行政院國家科學委員會補助專題研究計畫成果報告

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計畫類別：☑個別型計畫　□整合型計畫

計畫編號：NSC 91－2415－H－002－003－

執行期間：91 年 8 月 1 日至 92 年 7 月 31 日

計畫主持人：陳思寬教授

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□赴國外出差或研習心得報告一份

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□出席國際學術會議心得報告及發表之論文各一份

□國際合作研究計畫國外研究報告書一份

執行單位：國立台灣大學國際企業系

中 華 民 國 九十二年 十 月 三十一日

行政院國家科學委員會專題研究計畫成果報告

實質匯率動態與貿易條件變動

The Dynamics of the Real Exchange Rate and the Terms of Trade Movements

計畫編號：NSC 91-2415-H-002-003
執行期限：91 年 8 月 1 日至 92 年 7 月 31 日
主持人：陳思寬教授　國立台灣大學國際企業系

一、中文摘要

本研究計畫擬修正前人模型，以建立一在資本不完全移動之下的開放經濟體系跨期最適化模型，在沒有外生衝擊的狀況下來討論實質匯率波動與貿易條件變動之間的關係。也就是說，我們想要研究貿易條件的變動對於實質匯率的內生波動會產生什麼樣的影響。同時我們也探討本計畫理論模型所得出的結論，與各國實際的實質匯率和貿易條件資料所隱含的關係是否一致。

關鍵詞：實質匯率，貿易條件，不確定性

Abstract

This research project proposes to modify previous models and to construct an intertemporal optimizing model of an open economy facing imperfect international capital markets. The aim of this project is to consider separately the changes of terms of trade effect on the real exchange rates in the absence of exogenous shocks to the economy. In other words, we look into the endogenous fluctuation of the real exchange rate and its relationship with the terms of trade changes. We also test the results of our theoretical models on the data of real exchange rates and terms of trade of several countries to examine the relationship between the two variables.

Keywords: real exchange rates, terms of trade, indeterminacy.

THE DYNAMICS OF THE REAL EXCHANGE RATES AND THE TERMS OF TRADE MOVEMENTS

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This paper modifies previous models and constructs an intertemporal optimizing model of an open economy facing imperfect international capital markets. The aim of this paper is to consider separately the changes of terms of trade effect on the real exchange rates in the absence of exogenous shocks to the economy. In other words, we look into the endogenous fluctuation of real exchange rates and its relationship with the terms of trade changes. We also test the results of our theoretical models on the data of the real exchange rate and the terms of trade of several countries to examine the relationship between the two variables.

Preliminary Draft: October 2003

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1 Introduction

Among the puzzles which have emerged concerning the exchange rate over the past three decades are that real exchange rates are hard to distinguish from random walk and that empirically measured fundamentals only seem to explain a small fraction of short-term real exchange rate movements in many industrial countries. Lothian and Taylor (1996, 1997) also pointed out that real exchange rates are more variable under a floating rate regime than under a fixed rate regime. But recent surveys of exchange rate models, such as Rogoff (1996) and MacDonald and Marsh (1999), tend to find that existing exchange rate models are unsatisfactory. The new open economy macroeconomic models pioneered by the work of Obstfeld and Rogoff (1995, 1998, 2000) built a systematic approach with microfoundations under stochastic settings and look into several issues including the issue of relative international price movements, that is the real exchange rate and terms of trade.[1]

On the empirical side of the real exchange rate literature, several research papers link real exchange rate changes to the terms of trade changes and macroeconomic shocks. Amano and van Norden (1995) find that terms of trade shock have a significant effect on the Canada-US real exchange rate. Lee and Solt (2001) also find that real exchange rate changes are negatively related to terms of trade changes. While Engel (1999) also show that movements in the relative price of traded goods are important for the U.S. real exchange rates.

