163729E-01	.417634	-.837968E-01	.637272E-02	.765975E-02	.427817E-01
32	.710072E-01	-.165189E-01	.419061	-.840397E-01	.634943E-02	.764225E-02	.427657E-01
33	.709743E-01	-.167278E-01	.420140	-.842828E-01	.633830E-02	.762953E-02	.427795E-01
34	.716118E-01	-.169984E-01	.422174	-.846076E-01	.633124E-02	.761592E-02	.428406E-01
35	.715149E-01	-.175031E-01	.423511	-.849362E-01	.632845E-02	.761080E-02	.426474E-01
36	.717463E-01	-.175520E-01	.425272	-.852670E-01	.632532E-02	.760284E-02	.428126E-01
37	.719348E-01	-.175702E-01	.426419	-.855535E-01	.632432E-02	.759636E-02	.429320E-01
38	.724904E-01	-.180115E-01	.427801	-.858155E-01	.632494E-02	.759239E-02	.428001E-01
39	.728832E-01	-.182932E-01	.428940	-.860589E-01	.633250E-02	.759229E-02	.427662E-01
40	.727647E-01	-.184711E-01	.430755	-.863580E-01	.633626E-02	.758808E-02	.428812E-01
41	.726847E-01	-.182579E-01	.431505	-.866007E-01	.634988E-02	.759298E-02	.430707E-01
42	.729828E-01	-.183920E-01	.433483	-.868953E-01	.635158E-02	.759287E-02	.431459E-01

TABLE 6.6

THE PERCENTAGE CHANGES IN ENDOGENOUS VARIABLES DUE TO A PERMANENT INCREASE OF 10% OF ENERGY PRICES

	FY	FFY	FR	FFR	FP	FFP	FFE
3	0.	0.	0.	0.	0.	0.	0.
4	-.449261E-02	-.200653E-02	-.328102E-01	-.230563E-01	.569734E-03	.288971E-02	.240683E-02
5	-.755530E-02	-.254387E-02	-.479639E-01	-.333721E-01	.172032E-02	.438375E-02	.381624E-02
6	-.890604E-02	-.297765E-02	-.576309E-01	-.400479E-01	.206137E-02	.526498E-02	.464944E-02
7	-.102592E-01	-.334193E-02	-.651158E-01	-.452335E-01	.246449E-02	.590834E-02	.531459E-02
8	-.109655E-01	-.358348E-02	-.696750E-01	-.483758E-01	.268475E-02	.627968E-02	.567688E-02
9	-.108914E-01	-.371921E-02	-.725330E-01	-.503539E-01	.282649E-02	.648638E-02	.579933E-02
10	-.104140E-01	-.377186E-02	-.741662E-01	-.514812E-01	.291753E-02	.659043E-02	.587714E-02
11	-.102671E-01	-.381072E-02	-.747678E-01	-.518966E-01	.280511E-02	.660502E-02	.581162E-02
12	-.111451E-01	-.385259E-02	-.751420E-01	-.521606E-01	.291522E-02	.661195E-02	.598897E-02
13	-.111397E-01	-.337578E-02	-.756506E-01	-.525143E-01	.285491E-02	.662731E-02	.598800E-02
14	-.113434E-01	-.390828E-02	-.763442E-01	-.530008E-01	.275651E-02	.665967E-02	.608773E-02
15	-.115205E-01	-.390448E-02	-.766382E-01	-.531972E-01	.290522E-02	.666244E-02	.610758E-02
16	-.119511E-01	-.390448E-02	-.771500E-01	-.535522E-01	.292365E-02	.668365E-02	.627868E-02
17	-.121881E-01	-.392279E-02	-.775797E-01	-.538455E-01	.279079E-02	.669510E-02	.636501E-02
18	-.119432E-01	-.392053E-02	-.779314E-01	-.540874E-01	.290815E-02	.669817E-02	.638206E-02
19	-.118908E-01	-.389595E-02	-.781354E-01	-.542267E-01	.287351E-02	.669362E-02	.645610E-02
20	-.119439E-01	-.390287E-02	-.784304E-01	-.544344E-01	.279871E-02	.669178E-02	.646576E-02
21	-.114185E-01	-.385559E-02	-.786937E-01	-.546209E-01	.284744E-02	.669061E-02	.655465E-02
22	-.108031E-01	-.382592E-02	-.787899E-01	-.546862E-01	.283191E-02	.667540E-02	.651227E-02
23	-.105685E-01	-.377112E-02	-.784430E-01	-.544400E-01	.277891E-02	.663068E-02	.652981E-02
24	-.100169E-01	-.371992E-02	-.783242E-01	-.543596E-01	.274111E-02	.659679E-02	.647246E-02
25	-.100926E-01	-.371832E-02	-.783800E-01	-.544002E-01	.280970E-02	.658073E-02	.653442E-02
26	-.100695E-01	-.371552E-02	-.783924E-01	-.544057E-01	.275060E-02	.655989E-02	.651021E-02
27	-.100156E-01	-.372964E-02	-.786533E-01	-.545898E-01	.275321E-02	.655853E-02	.654725E-02
28	-.972747E-02	-.375960E-02	-.795261E-01	-.552042E-01	.278840E-02	.660282E-02	.659466E-02
29	-.991040E-02	-.386626E-02	-.810392E-01	-.562674E-01	.289931E-02	.669335E-02	.661624E-02
30	-.106000E-01	-.394981E-02	-.823438E-01	-.571743E-01	.276297E-02	.677407E-02	.687607E-02
31	-.101800E-01	-.398980E-02	-.838721E-01	-.582410E-01	.278051E-02	.686127E-02	.693876E-02
32	-.106897E-01	-.406951E-02	-.852434E-01	-.591978E-01	.293295E-02	.693849E-02	.707975E-02
33	-.114437E-01	-.411614E-02	-.861217E-01	-.598036E-01	.296053E-02	.698264E-02	.730900E-02
34	-.122641E-01	-.417595E-02	-.870380E-01	-.604390E-01	.288996E-02	.703040E-02	.746020E-02
35	-.138903E-01	-.429269E-02	-.881935E-01	-.612453E-01	.303058E-02	.709360E-02	.773041E-02
36	-.133813E-01	-.434471E-02	-.892598E-01	-.619828E-01	.301751E-02	.714682E-02	.777790E-02
37	-.144889E-01	-.438789E-02	-.903441E-01	-.627378E-01	.302137E-02	.720286E-02	.806987E-02
38	-.154584E-01	-.444794E-02	-.907138E-01	-.629898E-01	.300603E-02	.720318E-02	.809060E-02
39	-.168803E-01	-.446381E-02	-.907692E-01	-.630261E-01	.291202E-02	.718486E-02	.827670E-02
40	-.178724E-01	-.446878E-02	-.907662E-01	-.630217E-01	.298002E-02	.716325E-02	.845623E-02
41	-.172025E-01	-.446535E-02	-.912705E-01	-.633768E-01	.302743E-02	.717690E-02	.840899E-02
42	-.182465E-01	-.448201E-02	-.917388E-01	-.637022E-01	.289038E-02	.719550E-02	.862220E-02

TABLE 6.6 (CONTINUED)

	GY	GFY	GR	GFR	GP	GFP	GFE
2	0.	0.	0.	0.	0.	0.	0.
3	-.276560E-02	-.214458E-02	.275943E-02	.192842E-02	.184108E-03	.306969E-02	.928157E-03
4	-.120912E-01	-.462431E-02	-.461259E-02	-.483991E-02	.106884E-02	.528256E-02	.139343E-02
5	-.171877E-01	-.621303E-02	-.596227E-02	-.628775E-02	.140338E-02	.699101E-02	.186626E-02
6	-.206634E-01	-.756873E-02	-.900539E-02	-.915296E-02	.181994E-02	.831253E-02	.218668E-02
7	-.241425E-01	-.867006E-02	-.107097E-01	-.108188E-01	.209114E-02	.939463E-02	.249519E-02
8	-.280787E-01	-.964990E-02	-.122914E-01	-.123425E-01	.231905E-02	.102311E-01	.271576E-02
9	-.304854E-01	-.104160E-01	-.135859E-01	-.135805E-01	.249126E-02	.108329E-01	.283212E-02
10	-.308206E-01	-.108297E-01	-.144880E-01	-.144497E-01	.262685E-02	.112644E-01	.301201E-02
11	-.323089E-01	-.112055E-01	-.151764E-01	-.151075E-01	.272116E-02	.115516E-01	.310341E-02
12	-.342004E-01	-.114991E-01	-.156728E-01	-.155813E-01	.279624E-02	.117424E-01	.316639E-02
13	-.347451E-01	-.117221E-01	-.159958E-01	-.158981E-01	.284058E-02	.119019E-01	.321969E-02
14	-.348043E-01	-.119157E-01	-.163617E-01	-.162460E-01	.288501E-02	.120219E-01	.324249E-02
15	-.343175E-01	-.120231E-01	-.165360E-01	-.164221E-01	.291505E-02	.121126E-01	.327461E-02
16	-.338561E-01	-.121083E-01	-.167249E-01	-.166106E-01	.294622E-02	.122021E-01	.329437E-02
17	-.339528E-01	-.122552E-01	-.169252E-01	-.168075E-01	.297398E-02	.122810E-01	.332736E-02
18	-.337309E-01	-.122732E-01	-.170803E-01	-.169627E-01	.299628E-02	.123469E-01	.335752E-02
19	-.338151E-01	-.123467E-01	-.172570E-01	-.171329E-01	.301434E-02	.123907E-01	.337763E-02
20	-.328474E-01	-.123554E-01	-.173980E-01	-.172689E-01	.303523E-02	.124167E-01	.338811E-02
21	-.319073E-01	-.122604E-01	-.175215E-01	-.173862E-01	.304043E-02	.124256E-01	.339123E-02
22	-.309102E-01	-.121702E-01	-.175866E-01	-.174504E-01	.304765E-02	.124193E-01	.340122E-02
23	-.306943E-01	-.120974E-01	-.176031E-01	-.174681E-01	.304741E-02	.123926E-01	.340286E-02
24	-.293155E-01	-.119757E-01	-.176465E-01	-.175084E-01	.304600E-02	.123638E-01	.339854E-02
25	-.290558E-01	-.120108E-01	-.176385E-01	-.175054E-01	.303873E-02	.123415E-01	.339349E-02
26	-.285723E-01	-.120132E-01	-.176393E-01	-.175115E-01	.304236E-02	.123216E-01	.339890E-02
27	-.288617E-01	-.120876E-01	-.176499E-01	-.175296E-01	.303863E-02	.123222E-01	.340746E-02
28	-.281766E-01	-.121014E-01	-.177807E-01	-.176571E-01	.305806E-02	.123447E-01	.342505E-02
29	-.281612E-01	-.122063E-01	-.179347E-01	-.178107E-01	.308155E-02	.124026E-01	.345986E-02
30	-.297495E-01	-.123939E-01	-.181129E-01	-.179863E-01	.310027E-02	.124579E-01	.349607E-02
31	-.288118E-01	-.123945E-01	-.183041E-01	-.181770E-01	.311973E-02	.125315E-01	.353410E-02
32	-.302167E-01	-.125867E-01	-.185976E-01	-.184541E-01	.314783E-02	.125864E-01	.357467E-02
33	-.312613E-01	-.126602E-01	-.187640E-01	-.186166E-01	.317285E-02	.126268E-01	.360959E-02
34	-.328450E-01	-.128515E-01	-.189361E-01	-.187848E-01	.319077E-02	.126699E-01	.364099E-02
35	-.350756E-01	-.131337E-01	-.190748E-01	-.189282E-01	.321244E-02	.127349E-01	.367070E-02
36	-.357592E-01	-.133086E-01	-.193101E-01	-.191565E-01	.323519E-02	.128040E-01	.370083E-02
37	-.358584E-01	-.133810E-01	-.195125E-01	-.193560E-01	.326447E-02	.128711E-01	.373349E-02
38	-.370068E-01	-.135966E-01	-.196870E-01	-.195243E-01	.328424E-02	.129061E-01	.375124E-02
39	-.379255E-01	-.137576E-01	-.197953E-01	-.196302E-01	.329192E-02	.129189E-01	.376103E-02
40	-.381429E-01	-.138135E-01	-.198845E-01	-.197172E-01	.330269E-02	.129194E-01	.377210E-02
41	-.377223E-01	-.138031E-01	-.199533E-01	-.197898E-01	.330886E-02	.129379E-01	.378238E-02
42	-.380380E-01	-.139148E-01	-.200849E-01	-.199164E-01	.332032E-02	.129514E-01	.378974E-02

