CURRENCY SUBSTITUTION AND TRANSACTIONS COSTS: ISSUES, IMPLICATIONS AND EVIDENCE FOR CANADA.

by

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Abstract

In this thesis we examine currency substitution in Canadian money demand vis à vis the currencies of seven industrialized countries. A variant of the model developed by Bordo and Choudhri (1982a) is estimated to test for the presence and extent of this substitution. The results (except for the British pound) conform to expectations and complementarity between currencies is revealed. The modified model is then enhanced by the introduction of foreign exchange transactions costs. The resulting increased explanatory power indicates that previous tests which have omitted such costs understate the extent of currency substitution. Corroborating our results as well as those of other studies that appear in the literature, we also provide an explanation of why the degree of currency substitution under flexible rates exceeds that under fixed rates. Lastly we question the validity of the Cuddington (1983) type tests for the presence of currency substitution which do not distinguish between exchange rate regimes.

Résumé

Cette thèse examine la substitution monétaire dans la demande de la monaie au Canada vis à vis les devises de sept pays industrialisés. Une variante du modèle Bordo et Choudhri (1982a) est utilisée afin de verifier la présence et le degré de cette substitution. Les résultats (sauf dans le cas de la livre sterling) s'accordent aux attentes et révélent une complémentarité entre les devises. Le modèle modifié est alors amélioré par l'incorporation des côuts de transaction dans les échanges des devises. Le pouvoir augmenté d'explication qui en résulte, indique que les tests précédents qui ont omis ces côuts de transaction sousestiment le degré de la substitution entre les devises. Confirmant nos résultats ainsi que ceux d'autres études la thèse explique aussi les raisons pour lesquelle le degré de substitution entre les devises sous un régime des taux d'échange flexibles dépasse celui d'un régime fixe. Finalement on met en question la validité des tests du type Cuddington (1983) dans la vérification de la présence de la substitution entre les devises car ils ne font pas la distinction entre les régimes de taux d'échange.

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CHAPTER 1

INTRODUCTION

The contemporary revival of the monetary approach to balance of payments (MABP) and to exchange rate theories may be traced to Friedman's contribution to the 'rehabilitation' of the quantity theory of money. Extension of this doctrine to monetary aspects of open economy analysis is credited to the initial works of Meade (1951a,b), Polak (1957) (institutional development at the IMF) and Johnson (1958) (development in the academic circles). Refinement of the theory and further contributions benefitted from the works of Hahn (1959), Mundell (1961,1962,1963,1968), Fleming (1962), Pearce (1961), Kemp (1962), McKinnon and Oates (1966) and McKinnon (1968).

The failure of the Bretton Woods system of adjustable pegs and the transition to the current managed float witnessed the extension of the MABP to an analysis of the exchange rate. Principal contributors to the monetary theory of exchange rate determination include Bilson (1978b,1979), Dornbusch (1976a,b), Frenkel (1976) and Frankel (1979). The approach is best characterized by Mussa's (1976b) observation that the exchange rate is the price of different national monies and as such is determined by the equilibration process in the respective money

markets.

The passive role assigned to nonmoney assets under this theory came under severe criticism in the face of the visibly enhanced role of the market for financial assets as well as the high degree of interaction between it and the money market. Critics argued that it was no longer sufficient to model short run exchange rate behaviour on the basis of money market equilibrium only. The exchange rate, they argued, was determined, just like, and concurrently with, the prices of other commodities, in the equilibration process of the markets for financial assets. The monetary theory thus evolved into a theory of portfolio choice permitting arbitrage between transactions separated by either time or physical space. The principal contributors to this view include Branson (1977, 1979), Girton and Henderson (1977), Henderson (1977,1980), Isard (1978) and Kouri (1976).

These asset market approaches to exchange rate determination however stipulate asymmetrical asset demand functions. While domestic (and foreign) residents are generally permitted to freely hold both domestic and foreign interest bearing securities, money may only be held by the residents of the country that issues it. Such 'country specific' money demand functions imply that Canadians may hold Canadian dollars only, and only Canadians may hold

Canadian dollars. Underlying such an assumption is the premise that currencies yield no monetary services outside the respective national boundaries. Alternatively, the elasticity of substitution between domestic and foreign currencies is assumed to be zero.

It is clear however that the act of acquiring or disposing securities denominated in foreign currencies (for the portfolio balance model) must, as a first step, include conversion into foreign currency cash balances. It is stipulated in such cases that these balances are held momentarily and are instantanously converted to their intended use yielding the predicted effect on the money supply and the exchange rate. It is also predicated, in at least the monetary models, that the demand for money is a stable function of a few variables; short run disequilibrium in the domestic money market and therefore changes in the exchange rate are generally due to divergent behaviour on the supply side (alternatively, monetary policy 'excesses').

Casual observation indicates that this asymmetrical country specific money demand restriction is unrealistic and may noticeably distort the conclusions of these models. The theory of currency substitution (CS) relaxes this country specific money demand assumption of asset market models by permitting transactors to optimize, through substitution, the currency composition of their portfolios. To this

extent it merely extends to the currency markets the alternatives available in other asset markets. Advocates argue that substitution between currencies may be justified on the same grounds as the optimizing process in the other financial asset markets.

In this thesis we examine the issues and policy implications of the theory of currency substitution (CS). To this end we provide a synthesis of the analytical argument underlying the theory as well as a survey of existing empirical tests. The latter part of the thesis summarizes our own empirical findings.

Chapter 2 traces the development of the theory of CS to the early 1970s contribution by Klein (1974), Tullock (1975) and Hayek (1976a,b) to the notion of competitively supplied unregulated private sector currencies. It is shown that the essence of the theory was advocated by Hayek as early as 1960. With reference to the works of Boyer (1978), King et al. (1978) and Miles (1978a,b) we identify the weakness of the country specific money demand assumption of conventional asset market models stressing that transactors experiencing recurrent demand for foreign currencies may exhibit motives for holding balances of such currencies similar to foreign residents. The extent of substitution between currencies is shown to be related to the degree to which they provide similar monetary services. This in turn is traced to the

degree of world goods and capital markets integration.

Supply side CS is distinguished from CS in demand. The former is shown to be related to the nature of the exchange rate regime. The latter to the degree of integration in world goods and capital markets. With considerations now shifted to world demand for domestic money, predicted movements in exchange rates no longer follow monetary policy 'excesses'. CS is shown to cause exchange rate instability such that perfect demand side CS implies indeterminate exchange rates. The case for a reversion to fixed rates is countered by the Girton and Roper (1981) argument that endogenizing the behavioural responses of issuers may well dampen exchange rate volatility.

Chapter 3 presents a summary of existing empirical evidence for the presence and extent of CS. The empirical studies are divided into two groups: (i) those that test directly for the presence and extent of CS; and (ii) those that examine the validity of its implications. The former is divided further into three parts. One deals with the Miles (1978a,b, 1981) type models which estimate the elasticity of substitution by maximizing a CES function for the production of money services subject to holding costs. Variants and criticisms of this type of models are also presented.

The second category of direct tests reports on the Bordo and Choudhri (1982a) type models which test for the presence of cross elasticity between currencies using the money demand function as the 'tool of analysis'. Variants of this type of model include a five country study by Batten and Hafer (1984), incorporation of the effects of postal strikes by Daniel and Fried (1983), Winder's (1983) study using an alternative measure of 'foreign influences' and Cuddington's (1983) portfolio balance version. The third category which describes models within the portfolio balance framework shares the Cuddington (1983) study and includes Brillembourg and Schadler's (1979) attempt at estimating an eight country matrix of 'semielasticities'.

Indirect tests of CS report on Evans and Laffer's (1977) attempt to test for the implied interdependence by examining the link between exchange rate movements and changes in money supplies. Also reported is Brittain's (1981) study of the interdependence in the divergence from respective national trends of income velocities. The implied direct systematic link between 'world money' and national inflation rates is examined within the McKinnon (1982) framework. At the end of the chapter we present criticisms of the theory of CS. It is argued that while perfect CS may imply intercountry transmission of monetary disturbances, perfect nonsubstitution does not guarantee monetary independence.

In chapter 4 we present a variant of the Bordo and Choudhri (B-C) (1982a) type models of CS. Our model differs from its predecessor as it includes the argument for the return on the US dollar in addition to that for the individual foreign currencies. This, it is argued, yields a theoretically more acceptable model for a small country such as Canada which is noticeably influenced by the behaviour of the US currency. A similar justification may be provided for almost all other countries given the singularly important role of the US dollar in world financial markets.

The B-C model as well as our variant of it are used to test for the presence of CS in Canadian money demand with respect to the currencies of the US, Belgium, France, Germany, the Netherlands, Switzerland and the United Kingdom. The sample period (based on quarterly data) extends from 1960/1 to 1984/3, and results for both the fixed and the flexible rate periods are presented. The findings indicate evidence of CS in most cases. It is also suggested that ours is a test for the presence of nonzero cross elasticity such that substitutability as well as complementarity between currencies may be examined.

Chapter 4 also questions the validity of the Cuddington (1983) type tests which fail to distinguish between different exchange regimes since the parametric estimate for

the CS argument under separate regimes is expected to diverge from when this distinction is ignored. Additionally we provide what we believe to be an intuitively more acceptable explanation of why the degree of CS under flexible rates should exceed that under fixed rates. This is confirmed by the results of our study as well as by the majority of other empirical tests. The chapter draws to a close by presenting the numerical values of the respective cross elasticity measures. Comparison of these with own interest and income elasticity values highlights the magnitude of the expected shifts between currencies.

The analysis in chapter 4 assumes the discrepancy between the spot and forward exchange rates to be an accurate measure of the return on foreign currency. In chapter 5 we argue that while relatively small compared to the totality of the transaction, the cost of transacting in foreign exchange markets may not be quite as insignificant when compared to the yield on the foreign currency. Such costs must therefore be incorporated in tests of CS. The Frenkel and Levich (1975, 1977, 1981) cost estimates (based on triangular currency arbitrage) are adopted and modified to fit the unique foreign exchange history of Canada. These costs are incorporated directly in the B-C type model as well as in our variant of it. Both types of models are estimated with respect to the US dollar and the British pound for quarterly data for the same sample period. The

results indicate, at worst, some improvement in the level of significance. The chapter draws to a close by tabulating the respective cross elasticity measures for purposes of comparison.

In chapter 6 we conclude our study by summarizing the principal findings and presenting some suggestions for further research.

CHAPTER 2

Currency Substitution and Exchange Market Theories

In this thesis we relax the country specific money demands assumption of traditional monetary and portfolio balance models by introducing currency substitution (CS) in money demand. This permits one (as Girton and Roper (1981,p.12) point out) to distinguish between issues that relate to intercountry trade from those that relate to the exchange markets. The theory of CS described below is applicable irrespective of the number of countries involved, even though tractability often requires models to be restricted to a two country framework. The literature on CS stresses that relaxing the country specific money demand assumption permits consideration of currency issues that focus on the '...multicurrency concept of exchange market pressure." (Girton and Roper (1981,p.14)).

Section 2.1 traces the origin of CS to the mid-1970s movement towards unregulated competitively supplied private sector currencies. Citing Hayek (1960,1976a,b) and Klein (1974) as the principal contributers to this literature it is asserted that competing monies, supplied in a free market environment would endogenize the supply process contributing

to exchange rate stability. The 'willingness to hold' of any currency (later described as demand side CS) is stressed as a more effective regulator of excess supply than the 'benevolent' actions of an 'inept' and manipulated central authority. To the extent that the 'competitive supply of money' implies CS, Hayek is shown to have advocated it in 1960.

Section 2.2 highlights the implausibility of the country specific money demand argument which implies that foreign currencies yield no transactions services in the domestic country. It is suggested that transactors such as multiplant transnational corporations and money-centre banks may well experience recurring demand for foreign currencies and, hence, may demonstrate transactions, speculative or precautionary motives for holding foreign currency cash balances. Subsection 2.2.1 describes the methodology commonly employed in estimating relative currency demands. This is done by way of Tobin's (1958) two stage money demand process where the proportion of total assets held as cash balances is determined along with other asset demands in the first stage. Once the total amount allocated to money is determined relative holding costs then determine the quantity of each particular currency held.

Section 2.3 attempts to identify the factors that determine the degree of substitution between currencies. It

is argued that currencies are substitutes to the extent that they provide similar monetary services. For the transactions motive this means the ease with which a unit of domestic currency may purchase foreign commodities. The provision of similar monetary services is linked to the degree of world goods and capital markets integration. The existence of significant integration in such markets points to a strong a priori case for CS.

Section 2.4 describes the effect of CS on monetary independence. Substitution between currencies in demand is distinguished from supply side CS. The two are analyzed with respect to both fixed and flexible exchange rates. Subsection 2.4.1 examines the former. The issue of perfect supply side CS induced by fixed rates is described and critically analyzed. The implications are that fixed rates endogenize national money supplies. Subsection 2.4.2 examines monetary independence under flexible rates. It is shown that since transactors may diversify the currency composition of their cash holdings, predicted movements in exchange rates may no longer follow as foreign demand for domestic money balances may absorb the excess supply.

Section 2.5 examines the effect of CS on exchange rate volatility within the context of the Girton and Roper (1981) model. It is shown that increased CS causes exchange rate instability such that in the limit, when perfect CS exists,

the exchange rate becomes indeterminate. These results, however, are attributed to the exogenously determined money supply and rate of return variables in both countries. Once the behavioral responses of issuers are endogenized it is argued that CS may well induce exchange rate stability.

2.1 Free Monies

> "...government has failed, must fail, and will continue to fail to supply good money" (Seldon in Hayek (1976b, p.4)).

Just as the monetary approach to the balance of payments (MABP) and to exchange rate determination traces its origin to domestic monetarism, similarly substitution between national currencies traces its roots to the early to mid 1970s movement towards unregulated, competitively supplied, private sector currencies. Principal contributors are Hayek (1976a,b) who concedes intellectual precedence to Klein (1974, but written in 1970) and Tullock (1975). This section synthesizes their contribution. There seems little doubt that this movement was influenced in no small degree by the exhaustive theoretical and empirical addition to literature analyzing the 'nearness' or the degree of substitutability between money and liquid financial assets.[1] The revival of interest in these issues followed closely on the heels of the 'contemporary rebirth' of the quantity theory of money in the 1950s and early 1960s. Since

stability in the money market and, thereby, in the entire system was recognized as dependent in part on the ability of the monetary authority to effectively regulate the size of the money stock, money substitutes and the degree of substitutability came under close scrutiny.[2]

Working on the basic premise that money is a good just like other goods in the economy, Hayek as well as Klein argue for demonopolization from the world governments of the money supply process. The argument advocates, and to some extent presupposes, the abolition of state inspired (often indirect) restrictions to unhindered intercurrency acceptability of money.

Both authors propose a perfectly competitive unregulated market structure for the issue of currency where the government has removed from it the 'exclusive' right of issue. It is argued that regulations would only serve to move the firm away from its profit maximizing (unregulated) supply of money, and may possibly distort efficiency conditions which in turn may induce excess supply. Hayek observes:

> "What is so dangerous and ought to be done away with is not government's right to issue money but the exclusive right to do so and their power to force people to use it and to accept it at a particular price." (1976a,p.16).

The state, he adds, may continue to be a competitive

supplier of currency to the extent that by virtue of its unique position it is able to provide 'consumer confidence' at a lower cost. This may not be an abstract proposition as many activities of the state, such as the provision of national defense, are confidence inspiring.[3] This he argues will remove money from politics, thus removing from the state the ability to destabilize under the pretence of fine tuning. Since politicians work under Hayek's mutated Keynesian aphorism 'in the long run we are all out of office' so it is argued that political benefits from 'more and cheap money' prove beyond the self imposed constraints of a short lived government.[4]

This point is best enunciated in Klein's (p.450) argument that the party in office does not own the 'national currency brand' name and can afford to manipulate it to its short term advantage. A private issuer would have property rights to its own brand name and would pursue a more stable path. Additionally, a private issuer would not be as susceptible to pressure groups as the government.

The argument for the private issue of currency is based on the premise that something is legal tender not by government decree but due to consumer confidence. In the case of a private issuer the demand for its (ith) money may be expressed as:

$$mdi = mi(r,c,z) \qquad (2.1)$$

Where r = opportunity cost; c = consumer confidence; and z = the vector of all other arguments. The partial derivatives are as follows: $\partial mdi/\partial r < 0$ and $\partial mdi/\partial c > 0$.

Consumer confidence depends on expected stability in the value of the currency vis à vis some widely agreed upon standard price level.[5] A currency expected to display intertemporal stability would attract consumers, increasing demand, and the concomitant stream of seignorage to the issuer.[6] All private issuers will scramble to provide a currency displaying greater degree of stability than its competitors. Any currency then, would be regulated by the consumers' 'willingness to switch' to substitutes, stability being ensured by the issuers desire for 'self gain' from seignorage as opposed to the 'benevolent' actions of an 'inept' and often manipulated central authority.

The adjustment process (given flexible conversion rates between currencies) works through an 'inverse' Gresham's law whereby a currency currently depreciating, and expected to do so in the future, would be replaced by one expected to preserve its value (Hayek 1976b,p.34-5). Such behavior is commonly observed in countries with galloping inflation, where contracts are often denominated in a relatively more stable currency. Hayek observes:

> "Money is one thing competition would not make cheap, because its attractiveness rests on it preserving its 'dearness'." (Hayek(1976b,p.74).

The endogenizing of the money supply in response to competing monies/currencies is elucidated in Girton and Roper (1981) who go on to conclude that such competition may well result in monetary synchronization and, hence, stable exchange rates.

While in keeping with the free enterprise aims of Adam Smith, this argument runs in stark contrast to Friedman's prediction that an unregulated issue of money within a competitive framework would lead to an infinite price level (Friedman,1959,p.7). This forecast may well materialize were it not restrained by 'distinguishable' monies each being 'costlessly identifiable' (Klein 1974,p.429).

To the extent that a competitive supply process cannot be instituted, Hayek(1976b,p.99) calls for a gold standard as it would provide an effective physical check on the ability of the state to over issue currency. Similarly, between exchange regimes fixed rates are preferred since a payments deficit, and in the extreme, the stock of foreign reserves, provides a check on discretionary monetary policy (Hayek 1976b,p.82). By extension supranational currencies (ECU) are denounced as further extending the concept of monopoly and exclusivity of issue.

Competition in money supply is itself ineffective unless accompanied by willingness on the part of regulatory authorities to permit unrestricted holdings of all currencies. Additionally, barriers must be removed to augment the acceptability of, and, hence, demand for the various currencies. To the extent that voluntary exchange implies that freedom must be permitted on the supply as well as the demand sides, the literature on the competitive supply of money presupposes the abolition of restrictions on the demand side. With reference to open economy macroeconomics, this sets the ground rules for currency substitution in exchange market theories.[7] One may, therefore, argue that currency substitution was inadvertently advocated by Hayek as early as 1960:

> "I am doubtful whether it is necessary or desirable that they numivate banks) (or the government) should have the monopoly of issue of all kinds of money." (p.520-21)

2.2 Divergence From Tradition

While the works of Hayek, Klein and Tullock underwent contemporaneous development with the metamorphosis of monetary to asset market models, contributors failed to link the literature on competition in the money supply process (with its accompanying implicit assumption of unrestricted intercurrency demands) to the fast evolving exchange market theories. A notable exception are Girton and Roper

(1981,p.12), who claim precedence from Klein (and some works of Hayek) by stating that the first draft of their paper was prepared in 1974.

Remarkably few authors concede precedence to Hayek (1960), who it would seem, along with Klein and Tullock, would deserve the credit for providing the basic infrastructure for the theory. While they did suggest open economy applications this was done inadvertently as a natural extension of their treatise. Later contributors such as Miles (1978a), King et al. (1978) and Boyer (1978) to mention but a few, can rightly claim credit for specific theoretical and empirical applications to exchange market theories.

In conformity with domestic monetarism the traditional monetary and asset market models emphasize country specific money demands such that currency holdings of Canadian assets holders may consist of Canadian dollars only.[8] This is based on the implicit assumption that foreign currencies yield no transactions services in the domestic country. The argument suggests that only Canadians may obtain monetary services from Canadian currency, precluding consideration of foreign demand for Canadian dollars. While asset market models permit the holding of foreign currency denominated financial assets so that wealth owners may optimize the expected yield on their asset portfolios, it is assumed that

sale proceeds are instantaneously converted into domestic currency. This explains the explicit exclusion of the foreign money demand function in traditonal models. The models are constructed on the basic premise that the elasticity of substitution between local and foreign currencies is zero (King et al. 1978,p.200) such that Canadians may hold Canadian dollars only; and only Canadians may hold Canadian dollars.

Throughout this study it is assumed that the demand for money is the derived demand for the monetary services that flow from it (King, et al.p.200-203). The authors argue further that demand for a foreign currency, then, is directly related to the monetary services that can be obtained from that currency. To the extent that currency A yields no monetary services in country B the currencies are perfect nonsubstitutes. The degree of similarity of monetary services is related to the extent of world market integration; this is examined further in the following section.

While conventional monetary models restrict substitution in demand to zero, substitution in supply is related to the exchange rate regime, and may vary from zero under purely flexible rates to infinity when the rate is rigidly pegged. The gap in between may be viewed as a continuum along which the degree of exchange market

intervention by the authorities determines the degree of supply side substitutability. During fixed exchange rates the foreign reserves account transmits domestic policy 'excesses' to the rest of the world. During flexible rates, with 'accomodating' flows restricted to zero, all adjustment occurs through the exchange rate. The differential implications of these two adjustment processes are examined in subsections 2.4.1 and 2.4.2 below.

Consider the following implication of the above argument. If money demand, as defined above, is empirically observed to be stable, the responsibility for exchange rate mobility (particularly under the monetary approach, and to a lesser degree under the portfolio balance approach) falls on unforseen excesses in the supply process. However, currency substitution distributes the blame somewhat more evenly by permitting currency composition of money demand and, hence, demand for national currencies to be fast changing at the margin. Note also the implied asymmetry between money demand and other asset demand functions in conventional models. CS proposes identical specifications of all (financial) asset demand functions.

Professor Velk (McGill University) has pointed out that conventional theory of CS does not explicitly account for governments' demand for and supply of <u>both</u> local and foreign currencies. The point, he stresses, gains added relevance

since central banks may furnish foreign exchange on their own accounts. Furthermore, government money demand functions for foreign currency may contain arguments seperate from private sector money demand functions such that the former may well offset changes in the latter. Since this introduces analytical as well as empirical complexities we have chosen to omit such considerations in this study.

The implausibility of the country specific money demand functions argument of conventional models is confirmed by casual observance of the functioning of the present day foreign exchange markets. The trend towards increasing presence of global trading companies, multi-plant transnational manufacturing corporations, private sector money-centre banks and nonbank financial intermediaries, money market, mutual and pension funds, smaller importers, exporters, market speculators, interest arbitrageurs, business and pleasure travellers and residents of border towns all may justifiably demonstrate transactions, precautionary and speculative motives for holding a diversity of internationally traded currencies. All these subscribe to the common motive of optimizing expected returns on asset holdings by way of porfolio allocation (subject to holding costs) and/or reducing cost of future ventures in different countries. The latter may include maintaining receipts in different foreign currencies in

anticipation of uncertain future purchases, or simply to aid enterprise in such countries (Miles 1978a,p.428). Miles adds further that by this reasoning such firms may exhibit motives for money demand not dissimilar from those of native enterprises. The argument may, therefore, state that all who stand to benefit from the monetary services supplied by a currency may demand it. Motives for holding cash balances of foreign currency need not be restricted to any particular group of transactors. To the extent that an operator has recurring demand for foreign currency he may exhibit motives for demanding cash balances of that currency similar to that shown by foreign residents.'

The theory of CS, generally concentrates on the transactions .tive for money demand. It is assumed that speculative balances are generally held in the form of interest yielding securities and therefore fall more apprppriately in the realm of capital mobility. Prof. Velk suggests a 'fourth' motive for money demand which may loosely be termed the 'security/confidence' motive. He stresses that economic agents may simply choose to hold balances of currencies such as the US Dollar for other than transactions purposes; this he classifies as the security/confidence motive. By extension it may be argued that such balances may also be available for 'switching' upon inducement.

The effect of portfolio readjustment on currency demands has gained added relevance since the sharp increase in the values of the portfolios of oil-exporting countries accompanied by the accomodating rapid growth in the Eurocurrency markets. As individual OPEC members incur increasing trade deficits, the drawing down of the aggregate OPEC surplus is more than offset by the rapid increase in assets of mutual, pension and other money market funds. A significant proportion of such portfolio holdings may be held in currencies foreign to the domicile of the fund.

Recent literature has attempted to incorporate the concept of currency subsitution in the demand for money. Boyer (1978) has argued for fixed rates based on his (theoretical) findings of exchange market instability which results from currency substitution. Miles (1978a,b,1981), has attempted to estimate the elasticity of substitution by way of a CES function for the production of money services. Girton and Roper (1981) show that currency substitution, by highlighting the effects of policy differentials, induces synchronization of national monetary policies which tend to stabilize exchange movements. By extension they argue that exchange market instability is characterized by divergent monetary policies which flourish in the abscence of CS. King, et al. (1978) argue that the above models do not adequately represent the role of substitution in supply. This is rectified by their inclusion of domestic and foreign

money supply processes within a rational expectational framework. For the sake of brevity descriptions of theoretical models are restricted to those of Girton and Roper and Miles.

The implications of CS for independent monetary policy and exchange market stability do not arise from passive holdings of foreign currencies by domestic transactors. Such balances may exist due to historical circumstances (Miles 1978a,p.429).[10] CS is interpreted to represent those transactors who are 'willing to switch' the composition of their currency portfolios in response to changes in holding costs. As Miles has pointed out further what is required for the implementation of CS is that sufficient balances of foreign currencies be maintained by asset holders who while satisfied with the existing mix of currencies, stand ready to switch upon inducement. Hayek contends that this 'regulatory' behaviour on the part of asset holders stems purely from self gain and as such may be the most effective watch on policy excesses of issuers. For it to be effective it is not required that all resident transactors hold foreign currency balances only that a sufficient number do so that their optimizing behaviour may yield the predicted outcome.[11]

The preceeding summary of the argument that appears in the literature makes a strong case for the presence of

transactors who hold a significant part of their asset portfolios in a diverse composition of currencies. We consider now the methodology underlying the specification of respective national money demand functions.

2.2.1 The Two-Stage Demand Process

Many models described below stipulate a two stage money demand process whereby the proportion of total assets held in the form of money is determined alongwith the demand for other financial assets. Once the total amount allocated to money is determined, relative holding costs then determine the amount of each particular currency held.

This simplified two-stage demand process was employed by Tobin (1958) in his attempt to identify demands for particular interest yielding financial assets within a domestic portfolio allocation framework. In his case the first stage considered allocation of financial holdings between cash and all interest bearing financial instruments. The second stage considered the demand for each particular interest yielding asset. However, as Brillembourg and Schadler (1979,p.522) point out this simplification is not without restrictive assumptions. As applied to demand for particular currencies within a broader asset market framework this restriction, they argue, implies that: i) the composition of currency demand is invariant to changes in

expected returns on interest bearing financial assets; ii) that elasticities of demand between money and individual financial assets is assumed to be the same so that the latter may be aggregated into one composite financial asset; and iii) that this demand process implies differential speeds of adjustment in the two stages such that adjustments under stage two occurs much quicker than under stage one.

Notwithstanding these implications, one may take refuge in Tobin's statement that: " allocation first among, and then within, asset categories seems to be a permissible and perhaps even indispensable simplification both for the theorists and for the investor himself." (p.85)

In the second stage of the process, as in the first, asset demands depend on expected yields net of holding costs. In the case of interest bearing securities denominated in different currencies the yield has an interest component and a depreciation/appreciation component. Since currencies yield no pecuniary return the yield reduces to a change in the value of one in terms of the other. Hence, a significant influence on the demand for, say, Canadian dollars would be expectations concerning changes in its value with respect to other currencies.

2.3. Currency Substitution and Market Integration

Since money yields no pecuniary return demand for it is the derived demand for the services that flow from it. Currencies that yield similar monetary services are regarded as substitutes.[12] This notion of similar services flowing from different monies has as its predecessor the notion of similar characteristics in different commodities, put forward by Lancaster (1966) as interpretation of the theory of consumer behaviour. When two currencies possess identical characteristics such that they provide the same monetary services they are regarded as perfect substitutes. To the extent that transactors express a bias towards transactions in domestic currency, currencies are not perfect substitutes.

What is it that permits different currencies to provide similar monetary services? Simply, it is the degree of world market integration. In the commodity markets the degree of integration is directly related to the ease with which a unit of foreign currency may be used to purchase domestic commodities.

Just as the extent of commodity market integration determines the currency composition of the transactions motive for money demand, the extent of capital market integration determines the currency composition of the

speculative motive. To the extent that world capital markets exhibit a high degree of integration transactors would no longer be restricted to holding balances of their native currency. Instead they may optimize the currency composition of their asset holdings to satisfy the speculative motive for money demand.

The emphasis now shifts to the determinants of the degree of world market integration. As King et al. (1978,p.204) point out for the commodity market the degree of integration is negatively related to the factors which restrict the free flow of goods and services across national boundaries. The ones that figure prominently in this category are tariffs, quotas and nontariff barriers to trade as well as prohibitive transportation, transaction and information costs. Similarly in the capital markets the typical restrictions constraining increased integration are capital controls which impose penalties (such as witholding taxes), and outright restrictions on the ownership of financial assets and monies other than those native to the asset holders. Political uncertainty also appears as a prominant restriction on capital market integration.