Recently there has been a renewed interest in "indeterminacy", or alternatively put, in the existence of a continuum of rational expectations equilibria in nonlinear dynamic economic models.[2] Fluctuations could persist even in the absence of exogenous shocks to the economy.[3] This line of research intends to provide an alternative view of the real exchange rate fluctuations. In prior studies of exchange rate indeterminacy, it has been shown that indeterminacy can arise when there is easy substitution among alternative currencies. Barnett (1992) has shown that indeterminacy in both nominal and real exchange

[1]See Lane(2001) for an excellent general survey of the work stimulated by Obstfeld and Rogoff.

[2]See Benhabib and Farmer (1996) and literature cited therein.

[3]See Boldrin and Woodford (1990) for an excellent survey of endogenous fluctuations models, which are essentially nonlinear as claimed by them.

rates may arise within particular intervals in a two-good environment.

In two recent papers, Chen (1999, 2000) showed that a crucial condition for indeterminacy of the real exchange rate to occur in a two-good open economy model required that the Marshall-Lerner condition should not be fulfilled, i.e., the price elasticities of exports and imports should be low enough to imply an inverse relationship between the balance of trade and the relative price of imports. Empirically, exports and imports do not respond much to relative price changes in the very short run after a real depreciation. However, for most industrialized countries, the Marshall-Lerner condition does hold for adjustment periods beyond the very short run (say, six months). Chen, Chen and Chou (2001) constructs an intertemporal optimizing model of a semi-small open economy facing a downward sloping export demand and imperfect international capital markets. It is found that indeterminacy of short-term real exchange rates may arise if the intertemporal elasticities of substitution are sufficiently low.

This paper purports to modify the model of Chen (2000) and Chen, Chen and Chou (2001) in order to consider separately the changes of terms of trade effect on the real exchange rates in the absence of exogenous shocks to the economy. In other words, we would like to look into the endogenous fluctuation of real exchange rates and its relationship with the terms of trade changes.

The paper is organized in five sections. Following this introduction, Section 2 presents the basic model. Based on this model, Section 3 explores the possibility of the existence of indeterminacy of terms of trade and real exchange rate equilibria. Section 4 applies the model to the real exchange rates and the terms of trade data in the G7 countries. Section 5 concludes.

2 The Model

The basic framework is similar to that of Chen (2000) model except we assume that interest rate is a decreasing function of the net holdings of bonds and a simplified version of Chen, Chen and Chou (2001). We also generalize the model to incorporate not only tradable and nontradable goods but also exportable and importable goods. The small, open economy we consider is inhabited by identical agents who consume three types of goods. The nontradable good $C_{N,t}$ is produced by the home economy using labor as its sole production factor. The importable good $C_{F,t}$, which is not produced by the home economy, is supplied perfectly elastically to the economy on the world market at constant foreign price P_F^* and its home price is denoted as $P_{F,t}$. A constant flow of exportable output, $\bar{Y}$, is produced with the aid of a fixed stock of physical capital. The fixed supply of exportable good $C_{H,t}$ is partly consumed at home and partly exported to the rest of the world. The price of the exportable good, $P_{H,t}$, is freely flexible, as is the exchange rate (domestic currency price of foreign exchange), e_t. The economy is small in the importable good market but 'large' in the exportable good market. The terms of trade, $q_t = P_{F,t}/P_{H,t} = e_t P_F^*/P_{H,t}$, are therefore endogenously determined. Note that P_F^* is assumed to be unity to save notation.

Agent at home may save by foregoing consumption and accumulating instead the internationally traded bond, assumed to be indexed to the importable good (currency). The international rate of interest r, is assumed to be a decreasing function of the net holdings of international bonds, B,

$$r_t = r(B_t), \qquad r' < 0, \tag{1}$$

where B_t is the representative agent's holding of foreign bonds at the outset of period t (or the end of period $t-1$) and r_t is the real interest rate paid between period $t-1$ and t. Auernheimer (1987) and Obstfeld (1982) attributed the dependence of r_t on B_t to the imperfection of international capital markets faced by the home economy.