TABLE 6.6 (CONTINUED)

	JY	JFY	JR	JFR	JP	JFP	JFE
2	0.	0.	0.	0.	0.	0.	0.
3	-.582772E-03	-.995371E-03	-.380882E-02	.353854E-02	.636656E-03	.188968E-02	.491238E-04
4	-.602090E-03	-.128941E-02	-.341687E-02	.553410E-02	.989741E-03	.252091E-02	.772832E-04
5	-.740051E-03	-.146158E-02	-.419785E-02	.590786E-02	.992523E-03	.276669E-02	.822982E-04
6	-.723966E-03	-.150672E-02	-.400469E-02	.638146E-02	.109718E-02	.288355E-02	.889957E-04
7	-.812817E-03	-.159698E-02	-.450337E-02	.660752E-02	.116977E-02	.302272E-02	.919372E-04
8	-.807612E-03	-.165701E-02	-.405682E-02	.714429E-02	.118168E-02	.311165E-02	.994422E-04
9	-.866614E-03	-.170079E-02	-.440584E-02	.719721E-02	.133891E-02	.316593E-02	.999267E-04
10	-.798346E-03	-.169349E-02	-.403556E-02	.745993E-02	.141309E-02	.317324E-02	.103890E-03
11	-.809801E-03	-.169775E-02	-.411799E-02	.745648E-02	.137938E-02	.316791E-02	.103774E-03
12	-.812657E-03	-.172653E-02	-.418260E-02	.746758E-02	.121728E-02	.316895E-02	.104022E-03
13	-.821597E-03	-.174357E-02	-.431503E-02	.749924E-02	.138690E-02	.318611E-02	.104416E-03
14	-.822364E-03	-.175980E-02	-.443040E-02	.755433E-02	.138615E-02	.320647E-02	.105188E-03
15	-.803036E-03	-.176103E-02	-.426875E-02	.765891E-02	.128285E-02	.320337E-02	.106780E-03
16	-.791838E-03	-.175926E-02	-.437023E-02	.763343E-02	.127142E-02	.320171E-02	.106579E-03
17	-.799561E-03	-.176834E-02	-.434928E-02	.769256E-02	.136971E-02	.320558E-02	.107345E-03
18	-.776540E-03	-.177499E-02	-.447576E-02	.770417E-02	.134435E-02	.322114E-02	.107746E-03
19	-.762190E-03	-.177351E-02	-.447919E-02	.775137E-02	.131820E-02	.322313E-02	.108514E-03
20	-.772627E-03	-.178958E-02	-.467701E-02	.772646E-02	.131466E-02	.323171E-02	.108233E-03
21	-.729097E-03	-.176748E-02	-.460385E-02	.778863E-02	.137242E-02	.322904E-02	.109447E-03
22	-.701999E-03	-.176292E-02	-.472449E-02	.777026E-02	.138639E-02	.323286E-02	.109501E-03
23	-.665133E-03	-.175880E-02	-.467805E-02	.778174E-02	.139701E-02	.321832E-02	.110115E-03
24	-.654897E-03	-.174562E-02	-.491236E-02	.769763E-02	.129491E-02	.321496E-02	.109144E-03
25	-.675455E-03	-.174333E-02	-.499946E-02	.769759E-02	.136715E-02	.321150E-02	.108826E-03
26	-.719989E-03	-.176851E-02	-.526608E-02	.764456E-02	.131965E-02	.322255E-02	.107904E-03
27	-.732978E-03	-.177080E-02	-.529712E-02	.769960E-02	.123938E-02	.323255E-02	.108406E-03
28	-.759672E-03	-.178598E-02	-.547421E-02	.777857E-02	.142628E-02	.326743E-02	.109343E-03
29	-.784689E-03	-.182786E-02	-.539702E-02	.807492E-02	.139637E-02	.333280E-02	.113237E-03
30	-.809425E-03	-.188982E-02	-.555015E-02	.823931E-02	.140433E-02	.339198E-02	.115502E-03
31	-.755114E-03	-.189585E-02	-.546189E-02	.851682E-02	.148664E-02	.345199E-02	.119843E-03
32	-.756023E-03	-.194431E-02	-.548833E-02	.869118E-02	.146036E-02	.348830E-02	.122546E-03
33	-.734240E-03	-.196846E-02	-.539990E-02	.882576E-02	.157595E-02	.350351E-02	.124751E-03
34	-.758912E-03	-.200493E-02	-.557353E-02	.883405E-02	.152228E-02	.351590E-02	.124802E-03
35	-.809739E-03	-.207336E-02	-.586258E-02	.884484E-02	.153774E-02	.354332E-02	.124724E-03
36	-.821638E-03	-.209354E-02	-.598844E-02	.891179E-02	.145301E-02	.356874E-02	.125470E-03
37	-.790944E-03	-.208947E-02	-.578767E-02	.904878E-02	.158995E-02	.356553E-02	.127727E-03
38	-.829920E-03	-.211117E-02	-.581063E-02	.906359E-02	.154824E-02	.355827E-02	.127460E-03
39	-.841022E-03	-.212337E-02	-.574622E-02	.908704E-02	.158695E-02	.354430E-02	.127709E-03
40	-.840475E-03	-.211455E-02	-.568134E-02	.906936E-02	.155442E-02	.351974E-02	.127252E-03
41	-.804176E-03	-.211552E-02	-.579864E-02	.907201E-02	.146418E-02	.352827E-02	.127886E-03
42	-.797087E-03	-.212626E-02	-.571616E-02	.914299E-02	.150932E-02	.352828E-02	.128925E-03

TABLE 6.6 (CONTINUED)

	EY	EFY	ER	EFR	EP	EFP	EFE
2	0.	0.	0.	0.	0.	0.	0.
3	.441114E-01	.472713E-04	-.290042E-01	-.677467E-02	.437347E-02	.167756E-02	.533698E-03
4	.431368E-01	-.585270E-04	-.277396E-01	-.654621E-02	.308319E-02	.154190E-02	.565575E-03
5	.468870E-01	-.560609E-04	-.281036E-01	-.662961E-02	.310422E-02	.155379E-02	.570905E-03
6	.457942E-01	-.740698E-04	-.292966E-01	-.692097E-02	.317225E-02	.160001E-02	.602462E-03
7	.491159E-01	-.100437E-03	-.312230E-01	-.738964E-02	.309797E-02	.168338E-02	.654193E-03
8	.509700E-01	-.104207E-03	-.317657E-01	-.751899E-02	.312263E-02	.170241E-02	.666817E-03
9	.524616E-01	-.102455E-03	-.319742E-01	-.756692E-02	.312203E-02	.170382E-02	.671802E-03
10	.475933E-01	-.865898E-04	-.318652E-01	-.753178E-02	.317735E-02	.169518E-02	.660861E-03
11	.561730E-01	-.721910E-04	-.314834E-01	-.743314E-02	.330871E-02	.167505E-02	.652867E-03
12	.582808E-01	-.595682E-04	-.313583E-01	-.739547E-02	.325596E-02	.166696E-02	.643718E-03
13	.643652E-01	-.586281E-04	-.317134E-01	-.747815E-02	.341156E-02	.167915E-02	.652797E-03
14	.706347E-01	-.607179E-04	-.320418E-01	-.755663E-02	.327896E-02	.168906E-02	.662916E-03
15	.775795E-01	-.572264E-04	-.320113E-01	-.754732E-02	.344756E-02	.168271E-02	.663864E-03
16	.802747E-01	-.543838E-04	-.322206E-01	-.759478E-02	.330546E-02	.168849E-02	.668858E-03
17	.907954E-01	-.551643E-04	-.324639E-01	-.765241E-02	.331550E-02	.169607E-02	.676563E-03
18	.870133E-01	-.540040E-04	-.325885E-01	-.768114E-02	.330188E-02	.169531E-02	.679091E-03
19	.852364E-01	-.494006E-04	-.326196E-01	-.768557E-02	.343412E-02	.169339E-02	.677480E-03
20	.824544E-01	-.461207E-04	-.327272E-01	-.770875E-02	.351478E-02	.169317E-02	.677516E-03
21	.688251E-01	-.401869E-04	-.326873E-01	-.769598E-02	.336398E-02	.168829E-02	.671695E-03
22	.707583E-01	-.381050E-04	-.327243E-01	-.770353E-02	.343257E-02	.168651E-02	.674099E-03
23	.668353E-01	-.298171E-04	-.323940E-01	-.762062E-02	.349184E-02	.166871E-02	.662531E-03
24	.608967E-01	-.280655E-04	-.324867E-01	-.764141E-02	.351858E-02	.166807E-02	.663095E-03
25	.595177E-01	-.267065E-04	-.325762E-01	-.766155E-02	.351888E-02	.166817E-02	.662959E-03
26	.584971E-01	-.273960E-04	-.327165E-01	-.769493E-02	.351447E-02	.166918E-02	.664827E-03
27	.528438E-01	-.303901E-04	-.330238E-01	-.776909E-02	.334955E-02	.167707E-02	.667874E-03
28	.525057E-01	-.397009E-04	-.337156E-01	-.793790E-02	.346202E-02	.170022E-02	.687177E-03
29	.545270E-01	-.441267E-04	-.345153E-01	-.812846E-02	.342650E-02	.173004E-02	.705170E-03
30	.582328E-01	-.454678E-04	-.349324E-01	-.822703E-02	.350117E-02	.174265E-02	.713993E-03
31	.489751E-01	-.523547E-04	-.356790E-01	-.840731E-02	.353451E-02	.176572E-02	.727731E-03
32	.492640E-01	-.507503E-04	-.359906E-01	-.847925E-02	.340819E-02	.177556E-02	.729892E-03
33	.502113E-01	-.470751E-04	-.360511E-01	-.849080E-02	.340419E-02	.177226E-02	.729415E-03
34	.545778E-01	-.506564E-04	-.364698E-01	-.859120E-02	.352953E-02	.178339E-02	.740478E-03
35	.628937E-01	-.539686E-04	-.370647E-01	-.873256E-02	.348486E-02	.180343E-02	.756498E-03
36	.718261E-01	-.625762E-04	-.375488E-01	-.885190E-02	.349410E-02	.181502E-02	.775141E-03
37	.623811E-01	-.659773E-04	-.378847E-01	-.893314E-02	.355106E-02	.182205E-02	.778586E-03
38	.701104E-01	-.598484E-04	-.376550E-01	-.887479E-02	.348748E-02	.180842E-02	.772853E-03
39	.714832E-01	-.526179E-04	-.375088E-01	-.883546E-02	.348207E-02	.179791E-02	.765186E-03
40	.740748E-01	-.541085E-04	-.375403E-01	-.884369E-02	.355162E-02	.179346E-02	.767465E-03
41	.824096E-01	-.567675E-04	-.379450E-01	-.894056E-02	.353649E-02	.180531E-02	.783841E-03
42	.909832E-01	-.553006E-04	-.380451E-01	-.896314E-02	.361981E-02	.180678E-02	.788633E-03