Since the state can clearly influence these factors as well as the ones that affect capital market integration it can affect the degree of currency substitution (Lapan and Enders (1981, p.3)). In a way this reinforces Hayek's

suggestion that it is not enough to simply permit the competitive supply of money; the barriers restricting demand for such issue (erected principally by the government) should also be abolished.

Based on the increasing level of world trade which currently stands at approximately 10% of world production, one is tempted to concede significant integration in the goods market. However, the existing high levels of restrictions in the form of tariffs, quotas and other barriers testify to the great potential for further integration. In the capital markets the high degree of integration is confirmed by the size and the continuing trend towards growth in the euro currency markets. Additionally, the instantaneous arbitrage properties of such markets attest to the relatively high degree of integration where such markets exist.

2.4 Currency Substitution and Monetary Independence

This section considers the effect of CS on monetary independence. Substitution between currencies in demand is distinguished from supply side CS. The effects of the two are considered with respect to both fixed and flexible exchange rates. First, we examine the degree of monetary 'insulation' under fixed rates with no specific stipulation regarding substitution in demand. We then consider the

implication of demand side substitutability on monetary independence under a freely floating rate regime.

2.4.1 Under Fixed Exchange Rates

When the rate of exchange between two currencies is held fixed it demonstrates the willingness of the respective central banks to change unrestricted quantities of one for the other at the prescribed rate.[13] In effect the authorities view the currencies as perfect substitutes and as such are prepared to exchange whatever quantities necessary at that rate. Such action makes the elasticity of substitution in supply close to infinity.

While the point is not made by previous contributors (with the exeption of Cuddington (1983,p.119)) such a notion of perfect substitutability in supply, induced by a fixed rate system, assumes intertemporal fixity of exchange rate such that the value of the focus currency is not expected to change in terms of the others. For transactors to exhibit indifference between currencies the rate of exchange must be expected to remain constant over the transactors investment horizon. In the absence of such expectations one may observe massive shifts such as out of sterling in the 1960s and the US dollar a decade later, even though the respective exchange rates were 'pegged'.

Consider the implications for transactors. Assuming intertemporal fixity of exchange rates a given amount of one currency implies a fixed quantity of the other. If this constant conversion factor is expected to persist, as it is under fixed rates, then transactors may hold either currency resting secure in the knowledge that they can obtain, at any time, a given quantity of the other.

Under fixed exchange rates an increase in the domestic demand for cash balances, not accomodated by the domestic central bank, may induce transactors to sell increased quantities of domestic commodities and securities to foreign residents in an effort to augment their cash balances. Under the conventional restrictions of country specific money demands such foreign balances are assumed to be instantaneously converted into domestic currency with predictable effect on the domestic money supply. The introduction of CS no longer has this added stipulation. Any such balances may either be held in the foreign currency or may be submitted to the central bank for conversion to an equivalent quantity of domestic currency. The theory stipulates further that since fixed rates guarantee this conversion rate over time transactors may display indifference between the two since any quantity of one may be converted to a given quantity of the other (Miles 1978b,p.171).

It must be noted however that perfect substitutability in supply merely reflects the ease of availability of foreign currencies such that the elasticity of subtitution is infinite at the prescribed exchange rate. This however says little about demand side considerations which are determined by institutional factors such as world commodity and capital market integration. The two being distinct, one cannot make an a priori argument for greater degree of demand side CS under fixed rates. The currency composition of cash holdings is of course determined by the interaction of supply and demand side factors. The degree of demand side CS under fixed versus flexible rates is explicated further in section 4.10.

Consider the implications of CS for monetary policy during fixed rates. It was argued above that domestic residents may freely hold foreign currency and may easily switch between it and domestic currency. However the central bank exercises control on <u>domestic</u> money only with no direct influence on foreign money. This seriously undermines the ability of the central bank to effectively regulate the availability of money to local residents. The very substitutability enhancing behaviour of the central bank proves to be the root cause of its inability to effectively exercise monetary control as fixed exchange rates permit policy neutralizing flows which offset discretionary policy initiatives of the monetary authority

(Miles 1978b,p.172).

2.4.2 Implications Under Flexible Exchange Rates

The cause of interconnecting money supplies and the accompanying lack of effectiveness of discretionary monetary policy is the ease of substitutability between currencies induced by fixed exchange rates. The proper remedy would be to restrict or completely abolish substitutability in supply. This may be achieved by: i) the imposition of exchange controls (as in many developing countries) where the allocation of foreign exchange, for specific purposes, is sanctioned by the central bank; ii) it may also be achieved by the refusal of the central bank to fix the value of its currency in terms of other currencies. Proponents of the latter alternative argue that with the source of substitutability between currencies controlled by adoption of floating exchange rates, the accomodating capital flows are reduced to zero so that the entire adjustment must occur through changes in the exchange rate.

However, few would quarrel with the observation that the current state of the exchange markets best describes a system of managed float where exchange market pressure is 'alleviated' in part by changes in the exchange rate and 'absorbed' in part by accomodating flows. Such accomodating flows express the central bank's desire to dampen large

fluctuations in the value of the currency, alluding to a range wherein the bank considers the currencies to express some degree of substitutability. The effect of this residual substitutability in supply, has been overlooked in the literature.

Advocates of flexible rates attribute policy neutralizing flows entirely to perfect substitution in supply induced by fixed rates. Overlooked is demand side CS which provides the willingness to hold to complete the transaction. This failure, under fixed rates, to recognize the existence of demand side substitution to make the theory operational seems to be inadvertently extended to the theory of flexible rates. As Miles (1978b,p.173) points out the abolition of substitutability in supply was perceived as the only restriction required to restore effectiveness to monetary policy. History has proved this incorrect. Whereas the switch from fixed to flexible rates successfully curbed substitability in supply the desire to optimize the currency composition of portfolios did not subside. Transactors were merely induced to switch to private markets as the source of supply of foreign currencies.

Miles goes on to stress that based on this misperception proponents of flexible exchange rates described a system which would permit countries to pursue independent monetary policies according to national

priorities. However, experience indicates that the transactors who displayed demand for balances of foreign currencies during fixed rates continued to do so during flexible rates. Indeed one would expect the increased exchange rate mobility under flexible rates to require more frequent adjustment to the currency composition of asset holdings to either benefit from, or protect against, such movements. This would of course imply a greater degree of CS during flexible exchange rates. Empirical findings in this study as well as elsewhere in the literature (Miles 1978a, 1981; Batten and Hafer (1984)) lend credibility to this hypothesis (see chapter 4, particularly section 4.10). Lorrie Hogg, the Royal Bank's manager of corporate services observes:

> "...less than 10 years ago foreign currency prices were posted in the morning on a blackboard, where they could remain unchanged all day or even all week. Now the prices are blips on a computer screen that pulses change hundreds of times a day." (Report on Business Magazine, April, 1985,p.92).

To examine the implications for monetary independence with nonzero demand side CS consider the plausable assumption that there continue to exist transactors who demand cash balances in a variety of currencies. These asset holders would be continually optimizing the currency composition of their asset portfolios. Such substitution affects demand for and supply of currency exerting pressure on the exchange rate. Since the central bank does not

intervene, this pressure is alleviated by changes in the exchange rate.

Consider the reaction to an open market purchase by the domestic country, within a two country open economy framework. Faced with an excess supply of money domestic residents may increase their purchase of foreign commodities and foreign securities. The country specific money demand assumption of traditional theory postulates that the domestic currency so obtained by foreigners would be converted into foreign currency exerting the predicted upward pressure on (depreciating) the exchange rate. However, foreign transactors may simply choose to hold domestic currency, increasing the foreign money supply, and leaving the exchange rate unaffected. A domestic monetary expansion, therefore, may lead to an increase in the foreign country's money supply feeding foreign inflation. However, monetary independence and a halt to the intercountry transmission of inflation were the principal reasons for the institution of flexible rates (Miles 1978b,p.174).

Conversely an increase in the domestic demand for cash balances, not accomodated by domestic authorities, may be satisfied by increased holdings of foreign currency balances leaving unaffected the exchange rate.

This leads Miles (1978b,p.174) to argue that the degree

of monetary interdependence depends on the extent of demand side CS. When currencies are perfect subtitutes an increase in the demand for cash balances may be satisfied equally well by increased holdings of either currency such that the exchange rate may no longer change as predicted. Similarly an increase in the supply of one currency may be evenly diffused yielding a uniform increase in cash holdings of both currencies implying uniform inflation rates. The similarity of this with implications under fixed rates have caused some to propose a reversion to a system of pegged exchange rates.

Note that we have attempted to distinguish demand side CS or 'willingness to hold' from supply side CS. Our analysis accords a passive or accomodating role to supply side CS even under fixed rates. No matter what the exchange rate regime it is predominantly demand side considerations that determine the currency composition of asset portfolios. Prof. J. Handa (McGill University) has pointed out that since the supply process (exchange rate regime) determines holding costs it does influence the currency composition of cash balances.

2.5 Implications For Exchange Rate Volatility

This section seeks to describe the implications of demand side CS on exchange rate stability. In section 2.3

above we argued that increased goods and financial market integration implies the provision of similar monetary services such that the elasticity of substitution between currencies increases significantly. This focused further attention on the willingness to switch between currencies with its concomitant implications on exchange rate behaviour. Girton and Roper (1981) have shown that increased substitutability between currencies is directly related to exchange rate instability; and at the limit, when two currencies are perfect substitutes, the exchange rate becomes indeterminate. The following is a brief summary of their model.

The model describes a two country open economy system with the quantity of money in each exogenously determined. A three market monetary framework is conceived with the market clearing conditions for the third (nonmonetary) asset made redundant by Walras' law. Defined by currency[14], and in terms of relative returns, each money demand function is expressed in exponential form as:

$$M1/P1 = \theta 1(w)^{[\alpha 1(r1 - r) + \sigma 1(r1 - r2)]} \qquad (2.2)$$

$$M2/P2 = \theta 2(w)^{[\alpha 2(r2 - r) + \sigma 2(r2 - r1)]} \qquad (2.3)$$

where r, r1 ,r2 = expected <u>real</u> rates of return on the

nonmonetary asset, and on currencies 1 and 2 respectively; w = is a scalar such as real wealth; M = nominal money supply; P = the price level; σ, α = coefficients of substitution between the two currencies and between each currency and the nonmonetary asset respectively; both $\sigma, \alpha > 0$.

Taking the log of both equations and subtracting the log of (2.3) from the log of (2.2) and solving for prices yields

$$\ln(P1/P2) = \ln[(M1/\theta 1)/(M2/\theta 2)] - \alpha(r1 - r2) - 2\sigma(r1 - r2) \qquad (2.4)$$

Where it is assumed that $\alpha = \alpha 1 = \alpha 2$ and $\sigma = \sigma 1 = \sigma 2$. The latter symmetrical restrictions implies a singular value for the CS parameter, and the former reduces to zero the differential effect on the value of money of changes in r. The latter restriction implies identical cross elasticities for residents of each country for the two currencies. It stipulates that each currency provides the same degree of monetary services (in the foreign country). The restrictive nature of such limitations are most evident when applied to countries like the US and Canada, implying that the elasticity of substitution between Canadian and US dollars for Canadians equals that between the two currencies for residents of the US.

Equation (2.4) is linked to the exchange rate (S) via a 'multi-currency' version of PPP where intercurrency arbitrage, compared to intercountry arbitrage of conventional theory, ensures that S = P1/P2. Assuming e = lnS, equation (2.4) can be rewritten as:

$$e = e^* - \eta(i1 - i2 - \dot{x}) \qquad (2.5)$$

Where $e^* = \ln[(M1/\theta1)/(M2/\theta2)]$; $\eta = \alpha + 2\sigma$; i1, i2 = respective nominal rates of interest; $\dot{x}$ = expected rate of depreciation.[15] It is assumed further that the elements of e^* are exogenously determined and i1, i2 are fixed.

Equation (2.5) gives the final reduced form equation for exchange rate determination. Consider the implications of exogenously determined changes in $\dot{x}$. i) $\partial e/\partial \dot{x} = \alpha + 2\sigma = \eta$; for a given change in $\dot{x}$ this suggests a positive relationship between the CS parameter σ and a change in the exchange rate such that as the degree of CS increases a greater change in S is required to restore equilibrium. Hence, increased CS is associated with exchange rate instability. ii) By extension in the case of perfect CS, as σ approaches infinity, the exchange rate becomes indeterminate. The authors stress that in this case S is indeterminate in addition to being unstable as 'instability does not presuppose determinacy'.

That CS implies unstable exchange rates is attributed by Girton and Roper (Section 3) to the assumption of exogenously determined money supplies and fixed returns on monies; both remain invariant to changes in S. Once the responses of money issuers are endogenized such that the return on money may be manipulated to influence demand CS is shown to induce stability.[17] Exchange market volatility may be reduced by either an issuers' cartel or via the competitive supply of money. The route through collusion guarantees for each issuer a protected market share and fixed exchange rates within a synchronized monetary framework. While such a currency union may serve to stabilize the exchange rate, they argue (p.21) that experience suggests that high rates of inflation may persist.

The second alternative which they suggest for achieving stability stresses competition in the money supply process a la Hayek and Klein. It is assumed that issuers maximize profits, which here accrue in the form of seignorage. A competitive environment will induce issuers to make attractive to holders their respective currencies. Such inducement may be offered by way of real rates of return competition such that issuers may offer, explicitly, nominal interest rates on money or incur gains via appreciation. The profit motive will induce every issuer to stabilize, relative to others, the value of his currency, in the

process providing stable exchange rates as well as reduced rates of inflation.

FOOTNOTES TO CHAPTER 2

1. Within the present context this issue gains even more relevance and requires added attention due to increased market integration yielding a far greater number of 'near monies' which successfully obfuscate the attempt at distinction.

2. Interested readers are referred to Chetty (1969), Feige (1964), Hamburger (1966), Lee (1967) and Gurley and Shaw. A good survey of empirical studies is Feige and Pearce (1977).

3. To the extent that a natural monopoly exists the state may well be the only supplier of currency (Klein 1974,p.447).

4. Hayek (1976b,p.47) distinguishes money from currency since the latter seems to stress the monetary services attribute of it.

5. Hayek (1976b,p.63) goes on to stress that since issuers would aim for international acceptability of their currency the standard price index must include proportional representation of consumer and industrial prices across different regions.

6. For 1967 Grubel(1981,p.482) estimates seignorage for the United States and the United Kingdom valued at US$ 800 million and 100 million pounds respectively. For this reason a payments deficit may be described as currency export based on foreign demand for 'monetary services' obtained from it. Similarly, unwanted holdings of, say, the US dollar during the 'overhang' of the late 1970's may be described as reducing its 'brand name value' Klein (p.446). As a corrolary he goes on to add that this may explain long run exchange movements unaccounted for by PPP.

7. It is also argued that in the long run stable prices may be translated to stable exchange rates via purchasing power parity. So even before the advent of the theory of currency substitution the 'denationalization' of money bore important implications for exchange rate theories.

8. Justifications for and implications of demand side currency substitution may be found in, among others, Boyer(1978), King et.al. (1978) and Miles (1978a,b). This section synthesizes their principal arguments which appear in the initial sections of their works.

9. Miles 1978a, p. 428.

10. As a case in point consider gold in Pakistan. As in many developing countries, official import of the metal has been banned since several years. However, a vibrant domestic gold market sustained by continuous illegal supply is justified and legitimized under the guise of historical supply (during British rule).

11. Miles (1978a,p.429).

12. While implicit in most analyses of demand side CS, the role of monetary services and market integration as determinants of the degree of substitution in demand is best examined by King et al. (1978) p.200-205. This section draws in part on their work.

13. This summary of the implications of supply side CS draws on Miles (1978b,p.171-2). Other authors have put forth similar views e.g. King et al. (1978).

14. Recall that money demand defined by currency, as opposed to by country, permits the explicit consideration of exchange rate determination (Girton and Roper, 1981,p.12).

15. Recall that r1, r2 denote the respective <u>real</u> rates of return. Nominal rates i can be expressed as $i1 = r1 + P1e$ and $i2 = r2 + P2e$; where Pe = respective expected rates of inflation. Therefore $r1 - r2 = i1 - i2 - x$; where x = the expected rate of depreciation linked via PPP to the differential rate of inflation.

16. In the appendix to their paper the authors relax this restriction endogenizing x within a rational expectations framework. The qualitative aspects of the model remain unaffected.

17. The authors also argue that in the presence of other competitively supplied monies, one that follows Friedman's fixed growth rate will prove inferior (Girton and Roper (1981,p.26).

CHAPTER 3

SOME DIRECT AND INDIRECT TESTS OF CURRENCY SUBSTITUTION

Chapter 2 stressed that diversification in the currency composition of money balances is justified for the same reasons as portfolio diversification in the case of interest bearing liquid financial assets. The degree of currency substitution (CS) measures the willingness to switch in the face of changes in relative holding costs. When executed such switches transmit disturbances across national boundaries; disturbances which undermine national monetary sovereignty. That demand for national currencies becomes unstable as a result of such actions is an important implication of this argument. Unstable national money demands in turn imply exchange rate instability. Needless to say that the presence and extent of demand side CS becomes a pressing empirical issue.

This chapter classifies and reports on the principal tests of CS that have appeared in the literature. Essentially these can be divided into two groups: (i) tests which seek to test for the presence and extent of CS; and (ii) indirect tests which seek to test for the validity of the implications of CS.

Section 3.1 provides justification for disaggregating the first group into two parts: (i) tests that seek to measure the cross elasticity of demand between currencies; and (ii) tests which estimate the elasticity of substitution.

Section 3.2 sheds more light on the issue of direct versus indirect tests of CS. The former is subdivided further into 3 categories according to the different modelling techniques employed. The three are: (i) the Miles type models which are based on maximizing a CES function for the production of money services subject to holding costs; (ii) the Bordo and Choudhri type models which study the effect of foreign influences on domestic money demand; and (iii) those models which analyze CS in the broad portfolio balance (PB) framework. This section also itemizes the indirect tests of CS.

Section 3.3 presents the theoretical part of Miles' (1978a) model. The gist of the model revolves around maximizing the production of monetary services as described by a CES production function subject to the cost of holding such balances. Section 3.4 summarizes his empirical findings. Based on data that spans the fixed and the flexible exchange rate periods he estimates the elasticity of substitution for Canadians, Germans and Americans. In all three cases estimates of the elasticity of substitution

under flexible rates exceed those under fixed rates; the former being significant at least at the 90% confidence level.

Section 3.5 reports on a study by Miles and Stewart (1980) which attempts to, incorporate into Miles' original framework uncertainty in the price of a currency as characterized by exchange rate volatility. The model is estimated for residents of Germany and the U.S. confirming the influence of exchange rate uncertainty on the currency composition of asset portfolios.

Section 3.6 reports briefly on the criticisms of Miles' model that have appeared in the literature. It summarizes Bordo and Choudhri's (1982a) criticism that the high numerical value of the elasticity of substitution is due to specification bias. The section also states Spinelli's (1983) contention that given the two-stage money demand function the elasticity parameter may only reflect the 'gross substitute' nature of the two currencies. The last part presents the Laney, Radcliffe and Willet (1984) argument that given the small relative quantity of foreign balances, the resulting currency shifts are 'policy negligible'.

Section 3.7 briefly describes a model that is procedurally related to that of Miles. Chung (1983)

constructs a two-level CES utility function for monetary services from which he derives the relative foreign currency demands for U.S. dollars. At 4.36 and 1.62 the elasticities of substitution for German and Japanese residents respectively, suggest significant responsiveness vis à vis the U.S. dollar. However, reservations are expressed about the conclusions he draws from such findings.

Sections 3.8 to 3.12 describe the second category of the direct tests of CS. In this category the pioneering attempt at using the money demand function as the instrument for testing for CS is by Bordo and Choudhri (B-C) (1982a). Their model tests for the importance of CS by examining the explanatory ability of foreign currency holding costs on domestic money demand. Empirical tests spanning a 10 year sample period yields no evidence of CS for Canadian residents vis a vis the U.S. dollar. Section 3.9 reports on the Batten and Hafer (1984) study which estimates a B-C type model to test for the importance of CS between the U.S. dollar and the currencies of five industrialized countries. Their empirical findings, which distinguish between the two exchange rate regimes, find selective support for CS.

Section 3.10 describes Daniel and Fried's (1983) attempt at 'reconciling' the contradictory empirical findings of Miles (1978a,1981) and Bordo and Choudhri(1982a). Considering only the transactions motive

for money demand they argue that, for Canada, the contradiction may be attributed to misspecification of the money demand function due to the exclusion of postal strikes. Our reservations regarding the interpretation of their empirical findings are also presented.

Within the framework outlined by Bordo and Choudhri, Winder (1983) proposes an alternate measure of foreign influence on national money demand. Section 3.11 presents his arguments for substituting the spot-forward exchange diffential with a measure of the uncertainty with which expectations of future inflation are held. Being unobservable this is proxied by changes in the focus currency's price of gold.

In section 3.12 we present Cuddington's (1983) argument against the analysis of CS within the 'restricted' framework of exchange markets only, at the exclusion of the other markets of the general portfolio balance (PB) model. Such a simplification may obfuscate the distinction between currency substitution and 'asset substitution' such that tests of the former may be affectd significantly by the latter. This is rectified by the explicit inclusion of arguments to differentiate and capture the effect of each. Criticisms of this (ours and those of Batten and Hafer (1984)) are presented in section 4.2 of the following chapter.

Section 3.13 presents an empirically testable model to estimate the cross responsiveness in currency demands within a broad portfolio balance (PB) framework. Presented by Brillembourg and Schadler (1979), the model isolates the second of the two stage demand processes so that attention may be focused on the allocation of the total money stock between currencies. The parametric indicators are then compared to similar estimates of a model where such cross responsiveness is restricted to zero.

Section 3.14 describes the Evans and Laffer (1977) test for CS. The literature on CS postulates an inverse relationship between it and the degree of monetary independence, Evans and Laffer seek to measure the extent of this independence as a test of the degree of subsititutability between the currencies of six industrialized countries. They test the hypothesis that if the degree of CS is indeed high, uncoordinated monetary excesses would imply uniform inflation rates with no systematic effect on the exchange rate.

Section 3.15 examines the effect of CS on the interdependence of fluctuations in the income velocity of money within the context of the model developed by Brittain (1981). The purpose of this section is: (i) to identify the instability in national velocity-measures; (ii) to link the divergences from respective national trends of such income

velocities; and (iii) to explain this coincidental intercountry divergence within the framework of a portfolio balance model where foreign monies enter as legitimate arguments in the domestic money demand function.

Section 3.16 describes tests of CS which examine the implied concept of 'world money'. Explicitly stated in McKinnon (1982) the argument is based on the premise that perfect substitutability implies complete monetary interdependence which in turn yields uniform rates of growth in money supplies and identical inflation rates. The concept of world money implies a direct systemtic link between world money supply and national rates of price inflation. Formal estimates of this relationship are examined with reference to studies by Ross (1983), McKinnon and Tan (1983), Spinelli (1983) and Goldstein and Haynes (1984).

Section 3.17 presents some 'less formal' tests to compare the extent of CS during the two exchange regimes. The first compares the extent of monetary independence by examining the divergence in the dispersion between changes in the money supplies and changes in national rates of inflations for the two exchange rate regimes. The second considers dispersion between national CPIs as an indicator of the appropriate degree of independence.

Section 3.18 draws this chapter to a close by presenting some criticisms of the theory of CS. It is argued that CS is not the sole cause of monetary interdependence under flexible rates; capital mobility, wealth and terms of trade effects may all contribute to the intercountry transmission of monetary disturbances. This section also briefly discusses the added explanatory power of foreign variables and the magnitude of the numerical values of the elasticity of substitution.

3.1 BACKGROUND

The attempt to account for the effect of currency substitution (CS) on exchange market theories has been traced by Miles (1978a,p.432) to McKinnon's (1969) explicit recognition of the demand for certain widely traded 'key' currencies by transactors domiciled in a diversity of countries. He goes on to trace the first documented attempt at estimating the elasticity of substitution in demand to Chen (1973). Chen's effort, however, was self defeating due to the adoption of a Cobb-Douglas production function where the elasticity of substitution is definitionally restricted to one.

With CS, as in the case of most empirically verifiable hypotheses, the estimator is faced with two options. He may undertake an exercise to test for the existence of

substitution between two currencies. Alternatively, he may test for the validity of the implications of CS by comparing models that include it with ones that do not. Examples of direct attempts are described in sections 3.3 to 3.13. While some indirect tests are summarized in sections 3.14 to 3.17 below.

Attempts at direct tests may be further divided into two groups. An estimator may seek to test for the presence of cross elasticity between currencies, or he may seek to estimate the elasticity of substitution. The theoretical development as well as empirical estimation of the latter technique was at the hands of Miles (1978a, 1981) and to a lesser degree by Chung (1983). Their attempts focused on estimating the percentage change in relative quantity demanded of the focus currency in response to a change in its relative holding cost. Their procedure has fallen prey to serious criticism (see section 3.6).

The other technique was theoretically developed and empirically tested by Bordo and Choudhri (1982a). Their procedure enjoys a much wider following in the literature. They sought to test for responsiveness in demand for the focus currency in response to a change in the return on its substitute. Essentially this tests for the presence of 'cross responsiveness' (elasticity) in the demand for money. Once its presence is confirmed the numerical value of the

cross elasticity measure can be estimated. In this thesis we follow this technique to test for the presence of 'cross responsiveness' between the Canadian dollar and the currencies of seven industrialized countries (see chapter 4 below).

3.2 CLASSIFICATION OF ESTIMATION TECHNIQUES

As indicated above tests of CS may be divided into two principal groups. The first includes models that test for the presence of cross responsiveness between currencies using money demand as the 'tool of analysis'. It also includes attempts at 'direct' estimation of the numerical value of the elasticity of substitution. The second group describes a variety of 'indirect' tests which seek to confirm the existence of CS based on the differential predictive ability of models which account for such foreign influences with those that do not.

The first group is further disaggregated according to the different procedures used to test for CS; three broad categories may be defined. (i) For tests of CS historical precedence rests with the Miles type of analysis. This estimates the numerical value of the elasticity of substitution based on maximizing the production of money services as described by a CES production function subject to the restrictions imposed by the costs of holding such

balances. Examples are Miles (1978a, b, 1981), Miles and Stewart (1980) and Chung (1983). (ii) The second category in the same group examines the effect of CS on the domestic demand for money. This technique was introduced by Bordo and Choudhri (1982a) based on the premise that the introduction in the money demand function of arguments that explain the return on foreign currencies should yield increased explanatory power. Variants of this model have been estimated by Cuddington (1983), Daniel and Fried (1983), Winder (1983) and of late by Batten and Hafer (1984). A variant of this procedure is also used for empirical estimation in this thesis. (iii) The third category includes studies which attempt to test for CS in a broader portfolio balance (PB) framework such that the analysis of CS may no longer be restricted only to the exchange markets at the exclusion of the other markets of the general PB model. In this domain fall studies by Brillembourg and Schadler (1979), and Cuddington (1983); the latter may be viewed as a portfolio balance interpretation of the Bordo and Choudhri procedure. Models in this category are only briefly examined.

The second group tests for CS by examining the implications of theories which explicitly account for such foreign influences. It asks whether CS enhances the ability of conventional theories in explaining observed behaviour. Studies reported in this category include attempts by Evans

and Laffer (1977) to test for the link between changes in money supplies and exchange rate movements; by Brittain (1981) to examine coincidental movements in the income velocity of money; by McKinnon (1982) to test for the hypothesis of a world money supply and its influence on domestic inflation rates. Also included here are studies by Spinelli (1983) and Goldstein and Haynes (1984) as criticisms of McKinnon (1982).

An alternative view of the theory of CS which is based on a stratified hierarchy of currencies is advanced (verbally) by Prof. Velk. These stratas, which for purposes of simplicity, may be restricted to four, comprise: i) the US Dollar; ii) European baskets of currencies e.g. the ECU; iii) the currencies of Western Europe; and iv) currencies of the developing world. Post war experience, he argues, indicates that the degree of cross responsiveness between currencies within a stratified group may diverge significantly from the degree of cross responsiveness between currencies in different currency stratas. By way of example he points to the noted lack of substitutability between European currencies immediately after W.W. II. The same currencies could more easily be converted to the US Dollar such that conversion between some European currencies involved the US Dollar as the vehicle.

Similar observations he stresses may be made between

certain currencies of the developing world; conversion between the currencies of Ghana and Bangladesh for example may well involve a third currency. To the extent that such hindrances may exist Prof. Velk argues that B-C type models of conventional theory, which do not distinctly recognize 'cross strata' substitution, may well be susceptible to misspecification.

While we recognize the possibility of such 'triangular cross strata substitution' versus the direct substitution considered in conventional models we have chosen to follow the latter. It should be stressed however that to the extent that currencies of the third world face cross strata substitution this may well be due to high transactions costs resulting from a lack of appropriate currency markets and possibly due to historical colonial bonds.

