Population Structure and Real Exchange Rate: Evidence from OECD Countries

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Abstract
Real exchange rate (RER) influences consumption and resource allocation decisions between non-tradable and tradable goods, and also represents a country's comparative advantage. In the literature, terms of trade, interest rate differential, inflation differential, international capital flows, productivity differential, current account etc. are found to have significant power to explain the movements in long-run equilibrium RER in developing as well as developed countries. This paper, however, suggests a methodology with which to analyze the influence of population structure on RER under the premises of the life cycle hypothesis. The methodology involves deriving a simple overlapping generation model followed by Obstfeld and Rogoff (1996) and then develop an estimable structural model in order to examine the impact of population structure on RER in an open economy.

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1. INTRODUCTION

The real exchange rate (*RER*) is an important consideration in open economy macroeconomics. It is commonly used as a measure of competitiveness of the traded goods sector and even as a measure of the standard of living in one country relative to another [Dwyer and Lowe 1993]. It influences consumption and resource allocation decisions between non-tradable and tradable goods, and also represents a country's comparative advantage. Different real (i.e. terms of trade, productivity) and nominal (i.e. money supply) shocks cause *RER* to deviate from its long-run equilibrium value, temporarily or permanently.

There is an impressive body of empirical literature that has examined the influence of real and nominal shocks on *RER*. Terms of trade, interest rate differential, inflation differential, international capital flows, productivity differential, current account etc. are found to have significant power to explain the movements in long-run equilibrium RER in developing as well as developed countries.

Recently demography has been subjected to empirical research to examine its influence on RER in a few studies. Although demography has been analyzed to explain the behavior of savings, capital flows and current account [Higgins 1997; Serge, Guest and McDonald 2000], the theoretical as well as empirical relation between RER and demography is not so developed. Gente [2001] shows that in a two-sector, two-period overlapping generations model, a fall in the birth rate leads to a long-run real exchange rate appreciation. On the empirical side, Andersson and Osterholm [2005] find that, in Sweden, demographic structure has significant explanatory power on RER. The same result is found in another study of the same authors [Andersson and Osterholm, 2006] in the context of OECD countries. However, previous studies in this area consider only age structures as the independent variables. So, a complete model of real exchange rate incorporating population dynamics is warranted for understanding the impact of population structure on the real exchange rate. Since there is no study that addresses this issue comprehensively, the proposed study intends to fill this gap.

2. OBJECTIVES

The objective of the proposed research is to examine the impact of population on real exchange rate of some selected developed countries. The specific objectives are:

1. to develop and estimate a model of RER with, among other variables, the share of working age population as an independent variable and examine whether it has any significant influence on the movement of RER;
2. to use the estimated model, in case a significant relationship is found between RER and working age population, in predicting RER of the countries under consideration to ensure the influence of population growth on RER movement;
3. to make some suggestions for public policy based on the findings of the proposed study.

3. STATEMENT OF THE PROBLEM

There is an impressive body of literature on the determinants of real exchange rate. A wide range of factors have been identified in these studies as responsible for the equilibrium value of RER. These factors include terms of trade (Chowdhury 2000; Mkenda, 2001; Choudhri and Khan, 2004), capital inflow (Choudhury, Mamta B, 2000, 2004), real interest rate differential (Athukorala and Rajapatirana, 2003; Chortareas and Driver 2001), trade balance (Lane and Milesi-Ferretti 2001), relative productivity (Alexius 2000; Wang and Dunne 000), government consumption (Chowdhury 2000; Mkenda, 2001), labor productivity (Choudhri and Khan, 2004) and oil price (Wang and Dunne 2000).

In addition to these factors, recently research attention has been focused on the structure of population of an economy as an important influence on RER. The focus has been on the impact of the structure of the population on saving and consumption behavior as postulated in Life Cycle Hypothesis (LCH), as suggested by Andersson and Österholm (2005, 2006).

Over the last couple of decades, population growth rates in developed countries have slowed down. During 1950-1955 population growth rate in the developed countries was 1.20 percent, whereas this growth rate declined to 0.36% during 2000-2005[1]. This trend will result in a

[1] World Population Prospect: The 2006 Revision

smaller share of working age population. A projection by the United Nation nations shows that over the period 2005-2050, the share of the population aged 15-59 will decline from 62.9 percent of the total population of the developed countries to 52.2 percent[2]

Given the possible channel of influence of population dynamics on RER, it remains an issue to examine empirically what impact population growth does exert on RER in the context of developed countries. Theory linking demography and RER predicts that a falling rate of population growth (an aging population) is associated with long-run appreciation of RER (Gente 2001). This theoretical prediction fits quite well with the statistical data on developed countries as reported in Table 1 below.