TABLE 6.6 (CONTINUED)

	UY	UFY	UR	UFP	UP	UFP	UFE
2	0.	0.	0.	0.	0.	0.	0.
3	-.527086E-03	-.100531E-02	-.638662E-02	-.114424E-01	.271898E-02	.143350E-02	.108833E-02
4	-.705616E-03	-.863432E-03	-.977826E-02	-.149051E-01	.347524E-02	.210076E-02	.123222E-02
5	-.734405E-03	-.577164E-03	-.111136E-01	-.152953E-01	.351201E-02	.232383E-02	.111665E-02
6	-.741345E-03	-.385700E-03	-.115884E-01	-.151415E-01	.343552E-02	.237813E-02	.103392E-02
7	-.764191E-03	-.413212E-03	-.118676E-01	-.155712E-01	.351148E-02	.241826E-02	.106809E-02
8	-.796393E-03	-.479776E-03	-.121974E-01	-.161957E-01	.363513E-02	.247404E-02	.112723E-02
9	-.820691E-03	-.496274E-03	-.124727E-01	-.166004E-01	.370799E-02	.251413E-02	.116173E-02
10	-.822985E-03	-.466946E-03	-.126545E-01	-.167289E-01	.371346E-02	.253022E-02	.116267E-02
11	-.822825E-03	-.442734E-03	-.127132E-01	-.167003E-01	.369245E-02	.252538E-02	.114860E-02
12	-.820837E-03	-.446074E-03	-.127322E-01	-.167019E-01	.368036E-02	.251596E-02	.114096E-02
13	-.828907E-03	-.484441E-03	-.127780E-01	-.169035E-01	.371569E-02	.251599E-02	.116855E-02
14	-.831442E-03	-.506935E-03	-.129031E-01	-.171396E-01	.375645E-02	.253023E-02	.119014E-02
15	-.831963E-03	-.472864E-03	-.130258E-01	-.171606E-01	.374791E-02	.253889E-02	.117732E-02
16	-.825903E-03	-.420377E-03	-.131096E-01	-.170730E-01	.371554E-02	.253934E-02	.115430E-02
17	-.829129E-03	-.414992E-03	-.131555E-01	-.170982E-01	.370898E-02	.253807E-02	.114964E-02
18	-.828709E-03	-.419427E-03	-.132230E-01	-.172044E-01	.371766E-02	.254088E-02	.115906E-02
19	-.833330E-03	-.422296E-03	-.132841E-01	-.172968E-01	.372259E-02	.254101E-02	.116770E-02
20	-.834249E-03	-.440582E-03	-.133396E-01	-.174420E-01	.374174E-02	.254314E-02	.118450E-02
21	-.829604E-03	-.429978E-03	-.134056E-01	-.175166E-01	.374718E-02	.254654E-02	.119115E-02
22	-.827059E-03	-.426680E-03	-.134500E-01	-.175885E-01	.374661E-02	.254631E-02	.120151E-02
23	-.818785E-03	-.413529E-03	-.134557E-01	-.175642E-01	.372502E-02	.253773E-02	.119949E-02
24	-.815182E-03	-.398675E-03	-.134741E-01	-.175581E-01	.370593E-02	.253082E-02	.120115E-02
25	-.815416E-03	-.405128E-03	-.134888E-01	-.176071E-01	.369974E-02	.252525E-02	.120753E-02
26	-.822094E-03	-.439405E-03	-.135000E-01	-.177648E-01	.371662E-02	.252238E-02	.123094E-02
27	-.829649E-03	-.469838E-03	-.135634E-01	-.179723E-01	.374328E-02	.252894E-02	.125770E-02
28	-.848787E-03	-.544734E-03	-.136614E-01	-.184206E-01	.381866E-02	.254501E-02	.132174E-02
29	-.881721E-03	-.648827E-03	-.139231E-01	-.191468E-01	.394833E-02	.259191E-02	.140534E-02
30	-.904766E-03	-.745838E-03	-.141929E-01	-.198391E-01	.406963E-02	.263781E-02	.148191E-02
31	-.930730E-03	-.776648E-03	-.145329E-01	-.204490E-01	.417206E-02	.269045E-02	.154985E-02
32	-.951604E-03	-.808215E-03	-.147996E-01	-.208794E-01	.423594E-02	.272827E-02	.158172E-02
33	-.957194E-03	-.801384E-03	-.149940E-01	-.210458E-01	.424590E-02	.274821E-02	.158079E-02
34	-.966864E-03	-.784967E-03	-.151630E-01	-.211403E-01	.424592E-02	.276275E-02	.156982E-02
35	-.973185E-03	-.808415E-03	-.153481E-01	-.213700E-01	.426847E-02	.278232E-02	.157186E-02
36	-.982913E-03	-.823318E-03	-.154955E-01	-.216091E-01	.429935E-02	.279688E-02	.159217E-02
37	-.985048E-03	-.754037E-03	-.157189E-01	-.215960E-01	.427179E-02	.281510E-02	.156156E-02
38	-.986283E-03	-.735203E-03	-.157544E-01	-.214971E-01	.423810E-02	.280728E-02	.153113E-02
39	-.983642E-03	-.701440E-03	-.157722E-01	-.213476E-01	.419764E-02	.279709E-02	.149919E-02
40	-.967133E-03	-.610033E-03	-.158217E-01	-.210345E-01	.412044E-02	.278667E-02	.143989E-02
41	-.962823E-03	-.594861E-03	-.158141E-01	-.209973E-01	.410429E-02	.277611E-02	.143827E-02
42	-.962328E-03	-.574206E-03	-.158686E-01	-.209737E-01	.409115E-02	.277633E-02	.142391E-02

TABLE 6.7

THE PERCENTAGE CHANGES IN ENDOGENOUS VARIABLES DUE TO A TEMPORARY INCREASE OF 10% OF FOREIGN MONEY SUPPLY

	FY	FFY	FR	FFF	FP	FFP	FFE
3	.772485E-01	.153917	.780219E-01	-.642076E-01	0.	0.	-.185593
4	-.278893E-01	-.166162E-01	-.217913	-.155735	.219721E-02	.177706E-01	.140680E-01
5	-.152933E-01	-.230793E-02	-.874982E-01	-.590583E-01	-.769654E-02	.898663E-02	.830850E-02
6	-.786361E-02	-.220730E-02	-.494534E-01	-.340922E-01	-.241521E-02	.466553E-02	.419291E-02
7	-.413545E-02	-.383319E-03	-.250117E-01	-.171386E-01	-.145954E-02	.239597E-02	.221843E-02
8	-.214199E-02	-.541640E-03	-.130785E-01	-.897864E-02	-.662731E-03	.123283E-02	.114167E-02
9	-.105942E-02	-.276662E-03	-.676886E-02	-.464429E-02	-.326799E-03	.634182E-03	.581351E-03
10	-.513805E-03	-.143331E-03	-.351428E-02	-.241166E-02	-.158350E-03	.326791E-03	.298586E-03
11	-.260614E-03	-.744678E-04	-.182280E-02	-.125082E-02	.592165E-04	.168522E-03	.151927E-03
12	-.146106E-03	-.388104E-04	-.945734E-03	-.648982E-03	-.626490E-05	.871106E-04	.808499E-04
13	-.752760E-04	-.200969E-04	-.490637E-03	-.336683E-03	.836964E-04	.450050E-04	.416750E-04
14	-.393977E-04	-.104670E-04	-.254544E-03	-.174673E-03	.195881E-03	.232537E-04	.217843E-04
15	-.206091E-04	-.540380E-05	-.132057E-03	-.906200E-04	.659842E-04	.120083E-04	.112923E-04
16	-.110186E-04	-.278255E-05	-.685120E-04	-.470140E-04	.582590E-04	.620717E-05	.597837E-05
17	-.585570E-05	-.143451E-05	-.355500E-04	-.243910E-04	.207312E-03	.320733E-05	.311324E-05
18	-.298747E-05	-.756108E-06	-.184400E-04	-.126540E-04	.917647E-04	.164978E-05	.159838E-05
19	-.157033E-05	-.388862E-06	-.956700E-05	-.656500E-05	.132949E-03	.864193E-06	.862908E-06
20	-.786184E-06	-.193860E-06	-.496300E-05	-.340600E-05	.194396E-03	.461944E-06	.430623E-06
21	-.416085E-06	-.817065E-07	-.257500E-05	-.176700E-05	.134474E-03	.230222E-06	.223087E-06
22	-.157258E-06	-.540098E-07	-.133500E-05	-.916000E-06	.144557E-03	.125124E-06	.136375E-06
23	-.772338E-07	-.267828E-07	-.693000E-06	-.476000E-06	.185820E-03	.623921E-07	.457532E-07
24	-.733230E-07	-.264417E-07	-.359000E-06	-.247000E-06	.197565E-03	.207257E-07	.227156E-07
25	0.	-.263950E-07	-.186000E-06	-.128000E-06	.114161E-03	.206635E-07	.229219E-07
26	-.736384E-07	0.	-.970000E-07	-.670000E-07	.166065E-03	0.	.228247E-07
27	0.	0.	-.500000E-07	-.350000E-07	.150444E-03	0.	0.
28	0.	0.	-.260000E-07	-.170000E-07	.114951E-03	0.	0.
29	0.	0.	-.100000E-07	-.100000E-07	.241820E-04	0.	0.
30	0.	0.	0.	0.	.176170E-03	0.	0.
31	0.	0.	0.	0.	.177655E-03	0.	0.
32	0.	0.	0.	0.	.484932E-04	0.	0.
33	0.	0.	0.	0.	.428405E-04	0.	0.
34	0.	0.	0.	0.	.136584E-03	0.	0.
35	0.	0.	0.	0.	.909441E-05	0.	0.
36	0.	0.	0.	0.	.480743E-04	0.	0.
37	0.	0.	0.	0.	.563951E-04	0.	0.
38	0.	0.	0.	0.	.737947E-04	0.	0.
39	0.	0.	0.	0.	.157334E-03	0.	0.
40	0.	0.	0.	0.	.784846E-04	0.	0.
41	0.	0.	0.	0.	.322129E-04	0.	0.
42	0.	0.	0.	0.	.172452E-03	0.	0.