3.3 THE MILES MODEL

Contemporary development of the theory of CS has benefited from analytical as well as empirical contributions by Miles (1978a, b, 1981). His principal contribution to thought lies in the development of an empirically testable model for estimating the elasticity of substitution based on a constant elasticity of substitution (CES) function for the production of money services. The framework so developed is used to estimate the elasticity of substitution: (i) between

Canadian and U.S. currencies for Canadians (1978a); and (ii) between domestic and all foreign currencies for both Americans and Germans (1981). This section describes his theoretical model and the next summarizes his empirical findings.

The procedural form draws on a similar method employed by Chetty (1969) to measure the elasticity of substitution between money and other liquid financial assets; to this end it reinforces the assertion made earlier that the theory of CS originates from the debate concerning the degree of substitutability between money and liquid financial assets (see section 2.1 above).

Miles presents a linearly homogenous CES function for the production of monetary services where domestic and foreign currency balances feature as inputs. As per microeconomic theory optimum input utilization (optimum currency composition of asset portfolios) requires the equalization of the ratio of marginal productivities (of the two money inputs) to the marginal rate of substitution in production, as well as to the ratio of the costs of holding such cash balances.

The gist of the model revolves around maximizing the production of monetary services as described by the CES production function subject to the cost of holding such

balances. The production function is converted into money units by invoking purchasing power parity (PPP) such that S = Pd/Pf. For further simplification it is assumed that Pd = 1. The production function may now be expressed as:

$$MS = [\ \alpha 1 Md^{-a} + \alpha 2 sMf^{-a}\ ]^{-(1/a)} \qquad (3.1)$$

Where MS = money services

M = nominal cash balances held

α = degree to which cash balances provide similar money services in the domestic country

a = elasticity of substitution between Md and Mf. d and f denote domestic and foreign countries respectively.

With the introduction of PPP the model falls prey to all the criticisms directed at PPP as a theory of exchange rate determination.[1] Additionally, Cuddington (1983, p. 116-7) has argued that it is only when divergences occur from the purchasing power exchange rate that 'incentives' to switch between currencies arise.

Equation (3.1) describes the production of monetary services in terms of the domestic currency values of domestic and foreign money balances. Since under the two-stage money demand process the availability of such holdings is limited to the total value of cash balances a

transactor chooses to hold, so are limited the amount of monetary services that may be obtained from them. The costs associated with holdings of cash balances and which serve to qualify the benefits in terms of monetary services are described as:

$$Mo = Md(1 + rd) + sMf(1 + rf)^2 \qquad (3.2)$$

where Mo = quantity of total real cash balances as determined in the first stage of the demand process.

r = return on cash balances as a measure of the holding cost.

This nominal transformation of the physical units form of the asset constraint is obtained in the same manner as in equation (3.1). A transactor must allocate his cash holdings such that he maximizes the benefits subject to these costs.

Substituting the first order marginal conditions for (3.1) and (3.2) into the utility maximizing condition yields the utility maximizing equation for the currency composition of asset portfolios. Taking logs and rearranging to solve for Md/sMf provides Miles with the following empirically testable reduced form equation for the maximization of monetary services:

$$\ln (Md/sMf) = (1/1 + a) \ln(\alpha 1/\alpha 2) + (1/1 + a) \ln(1 + rd/1 + rf) + u^3 \qquad (3.3)$$

Parametric values consistent with a high degree of elasticity of substitution should be reflected by a high numerical value for $n = (1/1+ a)$. The degree of substitutability between currencies may also be reflected by the value of the $\alpha 1/\alpha 2$ ratio.

3.4 THE MILES MODEL: EMPIRICAL EVIDENCE

The preceeding chapter showed that demand side CS holds grave implications for the ability of a country to pursue independent monetary policy (section 2.4). It was shown there and in section 2.5 that the degree of monetary sovereignty that authorities enjoy is inversely related to the degree to which currencies are substitutes in demand. This may vary from complete independence in the case of perfect nonsubstitutability when a country may pursue independent policy objectives to the extreme opposite when currencies are perfect substitutes and market integration restricts the authorities to complete monetary conformism. Clearly the degree of CS becomes an important empirical proposition.

In his pioneering attempt to address this issue

Miles(1978a) estimates the elasticity of substitution between the Canadian and U.S. currencies for Canadians. In subsequent studies (1981) he broadens the analysis by estimating the elasticity between domestic currencies and all foreign monies for residents of both the U.S. and Germany.

Miles estimates the elasticity of substitution between the two currencies for Canadians using quarterly observations over a 15 year period from 1960/4 to 1975/4. This period was punctuated by an eight year spell when Canada adopted fixed exchange rates. The model was estimated for the entire sample period and when seperated by exchange rate regimes. The elasticity of substitution is found to be different from zero at the 95% confidence level for both flexible rate periods, permitting the rejection of the hypothesis that currencies are nonsubstitutes. No evidence of CS is found during the fixed rate period. At 5.78 (during the flexible rates of the 1970s) the numerical value of the elasticity measure indicates a high degree of CS between the Canadian and U.S. currencies for Canadian residents.

Results indicate evidence of CS during flexible rates with no support for CS during fixed rates. As explanation Miles puts forward the argument that it is only during the flexible rate regime that the substitutability enhancing

actvities of the private markets are invoked such that "... the public will have to resort to performing all of its substitution through private markets." Miles (1978a; p. 435). Our explanation of this as well as of our findings is presented in section 4.10 below.

In a later study (1981) the model was estimated for two more countries. The first estimates the elasticity of substitution between the U.S. dollar and all other currencies for U.S. residents. The other estimates the same between the Deutsche mark and all foreign currencies for West German residents. In both cases the model is estimated for the sample period as a whole and when separated by exchange regimes. Both tests find evidence of CS during the flexible rate period. For the U.S. the numerical value of the elasticity measure is found to be different from zero at the 90% confidence level for eight of the nine variants estimated. The average value of the elasticity of substitution is 3.72. For Germany the estimated value of the elasticity measure is 2.78 at the 97.5% confidence level (Miles 1981, p.80-83).

For the entire sample period eight of nine parametric estimates for the U.S. are significant at the 90% level. There is no support for CS for Germany during this period.

In the case of fixed rates tests for both countries

fail to reveal statistically significant differences from zero (except in one case for the U.S.). This pattern is repeated for the majority of empirical studies including ours.

Parametric estimates indicating a noticeable degree of substitutability between currencies translate into increased volatility in exchange rates in response to changes in relative holding costs. This prompts Miles (1981, p.85) to call for greater monetary coordination as he reinforces his advocacy of currency blocs such as the European Monetary System (EMS). The same argument is extended a step further by his call for a reversion to fixed exchange rates and for close coordination of monetary policies across national boundaries.

A similar call for a reinstatement of fixed rates is made by Boyer (1978 p.197). Recall that these proposals are countered by Girton and Roper (1981) see section 2.5 above, who argue that if the behaviour pattern of the monetary authorities is endogenized in recognition of the 'willingness to switch' (as in Hayek 1976a, b) recognition of CS may actually exert a stabilizing influence on exchange rate movements.

3.5 INCLUDING UNCERTAINTY

The original model as developed in Miles (1978a) and described above excluded uncertainty particularly associated with the exchange rate. This assumption is relaxed in Miles and Stewart (1980). Based on Stewart (1978) the authors show that faced with uncertainty in the price of a currency, as characterized by exchange rate volatility, risk neutral asset holders will shift out of the fluctuating currency and into one that offers price stability.

Changes in the value of each currency is measured with respect to the numeraire currency, Pw. It is assumed that Pw = 1 and that relative PPP holds such that the exchange rates may be given by Sd = Pw/Pd and Sf = Pw/Pf. With the explicit incorporation of the exchange rate uncertainty equation (3.3) changes to:

$$\ln(SdMd/SfMf) = \sigma\ln(\sigma 1/\sigma 2) + \sigma\ln((1 + if)/(1 + id)) + \sigma\ln(Bf/Bd) \qquad (3.4)$$

where Sd, Sf = expectations of the respective exchange rates; B = respective measures of uncertainty.[4] The form of (3.4) which is estimated is expressed as:

$$\ln(DC/FC) = a + \sigma\ln((1 + iFC)/(1 + iDC)) + b\ln(SDF/SDD) \qquad (3.5)$$

where SDF and SDD = respective standard deviations of percentage changes in Sf and Sd; and serve as proxy for Bf and Bd; DC and FC reflect domestic currency values of Md and Mf respectively. $b = Y\exp\sigma$; Y reflects nonlinearity in B.

Equation (3.5) is estimated for residents of Germany and the U.S. for quarterly data spanning the flexible rate period from 1971-78 with minor variations. For the U.S. both σ and b display significance at the 95% confidence level. For Germany the findings are somewhat less conclusive at 90% and 85% confidence levels for σ and b respectively. This, claim Miles and Stewart (1981, p.620-621), confirms the significant influence of exchange rate uncertainty on the currency composition of asset portfolios.

3.6 CRITICISMS OF MILES' MODEL

Miles' method for estimating the elasticity of substitution has been criticised on theoretical as well as empirical grounds. This section summarizes the major criticisms that have appeared in the literature.

On a theoretical level Bordo and Choudhri (B-C) (1982a, part 3) have argued that the high numerical values of the elasticity of substitution in Miles' estimates are due to specification bias. Estimation of the model corrected for

such omissions proved successful in reconciling Miles' finding with those of B-C. Their modification to Miles' model are based on the following form of the money demand functions:

$$\ln(Md/Pd) = Bo + B1 \ln y + B2\ id + B3\ if \qquad (3.6)$$

$$\ln(sMf/Pd) = Go + G1 \ln y + G2\ id + G3\ if \qquad (3.7)$$

Where the foreign interest rate parameters (B3,G2) capture the effect of CS on the respective money demands.

Since Miles examines the effect on relative holdings of money balances in response to changes in relative holding costs; B-C subtract (3.7) from (3.6) and rearrange to obtain the relative money demand function.

$$\ln(Md/SMf) = Do + D1 \ln y + D2\ id + D3\ (if - id) \qquad (3.8)$$

Where $Do = Bo - Go$; $D1 = B1 - G1$; $D2 = B2 - G2$;

$D3 = B3 - G3$.

B-C (p.54) estimate (3.8) for the entire period (1960/4 - 1975/4) and for the aggregated flexible rate subperiods. They find D3 insignificantly different from zero. Whereas D2 is found to have a significant negative value. The high

significance levels for the elasticity estimates obtained by Miles are attributed to specification bias particularly due to the exclusion of id. Since id is expected to be highly correlated to (if - id), when omitted part of its explanatory power may well be captured by (if - id) such that the latter appears to be more significant than it actually is.[6] Further, B-C also question the validity of D3 as an accurate measure of CS.

The validity of η in Miles as an accurate measure of CS is challenged by Spinelli (1983, p. 777) who argues that a positive η may merely reflect the fact that assets are gross substitites. A positive η is interpreted as the measure of the ease with which a change in the relative holding costs induces a shift in the currency composition of the money balances portfolio assuming <u>constant</u> the totality of cash balances.[7] While valid in the case of substitution between asset groups (such as domestic versus foreign securities) due to the constancy of total wealth, this assumption may not apply to two components of the cash balances portfolio. Indeed a change in relative (bond) interest rates may well induce changes in the total quantity of money held obscuring the measurement of CS. For example an increase in domestic interest rates may induce a shift out of domestic <u>and</u> foreign monies such that a positive η merely reflects the gross substitute nature of the two currencies.

Laney, Radcliffe and Willett (LRW) (1984) question the policy importance of the numerically high values of the elasticity of substitution obtained by Miles on the basis that they imply 'policy negligible' changes in relative foreign and domestic currency holdings.

Since foreign currency (FC) holdings are small to begin with a change in FC when compared to domestic currency (DC) holdings fades in importance. Note LRW do not question the numerical value of the elasticity, only its policy implications. Using average quantities of all foreign and domestic currency holdings of U.S. residents and assuming 4 as the average of Miles' estimates for the elasticity of substitution during flexible rate periods, LRW (p.1197-8) estimate a $110 million dollar change induced by a one percentage point change in the domestic r. Since this figures as 3.7% of all FC (110/3,000), and only .025% of DC (110/440,000,000), the authors conclude the latter to be 'undetectable' and the former policy negligible.

By way of response Miles (1984, p. 1201-2) points out that the theory of CS stresses the willingness to switch between currencies at the margin and as such this relatively small change may prove significant. Additionally, a lack of organized data has restricted foreign currency balances to "short term claims on unaffiliated foreigners payable in foreign currencies by non-banking enterprises" (p.1202). To

the extent that FC excludes:(i) other foreign currency holdings of U.S. residents; (ii) U.S. dollar holdings of foreign residents; and (iii) eurodollar balances; with the latter two well exhibiting a high marginal propensity to switch, the elasticity of substitution may exceed that estimated by Miles implying greater influence in the exchange markets.

3.7 OTHER CES MODELS OF CURRENCY SUBSTITUTION

A model not dissimilar to that of Miles (1978a, 1981) is developed and estimated by Chung (1983) in an effort to measure the elasticities of substitution between the U.S. dollar and the currencies of Japan and Germany, for their respective residents. Emphasizing the demand for money as the derived demand for the stream of utility yielding financial services that flow from it Chung constructs a 'two-level' CES utility function for monetary services.[1] From this function he derives the relative foreign country demands for U.S. dollars. The model essentially considers the utility maximizing (through asset substitution) behaviour of wealth owners subject to the asset constraint imposed by total asset holdings.

The empirical test is based on quarterly data spanning the flexible rate period from 1973 to 1979 (with slight variations). Estimates of parametric indicators show

divergence from zero to be statistically significant at the 5% level. At 4.36 and 1.62 the elasticities of substitution for Germans and Japanese residents respectively suggest significant responsiveness between these currencies and the U.S. dollar. The relatively higher level for Germany is attributed to the relatively greater similarity between the institutional structures of the two countries (p.24-25).

One may however want to quarrel with his interpretations of the results. High numerical values and positive signs for elasticity measures are interpreted to reflect exchange market stability; in contradiction to the findings of the extensive theoretical literature on the subject see e.g. chapter 2, particularly section 2.5.

3.8 THE BORDO AND CHOUDHRI TYPE MODELS

The Bordo and Choudhri B-C (1982a) study marks the pioneering attempt to analyze demand side CS using the demand function for money as the 'tool of analysis'. In so doing it describes what we have called the second category of 'direct' tests of CS. Sections nine to twelve of this chapter present brief summaries of the variations of this procedure that have appeared in the literature; each adds a unique element to increase the explanatory ability of the basic model.

The B-C study may be divided into two parts. The first seeks to test for the presence of demand side CS between Canadian and U.S. currencies for Canadian residents by way of the money demand function. The second strives to expose the weakness in Miles' (1978a) pioneering attempt at estimating CS by way of a CES function for the production of money services. The latter was discussed earlier in conjunction with Miles' analysis (see section 3.6 above). We present below a brief description of Bordo and Choudhri's method for the examination of the former.

The stipulation of a stable demand function for national monies in traditional theories is criticized by proponents of CS who attribute this stability to the forced exclusion of the influence of foreign holding costs on the domestic demand for money. It is argued that the inclusion of such costs would increase the explanatory powers of the money demand estimates. Bordo and Choudhri attempt to estimate precisely this differential explanatory ability (with and without the argument for CS) as a measure of the presence of cross responsiveness (substitution) between currencies. Should the estimates suggest significantly enhanced explanatory ability the case for the existence of CS would be reinforced.

A traditional single equation money demand function is specified for both the narrow M1 and the broader M2

definitions of the money stock. Note that the implied single-stage money demand process differs from the two-stage demand process a la Tobin employed in the previously considered models of Miles (1978a, b, 1981) and in the models by Brillembourg and Schadler (1979) below. In its general form the demand function is expressed as:

$$\ln(M/P) = Ao + B1 \ln y + B2\, rs + B3\, rL + B4\, ro + B5\, E + B6 \ln(M/P)t\text{-}1 + B7 \ln(Mt\text{-}1/P) + e \quad (3.9)$$

Where y = level of real income (GNP); rs = short term interest rate as measured by 90 day rate on finance company paper; rL = long term rate measured by 5 year GIC at Trust Companies; ro = rate on pure savings accounts; E = 4(F-S)/S = expected holding cost of the U.S. dollar as measured by the 90 day forward premium/discount.

E is the variable that introduces CS by including the return on foreign currency cash balances as a measure of the opportunity cost of holding domestic cash balances. Since both monies are noninterest bearing the return is restricted to appreciation of one in terms of the other. With quarterly observations the appropriate appreciation is measured by the discrepancy between the spot (S) and the expected future spot rate (Se) 90 days hence. Se being unmeasurable, the efficient market hypothesis permits its approximation by the forward rate (F), such that in the

absence of transactions costs risk neutral transactors acting on the basis of all 'currently available information' ensure that F = Se.'

If CS does exist the E argument is expected to be negative and significantly different from zero. Different versions of equation (3.9) were estimated, each for quarterly data over a sample period extending from 1970/4 to 1979/4. The ones that correspond closely to our tests are presented for comparison in table 4.2 below. In none of the tests was E found to be different from zero at an acceptable confidence level. This leads B-C (p. 51) to conclude that there exists no evidence of CS between the Canadian and U.S. currencies for Canadian residents.

3.9 THE BATTEN AND HAFER STUDY

Batten and Hafer (1984) extend the Bordo and Choudhri procedure to test for the presence and extent of demand side CS between the currencies of five industrialized countries and the U.S. dollar for the residents of each respective country. The five are Canada, France, Germany, the Netherlands and the UK. Based on quarterly observations for a sample period extending from 1966 to 1984 (with slight variations) they estimate the following (slightly modified) semilog specification of the money demand function:

$$\ln(M/P) = Ao + B1 \ln y + B2\, rs + B3\, E + B4 \ln(M/P)t-1 + e^{10} \qquad (3.10)$$

Their findings yield weak support for CS. During the flexible rate period the introduction of E yields statistically significant parametric estimates at the 5% level for only two of the five sample countries: Canada and Germany. No evidence of CS was found during the fixed rate period. The argument is weakened further by the extent of responsiveness which indicates a low .0007% change in Canadian money demand for a 1% change in E; and a .003% change in German money demand for a similar 1% change in E for the Deutsche mark (p.10).

Recall that Bordo and Choudhri found no evidence of CS between the Canadian and U.S. currencies for Canadian residents. This inconsistency is attributed to different sample periods employed for the two studies. Batten and Hafer's equation reestimated for the contracted period up to 1979 does not yield statistically significant evidence of CS either. Hence, the statistical significance as observed here is attributed by them (note 18) to post 1979 data.

Based on these findings the authors cite a lack of empirical support for CS. In the two cases when it does appear significant the extent of responsiveness is negligible.[11]

3.10 CURRENCY SUBSTITUTION AND POSTAL STRIKES

Daniel and Fried (1983) attempt a 'reconciliation' of the contradictory empirical findings of Miles (1978a) and Bordo and Choudhri (1982a) concerning the presence and importance of demand side CS. Considering only the transactions motive for money demand and following the procedure developed by B-C they show that, within the Canadian context, the contradiction may be attributed to the misspecification of the money demand function due to the inadvertent exclusion of the effect of postal strikes.

This shortcoming is resolved, argue the authors (p.615-6), by the adoption of a procedure slightly different from the one developed by Gregory and McKinnon (1980), who assume that during a postal strike the 'actual' quantity of money exceeds its 'available' quantity. In confirmation of this their findings indicate that conventional estimates of money demand underestimate during and overestimate immediately after, a postal strike.[12] For the postal strike to influence estimates of CS it must affect the E variable in the B-C type models. Consider Daniel and Fried's (p. 620) intuitive argument for this. A strike causes the 'available' stock of money to fall short of its 'actual' supply. This results in excess demand for both Canadian and U.S. currencies which is accomodated by the Bank of Canada. The total quantity of money increases,

however, the desired currency composition of cash holdings is not attained. An incipient attempt to switch between the two currencies causes the forward premium F to change. Since F changes, E is affected and the link between postal strikes and currency substitution is established.

The 'correctly' specified version of the B-C type money demand equation is given by Daniel and Fried (p.617) as:

$$mt = bo + (1 - x)mt-1 + xa\ yt + xB1\ Et + xB2\ rt + xB3\ FSt + G\ St - (1 - x)GSt-1 + seasonals + e \qquad (3.11)$$

Where x = coefficient of adjustment; mt = ln(M/P); FSt = 'forward premium slope dummy'; St = the fixed portion of the effect of a postal strike. FSt accounts for the above discussed effect of the postal strike on E.

Equation (3.11) is estimated for quarterly data over a 12 year flexible exchange rate period from 1970/3 to 1982/2. All parametric indicators have the expected signs and are significant at the 1% level. This, argue the authors, yields strong support for CS as well as for the link between CS and postal strikes.

One must stress however that their test is not entirely comparable to that of B-C since the time periods differ. As we have seen, later studies by Batten and Hafer (1984) did

find evidence of CS and attributed it to the later observations that they had included. Hence Daniel and Fried's results may simply be capturing the effect of these later observations. Their empirical results can therefore not be interpreted as providing strong support for their theoretical argument. This deficiency would have been resolved had they also tested for the presence of CS for the same period without the adjustment for postal strikes. Such a comparison would serve to clarify the issue.

3.11 AN ALTERNATE MEASURE OF FOREIGN INFLUENCE

Winder (1983) seeks to demonstrate the existence of CS in money demand by estimating a modified version of the conventional monetary models of Bilson (1978) and Hodrick (1978). While presented in a slightly modified form, his technique also tests for explanatory power of foreign influences on money demand. To this extent it is similar to the B-C type models. It may therefore equally well be estimated within the single equation money demand framework outlined by B-C with K (explained below) substituting for E.

The misspecification of money demand in conventional models due to the exclusion of foreign influences, he argues (p. 40), may be corrected by introducing an argument for the risk associated with holding each currency. If foreign influences are important then demand for a currency (and the

exchange rate) will be influenced by a change in the 'relative risk' of holding that currency.

This risk (K), argues Winder, is related to 'future inflation' and is determined by the 'uncertainty' with which expectations of 'future inflation' are held. Since K is unobservable it is proxied by changes in the focus currency's price of gold, a decrease in which signals expectations of future disinflation (p.41). Clearly this assumption is open for debate and to be accepted must be empirically supported.

The money demand function (for both countries) is expressed as:[13]

$$Md = ay \exp b1\ e \exp b2\ r\ e \exp b3k \qquad (3.12)$$

Where e is the natural log base. Writing in log form and differentiating Winder obtains the following exchange rate determination equation:

$$\%\Delta S = C + (\%\Delta M - \%\Delta M^*) + b1(\%\Delta y - \%\Delta y^*) + b2\Delta(r - r^*) + b3\Delta K - b^*3\Delta K^* \qquad (3.13)$$

Where * denotes the foreign country.

For empirical purposes the numerical values of K and K*

are obtained by calculating the standard deviation in the focus country's price of gold for each quarter and dividing it by the average quarterly price of gold(p.41).

Equation (3.13) is estimated for the U.S./German exchange rate for quarterly data over the flexible rate sample period from 1971/3 to 1978/4. The findings indicate expected signs for both the German and U.S. risk proxies. The former is found to be significant at the 1% level, the latter at the 5% level. When the two risk arguments are combined such that $\Delta(K - K^*)$ runs as a joint variable the results are equally supportive. Based on these findings Winder recognizes CS as adding "... realism as well as explanatory power to the traditional monetary model."(p. 43).

3.12 CURRENCY SUBSTITUTION IN A PORTFOLIO BALANCE FRAMEWORK

Cuddington (1983) argues that the model developed and estimated by B-C, and by many authors subsequently, analyzes CS within a restricted monetary framework. Since securities are assumed to be perfect substitutes in such models, interest rate parity (IRP) prevails such that $r = r^* + E$ holds. The inclusion of both sides of this equation and of E seperately, implies redundancy as well as perfect multicollinearity. Cuddington relaxes this assumption so that in the broader portfolio balance (PB) framework

securities exhibit varying degrees of substitutability and IRP no longer holds. Domestic and foreign returns now reflect the different respective opportunity costs. In such case all three arguments (r, E, r* + E) are required to be included as explanatory variables; the latter capturing the effect of capital mobility(Cuddington, p.118). He adds that this implies that it is no longer sufficient to attribute the presence of CS to a statistically significant E. Since E forms part of the capital mobility argument a high t value may merely reflect specification bias due to the exclusion of r* and may partly be due to capital mobility. Both (r* + E) and E must be included to distinguish the effect on money demand of capital mobililty from that of CS. This yields the following semilog form of the money demand function:

$$\ln (M/P) = Bo + B1 \ln y + B2\, r + B3\, (r^* + E) + B4\, E + e^{14} \qquad (3,14)$$

This equation is estimated for Canada, Germany, the United Kingdom and the U.S. using quarterly data for varying sample periods from 1960 to 1979 and for different monetary aggregates. The results are far from conclusive. Evidence of CS is found in only three of eight cases considered: for Germans between the DM and the U.S. dollar for the broad monetary aggregate M3 and for the UK with respect to the DM for both monetary aggregates (the positive sign indicating complementarity induces Cuddington to ignore the results for

the UK). Given the key currency nature of the DM and the U.S. dollar the results between these two countries, argues Cuddington (p.126), is clouded by the possible presence of simultaneous equation bias.

An important criticism of Cuddington's test for the presence of CS is that he fails to distinguish between exchange regimes. Section 4.6 below questions the validity of his results on the grounds that a lack of evidence of CS during the entire period does not imply its absence during individual exchange regimes. The results of our empirical tests tabulated in section 4.8 confirm this. Furthermore since international capital mobility ensures that interest rate parity (IRP) is continuously satisfied for the currencies of developed countries another criticism seeks to diminish the relevance of CS within the portfolio balance framework. This is discussed further in section 4.2 below.

3.13 THE BRILLEMBOURG AND SCHADLER PORTFOLIO BALANCE MODEL OF CURRENCY SUBSTITUTION

Brillembourg and Schadler (1979) develop an empirically testable model within the portfolio balance (PB) framework to estimate the cross 'semielasticities' of demand between the currencies of Canada, France, Germany, Italy, Japan, Switzerland, the United Kingdom and the United States. The second of the two stage demand process is isolated so that attention may be focused on the allocation of the total

money stock between currencies. The results so obtained are then compared to similar estimates of a model where cross elasticities between currencies are restricted to zero. This yields important comparative implications of the two models in predicting exchange rate behaviour and, hence, passes judgement on the need for incorporating CS in asset market approaches to exchange rate theory.

The model stipulates a portfolio balance framework with three assets (p. 518): national currencies, interest bearing securities and goods to which 'titles of ownership' are issued. All interest bearing securities are considered to be perfect substitutes such that interest rate parity (IRP) prevails. Furthermore all securities and other nonmoney assets are assumed to have (for analytical tractability) identical elasticities of demand with respect to money. This permits aggregation (by Hick's criterion) so that one composite nonmoney asset may be obtained. In the goods market ownership of titles versus the good itself is a technique which permits the separation of traded from nontraded goods yet allows both to form part of a foreign portfolio.

The model examines the utility maximizing behaviour of asset holders who face a tradeoff between risk and return. The adjustment of existing asset stocks to desired levels is by way of the Brainard-Tobin (1968) 'general disequilibrium'

adjustment process (p. 518).

Within the portfolio balance framework the authors present two methods from which the respective exchange rate equations may be derived. The first is too complex to solve analytically; it is based on a currency demand function no different from other asset demands in the general (PB) model. Attention is focused on the exchange rate by restricting consideration to the currency portion of the total asset portfolio. Since this form does not yield an easily testable model it is forsaken for the second method which modifies the original model to isolate the currency subsection by adopting the two-stage demand process which distinguishes between the proportion of assets allocated to total cash balances and the subsequent allocation of this given balance between individual currencies. Once the total cash holdings are determined in the first stage of the demand process (by the weighted summation of their equations (4) and (5)); the second stage of the demand process which determines the currency composition of these cash balances and the exchange rates (ek) is specified as:

$$ek = m - mk + \sum_{j}^{n} (\alpha kj - \alpha mj)rj + \gamma kT \qquad (3.15)$$

where rj = rate of return on currency j. The first two arguments show that the exchange rate depends on the

availability of focus currency mk relative to the total stock of money m. It also depends on the relative cross elasticities between individual currencies (αkj) and between total money and each currency (αmj)(p.524).

While the authors start off with a 'broad' portfolio balance model with goods, bonds and money; in the final analysis their model resembles the monetary models of conventional theory. In an effort to make empirically and analytically manageable their analysis they inadvertently drop the basic assumptions of the portfolio balance model by imposing IRP such that all securities may be traded in one market; this is further restricted by assuming constant the elasticity of substitution between money and all nonmoney assets such that all securities and goods merge into one composite asset. Consider also the role of wealth; while included in the first stage of the demand process the wealth argument must definitionally be excluded from the second stage of money demand reducing the general portfolio balance model to the familiar monetary framework of conventional theory; except of course for the inclusion of third currency cross responsiveness between currencies. Since this reduction must occur would it not be much simpler to start from one such model and work upwards to include the requisite cross responsiveness?

Equation (3.15) is estimated for each of the eight

countries in an effort to estimate the respective semielasticities. The test is performed for monthly data over a period from March 1973 to June 1978. The presence of cross responsiveness should yield nonzero parametric estimates. The findings (as per their table 1) are unclear at best. Only ten out of the 56 cross measures and four out of eight own elasticity measures display divergence from zero at the 5% significance level.