2.1 The Household Behavior

The representative household is assumed to have utility function that depends positively on nontraded, exportable and importable good consumption and negatively on work effort:

$$U_t = \ln C_{N,t} + \ln C_{H,t} + d^b \frac{C_{F,t}^{1-b}}{1-b} - \phi L_t, \quad b > 0, d > 0, \phi > 0, \tag{2}$$

where L_t is period-t labor supply and is supplied inelastically by households, with d, ϕ being scaling parameters. Here we have followed the typical treatment of the indivisible labor model by assuming separable utility and that the representative agent for this economy has preferences that are linear in leisure. $1/b$ represents the corresponding elasticity for the importable good consumption. while the exportable good consumption has perfectly elastic intertemporal substitution. Domestic consumption of the exportale good is simply a residual. The foreign residents import whatever quantity they want from the home economy at the given terms of trade; agents at home simply consume whatever quantity of the exportable goods is left: $C_{H,t} = \bar{Y} - C^*_{H,t}$, where $C^*_{H,t}$ is the foreign demand for home exportables. The objective of the representative agent is to maximize the expected value of her lifetime utility

$$E_t \sum_{s=t}^{\infty} (\frac{1}{1+\delta})^{s-t} U_s, \tag{3}$$

where E is the expectation operator and δ is the constant subjective rate of time preference. In maximizing (3), the agent is bound by a flow budget constraint linking the excess of her income over her expenditure to her accumulation of foreign assets:

$$q_t(B_t - B_{t-1}) = w_t L_t + \bar{Y} + q_t r_{t-1} B_{t-1} - \frac{P_{N,t} C_{N,t}}{P_{H,t}} - C_{H,t} - q_t C_{F,t}, \tag{4}$$

where $r_t B_{t-1}$ is the interest earning in terms of the importable good (currency) at the end of period $t-1$ and w_t is the real wage in units of the exportable good. To prevent agents in the home economy from engaging in Ponzi-games, the following transversality condition must hold:

$$\lim_{t \to \infty} (\prod_{s=0}^{t-1} (1 + r_s)^{-1}) B_t = 0. \tag{5}$$

Let λ_t denote the Lagrange multiplier associated with the flow budget constraint. From the point of view of the maximizing agent, r_t, w_t, $P_{N,t}$, $P_{H,t}$ and q_t are market parameters. The first-order conditions are

$$C_{N,t}^{-1} = \lambda_t \frac{P_{N,t}}{P_{H,t}}, \tag{6}$$

$$C_{H,t}^{-1} = \lambda_t, \tag{7}$$

$$d^b C_{F,t}^{-b} = \lambda_t q_t, \tag{8}$$

$$\phi = \lambda_t w_t. \tag{9}$$

$$1 + r_t = (1+\delta) \frac{\lambda_t q_t}{E_t \lambda_{t+1} q_{t+1}} = (1+\delta) \frac{C_{F,t}^{-b}}{C_{F,t+1}^{-b}}. \tag{10}$$

Equations (7) and (8) lead to

$$C_{F.t} = dq_t^{-\frac{1}{b}}. \tag{11}$$

where the intertemporal elasticity $1/b$ coincides with the price elasticity. Equation (9) equates the marginal disutility of labor with the value in utility terms of the wage, implying a infinite λ-constant elasticity of labor supply. The last optimality condition (10) equates the marginal rate of substitution of present for future imported good consumption to the price of future consumption in terms of present consumption, $(1+r_t)^{-1}$. An implication is that the agent smoothes the expected marginal utility of imported good consumption over time. We can derive the bond holdings function from (1) and (10) as

$$B_t = F(E_t q_{t+1}/q_t), \tag{12}$$

with

$$F' = \frac{\partial B_t}{\partial(E_t q_{t+1}/q_t)} = -(1+\delta)/r' > 0. \tag{13}$$