TABLE 6.7 (CONTINUED)

	GY	GFY	GR	GFF	GP	GFP	GFE
2	.556615E-01	.134987	.328320E-01	.748804E-01	0.	0.	.637033E-02
3	.429153E-01	.657173E-02	.496997E-01	.436208E-01	-.426834E-02	-.213402E-02	.491049E-03
4	-.992696E-02	-.551353E-04	-.167674E-01	-.142914E-01	.107460E-02	-.201555E-02	-.941817E-03
5	.117625E-01	.217044E-02	.112200E-01	.997855E-02	-.106868E-02	-.131234E-02	-.128013E-03
6	.915553E-04	.645578E-03	-.207289E-02	-.163893E-02	.238411E-04	-.105823E-02	-.349081E-03
7	.368563E-02	.910366E-03	.306013E-02	.278450E-02	-.340585E-03	-.750253E-03	-.149912E-03
8	.121458E-02	.497200E-03	.258731E-03	.316920E-03	-.962637E-04	-.572480E-03	-.161419E-03
9	.164716E-02	.458565E-03	.108828E-02	.101535E-02	-.139822E-03	-.418075E-03	-.988604E-04
10	.871409E-03	.303089E-03	.420274E-03	.417003E-03	-.744126E-04	-.313487E-03	-.834591E-04
11	.796652E-03	.243118E-03	.488075E-03	.463027E-03	-.687773E-04	-.231810E-03	-.582660E-04
12	.552359E-03	.175290E-03	.283765E-03	.279977E-03	-.456868E-04	-.173119E-03	-.454236E-04
13	.439530E-03	.134428E-03	.249761E-03	.238800E-03	-.366331E-04	-.128684E-03	-.331105E-04
14	.311683E-03	.992212E-04	.172060E-03	.165789E-03	-.262146E-04	-.959582E-04	-.249702E-04
15	.236590E-03	.746725E-04	.135287E-03	.129743E-03	-.200820E-04	-.714181E-04	-.184957E-04
16	.167488E-03	.553211E-04	.983560E-04	.945830E-04	-.148041E-04	-.532222E-04	-.138435E-04
17	.125186E-03	.415695E-04	.748680E-04	.718790E-04	-.111620E-04	-.396341E-04	-.102943E-04
18	.917345E-04	.308115E-04	.554640E-04	.533010E-04	-.828532E-05	-.295603E-04	-.770966E-05
19	.683722E-04	.230236E-04	.417500E-04	.400990E-04	-.620693E-05	-.220082E-04	-.574166E-05
20	.492938E-04	.171181E-04	.311330E-04	.299120E-04	-.462221E-05	-.164215E-04	-.430402E-05
21	.356538E-04	.126426E-04	.233440E-04	.224240E-04	-.345295E-05	-.122164E-04	-.319062E-05
22	.257542E-04	.935848E-05	.174470E-04	.167620E-04	-.257590E-05	-.909967E-05	-.240751E-05
23	.191270E-04	.695307E-05	.130650E-04	.125510E-04	-.193462E-05	-.679442E-05	-.179305E-05
24	.136505E-04	.512846E-05	.977300E-05	.938800E-05	-.144246E-05	-.506245E-05	-.132588E-05
25	.101105E-04	.387195E-05	.731500E-05	.702700E-05	-.105721E-05	-.377285E-05	-.985632E-06
26	.743177E-05	.287138E-05	.547200E-05	.526000E-05	-.803285E-06	-.281795E-05	-.754045E-06
27	.561468E-05	.215224E-05	.409600E-05	.393400E-05	-.589636E-06	-.211501E-05	-.564399E-06
28	.404469E-05	.160567E-05	.306400E-05	.294400E-05	-.442055E-06	-.155896E-05	-.396766E-06
29	.297957E-05	.120394E-05	.229300E-05	.220000E-05	-.315392E-06	-.114914E-05	-.313597E-06
30	.236528E-05	.915038E-06	.171600E-05	.165000E-05	-.230486E-06	-.862743E-06	-.230254E-06
31	.169972E-05	.665616E-06	.128400E-05	.124000E-05	-.187743E-06	-.638852E-06	-.188374E-06
32	.133435E-05	.508387E-06	.961000E-06	.923000E-06	-.145534E-06	-.476665E-06	-.146839E-06
33	.985801E-06	.373804E-06	.720000E-06	.690000E-06	-.103914E-06	-.355862E-06	-.105135E-06
34	.798803E-06	.268833E-06	.540000E-06	.510000E-06	-.621699E-07	-.275511E-06	-.631302E-07
35	.603957E-06	.217718E-06	.400000E-06	.380000E-06	-.620490E-07	-.195869E-06	-.630059E-07
36	.487255E-06	.163765E-06	.301000E-06	.290000E-06	-.412035E-07	-.155978E-06	-.209687E-07
37	.302307E-06	.135850E-06	.226000E-06	.220000E-06	-.205785E-07	-.970305E-07	-.418929E-07
38	.247681E-06	.822300E-07	.169000E-06	.170000E-06	-.205427E-07	-.772991E-07	-.209055E-07
39	.189447E-06	.827953E-07	.127000E-06	.120000E-06	0.	-.770023E-07	-.208608E-07
40	.126473E-06	.552021E-07	.940000E-07	.900000E-07	-.204676E-07	-.575309E-07	-.208425E-07
41	.622532E-07	.274414E-07	.710000E-07	.700000E-07	0.	-.382058E-07	-.207846E-07
42	.124852E-06	.275214E-07	.530000E-07	.500000E-07	0.	-.190288E-07	-.207265E-07

TABLE 6.7 (CONTINUED)

	JY	JFY	JR	JFR	JP	JFP	JFE
2	-.156194	.963942E-01	-.508675	-.108929	0.	0.	-.110960E-01
3	.645365E-01	.219343E-01	.610810	.250798	-.356311E-01	-.127159E-01	-.363943E-02
4	-.278088E-01	-.796646E-02	-.268345	-.120084	.175601E-01	.206386E-02	.173875E-02
5	.131211E-01	.421450E-02	.120047	.503210E-01	-.706633E-02	-.211204E-02	-.729036E-03
6	-.567370E-02	-.164616E-02	-.529640E-01	-.233476E-01	.337914E-02	.526016E-03	.337718E-03
7	.260599E-02	.800082E-03	.236169E-01	.100189E-01	-.133660E-02	-.368751E-03	-.144861E-03
8	-.119380E-02	-.334675E-03	-.104456E-01	-.456389E-02	.661376E-03	.116216E-03	.658533E-04
9	.540041E-03	.156439E-03	.464889E-02	.198597E-02	-.219829E-03	-.668564E-04	-.286279E-04
10	-.230166E-03	-.661861E-04	-.205918E-02	-.894990E-03	0.	.242110E-04	.129238E-04
11	.102677E-03	.302583E-04	.915426E-03	.392657E-03	-.218007E-03	-.124520E-04	-.566511E-05
12	-.450822E-04	-.132525E-04	-.405825E-03	-.175843E-03	.217675E-03	.490439E-05	.254242E-05
13	.198086E-04	.598084E-05	.180300E-03	.775190E-04	0.	-.236591E-05	-.110804E-05
14	-.866452E-05	-.262107E-05	-.799600E-04	-.345880E-04	0.	.984412E-06	.499756E-06
15	.383597E-05	.118134E-05	.355130E-04	.152900E-04	0.	-.468955E-06	-.217475E-06
16	-.163133E-05	-.516216E-06	-.157560E-04	-.680800E-05	0.	.191307E-06	.108910E-06
17	.706326E-06	.229591E-06	.699600E-05	.301500E-05	0.	-.846967E-07	-.435300E-07
18	-.336383E-06	-.856766E-07	-.310500E-05	-.134000E-05	0.	.422459E-07	.218243E-07
19	.164667E-06	.284011E-07	.137800E-05	.594000E-06	0.	-.210314E-07	0.
20	-.541131E-07	-.283934E-07	-.612000E-06	-.264000E-06	0.	0.	0.
21	.514717E-07	0.	.272000E-06	.117000E-06	0.	-.208671E-07	0.
22	-.487432E-07	0.	-.120000E-06	-.520000E-07	0.	0.	0.
23	0.	.277593E-07	.530000E-07	.230000E-07	0.	0.	0.
24	0.	0.	-.230000E-07	-.100000E-07	0.	0.	0.
25	0.	0.	.100000E-07	.400000E-08	0.	0.	0.
26	0.	0.	-.460000E-08	-.200000E-08	0.	0.	0.
27	0.	0.	.200000E-08	0.	0.	0.	0.
28	0.	0.	-.100000E-08	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.

TABLE 6.7 (CONTINUED)

	EY	EFY	ER	EFP	EP	FFP	EFE
2	-.145447	.168879	-.213078	.124505	0.	0.	-.278046E-01
3	.941385E-01	.218410E-02	-.237019E-01	-.415195E-02	-.229454E-01	.252970E-02	-.650944E-03
4	.119798E-02	-.117165E-03	-.288873E-02	-.753362E-03	.699464E-03	.100845E-03	.115443E-03
5	-.928228E-03	-.734766E-05	.403240E-03	.899300E-04	.231642E-03	-.265943E-04	-.410359E-05
6	.594148E-04	.145895E-05	-.977000E-05	-.136000E-05	0.	.129895E-05	-.557716E-06
7	.199596E-05	-.562356E-07	-.226500E-05	-.569000E-06	0.	.890173E-07	.644907E-07
8	-.624033E-06	-.282786E-07	.250000E-06	.540000E-07	0.	-.221307E-07	0.
9	.390147E-07	0.	0.	0.	0.	0.	0.
10	.117349E-07	0.	-.200000E-08	-.100000E-08	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.