With positive parametric estimates the currencies of Europe display complementarity with respect to each other. The U.S. and Canadian currencies are found to be substitutes to them (p.527). Further support for complementarity is found when the equations for the European countries are aggregated such that at 2.15 the own semielasticity measure exceeds all individual measures. This, argue the authors, yields support for a 'European currency bloc' (p. 528).

The comparison of the explanatory ability of the models with and without the incorporation of cross responsiveness yields no apparently clear results. A chi squared test however indicates significantly increased explanatory ability to the model with cross currency responsiveness.

3.14 INDIRECT TESTS OF CURRENCY SUBSTITUTION: THE EVANS AND LAFFER STUDY

Evans and Laffer (1977) test for the presence of CS by considering the predictive accuracy of policy implications that flow from it.[18] Since the theoretical literature postulates a direct relationship between CS and the degree of monetary interdependence, Evans and Laffer attempt to measure the extent of monetary interdependence between six developed countries as a test for the degree of substitutability between their currencies. The six are Canada, France, Germany, Italy, Japan, and the UK. The basic premise of their model is that perfect substitutability implies interconnected monetary policies and uniform rates of inflation such that uncoordinated monetary expansions would have no predictable effect on the exchange rate. Conversely, perfect nonsubstitutability would imply independent national monetary structures so that divergent monetary policies would cause divergent inflation rates and exchange rate changes as predicted by Purchasing Power Parity (PPP).

Combining PPP with Fisher's quantity theory, solving for the exchange rate S and taking logs yields the following equation for empirical estimation:

$$\%\Delta S = a1\ \%\Delta Ma - a2\ \%\Delta Mb - a3\ \%\Delta ya - a4\ \%\Delta yb - a5\ \%\Delta(Va/Vb) \qquad (3.16)$$

If currencies are perfect substitutes such that policy excesses are evenly distributed across the board, even under flexible exchange rates, the independent variables will exert no predictable influence on S and values of the parametric estimates should be close to zero. In the case of zero substitution policy excesses are restricted to the native country such that domestic variables only are affected, in this case parametric values are expected to approach unity (Miles 1978b, p.181).

Equation (3.16) estimated for monthly data for a sample period from 1968/1 to 1975/12 yields low parametric estimates such that for only some variables and for some countries are the estimates significantly different from zero. This is interpreted as further support for the presence of CS. One must note however that in the absence of agreement on the purchasing power exchange rate this test stands vulnerable to all criticisms directed at the PPP theory.

3.15 CURRENCY SUBSTITUTION AND THE INTERDEPENDENCE OF NATIONAL VELOCITIES

Brittain (1981) addresses, somewhat indirectly, the issue of CS analyzing it from the rather unique angle of the relationship between the apparent 'interdependence' of fluctuations in the income velocities of circulation of money for Germany, Italy, Switzerland, the UK and the U.S.

(his analysis concentrates on Germany and the U.S.). The purpose of his study is three-fold; (i) to identify the 'apparent instability' in national income velocities; (ii) to establish the interconnection between the divergence from respective national trends of velocity measures; and (iii) to explain the nature of the 'coincidental' intercountry divergence by the presentation of a diversified portfolio balance framework where money substitutes and foreign currencies figure as legitimate arguments in the money demand function.[16]

Empirical tests of the first two issues identify 'coincidental transnational movements' in the divergence from respective national trends of income velocities exhibiting a direct relationship between currencies of the same group and an inverse relationship between currencies of different groups (p.138-142). The country groups distinguish Germany and Switzerland from Italy, the UK and the U.S.

These tests are based on the period extending from 1955 - 1979 (the period varies slightly from country to country). Estimates of the coefficients of correlation for divergence from trend of national velocity measures indicate formation of country groups analogous to the substitute and complementarity issue of Brillembourg and Schadler (1979). This prompts Brittain to suggest: "... individuals favour

the Deutsche mark and the Swiss franc whenever they disfavour the Italian lira, the Pound Sterling, and the U.S. dollar..." (p. 138). To confirm this interdependence between national income velocities Brittain(p.139) regresses different combinations of divergences of income velocities from respective national trends as explanatory variables on the velocity of U.S. M1. This yields increased explanation of changes in the velocity of U.S. M1. This and other tests (p. 141-2) highlight the connection between national velocity measures implying a lack of independence of the former from the currency composition of asset portfolios. Indeed Brittain points out that the interdependence between velocity changes within and between groups implies behaviour 'jointly consistent' with interconnected monetary policies. Interestingly his findings (p.141-2) point to the existence of such behaviour mainly during the flexible rate period. This reaffirms the findings in this thesis and in other studies of a higher degree of CS during the flexible rate period.

The third point and perhaps the crux of his analysis is best described by a restatement of the Fisher Quantity theory equation in the following form:

$$V = P \cdot Y/Ms \qquad (3.17)$$

Brittain (p.137) argues that Ms may be stable such that

fluctutations in V may be attributed to changes in money demand. Such changes in demand are attributed to wealth owners who are continuously optimizing, through substitution, the currency composition of their portfolios. In keeping with this tradition money demand for currency c (Mdc), in a two country (C, US) world, is expressed as:

$$Mdc = b_0 + b_{1c}\, r_c + b_{2c}\, r_{us} + \sum_{i=1}^{2}\sum_{j=1}^{2} c_{ij}\, \sigma_i \sigma_j + b_{3c}\, Y_c + b_{4c}\, Y_{us} \qquad (3.18)$$

Where b = coefficients; r = expected holding costs; σ = variance of return as a measure of risk e.g. due to depreciation; Y = income, i = us and j = c.

Empirical tests of variants of (3.18) for the U.S., Germany and the UK based on quarterly data for the approximate sample period 1960-1979 yield the strongest results for Germany. This implies that a broader specification of money demand, one that permits CS and hence accounts for international currency movements, provides enhanced explanation of the German income velocity measures. Similar yet not quite as strong results were obtained for the U.S. Estimates for the UK were the weakest. This explanatory capability observed by Britain reinforces the case for the presence of demand side CS.

3.16 CURRENCY SUBSTITUTION AND WORLD MONEY SUPPLY

McKinnon (1982) examines CS within an analytically tractable, restrictive, two-country open economy framework with analysis limited to the very short run. His study is divided into 3 parts. The first tests for the presence of CS by examining the concept of 'world money'. This is done by testing for the effects of national versus world monies on domestic price inflation. The second part develops the demand side of the model under the assumption of perfect capital mobility such that transactors may freely hold balances of domestic and foreign currencies. The third part introduces the respective national money supply processes with the object of showing that CS may well imply unstable world money supply even when faced with stable world demand for money. This is done by comparing the implication of exchange market intervention policy when it is 'passively sterilized' to when it is not. Consideration is restricted in this thesis to the first part of his study, and criticisms of it, as an indirect test for CS.

Previous sections have stressed the direct link between CS and monetary interdependence such that in the extreme, when currencies are perfect substitutes, monetary excesses may be evenly diffused over all countries resulting in uniform rates of growth in money supplies and identical rates of inflation. This fosters the concept of a world

money and its relation to national price levels. The basic premise of McKinnon's analysis is that perfect nonsubstitutability between currencies implies complete monetary independence such that domestic monetary policy excesses would be completely contained locally resulting in a high domestic inflation rate. The same 'insulating' properties imply that no systematic link would be expected between the domestic rate of inflation and the rate of increase in the world money stock. Conversely, perfect substitutability between currencies predicates complete monetary integration such that monetary excesses no longer exhibit a systematic link with the rate of domestic inflation. However, a direct systematic link may be expected between the rate of domestic price changes and the rate of growth in the world money stock.

Evidence of the latter e.g. for the U.S. and Switzerland, when the U.S. experienced monetary growth 11.5% below that of Switzerland for 1978 yet witnessed (with a lag) inflation 8.5% in excess of that country, prompts McKinnon to state that:

> "While not conclusive, the data are at least consistent with the idea that national monies are substitutable to the extent of making national money demand functions appear quite unstable if foreign exchange considerations are ignored."(p. 324)

In constructing his model McKinnon assumes the world

demand for money to be stable so that the world stock of money best explains changes in national prices. Spinelli (1983, p. 758) has pointed out that according to Friedman's fixed monetary growth rule, world monetary stability requires that the rate of growth of world money must also be stabilized. To achieve this each country must adjust its national money stock to changes in demand for it (as per exchange market pressure) by 'nonsterilized' intervention.[17]

In response to McKinnon's informal 'analysis by observation' of the relationship between world money and national price levels, Ross (1983) attempts a formal analysis of this proposed systematic link. He regresses one year lagged values of US price changes on US (Mus) and world(Mw) money stocks. When ranked by the Spearman Rank method his results contradict McKinnon's findings such that US price changes are better explained by the US money supply.

In response McKinnon and Tan (1983) strive to demonstrate the validity of McKinnon's original assertion by dividing the sample period at 1970. The second half witnessing the transition to flexible exchange rates and enhanced 'key' currency role for the German and Japanese currencies is purported to be the relevant sample period. This data period does demonstrate validity for McKinnon's assertion using the identical ranking method. Additionally,

their results also show that a regression of lagged values of the U.S. and world money supplies on U.S. price inflation accords greater explanatory power to the world money supply variable lagged two years. U.S. money supply parameters are also found to be statistically significant. They also perform an F test to show that adding the world money supply does increase significantly the ability to explain the U.S. price level.

Spinelli (1983, part IV) reexamines McKinnon's hypothesis by estimating the relationship between domestic price inflation and national and international measures of money supplies for 'the group of ten' countries based on 'deseasonalized' quarterly data for the flexible exchange rate period from 1973/1 to 1980/3. The three equations estimated for each country are distinguished by the choice of independent variables: the first tests for the effect of changes in the domestic money supply (Md); the second includes rest of world (ROW) money as an added explanatory variable; the third employs McKinnon's specification of world money, Mw.[18] In nearly all cases his findings attribute the most explanatory power to case 2 (which considers both Md and MROW as regressors); case one (Md only) outranks case three (Mw) for all countries except France.[19] These results attribute to McKinnon's theory the <u>least</u> degree of explanatory power.

The assertion of a systematic link between world money supply and national prices (specifically for the U.S.) is also disputed by Goldstein and Haynes (1984). Based on quarterly data for ten industrialized countries they estimate a simplified version of the 'St. Louis type' equation for changes in the US price level (GNP deflator). The sample periods stretch from 1973/2 to 1982/2 and 1970/1 to 1982/2. The variable MROW represents, as for Spinelli, the world exclusive of the U.S. Their results indicate significant explanatory power to the U.S. M1 as opposed to the world and ROW money supplies. The authors use these findings to refute interdependence between countries and, hence, raise questions as to the importance of CS.

3.17 SOME 'LESS FORMAL' TESTS OF CS

Goldstein and Haynes (1984, p. 220) describe some, what they label, 'less formal' tests to compare the degree of CS under the two exchange rate regimes. Less formal because the evidence these tests provide is not conclusive. Both tests devised and executed by them indicate reduced degrees of CS under flexible as compared to fixed rates. The first compares changes in national money supplies and the respective consumer price indexes (CPI) for ten developed countries during two periods of six years each. Their basic premise is that increased interdependence (due to CS) would yield uniform national inflation rates i.e. unrelated to

changes in respective national money supplies. The measure of independence is the divergence in the dispersion between changes in the money supplies and changes in national measures of the CPI. Examined over two distinct sample periods 1963-69 and 1976-82 spanning both exchange regimes yields evidence of reduced CS during the latter (flexible rate) period.

The second test (p.220) considers dispersions between national inflation rates as a measure of the lack of monetary interdependence. Here again a lower level of dispersion was observed during the fixed rate period as compared to during flexible rates indicating increased independence (lesser degree of CS) during the latter.

The nature of these tests at best permits an imprecise comparison of the extent of CS during the two exchange regimes. The suggestion of a higher degree of CS during fixed as compared to flexible exchange rates disagrees with the empirical findings of this study as well as those of Miles (1978a, 1981) and Batten and Hafer (1984). Their findings also go against the theoretical case for greater CS during flexible rates put forward in section 4.10 below. For these reasons not much importance is attached to these

results.

3.18 CRITICISMS AND POLICY IMPLICATIONS

Criticisms of the theory of CS may be addressed to the theoretical underpinningss of models that incorporate it or to the implications obtained from such models. Arguments on both these fronts may be found in Laney, Radcliffe and Willet (LRW) (1984) as well as in Spinelli (1983).

Based on a rational expectations variant of the open economy models Spinelli (p. 762-6) shows that CS is only one of many factors which may compromise the insulating properties of flexible exchange rates. He also stresses the presence of perfect foresight and continuous adherence to PPP as other requirements for monetary independence under flexible rates.

LRW (p. 1196-7) stress that capital mobility, terms of trade as well as wealth effects all figure prominently as arguments which undermine the insulating properties of flexible exchange rates. To this extent CS merely provides one more channel through which monetary disturbances may be transmitted across national boundaries, but it is not the only channel. By extension this argument implies that the case for synchronized policy 'currency blocs' appears valid only when the degree of CS approaches infinity such that

this route for intercountry transmission of inflation overwhelms all others. While perfect CS can argue for a fixity of exchange rates, low levels of CS, argue LRW, cannot make a similar statement for flexible rates since the extent of transmission of monetary disturbances through other sources remains uncertain.

Yet another criticism of CS draws on its destabilizing influence on national money demands. This is attributed to the influence of changes in the holding costs of foreign currency balances. Spinelli (1983, p. 759) points out that countless studies over the last three decades have found low own interest elasticities of money demand and even lower responsiveness to changes in foreign returns (see section 4.11 below). He adds that the same studies using income/wealth and a measure of the home holding cost as independent variables generally explain the majority of movements in money demand.[20] Direct tests such as by Batten and Hafer (1984) present estimates of elasticity of substitution between currencies that fade in comparison to own elasticity measures such that while few dispute CS as a theoretical construct, many consider its implications to be 'policy negligible'.

FOOTNOTES TO CHAPTER 3

1. For a survey of the historical development of, and recent modifications to purchasing power parity as a theory of exchange rate determination see Bana (1981,chapter 2). The classic survey remains that of Officer(1976). Isard (1978,section 2.1) and Katseli-Papaefstratiou (1979) are two additional review articles.

2. Cuddington (1983, p. 116) has also questioned the use of 'uncovered' rates of return on treasury bills as accurate measures of the holding costs of domestic and foreign cash balances.

3. Note that this model does not account for uncertainty commonly associated with exchange markets. In a later paper Miles and Stewart (1980) (see section 3.5 below) explicitly consider uncertainty in the price of a currency as characterized by exchange rate volatility.

4. When uncertainty is reduced to zero, B1 = B2 = 1 such that the last term in (3.4) disappears.

5. Recall that as before FC reflects all foreign currencies.

6. The share of id explained by (if - id) may be measured by the auxiliary regression coefficient.

7. This is a direct consequence of the two-stage money demand process.

8. Utility is indexed with no further details given.

9. A brief review of the role of F as a predictor of Se appears in Bana (1981, Section 3.2). The nature of the relationship between the two centres on the issue of bias (associated with risk aversion) and variance. Evidence in support of the hypothesis includes studies by Isard (1978, section 2.3) and B-C (1982a, note 2). B-C (p.49) also quote further supporting evidence as Frenkel (1978, 1980a, 1980b) Hakkio (1980) and Levich (1979). Aliber (1976), among others, examines the issue of variance in F. The possibility of systematic bias in the residual error terms due to the approximation of Se with F calls for employment of the instrumental variable procedure wherever (F-S)/S is used as a measure of expected changes in the exchange rate. When the model was reestimated with the Durbin-Rank variable as the instrument for E the results remain unchanged (B-C,1982a,p.51).

10. Only the narrowly defined measure of the money stock is used. The (0,1) interactive variable technique is used to differentiate between exchange rate regimes.

11. A contentious point is the assertion by the authors (note 7) that in the face of easily accessible eurodeposit facilities the transactions motive for money demand in currency diversification should be negligible. The weakness of this argument is evident when compared to the domestic environment. If domestic residents hold cash balances for transactions motives rather than investing them in domestic interest earning assets similar motives exist for foreign transactors trading in the same domestic market.

12. The former is caused by borrowing to offset receivables stuck in a stationary postal system; since this shortfall is generally offset by the central bank; the overestimation stems from the augmented value of the lagged dependent variable (Daniel and Fried 1983, p. 615).

13. The coefficients of y and r are assumed to be identical for both countries.

14. Since world capital markets are highly integrated r, r* + E and E are expected to be correlated clouding the interpretation of explanatory ability by multicollinearity.

15. We were unable to obtain a copy of this unpublished study. The following summary is based on a description in Miles (1978b, p. 180-181).

16. Brittain (p.135-6) points out that Hamburger's (1977) empirical address of the same instability of income velocity for the U.S. resulted in significant enhancement of the explanatory powers once the effect on money demand of the rates of return on long term U.S. dollar denominated interest bearing financial assets and on equity issues were included. He strives for further enhancement of explanatory powers by permitting portfolio diversification over currencies as well.

17. Spinelli (1983, p. 756-8) has also pointed out that adjustment of growth in the domestic money supply consistent with the designated world money growth rate requires knowledge of the respective income velocities of money and of money multipliers.

18. Note that Mw = MROW + MUS. McKinnon does not consider MROW as an independent argument in his equations.

19. The similarity of results for countries both (economically) small and large lays to rest the notion that McKinnon's findings for the U.S. were due to the large

country nature of the U.S. and the concomitant large differences between MROW and MROW + MUS.

20. For a recent survey on money demand see Judd and Scadding (1982).

CHAPTER 4

EMPIRICAL TESTS FOR THE PRESENCE AND EXTENT OF CURRENCY SUBSTITUTION IN CANADIAN MONEY DEMAND

The evidence on the presence of demand side currency substitution (CS) is by no means conclusive and certainly not exhaustive. In cases where tests have confirmed its presence the extent of cross responsiveness was found to be policy negligible (Laney, Radcliffe and Willet (1984, p.1199) and Batten and Hafer (1984, p.10) such that the extent of changes in the currency composition of asset holders portfolio induced by changes in foreign currency holding costs would not exert significant influence on the exchange markets.

This chapter tests for the presence and extent of cross responsiveness in Canadian money demand. Section 4.1 suggests that most tests for cross responsiveness focus on the US dollar as the foreign currency. Even so these tests yield conflicting results for the presence and extent of CS. Little effort has been made at testing for the presence and extent of cross currency responsiveness for the Canadian dollar vis à vis the major European currencies.

Section 4.2 describes the framework within which we

test for the presence of cross currency responsiveness. The procedure adopted here corresponds to the one pioneered by Bordo and Choudhri (B-C) where the focus country money demand function serves as the 'tool of analysis'. The model specified diverges from that of B-C in that it includes, in addition to the respective foreign currency return variable, an argument for return on the US dollar. The section also explains the procedure used to calculate the 'cross' exchange rates for countries for which direct exchange data was not available.

Section 4.3 describes the (0,1) interactive variable technique which permits the seperation of the sample period into the respective exchange regimes without loss of the number of observations.

Section 4.4 seeks to provide theoretical as well as intuitive explanations for the variables included in the model. The introduction of the return on the US dollar in addition to that on the respective European currencies is explained. The section also seeks to clarify certain relevant econometric issues and to justify the ordinary least squares (OLS) estimation procedure employed.

Section 4.5 examines the issue of substitutability versus complementarity. It is argued that the theory of CS may more appropriately be characterized as a theory of cross

responsiveness in currency demands such that currencies may be considered to be either substitutes or complements. The latter implies comovements in currency values such that currency blocs like the EMS may well be justified.

Section 4.6 questions the validity of tests for the presence of cross currency responsiveness which fail to differentiate between exchange regimes. With particular reference to Cuddington (1983) it is suggested that the explanatory ability of the cross responsiveness argument under separate exchange rate regimes may diverge significantly from when the sample period fails to make such a distinction. This noticeably reduces the relevance of Cuddington type studies.

Section 4.7 presents the parametric estimates for the standard money demand function for Canada. This is to confirm the goodness of fit of the standard model to which the cross responsiveness arguments are subsequently added. This section also describes the various variants of the model employed in subsequent tests for the presence of cross currency responsiveness.

Section 4.8 presents the results of tests for the presence of CS. Estimates for equations both with and without the return on the US dollar variable are reported. The results indicate evidence of cross responsiveness for

most countries during flexible rates. No evidence of cross responsiveness is observed during fixed rates. Contrary to expectations results for the UK are inconclusive.

Section 4.9 presents a brief comparison of our results with those of Brillembourg and Schadler (1979) as the only other multicurrency test for cross responsiveness for the Canadian dollar. Based on the results of tables 4.2 to 4.8 this section also confirms the weakness of studies for the presence of cross responsiveness which do not differentiate between exchange regimes. Section 4.10 tries to present an intuitive explanation for the strong support for the presence of CS during flexible rates when compared to fixed rates. It is argued that intertemporal fixity in exchange values dampen expectations of large discrepancies between the spot and forward exchange rates such that the inducement to change the currency composition of asset portfolios is reduced.

Section 4.11 tabulates the numerical values of the cross elasticities of substitution for those currencies for which CS is found to exist at an acceptable significance level. Since the equation stipulates a semilog specification the formula for such calculations is derived. The elasticity measures are calculated using the mean as well as maximum values of the respective return on foreign currency arguments. The own interest as well as income

elasticity measures are also presented for comparison.

4.1 Background

A brief comparison of the empirical findings of principal contributors in the area highlights the discrepancy between empirical results for the same countries albeit for different time periods. As a case in point consider the various attempts at determining the presence of CS for Canadian and US residents with respect to the US and German currencies respectively. In their pioneering study Bordo and Choudhri (B-C) (1982a,table 1) find no evidence of CS between the Canadian and US currencies for Canadian residents. These results were reconfirmed by Cuddington 1983 (table 1 equation 4) as well as by Brillembourg and Schadler (1979, table 1). Conversely Batten and Hafer (1984, table 2), using a model similar to that of B-C find that Canadians do indeed consider the two currencies to be substitutes[1]; their findings are reconfirmed in section (4.7,table 4.2) below.

Similarly evidence of substitutability between the Deutsche mark (DM) and the US dollar for Germans yields conflicting results. Cuddington (table 7) and Brillembourg and Schadler (table 1) using different models find no evidence of CS whereas Batten and Hafer (table 2) do.[2] Further conflicts in empirical findings may also be found

for residents of France vis à vis the US dollar and for Britons with respect to the German mark.

The purpose of highlighting these conflicts is clearly not to demean these results but rather to stress their inconclusive nature which calls for further empirical research in this area. Note also that attempts at testing for the presence of CS have centered around the US dollar as a substitute for respective national currencies. Indeed the reserve or 'key' currency role of the US dollar justifies and requires such analysis, however the emergence of European currencies as increasingly important substitutes to the US dollar in financing world trade calls for an examination of the cross responsiveness of national currencies with respect to these monies as well. The only attempt to remedy this comes at the hands of Cuddington (1983, tables 3 and 4) for British residents vis à vis the German mark.[3]

In this thesis we attempt to cure this deficiency by testing for the presence of currency substitution (also referred to here as cross responsiveness) between the Canadian dollar and the currencies of seven industrialized countries, for Canadian residents. The countries considered are Belgium, France, Germany, the Netherlands, Switzerland, the United Kingdom and the United States.[4]

As was mentioned above, in their tests for foreign influences on Canadian money demand B-C find no evidence of CS for Canada. Replicating the study for a longer sample period B-H find support for CS but only during the flexible rate period. Based on this the former study recognizes CS as a conceptual curiosum with no practical applications (at least for Canadians vis à vis the US dollar). The latter, with low numerical value for the cross elasticity of money demand, find its effects to be 'policy negligible'.

In this thesis we employ a variant of the B-C model to test for the existence of CS in Canadian money demand vis à vis the currencies of each of the seven countries mentioned above. In cases where CS is found to exist within acceptable confidence levels the numerical value of the elasticity of substitution is calculated.

B-C type and other conventional models of CS consider the money supply process to be distinct from money demand such that the latter may freely be used as the tool of analysis. Prof. Velk has stressed that interaction may well exist between the two sides of the money market equation. By way of example he describes a small country which experiences demand for say bank supplied US Dollars. This increases the foreign source component of the monetary base increasing the available quantity of the small country's money stock. Two important implications result: a) the

aggregate of world 'subsidiary' monies increases; b) as does the available quantity of private bank issued US Dollars[5].

4.2 The Model

This study adopts the 'monetary' framework of B-C to test for the presence of cross currency responsiveness. To this end it considers the money demand function of the focus country, in our case, Canada, as the 'tool of analysis'. The 'monetary' model of B-C is distinguished from the 'portfolio balance' variant estimated by Cuddington (1983, p.118) to distinguish currency substitution from capital mobility (see section 3.12)[6].

The theory of CS seeks to examine the effect of foreign influences on the currency composition of Canadian asset holders. One way to achieve this is to estimate the effect on domestic real money demand of changes in the yield on foreign currency. In essence this considers cross responsiveness, or cross elasticity of money demand, as an indicator of CS. Since money yields no pecuniary return, any return on foreign currency must be in terms of expected changes in the domestic currency value of foreign currency.

The most general form of the model estimated here is presented below. It differs from that of B-C (see section 3.8 above) and more recently from that of B-H in that the

EUS argument is added to account for the singular importance of the expected return on the US dollar in addition to the expected return on holdings of individual European currencies. The single equation reduced form log-linear model has the following semilog specification:

$$\ln(M/P) = B0 + B1 \ln y + B2\, r + B3 \ln(M/P)_{t-1} + B4\, EFC + B5\, EUS + e \qquad (4.1)$$

Where M = Currency plus demand deposits; the narrow definition of the money stock, M1.

P = GNE inflator

r = a measure of short term (90 day) interest rate.

$(M/P)_{t-1}$ = one period lagged values of M and P respectively (the lagged dependent variable).

EFC = [(F-S)/S] x 4; where F and S are the forward and spot rates respectively in terms of Canadian dollars per foreign currency. In words EFC measures the percentage discrepancy between spot and forward exchange rates as a measure of the percentage expected return on holdings of the foreign currency. It is multiplied by four to annualize the return.

EUS = [(FUS - SUS)/SUS] x 4; annualized expected return on the US dollar.

Consider briefly the nature of exchange rate data. Values for the spot and forward rates for the U.S. dollar and for the Sterling were obtained from CANSIM. In the absence of published data on the direct spot and forward exchange rates 'cross rates' were used for the Canadian dollar vis à vis the currencies of Belgium, France, Germany, the Netherlands and Switzerland. Since spot and 90 day forward rates between the US dollar and these currencies were available, the respective US dollar rates were used as the common denominators to obtain the exchange rates with respect to the Canadian dollar. The transformation is as follows:

Available: US dollar/FC and US dollar/Canadian dollar. Rearranging we obtain:

$$(US\$/FC) \;/\; (US\$/C\$) = C\$/FC \qquad (4.2)$$

Where FC = the appropriate foreign currency. For consistency both the spot and the 90 day forward rates were obtained in this manner.

It is argued that risk free profit making opportunities through triangular arbitrage in the spot as well as forward exchange markets (separately) will guarantee that condition (4.2) is continuously satisfied. It is also assumed that foreign exchange transactions costs are negligible or non

existant such that the bid and ask spread (which is a measure of these costs) is negligible. As a curiosum, in cases where transactions costs cannot be assumed to be zero one may assume the exchange rate to be the midpoint of the bid and ask values. This would serve to successfully minimize the effect of such costs. The cross rates procedure seems to have also been used by Cuddington (1983, tables 3 and 4) to obtain the Pound Sterling/Deutsche mark spot and forward exchange rates.[7]

Consider Cuddington's argument that the B-C specification analyzes CS in a monetary framework at the explicit exclusion of the distinction from CS of capital mobility (see section 3.12). His attempt at analysis within the portfolio balance framework assumes that domestic and foreign securities are not perfect substitutes such that the argument for net return on foreign bonds (adjusted for changes in the exchange rate) must be explicitly included. The literature stresses that interest rate parity (IRP) does actually hold such that the domestic interest rate and expected depreciation/appreciation arguments rd and E respectively, presuppose the third foreign interest variable rf such that $E = rd - rf$. With E and rd given the introduction of rf is redundant. Any inducement to switch due to capital mobility is therefore captured by the domestic interest argument. A similar argument appears in Batten and Hafer (1984. p.8).

Data sources and definitions of variables, as specified for each country, appear in appendix 1.

4.3 Separation by Exchange Regimes

For the period under consideration here Canada was under flexible exchange rates upto 1962/2 and from 1970/3 onwards; the remaining years (from 1962/3 to 1970/2) were spent under a fixed rate regime. This breakdown permits an acceptable data set to separately determine the presence and extent of CS under both the fixed as well as flexible exchange rate regimes.

The parametric value for the CS argument is expected to display similarity within each exchange regime, yet diversity across regimes, hence the introduction of the dummy variable will appropriately define the two. The dummy variable of course may be introduced in two forms. One method would yield the following modification to equation (4.1):

$$\ln(M/P) = B0 + B1 \ln y + B2\, r + B3 \ln(M/P)t\text{-}1 + B4\, EFC + B5\, EUS + B6\, D1 + e \qquad (4.3)$$

D1 is the dummy variable which equals 1 during flexible rates and zero otherwise. A large statistically significant parametric estimate for D1 would indicate important

differences between exchange regimes vis à vis CS.