2.2 Production Technology and Labor Demand

The economy produces the nontradable good competitively. We can write the output of the nontradable industry as follows:

$$N_t = AL_t, A > 0, \tag{14}$$

where N_t denotes the output of the nontradabel good. Here we impose the assumption of constancy of marginal productivity of labor faced by individual firms and no externalities existing in the economy. For profit maximization. the firm will hire labor to satisfy the equality:

$$w_t = A. \tag{15}$$

From equations (6) and (9) in the preceding subsection, we have

$$w_t = \phi \frac{P_{N,t} C_{N.t}}{P_{H.t}}. \tag{16}$$

combining equations (15) and (16). we have

$$\frac{P_{N,t} C_{N.t}}{P_{H.t}} = \frac{A}{\phi}. \tag{17}$$

In general equilibrium all markets must clear. This requires that production of the nontraded good be totally consumed locally, that is

$$C_{N,t} = N_t = AL_t.$$

And since wage payments exhaust total nontraded good output in our model. so $w_t L_t = \frac{P_{N,t}C_{N,t}}{P_{H,t}}$. We therefore arrive the conclusion that $P_{N,t} = P_{H,t}$.

3 Market Equilibriuma And Local Stability

Since domestic consumption of the exportale good is simply a residual, the foreign residents import whatever quantity they want from the home economy at the given terms of trade,

$$C_{H,t} = \bar{Y} - C^*_{H,t}. \tag{18}$$

where $C^*_{H,t}$ denotes the exportable good demand for the home economy (the import demand of the rest of the world). Substituting (18) into the budget constraint (4) and remember that the nontradable good market must clear each period, we obtain

$$B_t - B_{t-1} = C^*_{H,t}/q_t - C_{F,t} + r_{t-1}B_{t-1}. \tag{19}$$

Under a regime of floating exchange rates, accumulation of foreign assets (net capital outflow) has to be 'financed' by a surplus in the current account.

For symmetry, we express the downward slopping export demand function faced by the home economy by

$$C^*_{H,t} \equiv g(\frac{1}{q_t})^{-\frac{1}{f}} = gq_t^{1/f}, g, f > 0, \tag{20}$$

we can write the balance of trade in terms of imported goods, T_t, as

$$T_t = C^*_{H,t}/q_t - C_{F,t} = gq_t^{\frac{1}{f}-1} - dq_t^{-\frac{1}{b}}. \tag{21}$$

Substituting (21) and (12) into (19), we obtain, under the assumption of perfect foresight, a nonlinear difference equation in q_{t+1}, q_t and q_{t-1}:

$$F(q_{t+1}/q_t) - (1+\delta)(q_{t-1}/q_t)F(q_t/q_{t-1}) = gq_t^{\frac{1}{f}-1} - dq_t^{-\frac{1}{b}}, \tag{22}$$

by noting that $1 + r_{t-1} = (1 + \delta)(q_{t-1}/q_t)$ from (10). Money is neutral even in the short term in this flexible-price model. Without loss of generality, if we set the steady-state value of the terms of trade to be unity: $q_{t+1} = q_t = q_{t-1} = \bar{q} = 1$, then the steady-state values of the remaining variables will be as follows: $\bar{r} = \delta$, $\bar{C}_H^* = g$, $\bar{C}_F = d$, $\bar{T} = g - d$, and $\bar{B} = (d-g)/\bar{r}$. For simplicity of exposition, we assume that $\bar{Y} = 1+g$ so that $\bar{C}_H = 1$ and $\bar{X}/\bar{C}_H = g$.

To investigate the system's dynamic properties in the neighborhood of the stationary state, we linearize the nonlinear dynamic system (22) around the stationary state. The resulting system of difference equations is

$$\begin{bmatrix} q_t - \bar{q} \\ q_{t+1} - \bar{q} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -(1 + \bar{r} + r'\bar{B}) & 2 + \bar{r} + r'\bar{B} + \frac{T'}{F'} \end{bmatrix} \begin{bmatrix} q_{t-1} - \bar{q} \\ q_t - \bar{q} \end{bmatrix}, \tag{23}$$

where $T' = \partial(X_t/q_t - z_t)/\partial q_t = \frac{g}{f} + \frac{d}{b} - 1$ and $F' = -(1+\delta)/r' > 0$. The characteristic equation of (23) is