	UY	UFY	UR	UFR	UP	UFP	UFE
2	.183798	.175811	.127647	.121329	0.	0.	-.365375E-01
3	-.801235E-03	.730422E-02	-.323400E-01	-.969434E-02	.143602E-02	.577114E-02	-.254414E-02
4	.333306E-03	.489835E-02	-.694350E-02	.109741E-01	-.301177E-02	.831225E-03	-.273112E-02
5	.395976E-03	.220591E-02	.125273E-02	.985920E-02	-.245210E-02	-.509765E-03	-.147621E-02
6	.225140E-03	.614744E-03	.226190E-02	.502521E-02	-.119031E-02	-.526697E-03	-.546542E-03
7	.860336E-04	.212485E-04	.139917E-02	.173080E-02	-.397810E-03	-.281967E-03	-.108459E-03
8	.185873E-04	-.105722E-03	.575985E-03	.278868E-03	-.511573E-04	-.102361E-03	.274257E-04
9	-.331890E-05	-.802429E-04	.145985E-03	-.134410E-03	.377070E-04	-.137107E-04	.410661E-04
10	-.600986E-05	-.373224E-04	-.609800E-05	-.151934E-03	.371062E-04	.544063E-05	.245437E-04
11	-.373861E-05	-.117546E-04	-.328530E-04	-.841980E-04	.195799E-04	.771563E-05	.980255E-05
12	-.153510E-05	-.127394E-05	-.226770E-04	-.315810E-04	.700439E-05	.454155E-05	.231969E-05
13	-.401868E-06	.140304E-05	-.100770E-04	-.654800E-05	.127519E-05	.178569E-05	-.195124E-06
14	.361701E-07	.123770E-05	-.290500E-05	.139200E-05	-.409258E-06	.406776E-06	-.636255E-06
15	.721752E-07	.649360E-06	-.148000E-06	.228600E-05	-.558568E-06	-.426282E-07	-.389695E-06
16	.718458E-07	.193129E-06	.459000E-06	.139000E-05	-.321502E-06	-.106144E-06	-.173446E-06
17	0.	.647111E-07	.361000E-06	.564000E-06	-.128212E-06	-.634565E-07	-.648745E-07
18	0.	0.	.174000E-06	.139000E-06	-.212840E-07	-.421264E-07	0.
19	0.	-.319776E-07	.560000E-07	-.900000E-08	.211966E-07	0.	0.
20	0.	0.	.700000E-08	-.340000E-07	0.	0.	.216521E-07
21	0.	0.	-.600000E-08	-.230000E-07	0.	0.	0.
22	0.	0.	-.500000E-08	-.100000E-07	0.	0.	0.
23	0.	0.	-.300000E-08	-.300000E-08	0.	0.	0.
24	0.	0.	-.100000E-08	0.	0.	0.	0.
25	0.	0.	-.100000E-08	0.	0.	0.	0.
26	0.	0.	0.	.100000E-08	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.

TABLE 6.8

THE PERCENTAGE CHANGES IN ENDOGENOUS VARIABLES DUE TO A TEMPORARY INCREASE OF 10% OF DOMESTIC GOVERNMENT EXPENDITURES

	FY	FFY	FR	FFR	FP	FFP	FFE
3	-.464780E-01	.669363E-02	.232534E-02	.186165E-01	0.	0.	-.151101E-01
4	-.110206E-02	.171032E-03	-.577984E-02	-.364657E-02	-.106069E-02	.735732E-03	.726503E-03
5	-.672073E-03	-.240823E-03	-.431647E-02	-.301281E-02	-.761754E-04	.389351E-03	.336406E-03
6	-.334481E-03	-.721430E-04	-.203005E-02	-.138499E-02	.523767E-04	.199349E-03	.182306E-03
7	-.177722E-03	-.457345E-04	-.108645E-02	-.746818E-03	.443723E-04	.102800E-03	.543854E-04
8	-.917155E-04	-.226370E-04	-.558370E-03	-.382957E-03	.759618E-04	.528255E-04	.490363E-04
9	-.454138E-04	-.119621E-04	-.290520E-03	-.199392E-03	.594260E-04	.271852E-04	.248999E-04
10	-.220697E-04	-.612865E-05	-.150590E-03	-.103332E-03	.399386E-04	.140029E-04	.127931E-04
11	-.111838E-04	-.320079E-05	-.781460E-04	-.536260E-04	.161371E-03	.724194E-05	.652093E-05
12	-.629692E-05	-.165030E-05	-.405390E-04	-.278190E-04	.464990E-04	.372712E-05	.346562E-05
13	-.321042E-05	-.852769E-06	-.210320E-04	-.144330E-04	.110934E-03	.194173E-05	.178638E-05
14	-.170553E-05	-.425355E-06	-.109110E-04	-.748700E-05	.209933E-03	.101010E-05	.944277E-06
15	-.862306E-06	-.254629E-06	-.566100E-05	-.388500E-05	.732352E-04	.513724E-06	.482348E-06
16	-.444297E-06	-.112426E-06	-.293700E-05	-.201500E-05	.620170E-04	.255966E-06	.268691E-06
17	-.270263E-06	-.562553E-07	-.153000E-05	-.104600E-05	.209235E-03	.148684E-06	.135358E-06
18	-.175733E-06	-.280040E-07	-.790000E-06	-.543000E-06	.927731E-04	.634531E-07	.675371E-07
19	-.872406E-07	-.277758E-07	-.410000E-06	-.281000E-06	.133473E-03	.421557E-07	.454162E-07
20	0.	0.	-.212000E-06	-.146000E-06	.194667E-03	.209974E-07	.226644E-07
21	0.	0.	-.111000E-06	-.760000E-07	.134599E-03	0.	.229037E-07
22	0.	0.	-.570000E-07	-.390000E-07	.144619E-03	0.	.227292E-07
23	0.	0.	-.290000E-07	-.200000E-07	.185861E-03	0.	0.
24	0.	0.	-.150000E-07	-.110000E-07	.197585E-03	0.	0.
25	0.	0.	-.900000E-08	-.600000E-08	.114181E-03	0.	0.
26	0.	0.	-.400000E-08	-.300000E-08	.166086E-03	0.	0.
27	0.	0.	-.200000E-08	-.200000E-08	.150444E-03	0.	0.
28	0.	0.	-.100000E-08	0.	.114951E-03	0.	0.
29	0.	0.	0.	0.	.241820E-04	0.	0.
30	0.	0.	0.	0.	.176170E-03	0.	0.
31	0.	0.	0.	0.	.177655E-03	0.	0.
32	0.	0.	0.	0.	.484932E-04	0.	0.
33	0.	0.	0.	0.	.428405E-04	0.	0.
34	0.	0.	0.	0.	.136584E-03	0.	0.
35	0.	0.	0.	0.	.909441E-05	0.	0.
36	0.	0.	0.	0.	.480743E-04	0.	0.
37	0.	0.	0.	0.	.563951E-04	0.	0.
38	0.	0.	0.	0.	.737947E-04	0.	0.
39	0.	0.	0.	0.	.157334E-03	0.	0.
40	0.	0.	0.	0.	.784846E-04	0.	0.
41	0.	0.	0.	0.	.322129E-04	0.	0.
42	0.	0.	0.	0.	.172452E-03	0.	0.

TABLE 6.8 (CONTINUED)

	GY	GFY	GR	GFR	GP	GFP	GFE
2	.744536E-04	.566662E-04	-.151567E-03	.358380E-04	0.	0.	.521341E-04
3	.406034E-03	.371412E-04	.556951E-03	.481648E-03	-.416899E-04	.224803E-04	.186045E-04
4	-.239064E-03	-.365218E-04	-.281860E-03	-.247253E-03	.240335E-04	.112019E-04	-.302478E-05
5	.631227E-04	.970590E-06	.968130E-04	.826450E-04	-.630031E-05	.107507E-04	.519971E-05
6	-.611264E-04	-.117397E-04	-.631100E-04	-.560500E-04	.593796E-05	.693690E-05	.608003E-06
7	.678941E-06	-.332168E-05	.124900E-04	.998000E-05	-.243560E-06	.560761E-05	.191525E-05
8	-.210229E-04	-.498002E-05	-.169550E-04	-.154100E-04	.184489E-05	.396010E-05	.783166E-06
9	-.625459E-05	-.262169E-05	-.110400E-05	-.145000E-05	.500996E-06	.302314E-05	.846445E-06
10	-.851651E-05	-.242449E-05	-.592900E-05	-.552300E-05	.761532E-06	.221197E-05	.520535E-06
11	-.468012E-05	-.162707E-05	-.218900E-05	-.217800E-05	.390657E-06	.167600E-05	.433850E-06
12	-.440240E-05	-.131668E-05	-.262800E-05	-.249100E-05	.369318E-06	.123409E-05	.303547E-06
13	-.290169E-05	-.916622E-06	-.153000E-05	-.148400E-05	.238158E-06	.926558E-06	.259860E-06
14	-.236809E-05	-.745162E-06	-.133800E-05	-.127800E-05	.194342E-06	.686335E-06	.172060E-06
15	-.165785E-05	-.514392E-06	-.916000E-06	-.883000E-06	.150993E-06	.512417E-06	.128740E-06
16	-.119161E-05	-.398198E-06	-.723000E-06	-.693000E-06	.107744E-06	.382588E-06	.853221E-07
17	-.919034E-06	-.313195E-06	-.524000E-06	-.505000E-06	.645203E-07	.296250E-06	.852530E-07
18	-.710619E-06	-.197690E-06	-.400000E-06	-.384000E-06	.643936E-07	.210693E-06	.638939E-07
19	-.513594E-06	-.169084E-06	-.296000E-06	-.284000E-06	.428064E-07	.167842E-06	.425308E-07
20	-.371561E-06	-.112066E-06	-.222000E-06	-.214000E-06	.427983E-07	.104462E-06	.212021E-07
21	-.299109E-06	-.110657E-06	-.166000E-06	-.160000E-06	.213145E-07	.832465E-07	.211299E-07
22	-.173235E-06	-.820919E-07	-.125000E-06	-.120000E-06	.212884E-07	.621845E-07	.211185E-07
23	-.171800E-06	-.543208E-07	-.930000E-07	-.900000E-07	0.	.413034E-07	0.
24	-.109204E-06	-.537012E-07	-.700000E-07	-.670000E-07	0.	.411582E-07	.210457E-07
25	-.540671E-07	-.268885E-07	-.520000E-07	-.500000E-07	.211443E-07	.410092E-07	0.
26	-.530841E-07	-.268353E-07	-.390000E-07	-.300000E-07	0.	.204199E-07	0.
27	-.534732E-07	-.269030E-07	-.290000E-07	-.280000E-07	0.	0.	0.
28	-.518550E-07	-.267611E-07	-.220000E-07	-.210000E-07	0.	0.	.208824E-07
29	-.513719E-07	0.	-.170000E-07	-.200000E-07	.210261E-07	.201603E-07	0.
30	0.	0.	-.130000E-07	-.100000E-07	.209533E-07	0.	.209322E-07
31	0.	0.	-.900000E-08	-.100000E-07	0.	0.	0.
32	0.	0.	-.700000E-08	-.700000E-08	0.	0.	0.
33	0.	0.	-.100000E-07	-.100000E-07	0.	0.	0.
34	0.	0.	0.	-.100000E-07	0.	0.	0.
35	0.	0.	0.	-.100000E-07	0.	0.	0.
36	0.	0.	-.200000E-08	0.	0.	0.	0.
37	0.	0.	-.100000E-08	0.	0.	0.	0.
38	0.	0.	-.100000E-08	0.	0.	0.	0.
39	0.	0.	-.100000E-08	0.	0.	0.	0.
40	0.	0.	-.100000E-08	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.