The other technique for accounting for differences during the two exchange regimes is by way of the (0,1) interactive method where EFC is divided into EFC1 and EFC2 such that EFC1 denotes the value of the EFC argument for all observations during the flexible rate regime; it equals zero when the exchange rate is held fixed. Similarly EFC2 denotes the value of EFC for all observations during the fixed rate period; it equals zero during flexible rates. The resulting equation has the following specification:

$$\ln(M/P) = B0 + B1 \ln y + B2\, r + B3 \ln(M/P)t-1 + B4\, EFC1 + B5\, EFC2 + B6\, EUS1 + B7\, EUS2 + e \qquad (4.4)$$

Where EFC1=EFC x D1; EFC2 = EFC x D2

D1 = 1 during flexible rates, 0 otherwise

D2 = 0 during flexible rates, 1 during fixed rates.

To report results for both types of equations which merely look at the same question from two different angles, indicates redundancy, hence estimates of only the second type (4.4) are reported in the tables below.

4.4 Some Econometric Clarifications

This section seeks to provide theoretical/intuitive explanations for the arguments included in equations (4.1,4.3 and 4.4). It also seeks to clarify certain relevant econometric issues and to justify the ordinary least squares (OLS) estimation procedure employed.

The lagged dependent variable

Since the money market may not clear in one quarter the lagged dependent variable is included to account for 'partial adjustment'. Although the equation includes an intercept term (and no extreme observations exist) the lagged dependent variable invalidates the use of the Durbin Watson statistic as an appropriate indicator of the extent of serial correlation in the stochastic disturbance terms. As an alternative the Durbin h statistic is reported. In cases when values of the Durbin h statistic do not fall within the critical value of +/- 1.65 (and the null hypothesis that residuals are serially uncorrelated is rejected at the 95% confidence level) the Cochran Orcutt procedure may be used to correct for first order autocorrelation. The type of procedure used is reported alongside each equation.

The forward rate as a predictor of the future spot rate

Consider the forward exchange rate F in the expected return on foreign currency, EFC, argument. The relevant exchange values that permit the realization of this return are the spot (S) and expected future spot (Se) exchange rates. The former is easily obtained, the latter is an unmeasurable value and must be proxied. In section 3.8 (particularly note 9) above it was argued that the forward rate F is considered to be an accurate measure of Se: for a discussion of the accuracy of F as a predictor of Se including the questions of bias (due to risk) and variance see Bana (1981, section 2.3). It is argued there (and in section 3.8 above) that evidence supporting F as an unbiased predictor of Se outweighs criticisms such that the correlation coefficient would be close enough to unity to provide an acceptable fit. This also minimizes the risk of capturing the effect of other left out variables and acceptably reduces the bias in the estimates of all other parameters which may arise from a poor fit of the proxy variable.

The EUS argument

The introduction of the EUS argument is where the model estimated here diverges from those estimated in previous studies. The variable measures the annual expected rate of

return on the US dollar vis à vis the Canadian dollar. It is argued, on an a priori basis, that the noticeable influence of the US financial markets on the Canadian economic scene coupled with the role of the US as the single most important trading partner of Canada warrants the inclusion of EUS in the Canadian money demand function in addition to the appropriate EFC argument. This is based on the premise that Canadians would be expected to consider the US dollar as the closest substitute to their own currency. The exclusion of EUS would therefore result in specification bias and exaggerated t statistics.

Since the US occupies a singularly important position as the currency of world trade and finance in Europe as well as in the emerging Pacific basin, this argument can equally well be extended to currencies of these regions. Attempts at estimating the cross elasticity of substitution between the currencies of these regions, must therefore include an argument for the return on the US currency. Failure to do so would indicate misspecification of the money demand equation. Since the return on the US dollar is expected to be correlated to other independent variables, particularly the return on the foreign currency in question and the domestic interest rate, in its absence the estimated parameters will be biased as the influence of the left out variable is captured by other independent variables. The variable capturing more of the influence will have a higher

bias in its coefficient. Since the variance of the affected variables decreases the t statistic will be higher indicating a higher level of significance than actually exists. For a superimposed plot of the different EFC variables and EUS see figures 1 and 2 below.

By this argument Cuddington's (1983, tables 3 and 4) test for the presence of CS between the Sterling and DM for British residents should include, as an argument, the return on the US dollar. In the absence of this the estimates may well be affected by specification bias such that the significance level for the CS parameter may indeed be exaggerated.

One possible shortcoming of including expected return arguments for two currencies in the same model comes from multicollinearity. Since the purpose of the test is to identify and separate the explanatory powers of independent variables the effect of multicollinearity must be considered. The degree of multicollinearity depends on the extent of the correlation between the respective variables. The extent of correlation between EUS and other expected rates of return variables need not be as significant as one may initially expect. Indeed the findings of Brillembourg and Schadler (1979) may serve to shed light here. Their results suggest segregation of currencies into geographical groups such that currencies within the European group

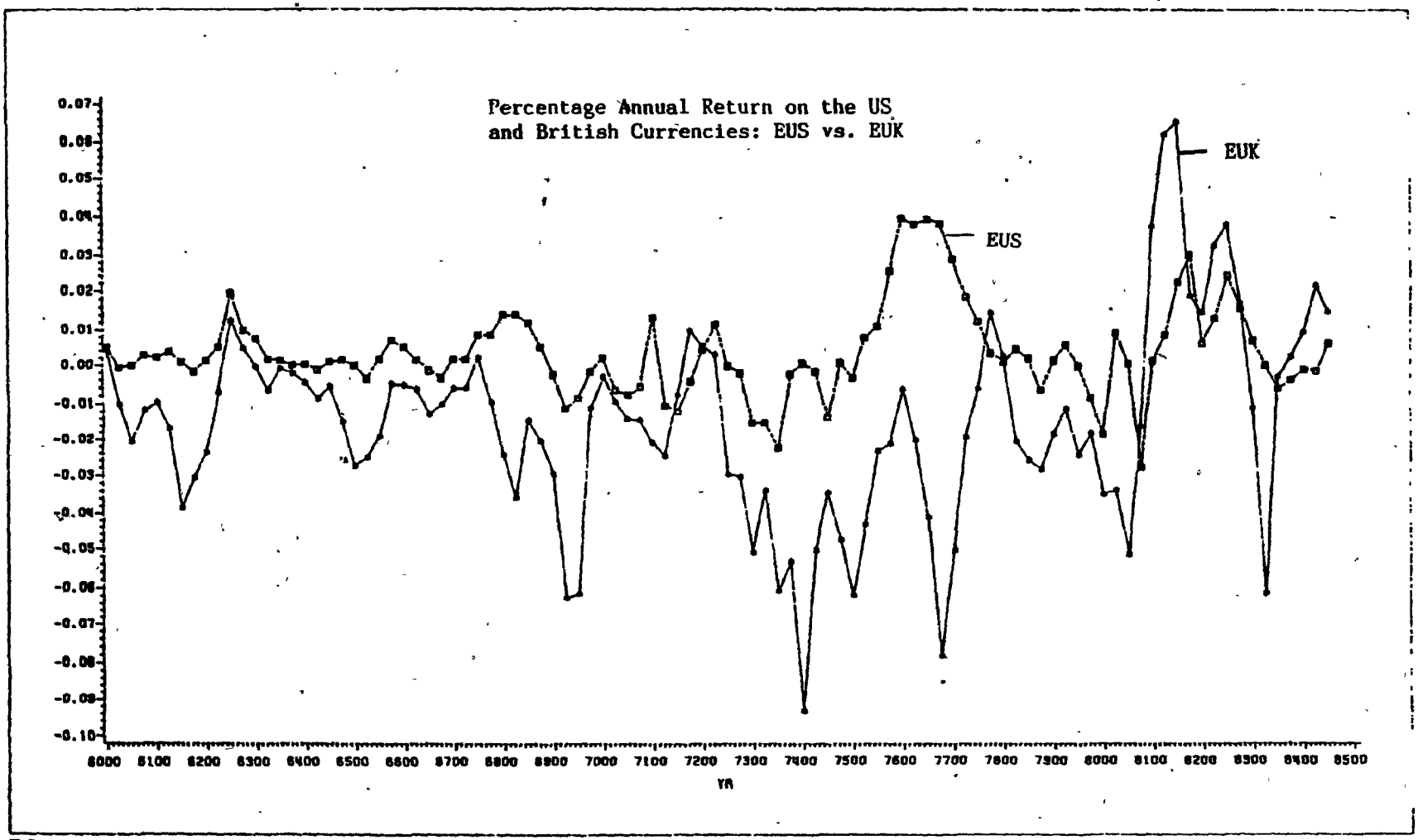
Percentage Annual Return on the US
and British Currencies: EUS vs. EUK
EUK
EUS
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
-0.10
8000 8100 8200 8300 8400 8500 8600 8700 8800 8900 7000 7100 7200 7300 7400 7500 7600 7700 7800 7900 8000 8100 8200 8300 8400 8500
YR

FIGURE 1

Percentage Annual Return on the Currencies of Belgium (EBF), France (EFF), Germany (EDM), The Netherlands (ENL), Switzerland (ESF) and the United States (EUS)

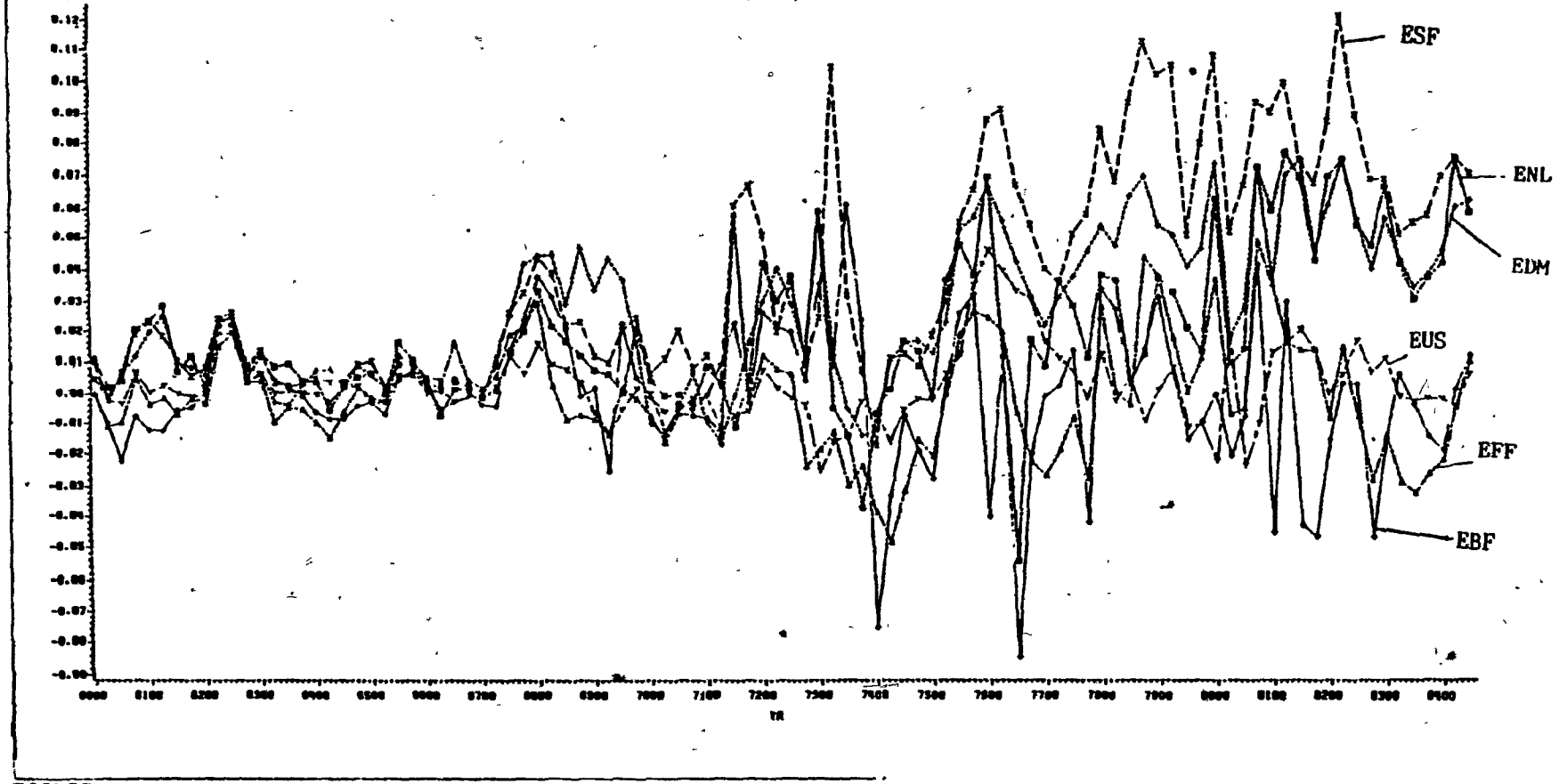

FIGURE 2

were found to display complementarity while the U.S. and Canadian currencies were considered substitutes for them. Additionally the sterling displayed little predictability with the Yen showing low responsiveness. Hence EUS is expected to demonstrate little correlation to other (European) EFC arguments.

The general a priori case therefore for multicollinearity appears very weak in light of the diversity of cross responses found by Brillembourg and Schadler. More specifically since EUS and the respective EFC argument considered in the model always belong to the currencies from different groups the possibility of multicollinearity is further reduced. Since the threat of multicollinearity is reduced on an a priori basis the estimated standard errors need no longer be exaggerated and the level of significance need no longer be underestimated by small t ratios.[8]

We have argued above that the inclusion in the Canadian money demand function of the dominant inducement (EUS) and the rate of return on one other currency need not invalidate results due to multicollinearity. However, the correct specification for money demand may well call for the inclusion of EFC arguments for all countries. While such should indeed be the theoretical specification of the model it significantly increases the possibility of

multicollinearity, particularly between variables that display complementarity i.e. for currencies which move together. Hence the estimator is restricted to EUS and one other EFC argument.

Simultaneous equation bias

The single equation money demand functions described in equations (4.1,4.3,4.4) assume unidirectional causation such that real income (y) and interest rates (r) influence the demand for money with no reverse causation from the quantity of money to these variables. However the Friedman - Modigliani debate raises precisely this question of bidirectional causation between M/P, and Y and r. If Y and r are not independent of the error term e in the above equations (i.e. if M/P is not independent of Y and r) the ordinary least squares (OLS) as well as generalized least squares (GLS) estimating techniques yield biased parametric estimates. This simultaneous equation bias arises as the OLS procedure estimates a single equation from a simultaneous model ignoring the information contained in the other equation.

One way of correcting for this bias is by way of the instrumental variable technique. As Intriligator (1978,p.402) has suggested this poses the problem of identifying an instrumental variable independent of the

error term yet closely correlated to the appropriate explanatory variables. Additionally since parametric estimates generally display a high degree of 'sensitivity' to the instrumental variable this creates the problem of choosing the appropriate instrument. He goes on to argue that the procedure is complicated further by the inclusion of the lagged dependent variable as the partial adjustment term. In this case the model will not have the 'desired properties' such as consistency if the residuals display serial correlation.' One way of resolving this is with the iterative instrumental variable technique (Lyttkens 1970).

One must also attempt to identify the expected improvement from using a simultaneous equations model. A comparison between the two estimation techniques was performed by Poloz (1980) who found that:

> "A comparison between the OLS and IV (instrumental variable) estimation of the parameters indicates that the extent of simultaneous equation bias was, on the average, very small over the sample period (1956/1 - 1978/4). Indeed, the extent of bias is always less than the standard error of the particular parameter." (p.413).

Based on the theoretical problems outlined above and the minor empirical improvements expected we employ the OLS estimation technique in this study.

A brief note on the multiple correlation coefficient R^2

and the comparability of the R^2s as a measure of the goodness of fit for the causal relationship described by the equations above. Since an explicit intercept term does exist and since the dependent variable as well as the functional form of the equations are identical, the only hindrance to the use of R^2 as a measure for comparing the goodness of fit across models comes from the differing number of independent variables (and in some cases the total number of observations) such that the reduced degrees of freedom may 'force the parameters'. This was corrected for by calculating the $\bar{R}^2$ which is adjusted for the degrees of freedom. As the $\bar{R}^2$s are generally high the independent variables appear to explain almost all of the movement in the dependent variable.

4.5 Substitute or Complement Currencies

The theory of CS has evolved into a theoretical and empirical study of the presence of cross responsiveness in demand between currencies. The theory is no longer restricted to analyzing substitutability between currencies; the analysis of cross responsiveness permits consideration of substitutability as well as complementarity. The initial indication of complementarity within currency groups and substitutability between groups is found in Brillembourg and Schadler (1979, section 2). Indications of complementarity between the Sterling and the DM also appear in Cuddington

(1983, equation 4 in tables 3 and 4) where surprisingly it is observed:

> "...(where the variable is significant) it enters with a positive sign rather than the negative sign suggested by the portfolio balance theory. Hence, one would probably be reluctant to conclude that there are important CS effects on money demand in the United Kingdom." (p.126).

In this study we test for the presence of cross responsiveness in Canadian money demand between the Canadian dollar and the currencies of seven countries. The null hypothesis that there exists no cross responsiveness between currencies requires that B4 (and B5) in equation (4.1) equal zero. Parametric estimates which diverge from zero indicate the presence of cross responsiveness between the respective currencies. The sign of the estimate determines whether the currencies are complements or substitutes.

Substitutability is indicated by a negative expected sign for the EFC parameter; signifying an inverse relationship between domestic and foreign currencies such that an increase in EFC decreases demand for the domestic currency. Conversely a positive expected sign for EFC indicates complementarity suggesting that certain currencies move together and may thus be held as a group. This gives rise to the notion of currency blocs such as the European Monetary System (EMS).

It should be noted that the cross return elasticity (as considered here) has a sign opposite to cross price elasticity, the more common measure. This is due to the inverse relationship between return and price. Substitutability which is reflected by a positive cross price elasticity measure assumes a negative value for the cross return measure. Similarly complementarity, signified by a negative cross price elasticity measure, adopts a positive sign for cross return elasticity.

Consider the implications for policy. Complementarity between currencies implies a simultaneous increase in returns for both currencies with respect to a common third such that a currency bloc (like the EMS) may be justified. All such currencies may move 'en bloc' against the US dollar. Should the Canadian dollar demonstrate complementarity with respect to European currencies an extreme case may be made for it to join the EMS. However this is stated as an abstraction only, since the extent of cross responsiveness would feature heavily in such a decision.

Note that so far we have discussed the methodology for testing for the presence of cross responsiveness between currencies. Section (4.11) below estimates the numerical values of cross return elasticity of money demand in those cases where the existence of cross responsiveness is

confirmed.

4.6 Estimates For The Period as a Whole Versus Separation by Exchange Regimes

In section (4.8) below we present results of tests for the presence of CS for the entire sample period as well as when separated by exchange regimes. This serves two purposes. First it provides a basis for comparison for the presence of cross responsiveness between the period as a whole and its component exchange regimes. Second it serves to cast serious doubt on studies that do not differentiate between exchange regimes in tests for the presence of CS.

Evidence in Miles (1978a,1981) indicates varying numerical values for the elasticity of substitution measure with a higher value observed during periods of flexible rates than during fixed rate periods. Both values were expectedly different from the numerical measure estimated for the entire sample period. Table 2 in Batten and Hafer (1984) also suggests that the CS argument generally enjoys a higher level of significance during flexible rates as compared to fixed rates.

One may justifiably argue that the explanatory ability of the cross responsiveness argument may diverge between separate exchange regimes and between these regimes and the

sample period embodying both these regimes. Hence evidence for the absence of cross responsiveness for the entire sample period does not indicate its absence during the individual exchange regimes. But this is what Cuddington has implicitly assumed. All of his tests except for Canada span periods which include both exchange regimes, with no allowance for differentiation. His findings therefore cannot be accepted as conclusive. If there is no evidence of cross responsiveness for the entire period (e.g. as per his tables 5 and 6 for US residents vis à vis the DM) that does not presuppose its absence during individual exchange regimes.

Since no direct comparison of explanatory power for the period as a whole as compared to individual regimes exists (at least within the B-C framwork) this hypothesis requires empirical verification. Since Miles' procedure has been severely criticized by Bordo and Choudhri his findings require further confirmation; Batten and Hafer do not directly address this issue. We take particular note of this issue by reporting, in the currency studies below, estimates for the period as a whole as well as when separated by exchange regimes. Should the explanatory ability of the EFC arguments for the former differ from the latter, as they are expected to, Cuddington's findings would be reduced in importance as they fail to recognize the fundamental reality of the exchange markets.

4.7 Empirical Evidence: Standard Money Demand

Table 4.1 presents the parametric estimates for the standard money demand function for Canada. These equations are reported to confirm the goodness of fit of the standard money demand model to which the EFC argument will shortly be added. The first two equations report the estimated parameters for the model for the period ending 1979/4. This is to ensure conformity with the last quarter in Bordo and Chaudhri's analysis. The last two report parametric estimates for the same model but spanning the entire length of the sample period. Equations (1) and (3) use the 90 day prime corporate paper rate (rcp) as the appropriate interest argument; (2) and (4) use the 90 day Government of Canada treasure bill rate (rtb). Each one of these equations is reported, some admittedly with minor differences, as each one has introduced to it the EFC argument as a test for the presence of CS.

Many variants of the standard money demand function were estimated corresponding to the different measures of the money stock, the interest rate as well as with different forms of the lagged dependent variable. These variants were estimated with and without the EFC arguments. The tables below present only the best fitting equations from all the ones tested.

Table 4.1

STANDARD MONEY DEMAND EQUATIONS FOR CANADA. TIME PERIOD AS INDICATED

No.	period	type of equation	Constant	ln y	(rx.01)	ln(M/P)t-1	$\bar{R}^2$	SSE	DW	h
1)	60/1-79/4	OLS	-0.611 (-4.876)	0.109 (3.941)	-0.756 (-8.001)	0.873 (18.925)	.9941	.01082	2.169	-.824
2)	60/1-79/4	OLS	-.751 (-5.379)	0.155 (5.011)	0.776 (-7.839)	0.789 (15.820)	.9939	0.01103	1.969	.154
3)	60/1-84/3	OLS	-0.331 (-3.753)	0.0552 (4.126)	-0.529 (-7.875)	0.944 (45.108)	.9899	0.01919	2.117	-.593
4)	60/1-84/3	OLS	-0.342 (-3.874)	0.0635 (4.308)	-0.523 (-7.462)	0.924 (40.857)	.9895	0.02001	2.019	-.422

Terms in parenthesis are at the respective t statistics. All parametric estimates are significant at the 1% level Equations (1) and (3) are based on the rcp measure of interest rates; (2) and (4) on the rtb measure.

All parametric estimates in table 4.1 are significant at the 99% confidence level. The low value of the Durbin h statistic indicates no noticeable degree of serial correlation in the stochastic disturbance terms. Signs of the estimates conform to expectations and high F values confirm the goodness of fit.

While good fits are obtained for the standard money demand equations with both rtb and rcp, the introduction of the cross responsiveness argument yields noticeably differing results for the two interest measures. The model with rcp as the interest measure yields noticeably better significance levels for the US dollar and marginally better results for the pound sterling. In all other cases the model with rtb yields better results, particularly for the Deutsche mark, where the confidence level for EDM1 improves from 86% to 98%.

This may be due to two reasons: first, the source and nature of exchange data differ between the groups. For the US and the UK data are from CANSIM and are quarterly averages of monthly values obtained from daily rates (see appendix 1). For all other countries exchange values are end of quarter observations obtained from the OECD Main Economic Indicators. The second explanation looks at the appropriateness of the two rates as measures of the

opportunity cost of holding cash balances. This suggests that rcp is an appropriate measure in the case of the US dollar and perhaps for the Sterling while rtb is appropriate for the other European currencies.

The model with the rtb measure is chosen as the standard. Estimates of models with rcp as the interest measure are reported in tables 2 to 7 of appendix 2. Since for the US the rtb measure yields significantly better results it is reported in the main body, in this case the equations with rcp appear in appendix 2 (table 1).

4.8 Empirical Evidence:Currency Studies

4.8.1 The US Dollar

Table 4.2 presents the findings for tests with respect to the US dollar. Estimates for both the sample period as a whole and when disaggregated by exchange regimes are reported. All equations are estimated using the OLS procedure. The Durbin h statistics indicate no need for adjusting for the first order Markov process. The model is estimated for two time periods. The first (equations (1) and (2)) has a sample cutoff at 1979/4 to correspond to the last observation of the test by Bordo and Choudhri. The second (equations (3) and (4)) spans the entire length of the

period upto 1984/3.

Parametric estimates for the shorter period tested yields, at best, weak support for CS. For the entire period tested EUS is significant at the 21% level. When the exchange regimes are considered separately the significance level improves to 15% for the flexible rate period while it deteriorates to 90% for the fixed rate period. The results for the flexible rate period agree with the findings of Bordo and Choudhri (1982a, table 1).

When the time period is extended to include the next 19 quarters the results change noticeably. Equations (3) and (4) show improvements in significance to the 6% level for the entire sample period. Significance improves to the 5% level when the flexible rate regime is considered separately. Similar increases in statistical significance are reported by B-H (note 18) who attribute the discrepancy to the addition of the later observations.

Note the support for the presence of CS during the flexible rate period with no evidence during fixed rates. This finding, which is repeated for other countries, is explained in section 4.9 below. Note also the negative sign of EUS1 which indicates that the currencies are substitutes in return. Estimates for the numerical value of the cross elasticity measures obtained from these parameters are

presented in table 4.9 below.

So far we have merely replicated previous findings to establish consistency and comparability. Our estimates are, however, based on an expanded and updated sample period.

Tables 4.3 to 4.8 present the results of similar tests for the currencies of Belgium, France, Germany, the Netherlands, Switzerland and the United Kingdom. A brief summary of the findings for each country follows.

4.8.2 The Belgian Franc

Table 4.3 presents the results of the test with respect to the Belgian franc. Additional results for the Belgian franc are summarized in table 2 of appendix 2. The tables in the main body present the overall best fitting results standardized across five European countries. The appendix contains the best fitting equations from the many variants tested. The particulars regarding type of data, and other variations are specified in the notes to the respective tables.

The first two equations, by including the EUS variable, estimate the theoretically more accurate form of the model. The latter two present estimates within the context suggested by B-C. Equations (1) and (3) test for the

presence of CS for the period as a whole regardless of exchange regimes. Equations (2) and (4) separate the two regimes by way of the (0,1) interactive variable technique.

All four equations indicate support for cross responsiveness between the two currencies. The level of significance at 9% and 7% for the period as a whole improves to 5% and 4% during flexible rates. No evidence of cross responsiveness exists during the fixed rate period. The level of significance deteriorates, at the margin, upon inclusion of the EUS argument. This is contrary to expectations as well as to the findings for other countries.

Two notable findings emerge: (i) evidence of cross responsiveness persists during flexible rates with no evidence during fixed rates; (ii) EBF1 has a positive sign indicating complementarity between the two currencies. The former, is repeated for the US as well as for all currencies except for the Sterling where the findings are inconclusive; it is explained in section 4.10 below. The latter indicates complementarity so that the currencies move together as (part of) a group.

The presence of cross responsiveness is particularly noticeable in this case as neither of the two currencies enjoy key roles in the international financial markets.

Table 4.2

A TEST FOR THE PRESENCE OF CS BETWEEN THE CANADIAN AND US CURRENCIES FOR CANADIAN RESIDENTS: FOR THE ENTIRE PERIOD AS WELL AS DISAGREGGATED BY EXCHANGE REGIMES

No. period	constant	ln y	(rcpx.01)	ln(M/P)t-1	EUS	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1) 60/1-79/4	-.644	.117	-.759	.860	-.149			.9941	.01059	2.195	-.953
	(-5.051)	(4.140)	(-8.067)	(18.298)	(-1.268)5*						
2) "	-.671	.122	-.768	.856		-.190	+.0988	.9941	.01049	2.238	-1.168
	(-5.091)	(4.214)	(-8.093)	(18.067)		(-1.486)3*	(.309)				
3) 60/1-84/3	-.333	.056	-.519	.942	-.231			.9902	.01845	2.079	-.403
	(-3.836)	(4.265)	(-7.837)	(45.596)	(-1.941)2*						
4) "	-.346	.0575	-.522	.942		-.258	.0165	.9902	.01835	2.095	-.479
	(-3.886)	(4.308)	(-7.837)	(45.458)		(-2.056)*	(.044)				

* = significance at the 5% level; 2* at the 10% level; 3* at the the 15% level; 5* at the 25% level.
The same model was also tested with the 90 day Government of Canada treasury bill rate replacing icp. The results are reported in appendix 2.
All Parameters other than EUS are significant at the 1% level.
The OLS estimation procedure is used.