Table-1: Correlation between RER and Population Growth Rate in 20 OECD Countries for the period 1950-2005

Country	Correlation	Country	Correlation
Australia	0.446 (0.026)	New Zealand	0.382 (0.041)
Luxembourg	0.110 (0.570)	Norway	0.481 (0.007)
Canada	0.130 (0.492)	Portugal	0.237 (0.206)
Denmark	0.555 (0.001)	United Kingdom	0.487 (0.006)
Finland	0.356 (0.053)	Bahrain	0.444 (0.026)
France	0.511 (0.005)	Netherlands	0.425 (0.019)
Singapore	0.253 (0.186)	Malta	0.321(0.084)
Italy	-0.397 (0.030)	United States	-0.387 (0.035)
Japan	-0.365 (0.047)	Switzerland	-0.200 (0.290)

Source: Calculated from IFS-2006 data. (Figures in parentheses are p values)

From Table 1 it is evident that the correlation coefficients of most of the countries are positive and significant, which implies that slower rate of population growth is causing the RER of these countries to appreciate. However, simple correlation analysis is not enough to draw significant conclusion about the nature of economic relationship among the variables. It needs in-depth analysis using appropriate methodology to address the problem at hand. The

[2] World Population Prospect: The 2006 Revision

research problem in this study is to identify the impact of population structure on RER in developed countries.

4. LITERATURE REVIEW

Research works on the real exchange rate are reasonably rich, especially in the context of developed countries. These studies examine different macroeconomic factors to quantify their impact on the long run value of real exchange rate. The factors that have generally been identified as the determinants of real exchange rate include productivity differentials, interest rate differentials, terms of trade, capital flows, trade balance, government expenditure, investment etc. However, research on the impact of population dynamics on RER is at its preliminary stage as only a few studies have examined this issue in the context of developed countries. The impact of population on other macroeconomic variables, such as output, current account, capital flows, inflation etc., have been in the research agenda of the academicians for a while.

An economy's savings and therefore, capital formation partly depends on the size of working age population. Higgins and Williamson [1996] wonderfully document how rising fertility and declining morality, that is, rising population, reduce the foreign capital dependency of Asian countries. They note that much of the impressive rise in Asian savings rate since 1960s can be explained by the equally impressive decline in youth dependency burden. They show with data over 1950-1992 that foreign capital dependency, measured by negative current account balance, of some Asian countries, namely Bangladesh, Pakistan and Sri Lanka, reached a peak when youth dependency of these countries were highest. Thus composition of different age group in an economy has a profound impact on its economic performance.

The age structural effect on saving is universal. Working age people save everywhere in the world. In a study on OECD countries over the period 1960-1995, Lindh and Malmberg [1999] find that age effects on saving are similar across a world sample, but that investment behaviour display different patterns. They find that a young working age population invests more in housing, whereas a middle-age working population invests in business. The housing investment is rationalized by the tendency of population to settle down by the formation and acquisition of permanent shelter during the youth, but the latter investment behaviour is left without any solid explanation.

Miles [1999] also comes to the same conclusion as above in regard to the impact of age structure on saving. He shows that due to fall in population growth rate over the next fifty years, saving is likely to fall in UK and Europe as the proportion of the population aged over 65 rises. However, this lower saving, according to him, is unlikely to affect the return on capital as the lower saving rate is likely to be offset by a smaller workforce. This implies that the lower saving rate coupled with smaller labour force is likely to keep the capital-labour ratio unchanged. If this happens, then over the next fifty years aggregate output of these countries is likely to fall.

The impact of age structure on saving is evidenced in developing countries. Athukorala (2003) finds that household saving in Taiwan is significantly influenced by its population structure. He finds that one percent increase in aged dependency ratio results in 2.5 percent decline in house hold saving. For young dependency ratio this increase is 0.10 percent. Although the result for young dependency ratio is significantly lower than that of old dependency ratio, findings of this study clearly support the view that age structure significantly shape the saving pattern in an economy.