TABLE 6.8 (CONTINUED)

	JY	JFY	JR	JFR	JP	JFP	JFE
2	-.363599E-02	.189316E-02	-.506290E-02	-.846131E-03	0.	0.	-.616678E-03
3	-.982926E-03	.132208E-03	-.103017E-01	-.721402E-02	.130482E-02	-.844354E-03	.103369E-03
4	.572290E-03	.325961E-03	.517546E-02	.129140E-02	.122458E-05	-.401682E-03	-.191191E-04
5	-.216038E-03	-.142424E-04	-.209224E-02	-.122250E-02	.398587E-03	-.845178E-04	.1757[illegible]0E-04
6	.111195E-03	.510647E-04	.998290E-03	.321952E-03	.136022E-03	-.511473E-04	-.470232E-05
7	-.447985E-04	-.741771E-05	-.419440E-03	-.217891E-03	.172867E-03	-.730950E-05	.312978E-05
8	.227244E-04	.856139E-05	.194211E-03	.712260E-04	.195635E-03	-.685443E-05	-.102048E-05
9	-.950617E-05	-.202155E-05	-.834700E-04	-.402760E-04	.658386E-04	-.373499E-06	.585127E-06
10	.430392E-05	.149055E-05	.379770E-04	.149330E-04	.142514E-04	-.981529E-06	-.217207E-06
11	-.181122E-05	-.457593E-06	-.165400E-04	-.762900E-05	.504033E-04	.433868E-07	.108527E-06
12	.868157E-06	.289356E-06	.744800E-05	.304600E-05	.212125E-03	-.151237E-06	-.434601E-07
13	-.367962E-06	-.115572E-06	-.327000E-05	-.146700E-05	.504894E-04	.215083E-07	.217262E-07
14	.180514E-06	.576059E-07	.147000E-05	.612000E-06	.580967E-04	-.214003E-07	0.
15	-.599370E-07	0.	-.645000E-06	-.285000E-06	.164961E-03	0.	0.
16	.582620E-07	0.	.288000E-06	.122000E-06	.169102E-03	0.	0.
17	-.588605E-07	0.	-.127000E-06	-.550000E-07	.762922E-04	0.	0.
18	0.	0.	.560000E-07	.250000E-07	.103625E-03	0.	0.
19	0.	0.	-.260000E-07	-.110000E-07	.133886E-03	0.	0.
20	0.	0.	.110000E-07	.500000E-08	.132147E-03	0.	0.
21	0.	0.	-.500000E-08	-.300000E-08	.790285E-04	0.	0.
22	0.	0.	.300000E-08	.100000E-08	.625738E-04	0.	0.
23	0.	0.	-.100000E-08	0.	.491269E-04	0.	0.
24	0.	0.	.100000E-08	0.	.140379E-03	0.	0.
25	0.	0.	0.	-.100000E-08	.643411E-04	0.	0.
26	0.	0.	.100000E-09	0.	.999166E-04	0.	0.
27	0.	0.	0.	0.	.194753E-03	0.	0.
28	0.	0.	0.	0.	.206128E-04	0.	0.
29	0.	0.	0.	0.	.100959E-03	0.	0.
30	0.	0.	0.	0.	.122683E-03	0.	0.
31	0.	0.	0.	0.	.856994E-04	0.	0.
32	0.	0.	0.	0.	.132602E-03	0.	0.
33	0.	0.	0.	0.	.368051E-04	0.	0.
34	0.	0.	0.	0.	.924489E-04	0.	0.
35	0.	0.	0.	0.	.845027E-04	0.	0.
36	0.	0.	0.	0.	.186066E-03	0.	0.
37	0.	0.	0.	0.	.597039E-04	0.	0.
38	0.	0.	0.	0.	.105369E-03	0.	0.
39	0.	0.	0.	0.	.674337E-04	0.	0.
40	0.	0.	0.	0.	.974496E-04	0.	0.
41	0.	0.	0.	0.	.184201E-03	0.	0.
42	0.	0.	0.	0.	.152001E-03	0.	0.

TABLE 6.8 (CONTINUED)

	EY	EFY	ER	EFR	EP	EFP	EFE
2	-.270940E-01	-.547889E-03	-.122843E-01	-.588544E-03	0.	0.	-.109569E-02
3	.128425E-02	.555971E-03	.932428E-02	.254643E-02	-.374620E-02	-.230794E-03	-.465979E-03
4	.327002E-02	.201559E-04	-.165190E-02	-.374576E-03	-.466309E-03	.104546E-03	.216455E-04
5	-.244259E-03	-.580521E-05	.588800E-04	.101060E-04	.231642E-03	-.638354E-05	.178193E-05
6	-.386637E-05	.280567E-06	.781000E-05	.202300E-05	0.	-.291144E-06	-.321759E-06
7	.237020E-05	.281178E-07	-.105100E-05	-.234000E-06	0.	.667630E-07	0.
8	-.152824E-06	-.292786E-07	.200000E-07	.300000E-09	0.	0.	0.
9	0.	0.	.100000E-07	.100000E-08	0.	0.	0.
10	.117349E-07	0.	-.100000E-08	-.100000E-08	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.

	UY	UFY	UR	UFR	UP	UFP	UFE
2	.593413E-02	-.116280E-02	-.138245E-01	-.343246E-01	0.	0.	-.182867E-02
3	.851235E-03	.178407E-02	.990313E-02	.186196E-01	-.444019E-02	-.224981E-02	-.183396E-02
4	.289373E-03	-.191694E-03	.541519E-02	.563420E-02	-.125860E-02	-.108312E-02	-.244115E-03
5	.442778E-04	-.499155E-03	.200553E-02	.467534E-03	-.542773E-04	-.349516E-03	.179043E-03
6	-.240857E-04	-.321094E-03	.402509E-03	-.757355E-03	.202942E-03	-.438521E-04	.177829E-03
7	-.262809E-04	-.137435E-03	-.980890E-04	-.641182E-03	.156877E-03	.353462E-04	.940746E-04
8	-.144812E-04	-.374774E-04	-.149622E-03	-.318306E-03	.742763E-04	.339283E-04	.336796E-04
9	-.538400E-05	-.226950E-06	-.895890E-04	-.106380E-03	.234626E-04	.176648E-04	.620235E-05
10	-.106272E-05	.699795E-05	-.359470E-04	-.153040E-04	.264109E-05	.624908E-05	-.207253E-05
11	.256571E-06	.512461E-05	-.867000E-05	.959500E-05	-.261066E-05	.110844E-05	-.272293E-05
12	.402049E-06	.241722E-05	.702000E-06	.995000E-05	-.240708E-05	-.389276E-06	-.156091E-05
13	.255734E-06	.717836E-06	.219700E-05	.535900E-05	-.125358E-05	-.494830E-06	-.607053E-06
14	.108510E-06	.325710E-07	.145900E-05	.195600E-05	-.430798E-06	-.299730E-06	-.151564E-06
15	.360876E-07	-.974040E-07	.632000E-06	.377000E-06	-.644502E-07	-.106570E-06	.216492E-07
16	0.	-.965643E-07	.175000E-06	-.106000E-06	.214335E-07	-.212287E-07	.433614E-07
17	0.	-.323555E-07	.400000E-08	-.151000E-06	.213687E-07	.211522E-07	.216249E-07
18	0.	0.	-.310000E-07	-.890000E-07	.212840E-07	0.	.216331E-07
19	0.	0.	-.230000E-07	-.350000E-07	.211966E-07	.209644E-07	0.
20	0.	0.	-.110000E-07	-.800000E-08	0.	0.	0.
21	0.	0.	-.300000E-08	.100000E-08	0.	0.	0.
22	0.	0.	0.	.300000E-08	0.	0.	0.
23	0.	0.	0.	.100000E-09	0.	0.	0.
24	0.	0.	.100000E-08	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.	0.