$$\lambda^2 - \gamma\lambda + \Delta = 0, \tag{24}$$

where

$$\gamma = \lambda_1 + \lambda_2 = 2 + \bar{r} + r'\bar{B} + \frac{T'}{F'}, \tag{25}$$

$$\Delta = \lambda_1\lambda_2 = 1 + \bar{r} + r'\bar{B}. \tag{26}$$

Local indeterminacy requires that both roots of the system have modulus less than 1. An equivalent condition is that the following three inequalities be fulfilled simultaneously:

$$1 + \Delta - \gamma = -T'/F' > 0, \tag{27}$$

$$1 + \Delta + \gamma > 0, \tag{28}$$

$$\Delta = 1 + \bar{r} + r'\bar{B} < 1. \tag{29}$$

For inequality (27) to hold, it requires that (given $F' > 0$)

$$T' = g/f + d/b - 1 < 0. \tag{30}$$

Note that if the balance of trade is zero in the steady state, (30) reduces to $T' = g(\frac{1}{f} + \frac{1}{b} - 1) < 0$.

Given that $\gamma > 0$, which is likely to obtain if capital mobility is reasonably high (r' relatively low and F' relatively large), inequality (28) holds as long as (27) holds. Finally, for inequality (29) to hold, it requires that $\bar{r} + r'\bar{B} < 0$, that is, an increase in foreign assets would decrease interest receipts in the neighborhood of the stationary state. As the interest rate perceived by individual households differs from the economy's true marginal rate of return on foreign bonds, the economy's net holdings of foreign assets may be socially excessive. This would happen if the household's subjective rate of time preference is relatively low. The social marginal rate of return on foreign assets will coincide with the market interest rate perceived by the agents if structurally the net holdings of foreign assets are zero in the stationary state. In this case $\bar{r} + r'\bar{B} = \bar{r}$, and hence $\gamma = 2 + \bar{r} + T'/F'$, and $\Delta = 1 + \bar{r} > 1$.

The modulus of the two roots of the system will have a value greater than unity, a classic case of Hopf bifurcation which indicates the emergence of cycles. All perfect foresight equilibria beginning near the stationary state may diverge from the stationary state and be attracted to an invariant circle. In this case we would still have indeterminacy in the sense that the equilibrium trajectories converge to the limit cycle (Woodford 1992, p. 225).

From previous section we already know that $P_{N,t} = P_{H,t}$. We can define the general price level of the home economy as

$$P_t = P_{N,t}^{\beta} P_{H,t}^{\beta} P_{F,t}^{\alpha} = P_{N,t}^{1-\alpha} P_{F,t}^{\alpha} = P_{H,t}^{1-\alpha} P_{F,t}^{\alpha},$$

where $\beta = 1/(2 + d^b)$ and $\alpha = d^b/(2 + d^b)$ representing the expenditure share on the exportable and importable goods respectively. The real exchange rate can then be written as

$$RER = \frac{e_t}{P_t} = \frac{e_t}{P_{N,t}^{1-\alpha} P_{F,t}^{\alpha}} = \frac{e_t}{P_{N,t}^{1-\alpha} e_t^{\alpha}} = (\frac{e_t}{P_{N,t}})^{1-\alpha},$$

because of the assumption that $P_{F,t}^*$ is normalized to unity. The terms of trade q_t can also be rewritten as

$$q_t = \frac{P_{F,t}}{P_{H,t}} = \frac{e_t P_{F,t}^*}{P_{N,t}} = \frac{e_t}{P_{N,t}}.$$

We therefore arrive the same conclusion as Obstfeld and Rogoff (p. 136, 2000) that the terms of trade moves with the real exchange rate. In the next section, we will using the data from the G7 countries to examine the relationship between the terms of trade and the real exchange rate.