Table 4.3

BETWEEN THE CANADIAN DOLLAR AND THE BELGIAN FRANC
1960/1 - 1984/3

No.	constant	ln y	(rtb x .01)	ln(M/P)t-1	EBF	EUS	EBF1	EBF2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.327	.0639	-.485	.919	+.117	-.136					.9898	.01904	1.993	.0356
	(-3.523)	(4.335)	(-6.958)	(40.611)	(1.768)2*	(-1.107)								
2)	-.310	.0619	-.483	.921			+.144	-.162	-.117	.118	.9897	.01879	1.987	.0681
	(-3.280)	(4.155)	(-6.695)	(40.331)			(2.000)*	(.561)	(-.887)	(.214)				
3)	-.342	.0660	-.512	.918	+.122						.9898	.01929	2.056	-.2844
	(-3.718)	(4.515)	(-7.372)	(40.599)	(1.851)2*									
4)	-.317	.0635	-.497	.919			+.154	-.110			.9898	.01896	2.034	-.1727
	(-3.393)	(4.314)	(-7.070)	(40.755)			(2.191)*	(-.570)						

Exchange rate data refers to the Belgium/Luxembourg Economic Union. rtb and M are quarterly averages of monthly data; exchange values are end of quarter observations.
All non EFC parametric estimates are significant at the 1% level.
The OLS estimation procedure is used.

Table 4.4

BETWEEN THE CANADIAN DOLLAR AND THE FRENCH FRANC
1960/1 - 1984/3

No.	constant	ln y	(rtb x.01)	ln(M/P)t-1	EFF	EUS	EFF1	EFF2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.402	.0739	-.572	.912	+.205	-.213					.9901	.01852	2.049	-.249
	(-4.150)	(4.807)	(-7.568)	(39.972)	(2.408)*	(-1.723)2*								
2)	-.422	.0766	-.588	.911			.249	-.303	-.210	.254	.9902	.01794	2.047	-.239
	(-4.337)	(4.973)	(-7.740)	(40.012)			(2.789)o	(-.951)	(-1.634)3*	(.499)				
3)	-.413	.0752	-.589	.912	.175						.9899	.01912	2.114	-.579
	(-4.229)	(4.838)	(-7.765)	(39.539)	(2.077)*									
4)	-.422	.0770	-.603	.909			+.228	-.189			.9901	.01853	2.097	-.493
	(-4.361)	(4.994)	(-7.986)	(39.780)			(2.563)*	(-.829)						

rtb and M are quarterly average of monthly data; exchange values are end of quarter observations.
All non EFC parametric estimates are significant at the 1% level.
o denotes significance at the 1% level. The OLS estimation procedure is used.

Table 4.5

BETWEEN THE CANADIAN DOLLAR AND THE DEUTSCHE MARK
1960/1 - 1984/3

No.	constant	ln y	(rtbx.01)	ln(M/P)t-1	EDM	EUS	EDM1	EDM2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.280	.0571	-.569	.927	.214	-.233					.9901	.01848	1.932	.345
	(-3.009)	(3.926)	(-7.603)	(42.068)	(2.457)*	(-1.856)2*								
2)	-.260	.0545	-.570	.929			.236	.155	-.237	-.238	.9899	.01841	1.922	.396
	(-2.603)	(3.562)	(-7.532)	(41.234)			(2.467)*	(1.102)	(-1.776)2*	(-.612)				
3)	-.313	.0612	-.584	.924	.171						.9898	.01917	2.000	0
	(-3.375)	(4.201)	(-7.749)	(41.497)	(2.017)*									
4)	-.297	.059	-.585	.926			.189	.123			.9898	.01912	1.991	.046
	(-3.007)	(3.883)	(-7.725)	(40.929)			(2.031)*	(.919)						

rtb and M are quarterly averages of monthly data; exchange values are end of quarter observations.
All non EFC parameters are significant at the 2% level. The OLS estimation procedure is used.

Table 4.6

BETWEEN THE CANADIAN DOLLAR AND THE DUTCH GUILDER
1960/1 - 1984/3

No.	constant	ln y	(rtbx.01)	ln(M/P)t-1	ENL	EUS	ENL1	ENL2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.297	.0542	-.520	.937	+.113	-.170					.9897	.01909	2.035	-.176
	(-3.128)	(3.523)	(-7.000)	(39.490)	(1.405)4*	(-1.362)4*								
2)	-.296	.0541	-.521	.938			.114	.119	-.167	.207	.9895	.01909	2.034	-.172
	(-2.914)	(3.365)	(-6.847)	(38.777)			(1.386)4*	(.343)	(-1.253)5*	(-.409)				
3)	-.317	.0574	-.538	.934	.0979						.9897	.01948	2.091	-.458
	(-3.365)	(3.758)	(-7.314)	(39.384)	(1.223)5*									
4)	-.308	.0564	-.536	.935			.100	.0372			.9895	.01948	2.090	-.454
	(-3.066)	(3.540)	(-7.203)	(38.885)			(1.239)5*	(.144)						

rtb and M1 are quarterly averages of monthly data;
exchange data is for the end of quarter.
The series on forward exchange rates had one missing value.
Due to the lag the number of observations were reduced by two.
All non EFC parameters are significant at the 1% level. The
OLS estimation procedure is used.

Table 4.7

BETWEEN THE CANADIAN DOLLAR AND THE SWISS FRANC
1960/1 - 1984/3

No.	constant	ln y	(rtb x.01)	ln(M/P)t-1	ESF	EUS	ESF1	ESF2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.256	.0550	-.550	.927	+.134	-.203					.9898	.01896	1.958	.213
	(-2.576)	(3.667)	(-7.328)	(41.514)	(1.875)2*	(-1.616)3*								
2)	-.251	.0543	-.548	.927			+.133	+.100	-.199	-.207	.9896	.01896	1.954	.234
	(-2.388)	(3.481)	(-7.053)	(40.706)			(1.809)2*	(.416)	(-1.502)3*	(-.457)				
3)	-.290	.0591	-.567	.924	+.109						.9897	.01950	2.030	-.152
	(-2.958)	(3.980)	(-7.548)	(41.143)	(1.549)3*									
4)	-.278	.0576	-.562	.925			+.108	.0384			.9896	.01947	2.023	-.117
	(-2.679)	(3.717)	(-7.348)	(40.697)			(1.531)3*	(.194)						

rtb and M are quarterly average of monthly data; exchange data is for the end of the period. All non EFT parameters are significant at the 2% level. The OLS estimation procedure is used.

TABLE 4.8

BETWEEN THE CANADIAN DOLLAR AND THE POUND STERLING
1960/1 - 1984/3

No.	constant	ln y	(rtb x.01)	ln(M/P)t-1	EUK	EUS	EUK1	EUK2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.341	.0627	-.514	.926	.0159	-.174					.9895	.01959	1.973	.138
	(-3.569)	(4.233)	(-6.923)	(38.224)	(.226)	(-1.386)4*								
2)	-.342	.0632	-.509	.925			.00463	.0398	-.197	+.0193	.9893	.01951	1.979	.107
	(-3.292)	(4.094)	(-6.821)	(37.784)			(.062)	(.272)	(-1.489)3*	(.047)				
3)	-.342	.0835	-.523	.925	.00182						.9894	.02001	2.020	-.102
	(-3.571)	(4.265)	(-7.039)	(38.013)	(.026)									
4)	-.336	.0629	-.519	.925			-.00322	.0274			.9893	.01999	2.017	-.087
	(-3.324)	(4.144)	(-6.792)	(37.810)			(-.044)	(.196)						

rtb and M1 and exchange rates are quarterly averages.
All non EFC parameters are significant at the 1% level.
The OLS estimation procedure is used.

4.8.3. The French Franc

Table 4.4 presents the results for the Canadian dollar with respect to the French franc. Since presentation in this case, as well as for the countries to follow, is identical to that for Belgium (except for the UK) the emphasis from here on is on interpretation of the results.

Equation (1) in table 4.4 shows strong support (at the 2% significance level) for cross responsiveness for the entire period. When separated, equation (2), the level of significance improves to 1% for the flexible rate period. Slightly less significant yet similar patterns are observed in equations (3) and (4). Table 3 of appendix 2 confirms this pattern of findings, the significance levels however are noticeably lower.

These results lead us to conclude that there exists cross responsiveness between the dollar and the franc during the flexible rate period. No evidence of the same is found during the fixed period. Furthermore, the positive sign during flexible rates indicates complementarity between the two currencies. Surprisingly the negative sign for the fixed rate parameter (although insignificant) suggests substitutability.

These results are consistent with expectations. Given

the comparatively greater presence of the French franc in international capital markets coupled with the noticeable trade flows between the two countries (particularly for Quebec) the rate of return on the franc may well be expected to exert a measurable influence on Canadian money demand

4.8.4 The Deutsche Mark

Table 4.5 examines the same relationship with respect to the German mark. Equations (1) and (2) show that the cross responsiveness parameters for the entire period and for the flexible rate period are significant at the 2% level. When the EUS term is omitted the significance level drops to 5% in both cases. As before no trace of cross responsiveness is observed during the fixed rate period. Signs for all EDM parameters are positive indicating complementarity between the two currencies in this case during both the flexible and fixed rate regimes.

The high level of significance is again consistent with expectations. The important reserve currency and currency of trade role of the Deutsche mark has made it, in some ways, an alternative (substitute) to the US dollar. This is justified by the increasing presence of eurocurrency assets denominated in German marks. This reserve currency role of the mark as well as the level of trade between Canada and Germany make a strong a priori case for cross

responsiveness between the two currencies. Hence EDM predictably does influence Canadian money demand (see also table 4 of appendix 2).

4.8.5 The Dutch Guilder

Table 4.6 (and table 5 of appendix 2) present the parametric estimates of tests for cross responsiveness between the dollar and the guilder (the Netherlands). The results indicate little support for cross responsiveness between the two currencies.

In table 4.6 equations (1) and (2) indicate significance for the ENL parameter at 17% for the entire period. There is no evidence of cross responsiveness during fixed rates. The pattern follows for equations (3) and (4) with reduced significance.

The results conform to expectations. We find only very weak support for cross responsiveness between the two currencies. This is consistent with the relatively scarce trade activity between the two countries as well as with the restricted role of the guilder in world financial markets. In almost all cases the estimates have positive signs lending further credibility to the issue of complementarity.

4.8.6 The Swiss Franc

Table 4.7 (and table 6 of appendix 2) presents estimates of the test between the Canadian dollar and the Swiss franc. In the former some evidence of cross responsiveness is observed between the two for the sample period as a whole, equation (1), and for the flexible rate period separately equation (2). No evidence is found during the fixed rate period. When the test is repeated without the EUS arguments the levels of significance drop yet the same pattern holds. As in previous findings the flexible rate period demonstrates noticeably stronger support for cross responsiveness as compared to fixed rates. Positive signs for the relevant parameters suggest complementarity between the currencies.

The findings are once more consistent with expectations. Evidence of cross responsiveness probably reflects the role of the Swiss franc as a stable investment currency.

4.8.7 The Pound Sterling

Table 4.8 reports on the results for the dollar with respect to the Pound Sterling. Further results are presented in table 7 of appendix 2.

Results indicate no evidence of cross responsiveness between the currencies. The levels of significance are poor in all instances and no conclusions may be derived regarding either complementarity or the relationship between fixed and flexible rates. While the results may run contrary to expectations they are not inconsistent with the findings of Brillembourg and Schadler (1979) who observe:

> "The relationships of the pound sterling with other currencies seem to be difficult to estimate with much precision,..." (p.527)

4.9. Comparative Summary

The only previous attempt at testing for the presence of cross responsiveness between the Canadian dollar and other European currencies is at the hands of Brillembourg and Schadler (1979). They, however, used a different model and consider a six year sample period during the flexible rate regime. A brief comparison yields little similarity in results. The most significant divergence was observed for the DM and the US dollar, currencies which yield conclusive results in our study. Estimates for the French franc, the Swiss franc and the pound sterling display similar signs yet noticeably diverging parametric values and significance levels. The other countries in the two studies do not correspond.

Consider also the implication for the Cuddington type studies which combine the exchange regimes. The results in tables 4.2 to 4.8 indicate instances of divergence between the parametric estimates for EFC, and EFC1 and EFC2 such that a test which fails to distinguish between exchange regimes at best makes very general statements regarding the existence of cross responsiveness during individual exchange regimes. This conclusion reduces the validity of Cuddington's findings. Furthermore since no systematic link is observed between such values one cannot venture an opinion as to whether his results under or overpredict reality. Because he fails to distinguish between exchange regimes his results may well be misleading in instances when e.g. significant explanatory ability during flexible rates is dominated by absence of the same during fixed rates yielding inconclusive evidence for the period as a whole. A lack of evidence for the period as a whole does not imply the same for individual regimes.

Note that the EUS argument in the test for the Pound Sterling is based on the exchange values which are quarterly averages. For the other five European countries EUS is calculated from exchange values which are end of quarter observations. Recall also that the EUS argument performs best with the rcp interest measure yet the rtb measure is used for the European countries (exclusive of the US). This explains the lower level of significance of EUS.

Furthermore the level of significance of EUS deteriorates slightly when it is added in addition to EFC. This is expected as EUS no longer appears as the only measure of foreign influences.

4.10 Fixed vs. Flexible Rates: A Reconciliation of the Findings

One would be tempted to argue for a greater degree of cross currency responsiveness during fixed rates as compared to flexible rates. Such an argument would be based on the premise that the attempt to peg exchange rates is a declaration by the central bank that it considers the respective currencies to be perfect substitutes at that rate (see subsection 2.4.1). With the central bank not guaranteeing conversion at any given rate during the flexible rate regime the degree of cross responsiveness is expected to be low. Proponents of such a view would expect the degree of cross responsiveness during the fixed rate period to exceed that during flexible rates.

Consider the fallacy in this argument. The degree of substitutability in supply is inadvertently extended to similar behaviour in demand, such that substitutability in demand during fixed rates is argued to exceed that during flexible rates. This extension of the argument is clearly unfounded. Indeed the findings of Miles (1978a,1981) and

Batten and Hafer (1984) confirm the results above which indicate noticeably greater support for cross responsiveness during flexible rates. Whereas Miles (1978a,p.435) attempts to explain his finding, we believe the explanation below to be more intuitively acceptable.

The inducement to switch is measured by the percentage discrepancy between S and F (spot and forward exchange rates). Such that EFC = (F-S)/S = the expected return on foreign currency holdings. Consider how EFC would differ during the two exchange regimes. Under fixed rates (we speak here of intertemporal fixity in exchange rates) F is not expected to diverge significantly from S, if at all. Divergences between the two are expected to be small and short lived. This is guaranteed by the central bank. If such discrepancies are small and not expected to persist the inducement to switch (to protect against or benefit from this) is dampened. Transactors realize that with fixed rates a given amount of one currency implies an equivalent quantity of the other with this value guaranteed over time. Hence the currency composition of portfolios do not change by much in response to incipient divergences between F and S explaining the reduced degree of cross responsiveness, or lack of evidence of it, during fixed exchange rates.

Even though supply side CS is perfect such that supply is infinite at a given exchange rate, it is by virtue of

this and expectations of its continuance that the inducement to switch is subdued. When no such check exists during flexible rates the reassurance is removed and expectations of further changes in S and F induce currency shifts.

The above argument may be applied to the Miles model through the imposition of interest rate parity which translates the percentage discrepancy between S and F to the divergence between domestic and foreign interest rates such that EFC = rd - rf.

4.11 Elasticity Measures

The preceeding sections tested for the presence of cross responsiveness between the Canadian dollar and seven major currencies by testing for the existence of explanatory power for the EFC argument in the Canadian money demand function. The test provided no information on the degree of cross responsiveness between different currencies. A direct and meaningful comparison of the degree of cross currency responsiveness requires access to estimated numerical values for the cross elasticity measures. Such measures would permit comparison of the degree of substitutability or complementarity between currencies as well as comparison with other measures of responsiveness such as own-interest and income elasticities of money demand.

Since the estimated equation describes a semilog functional form let us first derive the condition for the cross elasticity of money demand. Consider the following example:

$$\log A = a0 + a1 \log B + a2\, C \qquad (4.5)$$

We know that cross elasticity (X_{nMd}) is defined as:

$$X_{nMd} = (dA/dC) \times (C/A) \qquad (4.6)$$

from (4.5) we know $d\log A/dc = a2$

$$(dA/dc) \times (1/A) = a2 \qquad (4.7)$$

To obtain the elasticity equation we multiply (4.7) by C to get:

$$(dA/dC) \times (C/A) = Ca2 = X_{nMd}. \qquad (4.8)$$

The estimated elasticity measures are reported in table 4.9. The cross elasticity measures for each country are reported along with estimates of the own interest elasticity of money demand and income elasticity of money demand. The latter two permit comparison and put the cross elasticity

measure in proper perspective.

For each parametric estimate two elasticity measures are computed. The first uses the mean of the EFC and interest rate arguments; the second uses the maximum value of the same variables. Since the mean includes aggregation of negative and positive EFC values it may not accurately reflect the extent of absolute change in EFC. For this purpose elasticity measures using the maximum value of EFC are also presented.[10] The mean values of the EFC arguments do not include data for the fixed rate period, whereas average values for the interest rate include the entire sample period[11].

In terms of policy effects the own interest elasticity (from mean values) at approximately -.04 is low and indicates a steep liquidity preference schedule where a 1% change in domestic interest rates induce a mere .04% change in money holdings. In comparison, the cross elasticity of substitution between the US and Canadian dollars for Canadian residents at .00102 (for the flexible rate period) suggests a change in the currency composition of money demand of a mere .00102% for a 1% change in EUS. The largest change in EUS being 3.96% (1976/1) the concomitant movement between Canadian and US currencies is in the area of .0040% of money demand. For 1976/1 this translates into a switch of (17,761.3 x .0040) = 72 million Canadian

dollars. A change of this magnitude should exert little pressure on exchange markets which may switch many times this amount in one day. For the last observation a similar change would involve (28,466.0 x .0040) = 114 million dollars.

Similar shifts for the other currencies are as follows. In each case the estimate for the cross elasticity using the largest EFC value is used. This is multiplied by the average value of EFC to yield the expected percentage change in Canadian money demand. This is then converted into dollars using the M1 value for 1984/3 to maximize comparison. Admittedly the resulting dollar values yield a theoretical figure yet not far from present reality.

For Belgium this translates into a value of (.00041 x 6.04 x 28,466) = 70 million.

For France (.00049 x 4.70 x 28,466) = 66 million

For Germany (.00767 x 7.57 x 28,466) = 1,653 million

For the Netherlands (.00299 x 7.73 x 28,466) = 658 million

For Switzerland (.00674 x 12.03 x 28,466) = 2,308 million.

For an aggregate of 4,869 million (Canadian dollars) this figure which is on a quarterly basis may be put in proper perspective by the following observation:

"Everyday the Royal(Bank), one of Canada's largest currency traders, deals in about $1.5 billion in 53 currencies in both spot (today) and forward (30-,60-,or 90-day) markets for itself and its corporate clients." (Report on Business Magazine, April 1985, p.92).

TABLE 4.9

NUMERICAL VALUES OF ELASTICITY MEASURES

No.	Country	Mean/ High	cross return elasticity of Money demand	Own r/i elasticity	income lasticity	significance level of CS parameter
1)	U.S	M	-.00102	-.0413	.0575	5%
		H	-.01021	-.1097		
2)	Belgium with EUS	M	-.00041*	-.0345	.0619	5%
		H	.0087	-.0973		
3)	Belgium	M	-.00043*	-.0355	.0635	4%
		H	.0093	-.1002		
4)	France with EUS	M	-.00049*	-.0419	.0766	1%
		H	.0142	-.1185		
5)	France	M	-.00045*	-.0431	.0770	2%
		H	.013	-.1215		
6)	Germany with EUS	M	.00767	-.0407	.0545	2%
		H	.0179	-.1149		
7)	Germany	M	.00614	-.0418	.059	5%
		H	.0143	-.1179		
8)	Netherlands with EUS	M	.00299	-.0372	.0541	17%
		H	.0088	-.1049		
9)	Netherlands	M	.00262	-.0383	.0564	22%
		H	.0077	-.1080		
10)	Switzerland with EUS	M	.00674	-.0391	.0543	8%
		H	.0159	-.1104		
11)	Switzerland	M	.00547	-.0401	.0576	13%
		H	.0129	-.1133		

*The negative numerical values are due to the negative sign of the respective EFC means.
M and H denote the average and maximum values for the respective EFC variables. Estimates for the minimum value yield the wrong sign and are excluded. Mean values for the EFC variables include the flexible rate period only, whereas mean values for the rate of interest include observations over both regimes.

FOOTNOTES TO CHAPTER 4

1. The Bordo and Choudhri study covers the flexible rate period from 1970/4 to 1979/4. Cuddington, having obtained most of his data for Canada from them, finds similar results. Brillembourg and Schadler also examine a six year period from March 1973 - June 1978. Batten and Hafer attribute their (positive) results to the longer period over which they conducted their study. Our study for Canada, which considers a still wider data set, confirms the latter's conclusion.

2. The time period under consideration remains unchanged for Brillembourg and Schadler; In Cuddington it stretches from 1962/2 to 1979/2 and for Batten and Hafer from 1966/1 - 1984/1. Recall that Cuddington does not distinguish between exchange regimes, his findings may thus reflect the absence of CS during fixed rates. The shortcomings of tests which fail to distinguish between exchange regimes is highlighted in subsection (4.6) below.

3. There is of course the eight country matrix of "semielasticities' estimated by Brillembourg and Schadler (1979).

4. A lack of available data necessitates the exclusion of the Japanese yen and the Italian lira.

5. The increased stock of US Dollars exerts pressure on the US monetary authority to monetize it. Such actions augment the available quantity of the US money stock reducing its relative price (depreciation). Refusal by the authorities to do so does not increase the quantity of the US money stock, maintaining the price of the currency.

6. Cuddington's technique for differentiating currency substitution from capital mobility is criticised below.

7. John Cuddington was unable to confirm this from memory. The usage of cross rates to obtain the required Canadian exchange rates was also described as the only alternative by Ehsan Choudhri (Carleton University). Cross rates have also been used in exchange market studies by K. Marwah, Carleton University (forthcoming).

8. Another advantage of including the EUS argument is to capture and separate any influence absorbed by the respective EFC arguments due to the cross exchange rate transformation which uses the Canada/US spot and forward exchange rates as the common denominator (see section 4.2).

9. Serial correlation in errors implies correlation between

present and lagged dependent variables yielding biased parametric estimates (Intriligator 1978,p.402).

10. Elasticity estimates using the minimum values of the variables invariably yielded the wrong sign (for the cross elasticity measure) and are omitted.

11. In similar calculations Batten and Hafer use what appears to be the mean value of the respective EFC argument for the entire sample period. As a check when we duplicated their technique our cross elasticity estimate (vis a vis the US dollar) approached theirs at .0007.

CHAPTER 5

CURRENCY SUBSTITUTION AND TRANSACTION COSTS

The previous chapter presented the results of the tests for the presence and extent of cross responsiveness in Canadian money demand between the Canadian dollar and the currencies of seven industrialized countries. The analysis was performed under the assumption that foreign exchange transactions costs are zero such that the discrepancy between S and F was an accurate measure of the return on foreign currency. A casual observation of the foreign exchange market suggests that such costs do indeed exist and may vary over different time periods corresponding to exchange market stability as well as to the nature of the exchange rate regime. This chapter examines the effect of differential transactions costs (according to exchange rate regimes) on the models of CS considered in the previous chapter.

Section 5.1 argues that while transactions costs may not be small compared to the totality of the currency transaction they may not be as small with respect to the yield on the foreign currency (EFC) as described in chapter 5. These costs must therefore be included in tests for the presence and extent of CS. Incorporation of transactions costs reduces the value of EFC and therefore the inducement

to switch; in some cases it may reduce it to zero. This section also reports on the technique used in this study to incorporate such costs.

Section 5.2 highlights the lack of published estimates for the cost of transacting in foreign exchange markets. It is argued that the only estimates of such costs roughly corresponding to the sample period of this thesis is at the hands of Frenkel and Levich (1975,1977 and 1981) (henceforth F-L). Their technique for estimating such costs, which is based on triangular currency arbitrage, is described and their cost estimates are presented. Also discussed is McCormick's (1979) criticism of the 'quality' of exchange rate data used by F-L.

Section 5.3 attempts to apply F-L cost estimates to Canada's unique foreign exchange history. This is due to visible gaps in F-L's estimates of such costs as well as to Canada's experience with floating exchange rates during the 1950s and early 1960s. Recall also that Canada shifted to floating rates from 1970/3 on, considerably before other countries.

Section 5.4 describes the model estimated in this chapter, which differs from equations (4.1),(4.3) and (4.4) above in that the EFC argument is adjusted for transactions costs. These costs are added directly to the B-C type model

as well as to our, theoretically more applicable, variant of it which includes the return on the US dollar in additon to the EFC argument.

Section 5.5 presents the results of tests for both the B-C type model and our variant of it, in cases both with and without transactions costs. It is found that these costs improve the level of significance and the value of the parametric estimate during the flexible rate regime. Results generally remain unchanged for the fixed rate period. Based on this it is argued that past tests of CS, all of which ignore the costs of transacting in foreign currencies, understate the explanatory ability of foreign influences on domestic money demand.

Section 5.6 draws the chapter to a close by presenting and comparing the numerical values of the cross elasticity measures with and without the incorporation of transactions costs to determine the extent of this understatement. It is found that while the incorporation of transactions costs increases the numerical value of the cross return elasticity measures it still does not translate into currency switches large enough to have a significant effect on exchange markets.

5.1 Background

In chapter four the return on foreign currencies, as a measure of the inducement to switch was assumed to be accurately captured by the EFC argument which measures the percentage discrepancy between the spot and forward exchange rates. This was under the implicit assumption that there exist no costs of transacting in the foreign exchange markets. Casual observation will show that while relatively small (percentage wise) compared to the totality of the typical exchange market transaction, such costs may represent a significant proportion of the yield on foreign currencies as expressed by EFC.

Furthermore, evidence indicates that these costs vary over time according to the stability in exchange markets. This in turn is related to the type of exchange regime such that transactions costs under fixed rates may well be expected to diverge from costs under flexible rates. Tests performed by Frenkel and Levich (1977) prompts them to observe:

> "In the most recent managed float period, the cost of transactions in foreign exchange has risen to unprecedented heights. Depending on the currency and the maturity of the contract, the cost of transactions during the period is between six to 10 times higher than the corresponding cost during the tranquil peg." (p.1215)

In this chapter we test for the effect of foreign exchange transactions costs on the presence and extent of CS within the Bordo and Choudhri (B-C) framework considered above. Both the original B-C model and our variant of it are examined.

Transactions costs are introduced in the Frenkel and Levich (1975,1977,1981) (F-L) tradition such that the inducement to switch may no longer span the full extent of the discrepancy between S and F. These costs form a 'neutral band' which reduces the value of EFC. In cases where this band exceeds the value of EFC (so that the cost of transacting exceeds the yield on the foreign currency) the inducement to switch is reduced to zero and the existing composition of currency portfolios is maintained. Only when the absolute value of EFC exceeds transactions costs, $|EFC| > T$, is there inducement to switch between currencies.

Depending on the premium or discount associated with the forward rate, EFC may either be positive or negative. Therefore a simple variable transformation such as EFC - T to adjust for transactions costs would prove incorrect. The reduction in the inducement to switch should reduce equally a positive EUS as well as a negative EUS by the extent of the transactions costs. This is achieved by way of the following variable transformation:

If |EFC| > (T x .01) and EFC > 0 then EFCT=EFC-(T x .01)
else if |EFC| > (T x .01) and EFC < 0 then EFCT=EFC+(T x .01)
else EFC=0. (5.1)

Where T= foreign exchange transactions costs in percentage terms; EFCT = EFC adjusted for the respective estimates of these costs. Note that we incorporate transactions costs in the EFC argument at different stages: the first may be characterized as [(F-S)/S - T] x 4 such that transactions costs are deducted prior to annualizing the return. In the second case the argument is adjusted for T after annualizing the return, this is described as [(F-S)/S] x 4 - T. Results for both methods are presented and compared in the tables below. The latter more accurately reflects the adjustment for transactions costs.

5.2 Estimates of Foreign Exchange Transactions Costs

Consider briefly the procedure for estimating the (differential) costs of foreign exchange transactions. Typically these costs may be measured by the spread between bid and ask rates facing the transactor (see Papadia, 1981)[1]. While these spreads may be expected to vary during different exchange regimes, such variances may also be the result of varying degrees of 'stability' during the same exchange regime.

In the absence of reliable estimates of total transactions costs in currency markets (for the period of this study) based on the spread between bid and ask rates, we use estimates of such costs provided by Frenkel and Levich (1975) based on the alternate technique of triangular arbitrage between currencies. This procedure is subsequently expanded to cover transactions costs upto December 1979, (F-L (1977,1981) spanning almost entirely the period of this study.

The time periods over which these costs are calculated are distinguished on the basis of exchange market stability as opposed to the fixed or flexible nature of the exchange regime. Relative stability is measured by "...the degree of volatility of the ratio of the forward to the spot exchange rate." F-L (1977,p.1213). This measure of market stability was presented by Leamer and Stern (1972). Once such periods are established it is assumed that transactions costs remain constant throughout the entire period F-L (1977, p. 1212).

The triangular arbitrage technique considers the following exchange rate:

$$US\$/£ = (US\$/DM).(DM/£) \qquad (5.2)$$

Where the Deutsche mark is the 'vehicle' currency. A similar test was performed using the Canadian dollar as the

vehicle currency. In which case equation (5.1) changes to US$/£ = (US$/C$)(C$/£). The results differ slightly.