TABLE 6.9

THE PERCENTAGE CHANGES IN ENDOGENOUS VARIABLES DUE TO A TEMPORARY INCREASE OF 10% OF FOREIGN GOVERNMENT EXPENDITURES

	FY	FFY	FR	FFR	FP	FFP	FFE
3	-.134504E-01	-.165449E-01	-.293556E-01	-.175007E-01	0.	0.	-.304026E-01
4	-.136553E-02	-.390403E-02	.212400E-01	.169371E-01	.461618E-02	-.744731E-03	-.556152E-04
5	-.495806E-03	.445765E-03	.107598E-02	.355261E-03	-.107439E-02	-.312112E-03	-.376524E-03
6	-.236120E-03	-.164299E-03	.213762E-02	.152773E-02	-.174656E-03	-.172436E-03	-.140991E-03
7	-.149033E-03	-.225016E-04	.858120E-03	.579197E-03	-.181942E-03	-.869328E-04	-.827397E-04
8	-.783422E-04	-.218976E-04	.485040E-03	.334383E-03	-.135135E-03	-.449839E-04	-.412902E-04
9	-.385198E-04	-.974583E-05	.245320E-03	.168094E-03	-.917439E-04	-.231096E-04	-.212233E-04
10	-.186867E-04	-.528137E-05	.129270E-03	.880620E-04	-.563090E-04	-.119024E-04	-.109795E-04
11	-.952987E-05	-.271925E-05	.663890E-04	.455510E-04	-.169837E-03	-.613281E-05	-.553745E-05
12	-.536089E-05	-.142267E-05	.344680E-04	.236530E-04	-.508780E-04	-.318539E-05	-.293920E-05
13	-.270351E-05	-.739067E-06	.178780E-04	.122680E-04	-.113177E-03	-.163968E-05	-.150318E-05
14	-.144970E-05	-.396998E-06	.927600E-05	.636600E-05	-.211092E-03	-.838165E-06	-.790558E-06
15	-.776075E-06	-.198045E-06	.481300E-05	.330200E-05	-.733324E-04	-.449508E-06	-.416608E-06
16	-.355437E-06	-.112426E-06	.249600E-05	.171400E-05	-.623142E-04	-.234635E-06	-.223909E-06
17	-.180175E-06	-.562553E-07	.129000E-05	.888000E-06	-.209404E-03	-.106203E-06	-.112795E-06
18	-.878667E-07	-.280040E-07	.672000E-06	.461000E-06	-.928571E-04	-.634531E-07	-.675371E-07
19	0.	0.	.349000E-06	.239000E-06	-.133515E-03	-.210779E-07	-.227061E-07
20	0.	0.	.181000E-06	.124000E-06	-.194687E-03	0.	-.226644E-07
21	0.	0.	.940000E-07	.640000E-07	-.134619E-03	0.	0.
22	0.	0.	.490000E-07	.340000E-07	-.144619E-03	0.	0.
23	0.	0.	.260000E-07	.170000E-07	-.185861E-03	0.	0.
24	0.	0.	.130000E-07	.900000E-08	-.197585E-03	0.	0.
25	0.	0.	.700000E-08	.400000E-08	-.114181E-03	0.	0.
26	0.	0.	.300000E-08	.200000E-08	-.166086E-03	-.205899E-07	0.
27	0.	0.	.200000E-08	.100000E-08	-.150444E-03	0.	0.
28	0.	0.	.100000E-08	.100000E-08	-.114951E-03	0.	0.
29	0.	0.	0.	0.	-.241820E-04	0.	0.
30	0.	0.	0.	0.	-.176170E-03	0.	0.
31	0.	0.	0.	0.	-.177655E-03	0.	0.
32	0.	0.	0.	0.	-.484932E-04	0.	0.
33	0.	0.	0.	0.	-.428405E-04	0.	0.
34	0.	0.	0.	0.	-.136584E-03	0.	0.
35	0.	0.	0.	0.	-.909441E-05	0.	0.
36	0.	0.	0.	0.	-.480743E-04	0.	0.
37	0.	0.	0.	0.	-.563951E-04	0.	0.
38	0.	0.	0.	0.	-.737947E-04	0.	0.
39	0.	0.	0.	0.	-.157374E-03	0.	0.
40	0.	0.	0.	0.	-.784846E-04	0.	0.
41	0.	0.	0.	0.	-.722129E-04	0.	0.
42	0.	0.	0.	0.	-.177452E-03	0.	0.

TABLE 6.9 (CONTINUED)

	GY	GFY	GP	GFR	GP	GFP	GFE
2	.526953E-01	.183552E-01	.419246E-01	-.365992E-01	0.	0.	-.116720E-01
3	-.578893E-01	-.747312E-02	-.718620E-01	-.626733E-01	.583121E-02	.507737E-03	-.143844E-02
4	.214522E-01	.207489E-02	.294659E-01	.255046E-01	-.222022E-02	.103716E-02	.943384E-03
5	-.131908E-01	-.184118E-02	-.146160E-01	-.128067E-01	.122928E-02	.482897E-03	-.183730E-03
6	.331910E-02	.124691E-03	.521307E-02	.446433E-02	-.349201E-03	.485674E-03	.253841E-03
7	-.306854E-02	-.565111E-03	-.321286E-02	-.284699E-02	.293512E-03	.305480E-03	.177378E-04
8	.168041E-03	-.133917E-03	.729286E-03	.595110E-03	-.236322E-04	.250888E-03	.892591E-04
9	-.100685E-02	-.230507E-03	-.834491E-03	-.755197E-03	.879575E-04	.175651E-03	.332284E-04
10	-.243777E-03	-.114236E-03	-.164950E-04	-.363100E-04	.193429E-04	.135062E-03	.395607E-04
11	-.397190E-03	-.110469E-03	-.280132E-03	-.260095E-03	.348336E-04	.984267E-04	.231242E-04
12	-.209895E-03	-.718734E-04	-.916670E-04	-.920300E-04	.170972E-04	.741319E-04	.201642E-04
13	-.198956E-03	-.586638E-04	-.120550E-03	-.114058E-03	.166927E-04	.548393E-04	.138159E-04
14	-.128156E-03	-.418151E-04	-.673220E-04	-.654440E-04	.107104E-04	.410085E-04	.108183E-04
15	-.103132E-03	-.321209E-04	-.604570E-04	-.577390E-04	.877915E-05	.304888E-04	.783159E-05
16	-.705699E-04	-.235221E-04	-.408000E-04	-.393440E-04	.622762E-05	.227427E-04	.592988E-05
17	-.538948E-04	-.177951E-04	-.324860E-04	-.311420E-04	.479601E-05	.169286E-04	.439053E-05
18	-.390194E-04	-.131323E-04	-.234480E-04	-.225540E-04	.352019E-05	.125995E-04	.330118E-05
19	-.293390E-04	-.983507E-05	-.179250E-04	-.172070E-04	.265400E-05	.939914E-05	.246679E-05
20	-.210551E-04	-.728431E-05	-.132460E-04	-.127310E-04	.199012E-05	.699897E-05	.182338E-05
21	-.152546E-04	-.542221E-05	-.998600E-05	-.959100E-05	.147070E-05	.522372E-05	.137345E-05
22	-.109715E-04	-.399514E-05	-.744000E-05	-.714800E-05	.110700E-05	.389690E-05	.103491E-05
23	-.818911E-05	-.296049E-05	-.558200E-05	-.536200E-05	.807863E-06	.289124E-05	.759411E-06
24	-.578783E-05	-.220175E-05	-.417000E-05	-.400700E-05	.615165E-06	.218138E-05	.589279E-06
25	-.432537E-05	-.164020E-05	-.312300E-05	-.300000E-05	.465174E-06	.161986E-05	.419418E-06
26	-.318504E-05	-.123442E-05	-.233600E-05	-.224000E-05	.338225E-06	.120478E-05	.314185E-06
27	-.240629E-05	-.941603E-06	-.174800E-05	-.168000E-05	.252701E-06	.894812E-06	.229940E-06
28	-.176307E-05	-.635789E-06	-.130900E-05	-.125700E-05	.189452E-06	.668128E-06	.187942E-06
29	-.128430E-05	-.508331E-06	-.980000E-06	-.940000E-06	.147183E-06	.504008E-06	.125439E-06
30	-.967614E-06	-.376780E-06	-.733000E-06	-.700000E-06	.125720E-06	.361148E-06	.104661E-06
31	-.721092E-06	-.292871E-06	-.548000E-06	-.520000E-06	.834414E-07	.279498E-06	.627912E-07
32	-.533740E-06	-.214058E-06	-.410000E-06	-.394000E-06	.623715E-07	.198611E-06	.419683E-07
33	-.438134E-06	-.160202E-06	-.310000E-06	-.300000E-06	.415656E-07	.138391E-06	.420541E-07
34	-.342344E-06	-.134416E-06	-.230000E-06	-.220000E-06	.414466E-07	.118076E-06	.420868E-07
35	-.241583E-06	-.816442E-07	-.170000E-06	-.170000E-06	.206830E-07	.783476E-07	.210020E-07
36	-.182720E-06	-.545882E-07	-.129000E-06	-.130000E-06	.206017E-07	.584918E-07	.209687E-07
37	-.181394E-06	-.271700E-07	-.960000E-07	-.900000E-07	.205785E-07	.582183E-07	0.
38	-.123841E-06	-.548200E-07	-.720000E-07	-.600000E-07	.205427E-07	.386495E-07	.209055E-07
39	-.631357E-07	-.275984E-07	-.540000E-07	-.500000E-07	.204855E-07	.192506E-07	0.
40	-.632366E-07	0.	-.410000E-07	-.400000E-07	0.	.191770E-07	0.
41	-.622532E-07	-.274414E-07	-.300000E-07	-.300000E-07	.204138E-07	.191029E-07	0.
42	0.	0.	-.230000E-07	-.200000E-07	0.	.190288E-07	0.

TABLE 6.9 (CONTINUED)

	JY	JFY	JR	JFR	JP	JFP	JFE
2	.316441E-01	.325834E-01	.172413	.438257E-01	0.	0.	-.160912E-02
3	-.121315E-01	-.427816E-02	-.114487	-.460166E-01	.662587E-02	.273532E-02	.658184E-03
4	.517797E-02	.142949E-02	.500814E-01	.227519E-01	-.318182E-02	-.264889E-03	-.329298E-03
5	-.246113E-02	-.808833E-03	-.224785E-01	-.930769E-02	.151083E-02	.435799E-03	.134899E-03
6	.105827E-02	.300800E-03	.989240E-02	.440004E-02	-.446429E-03	-.845422E-04	-.636337E-04
7	-.488181E-03	-.151963E-03	-.441963E-02	-.186164E-02	.396748E-03	.736075E-04	.269074E-04
8	.222904E-03	.617809E-04	.195188E-02	.857343E-03	.866182E-04	-.201653E-04	-.123760E-04
9	-.101076E-03	-.295436E-04	-.869690E-03	-.369988E-03	.110464E-03	.130285E-04	.533116E-05
10	.429768E-04	.122684E-04	.384883E-03	.167806E-03	-.663466E-05	-.434054E-05	-.241100E-05
11	-.191739E-04	-.566271E-05	-.171217E-03	-.732640E-04	.592544E-04	.238627E-05	.106357E-05
12	.643353E-05	.248847E-05	.758650E-04	.329330E-04	.208076E-03	-.907420E-06	-.478062E-06
13	-.374094E-05	-.112682E-05	-.337100E-04	-.144760E-04	.522297E-04	.451674E-06	.217262E-06
14	.162463E-05	.489650E-06	.149600E-04	.647300E-05	.573163E-04	-.192602E-06	-.869141E-07
15	-.719244E-06	-.201692E-06	-.664100E-05	-.285700E-05	.165305E-03	.852645E-07	.434950E-07
16	.291310E-06	.860360E-07	.294600E-05	.127300E-05	.168931E-03	-.425126E-07	-.217819E-07
17	-.176582E-06	-.573978E-07	-.130800E-05	-.563000E-06	.763563E-04	.211742E-07	0.
18	.560638E-07	.285589E-07	.580000E-06	.251000E-06	.103603E-03	0.	0.
19	0.	0.	-.258000E-06	-.111000E-06	.133886E-03	0.	.218426E-07
20	0.	0.	.114000E-06	.490000E-07	.132147E-03	0.	0.
21	0.	0.	-.500000E-07	-.220000E-07	.790285E-04	0.	0.
22	0.	0.	.230000E-07	.100000E-07	.625738E-04	0.	0.
23	0.	0.	-.100000E-07	-.400000E-08	.491269E-04	0.	0.
24	0.	0.	.500000E-08	.200000E-08	.140379E-03	0.	0.
25	0.	0.	-.200000E-08	-.100000E-08	.643411E-04	0.	0.
26	0.	0.	.900000E-09	0.	.999166E-04	0.	0.
27	0.	0.	0.	0.	.194753E-03	0.	0.
28	0.	0.	0.	0.	.206128E-04	0.	0.
29	0.	0.	0.	0.	.100959E-03	0.	0.
30	0.	0.	0.	0.	.122683E-03	0.	0.
31	0.	0.	0.	0.	.856994E-04	0.	0.
32	0.	0.	0.	0.	.132602E-03	0.	0.
33	0.	0.	0.	0.	.368051E-04	0.	0.
34	0.	0.	0.	0.	.924489E-04	0.	0.
35	0.	0.	0.	0.	.845027E-04	0.	0.
36	0.	0.	0.	0.	.186066E-03	0.	0.
37	0.	0.	0.	0.	.597039E-04	0.	0.
38	0.	0.	0.	0.	.105369E-03	0.	0.
39	0.	0.	0.	0.	.674337E-04	0.	0.
40	0.	0.	0.	0.	.974496E-04	0.	0.
41	0.	0.	0.	0.	.184201E-03	0.	0.
42	0.	0.	0.	0.	.152001E-03	0.	0.