4 An Empirical Application to the G7 Countries

In this section we will examine the quarterly real effective exchange rates and terms of trade data of the G7 countries from 1974 to 2002 and compare the results with the implications from our theoretical model in the previous sections. The quarterly data of the real effective exchange rates are from the OECD main economic indicators and the quarterly data of terms of trade are computed by deviding the unit value of imports by the unit value of exports, both from IFS. Because the French data of unit price of imports and exports are only from 1990 QI to 2001 QIV, we choose to omit France and focus on the other 6 countries: United States, United Kingdom, Germany, Italy, Canada and Japan.

We first plot the time series data of the six countries in Figure 1. We could see that the two series of each country, the real effective exchange rate and the terms of trade, fluctuates volatily in the post-Bretton Woods era. Some of them move closely, others are not. In the following table we report the basic statistics of the twelve time series. For the purpose of comparison, we divided the real effective exchange rates by 100.

Next, we shall inspect the times series property of the real effective exchange rates (REER) and the terms of trade (TOT) data of the six countries. An important question to be determined at the outset is whether the real effective exchange rate and the terms of trade contain unit roots. If so, then we should use cointegration methods to explain their behavior. We use two different tests to answer this question, the augmented Dickey and Fuller (1979) and Phillips and Perron (1988) tests.

The results shown in Table 2 all point to the same conclusion except the terms of trade of the U. S. Both unit-root tests are unable to reject the unit-root null when performed on the level of each cousntry's real exchange rates and terms of trade series except that the terms of trade of the U. S. appears to be stationary. When we differenced each series. ($\Delta(X)$), all of them appear to be stationary. We therefore conclude that the real exchange rate of the six countries and the terms of trade of the five countries (exclude U. S.) all

Table 1: Basic Statistics

Variable	Mean	Std. Dev.	Skewness	Kurtosis
Canada REER	1.1424	0.1465	-0.1034	2.0741
Canada TOT	0.9923	0.0418	-0.6782	3.1347
Germany REER	0.9209	0.0534	0.1513	2.0217
Germany TOT	1.0372	0.0698	1.0044	2.8791
Italy REER	1.1431	0.0964	0.6741	2.5335
Italy TOT	1.0779	0.1161	0.3925	1.6866
Japan REER	0.7264	0.1580	0.0425	1.8826
Japan TOT	1.3571	0.3119	0.5589	1.9245
U. K. REER	1.1324	0.1245	0.0044	1.8236
U. K. TOT	1.1103	0.2335	1.3014	4.6236
U. S. REER	1.1458	0.1259	0.9576	3.3240
U. S. TOT	1.0047	0.0460	1.1669	5.5954

Table 2: Tests for Unit Roots: Augmented Dickey and Fuller (ADF) and Phillips and Perron (PP) Tests[a] (sample period: 1974QI to 2002Q4).

Variable	ADF	PP	Variable	ADF	PP
Canada REER	-0.9956	-0.8984	Δ(Canada REER)	-4.0394**	-7.1147**
Canada TOT	-2.9630*	-2.4598	Δ(Canada TOT)	-5.6539**	-8.6552**
Germany REER	-2.7806	-2.4510	Δ(Germany REER)	-5.0666**	-9.1313**
Germany TOT	-2.3062	-2.2423	Δ(Germany TOT)	-5.2880**	-8.5358**
Italy REER	-1.9328	-1.8236	Δ(Italy REER)	-4.8845**	-8.0603**
Italy TOT	-1.6506	-1.4058	Δ(Italy TOT)	-5.3728**	-9.0273**
Japan REER	-2.0682	-1.8643	Δ(Japan REER)	-4.8399**	-8.9500**
Japan TOT	-1.9771	-1.5894	Δ(Japan TOT)	-4.8117**	-6.5768**
U. K. REER	-2.1383	-2.0059	Δ(U. K. REER)	-5.1927**	-8.7232**
U. K. TOT	-3.0468*	-2.5160	Δ(U. K. TOT)	-4.7254**	-8.6285**
U. S. REER	-2.3317	-1.5548	Δ(U. S. REER)	-3.7359**	-8.2047**
U. S. TOT	-4.1558**	-4.0773**	Δ(U. S. TOT)	-6.2014**	-7.1149**

[a]Henceforth, * and ** represent significance at 5 and 1 percent levels, respectively. The critical values are calculated from the response surface estimates of MacKinnon (1991).