This technique is based on the premise that with zero transactions costs and with no other market imperfections currency arbitrage guarantees that condition (5.2) holds. If costs do exist then the RHS, with two transactions, must incur costs in excess of the LHS. F-L assume further that such costs are identical for all industrialized countries such that it costs the same to switch between Canadian and US dollars as it does to switch between French and Swiss francs. The extent by which the two sides of the equations differ, argue the authors (1977, p.1212), measures the cost of transacting in foreign exchange markets. To be conservative they consider as transactions costs the bottom 95% of such discrepancy in triangular arbitrage.

Frenkel and Levich's estimates of transactions costs are presented in table 5.1. The exchange rate measures the sterling price of US dollars; the triangular arbitrage involves the DM and the Canadian dollar as vehicle currencies. The time periods are dubbed the 'tranquil peg', the 'turbulent peg' and the 'managed float' respectively, with percentage transactions costs progressively increasing. Increased costs under flexible rates are attributed to heightened uncertainty which is reflected in wider bid ask spreads. Note that these estimates are for total costs.

Criticisms, more so of the quality of the data as opposed to the soundness of the technique, are to be found in McCormick (1979) who questions the validity of the cost estimates by attributing the large numerical values to the time difference between individual exchange rate observations. The basic premise of his argument is that, given the mercurial nature of the exchange markets, increased time differences between observations translate into increased divergence in exchange values and thus into higher transactions costs.[2] Using 'high quality' data (observations reported almost simultaneously) his estimates (for a six month time period) yield transactions costs one fifth of the costs using data from Frenkel and Levich's sources.

TABLE 5.1

Percentage Transactions Costs in the Spot Foreign Exchange Markets.

Period	Currencies	Vehicle	Cost
Jan 1962-Nov 1967	US$/£	DM(T1)	.051
	US$/£	C$(T2)	.058
Jan '68-Dec '69	US$/£	DM(T1)	.102
	US$/£	C$(T2)	.085
June '73-Dec '79	US$/£	DM(T1)	.565
	US$/£	C$(T2)	.489

Data from Weekly Review of International Money Markets, Harris Bank, Chicago. and Montagu Monthly Review, Samuel Montagu and Co. Ltd.
Reported from Frenkel and Levich 1977:table 1 and 1981 table 2.

5.3 The Case for Canada

The F-L study focuses on the US dollar-Sterling exchange rate hence it classifies exchange rate regimes vis à vis these currencies. Note, however, that unlike the major European countries Canada had adopted a system of flexible exchange rates from the early 1950s till the early 1960s. This unique foreign exchange history precludes the direct extension of the F-L exchange regime classification and transactions costs to Canada. Since flexible rates prevailed in Canada during what F-L term the 'tranquil peg', costs for the later 'managed float' are used during Canada's early experience with flexible rates. The adjusted disaggregation used in Canada-US and Canada-UK study in this chapter are:

T1: Transactions costs using the DM as the vehicle currency.

.565%	1960/1 - 1962/2	flexible period
.051%	1962/3 - 1967/4	tranquil peg
.102%	1968/1 - 1970/2	turbulent peg (extended 2 quarters from F-L)
.565%	1970/3 - 1984/3	flexible period (adjusted 12 quarters back and 19 quarters forward)

T2: Transactions costs using the Canadian dollar as the

vehicle currency

.489%	1960/1 - 1962/2	flexible rate period
.058%	1962/3 - 1967/4	tranquil peg
.085%	1968/1 - 1970/2	turbulent peg (extended by 2 quarters from F-L)
.489%	1970/3 - 1984/3	flexible rate period (adjusted 12 quarters back and 19 quarters forward).

Since F-L do not report cost estimates for the period of transition from fixed to flexible rates, their estimates of costs during the 'turbulent peg' are extended by two quarters till Canada floated its currency once more in 1970/3. Critics may justifiably argue for higher transactions costs during this unstable period but this alternative is necessitated by a lack of available estimates. Similarly it is also necessary to interpolate costs estimated for the later flexible rate period of the 1970s to the early flexible rate period (1960/1 - 1962/2). Since the flexible rate period in their study does not start until 1973/3 and ends at 1979/4 similar extensions are undertaken to fill in the gaps from 1970/3 - 1973/2 (since Canada moved to floating rates in 1970/3) and from 1980/1 to 1984/3.

A comparison of the incorporation of the two estimates of transactions costs (T1 and T2; pre and post annualization) on the respective EFC arguments for both the US dollar and the British pound is presented in figures 3 and 4. In each case the cost adjusted EFC is superimposed on the unadjusted EFC.

5.4 The Model

The model described below differs from equations (4.1,4.3 and 4.4 above) and more generally from the specification in Bordo and Choudhri in that the EFC argument is adjusted for foreign exchange transactions costs as per condition (5.1) above. The single equation log-linear model has the following semilog specification:

$$\ln(M/P) = B0 + B1 \ln y + B2\, r + B3 \ln(M/P)_{t-1} + B4\, EFCT1D1 + B5\, EFCT1D2 + B6\, EFCT2D1 + B7\, EFCT2D2 + B8\, EUS1 + B9\, EUS2 + e \qquad (5.3)$$

where EFCT1D1 = EFCT1 x D1, EFCT1D2 = EFCT1 x D2

EFCT2D1 = EFCT2 x D1, EFCT2D2 = EFCT2 x D2

Equation 5.1 is estimated separately for both methods of incorporating transactions costs i.e. before as well as after annualizing EFC. The (0,1) interactive variable technique is used so that the exchange rate regimes may be

separated without loss of observations. Accordingly D1 and D2 are dummy variables such that D1 = 1 during the flexible rate period and zero otherwise; conversely D2 = 1 during the fixed rate period and zero otherwise.

Only one set of transactions costs, those with respect to the spot exchange rate, are considered in this analysis. This is because the theory of CS, unlike the interest rate parity theory, does not stipulate that once converted into foreign currency the funds be reconverted (back) into any particular currency. This indeed is the essence of CS such that transactors may freely diversify the currency composition of their cash balances. Recall that interest rate parity requires that spot conversion into the foreign currency and future conversion back into the domestic currency be consummated simultaneously to insure risk free arbitrage.

5.5 Empirical Evidence

Equation (5.3) is estimated for the transactions costs adjusted EFC arguments, for the US dollar and the Sterling. Consideration is restricted to these two currencies since only for them were direct spot and forward exchange rate data available. Recall that for the other five countries the cross exchange rates technique was used (condition 4.2) to obtain spot and forward exchange values. The assumptions

which accompany such cross conversions would invalidate the introduction of transactions costs into that framework.

Table 5.2 presents the results of the tests for the presence of cross responsiveness vis à vis the US dollar. Two sets of equations are presented. Equations (1) - (5) present results for the shorter period corresponding to the shorter flexible rate period analyzed in B-C (1982a). Equations (2), (3), (6) and (7) adjust for T before annualizing EUS, the rest (except for equations (1) and (6) after annualizing. The last five equations present results for the whole sample period. Figures 3 and 4 provide superimposed plots of EUS and EUS adjusted for foreign exchange transactions costs, both pre and post annualization. Figure 3 adjusts for the T1 estimate and 4 for the T2 estimate of these costs. The equations presented in this table represent the best fitting equations of the many variants tested. These include, as in chapter 4, variations with respect to the lagged dependent variable and with respect to the appropriate measure of interest rates. As a curiosum the model was also estimated for the period as a whole without adjustment for exchange regimes for the period ending 1979/4 as well as for the entire sample period. The results are not presented, however, the pattern of findings is generally consistent with results for the flexible rate period.

Table 5.2

A Test of the Differential Effect Under Fixed vs. Flexible Rates of Foreign Exchange Transactions Costs on CS for Canadian Residents WRT US Currency

No.	Period	Constant	ln y	(rcpx.01)	ln(M/P)t-1	EUS1	EUS2	EUST1D1	EUST1D2
1)	1960/1-1979/4	-0.671 (-5.091)	0.122 (4.214)	-0.768 (-8.093)	0.856 (18.087)	-0.190 (-1.486)3*	0.0989 (0.309)		
2)	1960/1-1979/4	-0.653 (-5.198)	0.115 (4.200)	-0.749 (-8.048)	0.869 (19.243)			-.895 (-2.319)*	.0849 (0.195)
3)	1960/1-1979/4	-0.658 (-5.208)	0.117 (4.229)	-0.755 (-8.056)	0.866 (19.075)				
4)	1960/1-1979/4	-.671 (-5.088)	.121 (4.210)	-.765 (-8.064)	.857 (18.133)			-.245 (-1.484)3*	.109 (.317)
5)	1960/1-1979/4	-.669 (-5.077)	.121 (4.198)	-.765 (-8.063)	.857 (18.127)				
6)	1960/1-1984/3	-0.346 (-3.886)	0.0575 (4.308)	-0.542 (-7.837)	0.942 (45.458)	-.258 (-2.056)*	.0165 (0.0439)		
7)	1960/1-1984/3	-0.358 (-4.079)	.0540 (4.146)	-.531 (-8.148)	.953 (46.582)			-1.264 (-2.940)*	-0.0486 (-.096)
8)	1960/1-1984/3	-0.355 (-4.059)	0.0543 (4.168)	-.525 (-8.064)	0.952 (46.658)				
9)	1960/1-1984/3	-.351 (-3.952)	.0573 (4.319)	-.525 (-7.925)	.943 (45.833)			-.369 (-2.286)*	.0161 (.040)
10)	1960/1-1984/3	-.351 (-3.947)	.0574 (4.322)	-.524 (-7.912)	.943 (45.752)				

Table 5.2 (continued)

A Test of the Differential Effect Under Fixed vs. Flexible Rates of Foreign Exchange Transactions Costs on CS for Canadian Residents WRT US Currency

No.	EUST2D1	EUST2D2	$\bar{R}^2$	SSE	DW	h
1)			.9941	.01049	2.24	-1.168
2)			.9943	.01008	2.22	-1.048
3)	-.693 (-2.188)*	.109 (0.256)	.9943	.01018	2.22	-1.088
4)			.9941	.01049	2.243	-1.190
5)	-.231 (-1.446)4*	.110 (.320)	.9941	.01051	2.242	-1.185
6)			.9902	.01835	2.095	-.479
7)			.9906	.01754	2.10	-.500
8)	-1.016 (-2.938)*	-.0178 (-0.0358)	.9906	0.01755	2.09	-.476
9)			.9903	.01818	2.096	-.485
10)	-.349 (-2.233)*	.0190 (.047)	.9902	.01821	2.097	-.490

Terms in parenthesis denote the respective t statistics. * describes significance at the 5% level; each additional star indicates deterioration by 5%. All parametric estimates other than for CS arguments are significant at the 1% level. The Ordinary Least Squares (OLS) Estimation procedure was used. Data for y and P is on a quarterly basis; in all other cases values are quarterly averages of monthly data. Note that the EUS terms in equations (4),(5),(9) and (10) are adjusted for T after annualizing, the rest (except for equations (1) and (6)) prior to annualizing.

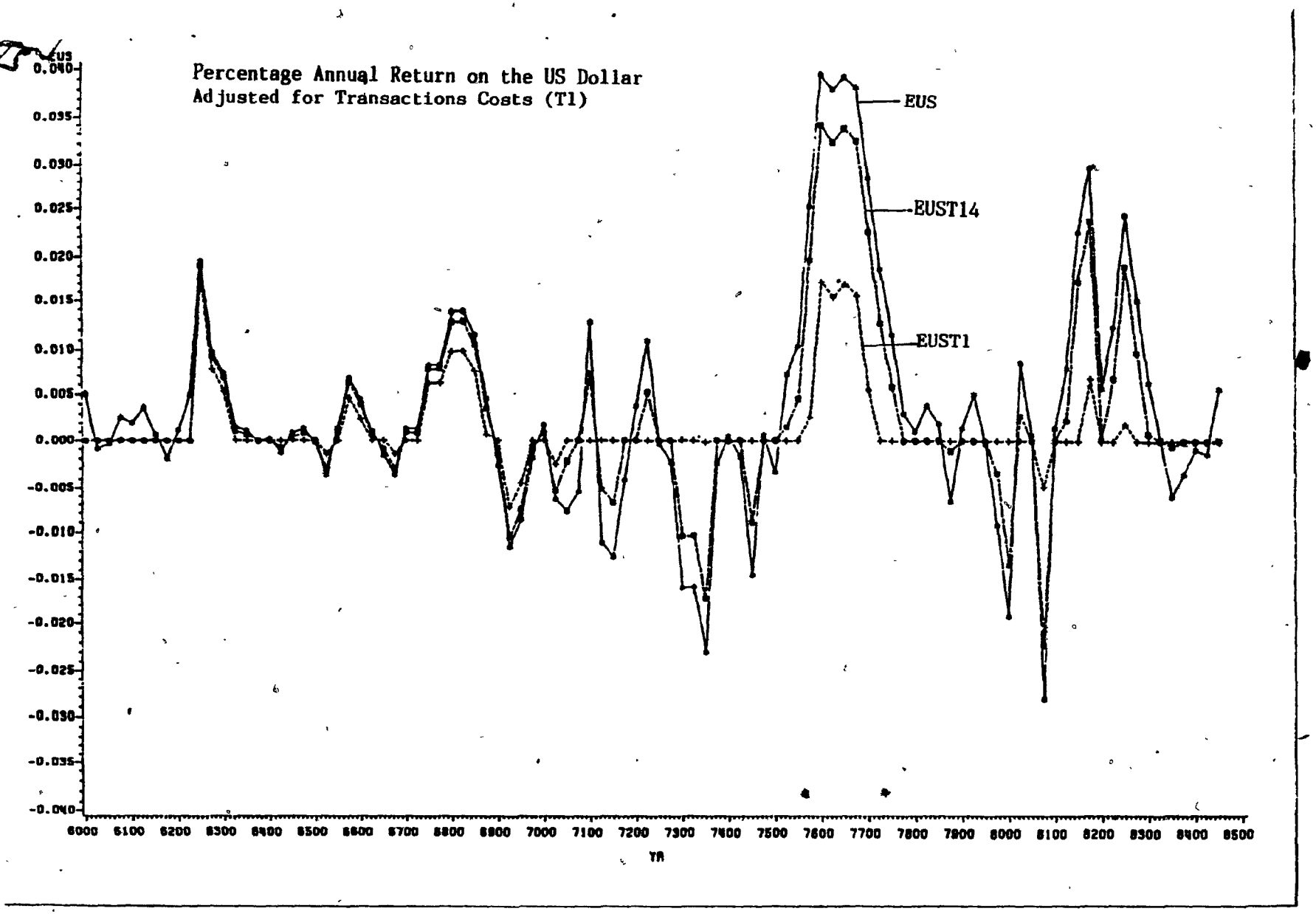

Figure 3 EUST1 denotes preannualized and EUST14 post annualized introduction of transactions costs

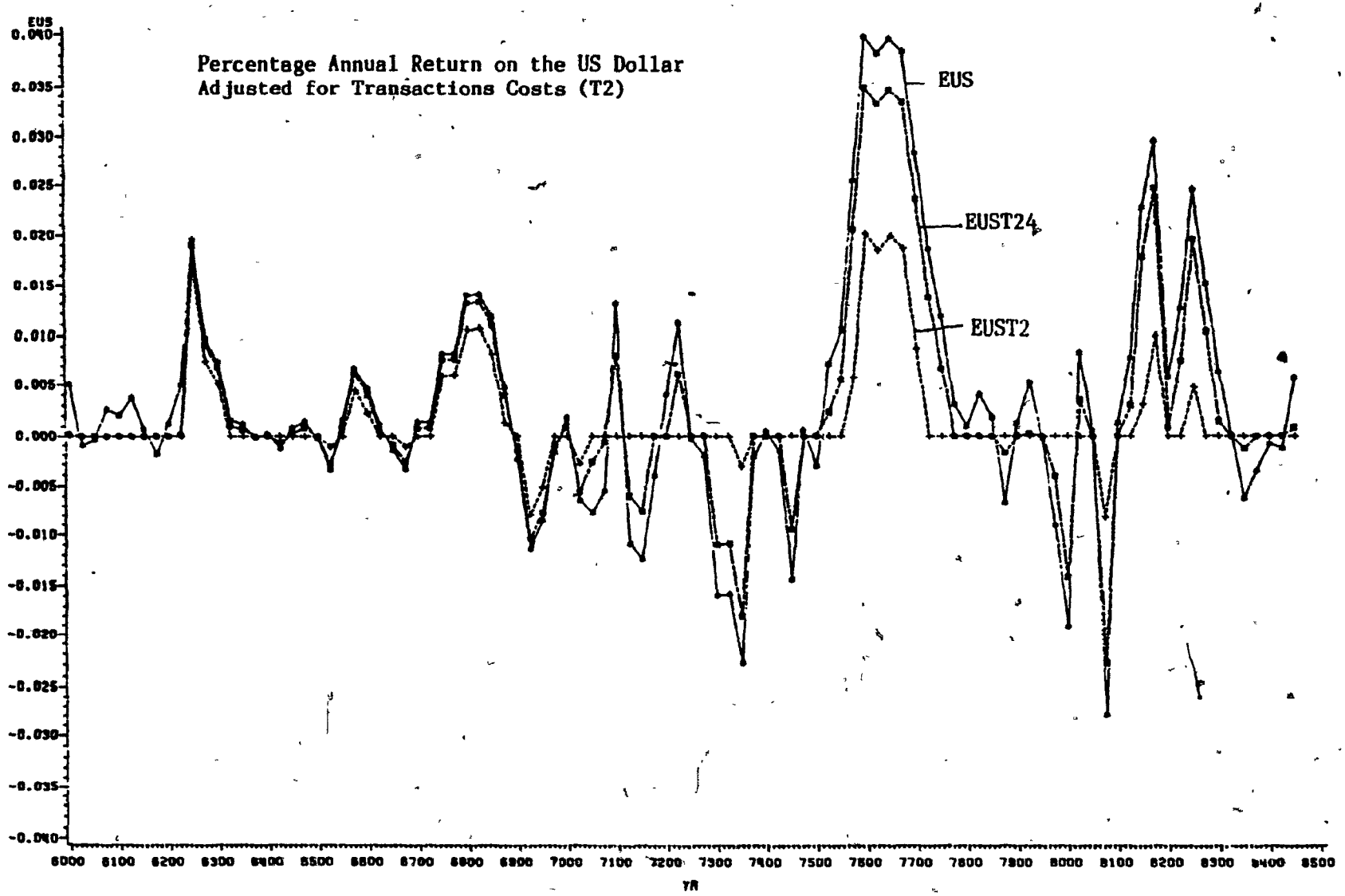

FIGURE 4

EUST2 denotes pre annualized and EUST24 post annualized introduction of transactions costs

Equations (1) and (6) are reproduced from table 4.2 for purposes of comparison. They describe previously done tests for the presence of cross responsiveness vis à vis the US dollar. Comparison of (1) and (6) with (2) and (3), and (7) and (8) respectively, puts in perspective the differential effect of introducing transactions costs. Note that in equations (7) and (5) the EUS argument is adjusted for the estimate of transactions costs T1; in equations (3) and (6) it is adjusted for estimates using T2.

Consider the findings for the period ending 1979/4. Equation (1) suggests weak support for CS during the flexible rate period with no support during the fixed rate period. With the introduction of transactions costs the results change little for the fixed rate period however, the improvement in the numerical value of the estimate and the level of significance during the flexible rate period is noticeable for equations (2) and (3) but not for (4) and (5). The level of significance improves from 15% in equation (1) to 3% and 4% in (2) and (3) respectively and stays more or less unchanged for equations (4) and (5). The preannualized introduction of transactions costs appears to modify the conclusions of B-C (1982a,table 1) who, for the same period, found no evidence of CS[3].

Equations (6) through (10) present the results for the

entire period ending 1984/3. Equation (6) (is reported from table 4.2) and shows that unadjusted for transactions costs support exists for the presence of CS during the flexible rate period (at the 5% significance level) but not for the fixed rate period. When EUS is adjusted for the costs of transacting in the currency markets the level of significance improves to the 1% level for equations (7) and (8) and to the 3% level for (9) and (10). In all cases the parametric estimates show increases. No evidence of CS is found during fixed rates. For the flexible rate period the negative sign of the parameter indicates substitutability in return. Hence the introduction of transactions costs demonstrates increased support for the presence of CS for this time period.

Table 5.3 presents results of tests for the presence of cross responsiveness with respect to the British pound. The model is estimated with and without the addition of the EUS1 and EUS2 arguments. The former, it was argued in section 4.4, accounts for the important role of the US dollar in Canadian trade and finance and as such presents the theoretically more accurate form of the model. The model is also estimated with the transactions costs adjusted EUS arguments (both pre and post annualization) replacing EUS1 and EUS2. Results for this are presented in appendix 3. Figures 5 and 6 provide superimposed plots of EUK and EUK adjusted for foreign exchange transactions costs. Figure 5

incorporates the T1 measure and 6 the T2 measure of these costs.

Equations (1) to (5) present estimates of the model with the EUS arguments; (6) to (10) introduce transactions costs in the B-C type framework.

Equations (1) and (6) are reproduced from table 4.8. Both indicate no evidence of cross responsiveness during either regimes. The introduction of transactions costs equations (2) to (5) and (7) to (10) indicates a noticeable improvement in the level of significance and in the parametric estimate for the flexible rate period. The improvement is greater for the pre annualized introduction of T. Results remain more or less unchanged for the fixed rate period. Results for our variant of the equation (with EUS1 and EUS2) are marginally better, and in all cases the equation with T1 yields slightly better results. Although improved the results still provide no support for cross responsiveness between the two currencies. The positive signs of the parameters indicates complementarity between currencies.

Table 5.3

A Test of the Differential Effect Under Fixed and Flexible Rates of Foreign Exchange Transactions Costs on CS For Canadian Residents WRT to the British Pound: 1960#1 - 1984/3

No	Constant	ln y	(rtbx.01)	ln(M/P)t-1	EUK1	EUK2	EUKT1D1	EUKT1D2	EUST2D1
1)	-.342 (-3.292)	.0632 (4.094)	-.509 (-6.621)	.925 (37.764)	.00463 (.062)	.0398 (.272)			
2)	-.386 (-3.673)	.0656 (4.271)	-.545 (-7.069)	.929 (40.228)			.151 (1.280)5%	.0564 (.361)	
3)	-.382 (-3.628)	.0652 (4.243)	.542 (6.999)	.929 (39.977)					.128 (1.152)
4)	-.352 (-3.354)	.0632 (4.108)	-.518 (-6.680)	.928 (38.302)			.0305 (.362)	.0478 (.322)	
5)	-.350 (-3.344)	.0632 (4.106)	-.517 (-6.667)	.927 (38.209)					.0264 (.318)
6)	-.336 (-3.324)	.0629 (4.144)	-.519 (-6.792)	.925 (37.810)	-.00322 (-.044)	.0274 (.196)			
7)	-.382 (-3.744)	.0653 (4.308)	-.557 (-7.293)	.929 (40.189)			.146 (1.232)	.0450 (.301)	
8)	-.378 (-3.691)	.0648 (4.277)	.554 (-7.213)	.929 (39.938)					.122 (1.096)1
9)	-.346 (-3.387)	.0629 (4.153)	-.529 (-6.851)	.927 (38.309)			.0214 (.255)	.0345 (.243)	
10)	-.345 (-3.376)	.0629 (4.150)	.527 (-6.837)	.927 (38.222)					.0175 (.212)

Table 5.3 (continued)

A Test of the Differential Effect Under Fixed and Flexible Rates of Foreign Exchange Transactions Costs on CS For Residents WRT to the British Pound: 1960/1 - 1984/3

No.	EUKT2D2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)		-.197 (-1.487)3*	.0193 (.047)	.9893	.01951	1.979	.107
2)		-.201 (-1.538)3*	.0115 (.028)	.9895	.01917	2.020	-.102
3)	.0555 (.359)	-.202 (-1.538)3*	.0104 (.026)	.9895	.01923	2.015	-.076
4)		-.199 (-1.511)3*	.00964 (.023)	.9893	.01949	1.987	.066
5)	.0466 (.314)	-.199 (-1.507)3*	.0111 (.027)	.9893	.01949	1.986	.071
6)				.9893	.01999	2.017	-.087
7)				.9895	.01967	2.061	-.310
8)	.0437 (.295)			.9894	.01974	2.056	-.285
9)				.9893	.01998	2.027	-.138
10)	.0334 (.235)			.9893	.01999	2.025	-.128

The OLS estimation procedure is used. All parametric estimates other than for CS arguments are significant at the 1% level. The EUK arguments in equations (4), (5), (9) and (10) are adjusted for T after annualizing, the rest (except for equations (1) and (8)) prior to annualizing. Data for Y and P is on a quarterly basis; all others are quarterly averages of monthly values.

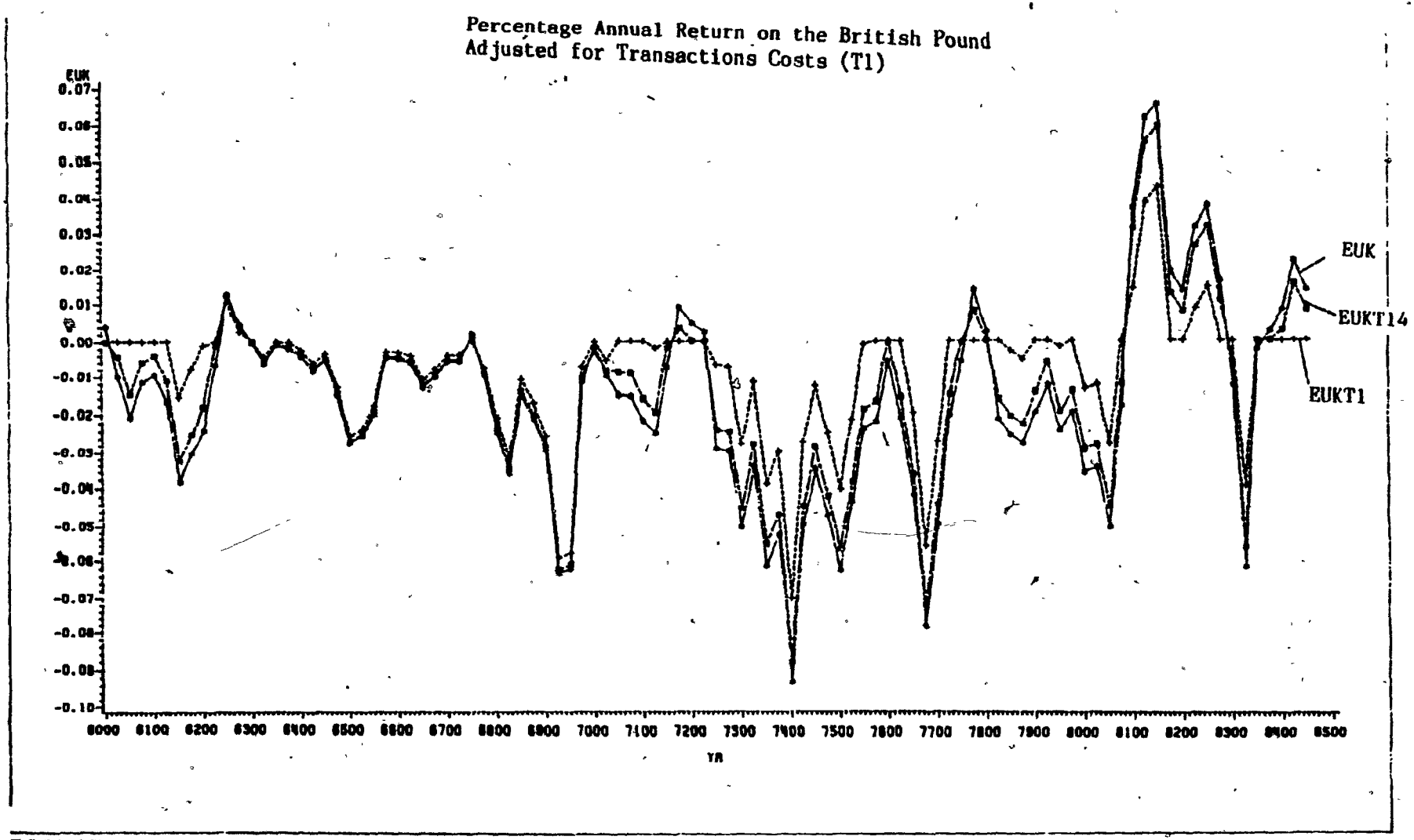

FIGURE 5 EUKT1 denotes pre annualized and EUKT14 post annualized introduction of transactions costs

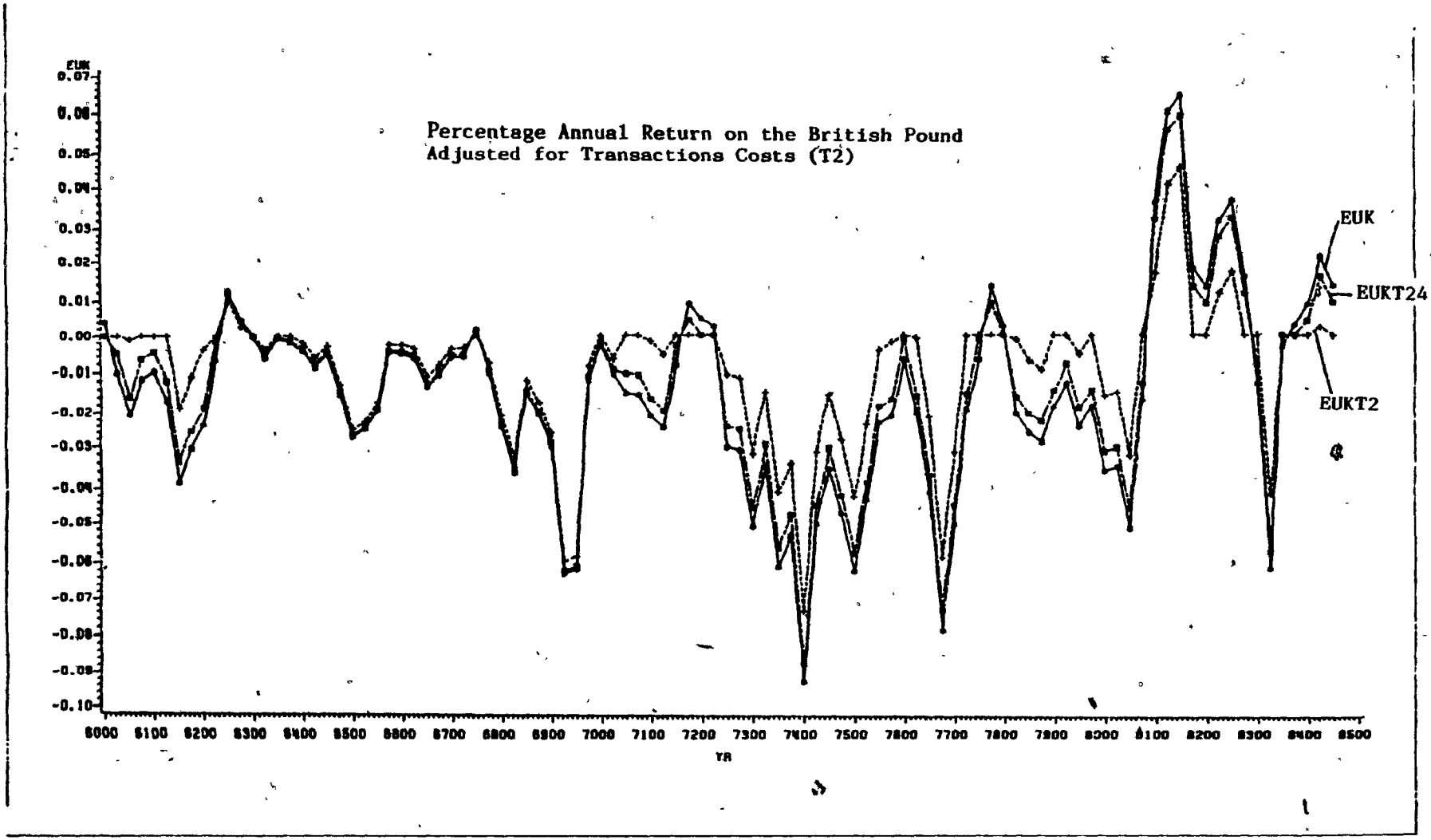

FIGURE 6 EUKT2 denotes pre annualized and EUKT24 post annualized introduction of transactions costs

Results for both countries indicate an improvement in significance levels upon incorporation of exchange market transactions costs. This implies that in reality past tests of CS, all of which ignore these costs, understate the explanatory ability of foreign influences on domestic money demand. Once an element of realism is introduced, through transactions costs, cross responsiveness may exist in more cases than previously believed.