TABLE 6.9 (CONTINUED)

	EY	EFY	ER	EFP	EP	EFP	EFE
2	.386020E-01	-.221893E-02	.314797E-01	-.764398E-01	0.	0.	-.110644E-01
3	-.507892E-01	.103864E-02	.534366E-01	.132078E-01	-.210723E-02	-.248266E-02	-.155366E-02
4	.130626E-01	.154871E-03	-.523553E-02	-.112847E-02	-.209839E-02	.380263E-03	.222847E-04
5	-.643503E-03	-.201079E-04	.732000E-05	-.111090E-04	.231642E-03	-.110302E-04	.998311E-05
6	-.517799E-04	.392794E-06	.387300E-04	.933700E-05	0.	-.197082E-05	-.943827E-06
7	.878223E-05	.112471E-06	-.307600E-05	-.645000E-06	0.	.222543E-06	0.
8	-.292914E-06	-.282786E-07	-.500000E-07	-.200000E-07	0.	0.	0.
9	-.390147E-07	0.	.300000E-07	.600000E-08	0.	0.	0.
10	.117349E-07	0.	-.200000E-08	-.100000E-08	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.

	UY	UFY	UR	UFR	UP	UFP	UFE
2	-.312439E-01	.850848E-03	-.221540E-01	-.297752E-01	0.	0.	-.564435E-03
3	.315809E-04	-.168981E-02	.486669E-02	-.840186E-03	.371551E-03	-.797586E-03	.766692E-03
4	-.107658E-03	-.929304E-03	.561765E-03	-.297270E-02	.773586E-03	-.337442E-05	.569690E-03
5	-.839042E-04	-.357839E-03	-.539470E-03	-.199583E-02	.487281E-03	.150978E-03	.262266E-03
6	-.404582E-04	-.730008E-04	-.501254E-03	-.871013E-03	.202875E-03	.109394E-03	.807205E-04
7	-.129215E-04	.160336E-04	-.259083E-03	-.244128E-03	.527510E-04	.499084E-04	.737712E-05
8	-.153977E-05	.261851E-04	-.906080E-04	-.775200E-05	-.904463E-06	.150374E-04	-.103145E-04
9	.143819E-05	.156919E-04	-.153750E-04	.419000E-04	-.107985E-04	.125392E-05	-.894444E-05
10	.131924E-05	.629496E-05	.647300E-05	.319470E-04	-.763951E-05	-.198834E-05	-.449422E-05
11	.696408E-06	.156941E-05	.769500E-05	.150480E-04	-.343737E-05	-.167353E-05	-.152484E-05
12	.219299E-06	-.979952E-07	.433000E-05	.471100E-05	-.101921E-05	-.821805E-06	-.238473E-06
13	.365334E-07	-.391547E-06	.164700E-05	.492000E-06	-.864535E-07	-.279686E-06	.130083E-06
14	0.	-.260568E-06	.353000E-06	-.560000E-06	.150779E-06	-.428185E-07	.129912E-06
15	-.360876E-07	-.974040E-07	-.640000E-07	-.503000E-06	.107417E-06	.213141E-07	.649475E-07
16	0.	-.321981E-07	-.116000E-06	-.256000E-06	.643005E-07	.212287E-07	.216807E-07
17	0.	0.	-.720000E-07	-.880000E-07	0.	.211522E-07	0.
18	0.	0.	-.290000E-07	-.140000E-07	0.	0.	0.
19	0.	0.	-.700000E-08	.700000E-08	0.	0.	0.
20	0.	0.	.100000E-08	.800000E-08	0.	0.	0.
21	0.	0.	.200000E-08	.400000E-08	0.	0.	0.
22	0.	0.	.100000E-08	.200000E-08	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.
							0.

CHAPTER 7

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

This chapter draws together the major conclusions of the study and discusses some of the implications of these conclusions for future research. The subjects addressed in the study have been the P.P.P. theory of exchange rates, the development of a particular theoretical model, some empirical considerations, the estimation of the model, and some simulation experiments based on it.

P.P.P. as a theory of exchange rates has been used extensively. Models developed to explain P.P.P. are numerous. An attempt was made to combine the recent literature on effective exchange rates with the P.P.P. computations, since effective exchange rates, though not determined by market forces, were more realistic for our purposes than actual bilateral rates. P.P.P. was derived as an *a priori* restriction of the reduced form parameters of a two-country model. Large country models of the asset approach to exchange rate determination have not been used by researchers and there is no other empirical work in this area.

The model is intended to be able to explain the volatility of exchange rates and the proposition that price and money supply differentials are reflected in the exchange rate. The model has been applied to five major OECD countries -- France, Germany, Japan, the UK and the US. The phenomenon of "overshooting" is of particular interest but was not imposed as a necessary feature of the model. The model has the advantage of examining not only the effects of exogenous nominal shocks, but also real shocks, such as an unanticipated increase in government spending. It can also handle shocks to foreign variables (nominal or real), which are equally important in a large country setting.

For each country, the rest of the world was treated as a single aggregate. Aggregation was performed using trade weights. The countries that enter the foreign aggregate were the major trade partners of the domestic country.

The price index used was the implicit GDP deflator, except for the UK and the US, for which the consumer price index was used.

Expected variables were treated with McCallum's instrumental approach. The lag structure and the predetermined variables used to explain the expected variables were determined empirically.

The estimation results were satisfactory. The signs of the coefficients were as expected, except for few variables for which the coefficients were not significantly different from zero. The statistics of the individual equations indicate that the fit of the equations was good. The most significant variable was found to be the money supply. It came out significant for all countries and for most equations. Foreign money supply, government expenditures and energy prices improved the fit of the equations and fitted well into the model.

Overshooting was not found to be the case, except for France. Overshooting was found to occur in France in response to a disturbance in the foreign money supply.

The restrictions implied by P.P.P. were tested by fitting the model with and without them and applying a likelihood-ratio test. On this basis, the restrictions were rejected. Model builders using P.P.P. as a basic relationship in their models should be aware that P.P.P. does not seem to hold during the floating exchange rate period of the 1970s and early 1980s.

Previous models have used the assumption that both domestic and foreign variables have coefficients with the same numerical values but opposite signs. The restrictions implied by this assumption were also tested using a log-likelihood ratio test, and again the restrictions were rejected. Such restrictions have been used in previous studies because of problems of multicollinearity. However, it was still possible in the present study to derive meaningful results, even without the restrictions.

Simulations were carried out with the estimated model. Since the model was not designed for forecasting purposes, the simulations were performed over the estimation period. We were able to show that the model tracked the data quite well for all countries.

Statistics calculated for the historical simulation indicate that the best fits were achieved for the price variables and the worst ones for the interest rate variables. It was argued that interest rates had the poorest fits because there was continuing intervention by the central banks of the major countries. The treatment of interest rates as purely endogenous variables should therefore be questioned. It might be more appropriate to model the behaviour of interest rates as a result of government policies. The results of the historical interest rate simulations imply that if lags were to be built into the interest rate equations, their fit might improve. The maintained hypothesis of interest rate parity should also be questioned. Nevertheless, the statistics for the historical simulation relating to interest rates are satisfactory.

Some simulation experiments were performed to examine the speeds of adjustment and the dynamic patterns of some of the variables. There was no indication of overshooting in any period after an initial shock, except for France. Most variables reacted as expected to various shocks.

There are many possibilities for extending the model. Two-country models are not widespread in the literature of the asset approach to exchange rate determination. Nevertheless, one might extend even further the model to a multicountry world. A three-country model is of particular interest for European countries or countries that participate in custom unions. The countries that participate in a union usually have fixed exchange rates among themselves, but flexible ones with regard to the rest of the world. Thus, a three-country model in which one exchange rate is fixed and another flexible is a promising subject for future research.

Given the recent literature of rational expectations, the treatment of expectations within the model could be developed further. The feasibility of this in empirical work depends, of course, on the facilities available and the computational difficulties. The latter can be formidable when the rational expectation restrictions are imposed. Proxies for the expected variables were constructed in the present study, but an extension of the model to allow for fully endogenous expectations might give a better representation of the economy. Regarding the simulation experiments, one would be better able to distinguish between unanticipated and anticipated shocks. Some policy reaction functions for the exogenous variables would also allow a richer menu of simulation experiments and would add more realism to the model.

An attempt was made in chapter 5 to justify the failure of the P.P.P. theory by the use of the concept of "news". It seems that the role of "news" might be a particularly fruitful extension for exchange rate determination models now that the majority of the profession accepts the proposition that exchange rates are determined in the asset markets.

The predictive performance of the P.P.P. theory was examined by using the notion of real exchange rate. The proportionate deviation of the real exchange rate from unity is the proportionate forecasting error of P.P.P. The fluctuations of the exchange rates were explained with the variation of relative national price indices. It was found that exchange rate changes were not matched by national price movements.

If a relevant yardstick to judge the excessive fluctuations of an exchange rate is the variation of national price levels, then indeed exchange rates may have fluctuated excessively. But this is a narrow interpretation of the P.P.P. theory. The asset market approach suggests that a better yardstick would be the variation of other asset prices(such as stock market indices, which are indeed volatile), rather than commodity prices.

With this interpretation, it seems that intervention in the foreign exchange market which ensures that exchange rates conform to purchasing power parities would be a mistaken course of policy. Government policy can, however, make a positive contribution to reducing costly and unnecessary variation of exchange rates by adopting more stable and predictable patterns of policy.

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