Table 3: Cointegration Tests Based on the Johansen (1988) and Johansen and Juselius (1990) Approach – Canada

No. of cointegrating vectors under the null	Trace statistic	Max-eigenvalue statistic
None	14.9416*	11.5149*
At most 1	3.4266	3.4266

Note: Critical values are taken from Osterwald-Lenum (1992). * represent significance at 10 percent levels.

Table 4: Cointegration Tests Based on the Johansen (1988) and Johansen and Juselius (1990) Approach – Germany

No. of cointegrating vectors under the null	Trace statistic	Max-eigenvalue statistic
None	14.9054*	9.6299
At most 1	5.2755	5.2755

Note: Critical values are taken from Osterwald-Lenum (1992). * represent significance at 10 percent levels.

contain a single unit root.

Our next step is to determine whether the non-stationary pairs of variables of each country identified in Table 2 are cointegrated. If we could find evidence of cointegration, this implies that the terms of trade can adequately capture all the permanent innovations in the real exchange rate data over the specified smaple period as the result of our theoretical model suggested.

From Tables 3 to 7 we could conclude that for all the cases except Italy, the real exchange rate is cointegrated with the terms of trade variable. Both tests indicate that there is one cointegrating equation at the 10, 5 or 1% level. This suggests that for Canada, Germany, Japan and U. K., the two variables would not move too far away from each other, displaying a comovement phenomenom for the real exchange rate and terms of trade data for the period of post-Bretton Woods era.

Table 5: Cointegration Tests Based on the Johansen (1988) and Johansen and Juselius (1990) Approach – Italy

No. of cointegrating vectors under the null	Trace statistic	Max-eigenvalue statistic
None	7.7046	5.4849
At most 1	2.2197	2.2197

Note: Critical values are taken from Osterwald-Lenum (1992).

Table 6: Cointegration Tests Based on the Johansen (1988) and Johansen and Juselius (1990) Approach – Japan

No. of cointegrating vectors under the null	Trace statistic	Max-eigenvalue statistic
None	21.4832**	18.1834**
At most 1	3.2998	3.2998

Note: Critical values are taken from Osterwald-Lenum (1992). ** represent significance at 5 percent levels.

Table 7: Cointegration Tests Based on the Johansen (1988) and Johansen and Juselius (1990) Approach – U. K.

No. of cointegrating vectors under the null	Trace statistic	Max-eigenvalue statistic
None	21.4832***	18.1834**
At most 1	3.2998	3.2998

Note: Critical values are taken from Osterwald-Lenum (1992). ** and *** represent significance at 5 and 1 percent levels, respectively.

5 Concluding Remarks and Further Research

Existing literature on exchange rate dynamics has proved unsuccessful in proving explanation based *solely* on economic fundamentals of real exchange rate movements. This paper has demonstrated the possibility of *endogenous* fluctuation of the real exchange rate and the terms of trade in an open economy facing a downward slopping export demand function. The empirical evidence from the G7 countries in this paper, although not fully conform to the implications of the theoretical model we constructed, may still provide partial reconciliation between that and the empirical studies in the literature. In the future, we expect to modify the assumptions of the model in order to consider the effects of the different pricing rules on the relative international price movements, that is, the terms of trade and the real exchange rates.