5.6 Transactions Costs and Cross Elasticity

The preceeding section showed that the incorporation of exchange market transactions costs in the EFC variable had in most cases a noticeable effect on the parametric estimate and on the level of statistical significance, particularly during the flexible rate period. Not only does this make a strong statement for the presence of cross responsiveness between currencies in Canadian money demand it also attests to enhancement in it when adjusted for transactions costs. Based on this it was argued that past tests of CS understate the explanatory ability of foreign influences on domestic money demand.

In this section we estimate and compare the numerical values of the cross elasticity measures with and without the incorporation of transactions costs to determine the extent

of this understatement. These values are presented with respect to the return on the US dollar only since for the British pound the cross responsiveness parameters did not display acceptable levels of significance.

Table 5.4 presents the cross return elasticity and own interest elasticity measures vis à vis the US dollar. The equation/reference numbers in table 5.4 correspond to those in table 5.2 such that the first five equations present results for the flexible rate period ending 1979/4 (corresponding to the B-C study). The last five equations present cross elasticity estimates for the entire flexible rate period ending 1984/3. Since no evidence of CS was observed for the fixed rate period it is not considered here. Equations (2), (4), (7) and (9) are based on the T1 estimate of transactions costs; equations (3),(5),(8) and (10) on the T2 estimates. All elasticity calculations are as per equation 4.8 above. Both the average (M) and the maximum (H) values of the respective EUS variables are considered; both are reported below. The mean values are calculated from the observations for the various EUS variables during the flexible rate period only. The own interest elasticity of money demand is presented for comparison.

A selective comparison of these measures reveals that the introduction of transactions costs approximately doubles

the numerical value of the cross return elasticity for the shorter period for the pre annualized introduction of T. When compared to the more representative post annualized introduction of T the value changes only marginally. For the longer period the cross elasticity estimate calculated using the mean of EUS increases by between a third and a half. In the post annualized case the improvement is marginal. Note that although the increases are noticeable in some cases they still remain small in comparison to the own interest elasticity: generally about 1/40th for estimates using the means.

Let us now attempt to translate these results into dollar figures. For this the maximum values of the various cost adjusted and unadjusted EUS variables is considered (centre column). The elasticity measure using the mean is used along with the money stock for the last observation (1984/3): 28,466 million Canadian dollars. The results are:

EUS1	.001017 x 3.96 x 28,466 =	114.6	million Canadian dollars
EUST1D1	.001432 x 1.96 x 28,466 =	68.9	" " "
EUST2D1	.001474 x 2.00 x 28,466 =	83.9	" " "
EUST14D1	.001059 x 3.39 x 28,466 =	102.2	" " "
EUST24D1	.001041 x 3.47 x 28,466 =	102.8	" " "

TABLE 5.4

NUMERICAL ESTIMATES OF THE RESPECTIVE ELASTICITY MEASURES FOR THE US DOLLAR

No.	Exchange Regime/Period Ending	EUS Var.	Mean/ High	Cross elasticity of CS	Own Interest Elasticity	Significance Level of EUS Parameter
1)	Flexible 1979/4	EUS1	M	-.000725	-.050738	15%
			H	-.007519	-.108902	
2)	Flexible 1979/4	EUST1D1	M	-.001354	-.049558	3%
			H	-.015188	-.106366	
3)	Flexible 1979/4	EUST2D1	M	-.001268	-.049756	4%
			H	-.013867	-.106794	
4)	Flexible 1979/4	EUST14D1	M	-.000752	-.050552	15%
			H	-.008310	-.108499	
5)	Flexible 1979/4	EUST24D1	M	-.000719	-.050552	16%
			H	-.008011	-.108499	
6)	Flexible 1984/3	EUS1	M	-.001017	-.041269	5%
			H	-.010202	-.109665	
7)	Flexible 1984/3	EUST1D1	M	-.001432	-.041997	1%
			H	-.021450	-.111600	
8)	Flexible	EUST2D1	M	-.001474	-.041523	1%
			H	-.020330	-.110339	
9)	Flexible 1984/3	EUST14D1	M	-.001059	-.041523	3%
			H	-.012517	-.110339	
10)	Flexible	EUST24D1	M	-.001041	-.041444	3%
			H	-.012103	-.110129	

M and H denote the average and maximum values for the respective EUS variables. Estimates for the minimum value yield the wrong sign and are excluded. Mean values for the EUS variables include the flexible rate period only, whereas mean values for the rate of interest include observations over both regimes.

These figures, which clearly are a hypothetical construct, biased on the high side due to the maximum value of the various EUS variables, suggest currency switches that are not significant when compared to the magnitude of current exchange market transactions. Note, however, that this is vis à vis the US dollar only. We observed in section 4.11 above that such shifts for some European currencies particularly those of Germany and Switzerland were noticeably larger.

FOOTNOTES TO CHAPTER 5

1. Also see estimated bid ask spreads for (currencies) for 1980-81 by D. Longworth, unpublished estimates; Bank of Canada. Kindly supplied to us by the author.

2. McCormick estimates the difference between different sets of exchange observations used in the F-L studies to be as high as 13 hours.

3. Recall that the post annualized adjustment for transactions costs as in equations (4) and (5) is more accurate.

CHAPTER 6

SUMMARY AND SUGGESTIONS

In this thesis we attempt to identify the effect of rectifying the asymmetry in conventional portfolio balance and monetary models by relaxing the country specific money demand assumption made therein. This, it was argued, would permit transactors to optimize through substitution the currency composition of their portfolios. The theory of CS then merely extends to the currency markets alternatives already available in the markets for financial assets. Substitution between currencies is justified on the same grounds as the optimizing behaviour of transactors in other financial asset markets. In short the theory of CS extends consideration to the world demand for domestic currency and to that extent adds a measure of realism to the asset market approaches to exchange rate determination.

The country specific money demand function added an element of stability to domestic money demand and therefore to the exchange rate, particularly within the framework of monetary models. With money demand assumed to be a stable function of a few arguments short run disequalibrium in the money market and the accompanying exchange rate volatility were attributed to monetary policy excesses. The theory of CS questions this by arguing that faced with changes in

relative holding costs, optimizing transactors may switch between currencies making money demand unstable and transmitting monetary disturbances across national boundaries. Such actions undermine national monetary sovereignty. Exchange rate volatility may thus originate on the supply as well as on the demand side of the money market equation.

In chapter 2 we provide intuitive justification for the theory of CS. Its origins are traced to the 1970s move, spearheaded by Klein (1974), Tullock (1975) and Hayek (1976a,b), towards competitively supplied unregulated private sector currencies. With further reference to the works of Boyer (1978), King et al.(1978) and Miles (1978a, b) it was suggested that there exist transactors who experience recurrent demand for foreign currencies and may therefore demonstrate motives for holding balances of foreign currencies little different from foreign residents/transactors. Demand side CS was distinguished from supply side CS, the latter was shown to depend on the nature of the exchange rate regime. The former was said to depend on the extent to which different currencies provide similar monetary services. This in turn was argued to be determined by the degree of integration in world goods and capital markets. It was also demonstrated that CS permits the transmission of monetary disturbances across national boundaries, even under flexible rates, in so doing it

compromises national monetary sovereignty. With reference to the Girton and Roper (1981) model it was shown that exchange rate volatility is directly related to the degree of CS; and in the extreme case of perfect CS the exchange rate becomes indeterminate. It was argued further that endogenizing the behavioural responses of currency issuers may well lead to enhanced exchange rate stability under CS.

For all the reasons outlined in chapter 2 the presence and extent of CS becomes an important empirical issue. To this end chapter 3 presented a summary of the existing empirical evidence on the presence and extent of CS. These studies were divided into two groups; the first included direct tests of substitution between currencies, the other summarized indirect tests of CS. The former was further subdivided into three parts: the first described the Miles (1978a, b, 1981) type of models which maximize a CES function for the production of money services subject to holding costs. His evidence supports the presence of CS particularly during flexible exchange rates. His procedure and his empirical findings face severe criticism at the hands of Bordo and Choudhri (1982a), Spinelli (1983) and Laney, Radcliffe and Willet (1984).

The second category of direct tests is based on the Bordo and Choudhri (1982a) type model which uses the money demand function as the 'tool of analysis'. Included here is

the five country study by Batten and Hafer (1984), the adjustment for postal strikes by Daniel and Fried (1983), the alternate measure of foreign influences by Winder (1983) and portfolio balance considerations by Cuddington (1983). Most yield selective support for the presence of CS. In cases where exchange regimes are distinguished, evidence generally indicates increased presence of CS under flexible exchange rates. For some currencies the signs of the parameters indicate complementarity. The third category of direct tests describe models of CS within a portfolio balance framework. This category shares the Cuddington (1983) study and includes the Brillembourg and Schadler (1979) attempt at estimating the 'semielasticities' matrix for eight countries.

Indirect studies of CS test the validity of the implications of CS. In this category we reported on the Evans and Laffer (1977) study which tests for a systematic link between changes in relative money supplies and movements in exchange rates. Additionally, Brittain (1981) attributes to CS the 'coincidental' divergences from respective national trends of income velocities. Lastly the implied concept of 'world money' and its effect on national inflation rates is examined within the McKinnon (1982) framework. In each case the authors claim evidence supporting CS.

Criticisms of the theory of CS were presented as arguing that CS indicates but one route through which monetary disturbances may be transmitted across national boundaries under flexible exchange rates. This suggests that perfect nonsubstitution between currencies does not imply monetary independence even under flexible rates.

In chapter 4 we present a variant of the model pioneered by Bordo and Choudhri (1982a). The difference centres on our incorporation of the argument for the yield on the US dollar in addition to that for the respective foreign currency. It is suggested that this provides a theoretically more acceptable model for a small country such as Canada for whose currency the US Dollar may be considered a viable substitute. It is argued further that to the extent that the U.S. dollar occupies a singularly important role in the international financial markets a similar procedure may be justified for most other countries.

Our model as well as that of B-C are estimated to test for the presence of demand side CS between the Canadian dollar and the currencies of the U.S., Belgium, France, Germany, the Netherlands, Switzerland and the United Kingdom. Quarterly observations are used for a sample period which extends from 1960/1 to 1984/3. The (0,1) interactive variable technique is used to separate exchange regimes. Our results indicate support for CS with respect

to the US dollar, the Belgian, French and Swiss francs and the Deutsche mark. Weak support was found for the Dutch Guilder. No evidence was found for the Sterling. In conformity with other studies our findings too indicate a significantly higher degree of CS during the flexible as compared to the fixed rate period. Additionally, for all currencies which yielded evidence of CS (except for the U.S. dollar) positive parametric estimates indicate complementarity.

In this chapter we also provide what we believe to be an intuitively more acceptable explanation of why the degree of CS under flexible exchange rates should exceed that under fixed rates. It is argued that under the latter expectations of intertermporal fixity dampens the willingness to switch between currencies in response to an incipient discrepancy between the spot and forward exchange rates. Our findings as well as those of other studies confirm our argument. The chapter also highlights the weakness of the Cuddington (1983) type studies which do not differentiate between exchange regimes. It is argued, on an intuitive basis, that the parametric estimate for the CS argument under separate exchange regimes will generally diverge from estimates when such differences are ignored. Our empirical findings confirm this indicating further that no systematic link exists between these two.

The chapter draws to a close by tabulating the numerical value of the respective cross elasticity measures. It is observed that cross estimates fade in comparison to own interest elasticity measures. Surprisingly cross estimates for Germany, Switzerland and the Netherlands (in that order) exceed that for the U.S. Translated into currency units the potentiality for switching appears to be most significant with respect to the Swiss and German currencies.

The empirical tests in chapter 4 were based on the premise that the divergence between the spot and forward exchange rates accurately measures the return on the foreign currency as the inducement to switch. It is stressed in chapter 5 that realism requires that this divergence be adjusted to reflect the cost of transacting in foreign exchange markets. While these costs may be insignificant compared to the totality of such transactions they may not be quite as small compared to the yield on the foreign currency. In the absence of other cost estimates based on the difference between the bid ask spreads, those estimated by Frenkel and Levich (1975, 1977, 1981), using the triangular currency artitrage technique, are used. These estimates are modified to suit the unique foreign exchange history of Canada.

The technique for incorporating these costs into the CS

argument is described and both the B-C model as well as our, theoretically more applicable, variant of it are estimated to test for the differential effect of transactions costs on demand side CS. Both types of models are tested with respect to the U.S. dollar and the Sterling for quarterly data over the sample period extending from 1960/1 to 1984/3. The results indicate enhanced explanatory power to the CS argument. The findings for the introduction of these costs prior to the annualization of the CS argument are stronger than those for the more realistic post annualized introduction. Based on this it is argued that past tests of CS, all of which ignore the costs of transacting in foreign exchange markets, understate the presence and extent of CS.

The chapter draws to a close by tabulating the cross elasticity values with and without adjustment for these costs. As expected the improvement for the post annualized introduction of transactions costs in the EFC argument is found to be much weaker than for pre annualized introduction.

The issue of complementarity has been explicitly recognized before in only Brillembourg and Schadler (1979, p. 577), even though it appeared, but was dismissed, in Cuddington (1983, p. 126). The indication of complementarity between currencies makes a case for currency blocs such as the EMS. Of importance, however, is the

extent of this complementarity as measured by the cross elasticity of demand between currencies. Whereas the presence of complementarity between the Canadian dollar and the European currencies suggest the inclusion of Canada into the EMS, the extent of this complementarity and the concomitant translation into currency units of such switches significantly weakens the argument. Further confirmation calls for a repetition of this study between member countries of the EMS to test for the presence and extent of complementarity between currencies of the EMS. A comparison of cross elasticity measures so obtained with those calculated in this study for Canada would cast the decisive vote on this issue.

In closing it is emphasized that the theory of CS is more appropriately considered within the framework of a narrow definition of money. This is based on the premise that in reality CS concentrates on the transactions motive for money demand. Speculative as well as other balances may well be held in the form of interest yielding securities and may thus more appropriately fall in the domain of capital mobility. This serves to further stress the role of the theory of CS as but one subset of the more general asset market theories of exchange rate determination. While changes in the currency composition of portfolio holdings induce exchange market pressure few would contest the fact that such changes would fade in comparison to similar

pressure induced by capital mobility associated with portfolio balance considerations.

APPENDECES

APPENDIX 1

DATA DEFINITIONS AND SOURCES

The two principal sources of data are the CANSIM minibase data bank of Statistics Canada, and the OECD Main Economic Indicators. The former was the main source of Canadian data, the latter for the other countries. Some data was also obtained through the kind offices of Dr. Ehsan Choudhri (Carleton University), Dr. Jacob Frenkel (University of Chicago) and Dr. David Longworth (Bank of Canada).

Time Period

The basic sample stretches from 1960/1 to 1984/3. Within this certain tests are performed over shorter time periods to enhance comparability with those which appear in the literature. In some cases a restricted time period is necessitated by the unavailability of data. The nature of the restrictions are specified with the respective tests.

Monetary Aggregates

M1 = Currency and demand deposits: seasonally adjusted and in million of Canadian dollars. The figures are quarterly averages of monthly data which are averages of

Wednesdays. Discontinuity at January 1966 was due to the revised definition of 'net demand deposits'; Subsequently defined net of public sector float.

Source: CANSIM data base.

Interest Rates

rtb = Average yield on 90 day Government of Canada Treasury bills. Quarterly average of monthly data obtained from the weekly tender on thursdays.

Source: CANSIM

rcp = rate of interest on 90 day prime corporate paper. Quarterly average of monthly data.

Source: CANSIM

Exchange Rates

All exchange data other than for SUS, FUS, SUK and FUK are from the OECD Main Economic Indicators.

SUS = Canadian dollars per US dollar: quarterly average of monthly data obtained from unadjusted average of daily noon spot exchange rates

Source:CANSIM

FUS = Canadian dollars per US dollar: quarterly average of

monthly data obtained from unadjusted average of daily noon 90 day forward exchange rates.
Source: CANSIM

SUK = Canadian dollars per British pound: quarterly average of monthly data obtained from unadjusted average of daily noon spot exchange rates.
Source:CANSIM

FUK = Canadian dollars per British pound; quarterly average of monthly data obtained from unadjusted average of daily noon 90 day forward exchange rates.
Source: The Bank of Canada accessed from CANSIM Mainbase. (All other data from CANSIM is from the minibase).

SBF = Canadian dollars per Belgian franc; end of quarter spot exchange rate; refers to the Belgium/Luxembourg Economic Union.

FBF = Canadian dollars per Belgian franc; end of quarter 90 day forward exchange rate; refers to the Belgium/Luxembourg Economic Union.

SFF = Canadian dollars per French franc; end of quarter spot exchange rate.

FFF = Canadian dollars per French franc; end of quarter 90

day forward exchange rate.

SDM = Canadian dollars per Deutsche mark; end of quarter spot exchange rate.

FDM = Canadian dollars per Deutsche mark; end of quarter 90 day forward exchange rate.

SNL = Canadian dollars per Dutch guilder; end of quarter spot exchange rate.

FNL = Canadian dollar per Dutch guilder; end of quarter 90 day forward exchange rate. The available data has a missing value for 1971/3.

SSF = Canadian dollar per Swiss franc; end of quarter spot exchange rate. For the length of the fixed rate regime the rate quoted is the buying rate.

FSF = Canadian dollar per Swiss franc; end of quarter 90 day forward exchange rate. For the length of the fixed rate regime the rate quoted is the buying rate.

All end of quarter data is for the last working day of the quarter. All exchange data except for the US and the UK represent cross exchange rates calculated as per condition (4.2) above using spot and forward US dollar/Canadian dollar

exchange rate from the same source as the common respective denominator.

Other data

y = Gross national expenditure in constant dollars: 1971 = 100. Seasonally adjusted at annual rates. Quarterly data.

Source: CANSIM

P = Gross national expenditure deflator: implicit price indexes for GNE; seasonally adjusted at annual rates. Quarterly data.

Source: CANSIM

APPENDIX 2

TABLES 1 - 7

Table 1

AN ALTERNATE TEST FOR THE PRESENCE OF CS BETWEEN THE CANADIAN AND US CURRENCIES FOR CANADIAN RESIDENTS: 1960/1 - 1984/3

No.	constant	ln y	(rtbx.01)	ln(M/P)t-1	EUS	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.336 (-3.624)	.0631 (4.296)	-.509 (-7.229)	.924 (41.039)	-.169 (-1.374)4*			.9896	.01961	1.968	.163
2)	-.347 (-3.659)	.0641 (4.323)	-.511 (-7.221)	.924 (40.887)		-.194 (-1.489)3*	.0525 (.135)	.9895	.01953	1.980	.102

The r variable is the 90 day Government of Canada treasury bill rate. Terms in parenthesis denote the respective t statistics. All non EFC parametric estimates are significant at the 1% level. * = significance at the 5% level; 2* at the 10% level; 3* at the 15% level; 4* and 5* at the 20% and 25% levels, respectively. The OLS estimation procedure is used.

TABLE 2

BETWEEN THE CANADIAN DOLLAR AND THE BELGIAN FRANC
1960/1 - 1984/3

No.	constant	ln y	(rcp x.01)	ln(M/P)t-1	EBF1	EBF2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.303	.0540	-.489	.940	+.115	-.181	-.201	+.119	.9902	.01787	2.058	-.2935
	(-3.416)	(4.050)	(-7.191)	(44.852)	(1.628)3*	(-.645)	(-1.578)3*	(.221)				
2)	-.304	.0547	-.501	.939	.134	-.129			.9902	.01838	2.108	-.5465
	(-3.413)	(4.088)	(-7.382)	(44.775)	(1.920)2*	(-.680)						

The r variable in this table and in the ones to follow is the 90 day prime corporate paper rate. Exchange rate data refers to the Belgium/ Luxembourg Economic Union. rcp and M are quarterly averages of monthly data; exchange values are end of quarter observations. All non EFC parameters are significant at the 1% level. The OLS estimation procedure is used.

Table 3

BETWEEN THE CANADIAN DOLLAR AND THE FRENCH FRANC
1960/1 - 1984/3

No.	constant	ln y	(rcp x.01)	ln(M/P)t-1	EFF1	EFF2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.367	.0612	-.551	.938	.173	-.191	-.283	.0869	.9904	.01759	2.085	-.429
	(-4.090)	(4.499)	(-7.934)	(45.028)	(2.031)*	(-.605)	(-2.241)*	(.173)				
2)	-.360	.0601	-.561	.939	+.137	-.151			.9901	.01857	2.124	-.628
	(-3.975)	(4.355)	(-7.962)	(44.403)	(1.609)3*	(-.659)						

rcp and M are quarterly average of monthly data; exchange values are end of quarter observations. All non EFC parametric estimates are significant at the 1% level. The OLS estimation procedure is used.

TABLE 4

BETWEEN THE CANADIAN DOLLAR AND THE DEUTSCHE MARK
1960/1 - 1984/3

No.	constant	ln y	(rcp x.01)	ln(M/P)t-1	EDM1	EDM2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.263	.0469	-.534	.949	.138	.0647	-.291	-.192	.9901	.01802	2.011	-.056
	(-2.668)	(3.249)	(-7.741)	(44.847)	(1.514)3*	(.473)	(-2.213)*	(-.498)				
2)	-.299	.0512	-.543	.947	.0762	.0322			.9898	.01904	2.082	-.415
	(-3.029)	(3.518)	(-7.768)	(44.070)	(.865)	(.248)						

rcp and M are quarterly averages of monthly data; exchange values are for end of quarter observations. All non EFC parameters are significant at the 1% level. The OLS estimation procedure is used.

TABLE 5

BETWEEN THE CANADIAN DOLLAR AND THE DUTCH GUILDER
1960/1 - 1984/3

No.	constant	ln y	(rcp x.01)	ln(M/P)t-1	ENL1	ENL2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.288	.0474	-.545	.953	+.0801	.0159	-.242	-.139	.9901	.01811	2.121	-.608
	(-3.003)	(3.205)	(-7.365)	(42.010)	(1.014)	(.048)	(-1.895)	2*(-.282)				
2)	-.296	.0491	-.527	.951	+.0598	-.0385			.9899	.01885	2.163	-.819
	(-3.066)	(3.294)	(-7.517)	(41.584)	(.762)	(-.353)						

rcp and M are quarterly averages of monthly data; exchange values are for end of quarter observations. The series on forward exchange rates had one missing value. Due to the lag the number of observations were reduced by two. All non EFC parameters are significant at the 1% level. The OLS estimation procedure is used.

TABLE 6

BETWEEN THE CANADIAN DOLLAR AND THE SWISS FRANC
1960/1 - 1984/3

No.	constant	ln y	(rcp x.01)	ln(M/P)t-1	ESF1	ESF2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.268	.0483	-.519	.947	+.0582	-.0456	-.259	-.0823	.9900	.01820	2.043	-.218
	(-2.597)	(3.303)	(-7.421)	(44.937)	(.843)	(-.198)	(-2.009)*	(-.186)				
2)	-.294	.0511	-.529	.946	.0279	-.0791			.9898	.01908	2.102	-.517
	(-2.846)	(3.478)	(-7.547)	(44.428)	(.421)	(-.412)						

rcp and M are quarterly averages of monthly data; Δ change values are for end of quarter observations. All non ESC parameters are significant at the 2% level. The OLS estimation procedure is used.

TABLE 7

BETWEEN THE CANADIAN DOLLAR AND THE POUND STERLING
1960/1 - 1984/3

No.	constant	ln y	(rcp x.01)	ln(M/P)t-1	EUK1	EUK2	EUS1	EUS2	$\bar{R}^2$	SSE	DW	h
1)	-.335	.0559	-.519	.943	.00298	.0709	-.262	-.0404	.9900	.01829	2.091	-.463
	(-3.490)	(4.041)	(-7.262)	(41.013)	(.042)	(.501)	(-2.052)*	(-.102)				
2)	-.318	.0545	-.522	.943	-.0129	.0482			.9897	.01915	2.112	-.569
	(-3.376)	(3.952)	(-7.226)	(40.620)	(-.181)	(.353)						

rcp and M and exchange values are quarterly averages of monthly data. All non EFC parameters are significant at the 1% level. The OLS estimation procedure is used.

APPENDIX 3

TABLE 1

Table 1

An Alternate Test for the Differential Effect of Foreign Exchange Transactions costs on Currency Substitution for Canadian Residents vis à vis the British Pound

1960/1 - 1984/3

No.	Constant	ln y	(rtbx.01)	ln(M/P)t-1	EUKT1D1	EUKT1D2	EUKT2D1	EUKT2D2	EUST1D1
1)	-.376 (-3.609)	.0616 (4.028)	-.537 (-7.027)	.937 (40.581)	.104 (.880)	.0661 (.434)			-.990 (-2.168)*
2)	-.373 (-3.584)	.0615 (4.032)	-.531 (-6.921)	.937 (40.449)			.0911 (.828)	.0638 (.423)	
3)	-.355 (-3.393)	.0631 (4.119)	-.519 (-6.724)	.928 (38.488)	.0273 (.325)	.0479 (.325)			-.299 (-1.762)2*
4)	-.353 (-3.385)	.0633 (4.124)	-.518 (-6.709)	.928 (38.358)			.0236 (.286)	.0458 (.311)	

Table 1 (continued)

An Alternate Test for the Differential Effect of Foreign Exchange Transactions costs on Currency Substitution for Canadian Residents vis à vis the British Pound

1960/1 - 1984/3

No.	EUST1D2	EUST2D1	EUST2D2	$\bar{R}^2$	SSE	DW	h
1)	-.0565 (-.103)			.9898	.01869	2.007	-.036
2)		-.817 (-2.232)*	-.0210 (-.039)	.9898	.01871	2.000	0
3)	.0104 (.024)			.9894	.01932	1.983	.087
4)		-.281 (-1.713)2*	.0158 (.036)	.9894	.01936	1.984	.082

The EFC terms in equations (3) and (4) are adjusted for Transactions costs prior to annualizing EUS; All other information as per table 5.2 above.

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