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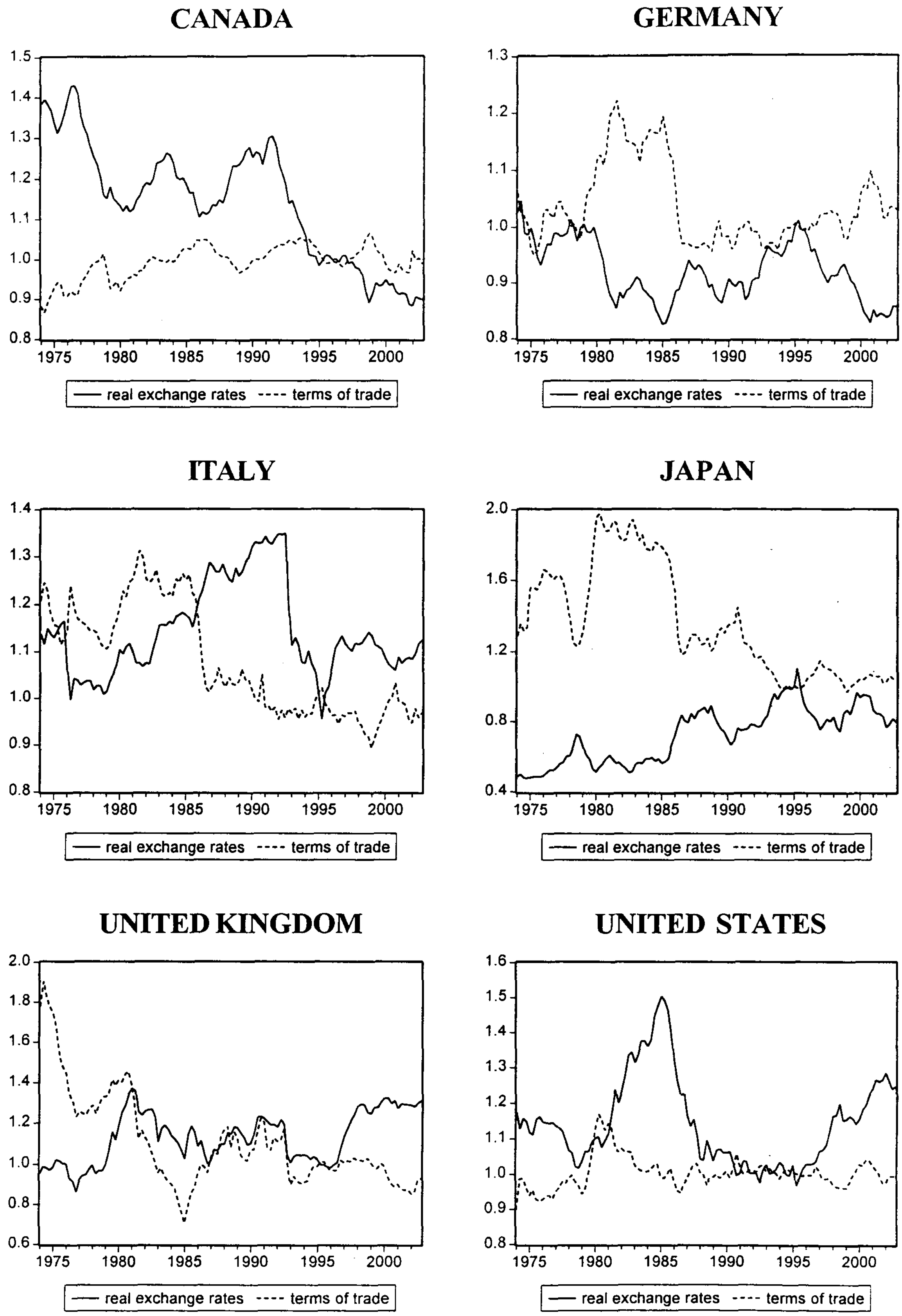
Figure 1



CANADA
1.5
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0.8
1975
1980
1985
1990
1995
2000
real exchange rates
terms of trade
GERMANY
1.3
1.2
1.1
1.0
0.9
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1975
1980
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1990
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2000
real exchange rates
terms of trade
ITALY
1.4
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1975
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real exchange rates
terms of trade
JAPAN
2.0
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1.2
0.8
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1975
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2000
real exchange rates
terms of trade
UNITED KINGDOM
2.0
1.8
1.6
1.4
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1975
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1990
1995
2000
real exchange rates
terms of trade
UNITED STATES
1.6
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real exchange rates
terms of trade