In addition to affecting savings and output, age structure has also been found useful in forecasting inflation and potential GDP. Analyzing Swedish data from 1946 to 1998, Lindh [1999] concludes that there is significant stable correlation of age structure with output growth and inflation. He also examines the predictive ability of age structure and finds that out-of-sample forecasts of inflation and GDP growth are not too bad. Despite significant findings on correlation of demography and inflation and GDP growth, this paper seems to lack solid theoretical base to link demography with inflation and GDP. Without sound theoretical foundation any relation between economic variables does not convey meaningful insight.

Bruer [2002] also examines the ability of demography to forecast inflation in Sweden and finds that demography has significant influence on the course of inflation. In terms of a closed economy IS-LM model he postulates that an economically active population should dampen inflation whereas an economically passive should inflict the opposite relation.

Recently Ö sterholm [2004] estimates the impact of age structure on GDP in 20 OECD countries employing a relatively new econometric methodology, namely panel co-integration, for the period 1970-1999. He finds that there is strong support for a co-integrating relationship between GDP and the size of five different age groups. Children and retirees are found to have negative or relatively less positive impact on GDP than productive or working age group, which supports the life-cycle hypothesis and human capital theory.

Age structure also has significant impact in financial markets. This is because when a large part of population enters into prime saving age, they tend to invest in financial assets, which causes price of those assets to increase. Yoo [1994], analyzing US data finds that a rise in the birth rate, followed by a decline, first raises then lowers asset prices. During the 1990s, stock prices in real terms in the USA were four times their value at the beginning of the 1980s. Passel [1996] links this increase with the dramatic rise in the share of population aged 40 to 64 who moved into their prime savings years. Other studies in this area that also find a significant relation between population growth and asset price include Bakshi and Chen [1994], Brooks [2002] and Geanakoplos *at el* [2004].

Research work on population dynamics and the real exchange rate is very limited. So far, a few studies have been conducted in the context of developed countries. Andersson and Österholm [2005] use Swedish age structure data over the period 1960-2002 to forecast real exchange rate. The study finds that the age structure has significant explanatory power on the real exchange rate and their out-of-sample medium-term forecasts of real exchange rate perform well. Findings of this paper indicate that in an aging economy population growth has appreciating effect on real exchange rate. This paper does not provide any theoretical model of how age structure should have impact on the real exchange rate.

Aloy and Gente [2005] also find significant appreciating impact of falling population growth in Japan on Yen/US dollar bi-lateral real exchange rate. This paper employs overlapping generations model (OLG) linking the population growth to real exchange rate.

Beside these country specific studies, Andersson and Österholm [2006] estimate a reduced-form equation where real exchange rate is regressed on different cohorts of population of 20 OECD countries over the period 1971-2002. They divide the total population into six groups:

children (0-14), young adults (15-24), prime aged (25-49), middle aged (50-64), young retirees (65-74) and old retirees (75- and above). Their results show that different age groups affect RER differently. The prime and middle age group (25-49 and 50-64 years respectively) have a depreciating impact, as they are productive and save for their retirement, which causes capital outflow. On the other hand, the study finds that young adults and retirees (15-24 and 65-above years respectively) have an appreciating effect. This is because these groups are not productive, they are dependent and they dis-save, so they seem to cause capital inflow and depreciation. In this study the authors do not provide any theoretical model linking the population growth to real exchange rate.

From the above discussion it is clear that the relationship between population and real exchange rate has been examined without developing a formal model. Thus, it remains an unexplored area of research to develop a model of the real exchange rate encompassing population dynamics and to examine the impact of the latter on the former within the framework of that model. The proposed research is an effort to accomplish this task.

5. METHODOLOGY

Conceptual Framework

A theoretical linkage between RER and demography comes from the relation between age structure of the population and the resultant consumption and saving pattern in an economy as postulated in the Life Cycle Hypothesis (LCH). According to the LCH, people smooth their consumption by saving during their working life and dissaving in the rest of the life until death (Modigliani and Brumberg, 1954). So in an economy, where the proportion of working population is greater than the proportion of the old, saving will be greater than dis-saving. Thus the theory identifies the age structure of the population as an important determinant of consumption and saving behavior. 'If the population were growing, there would be more young people saving than when the population is constant, thus more saving in total than dis-saving, and there would be net saving in the economy' (Dornbusch and Fischer, 1997: 305). Similarly there will be net dis-saving where population is falling. If aggregate saving does not exactly match domestic investments, there will be international capital flows, which will affect current account (Andersson and Österholm, 2005). This, in turn, will influence the real exchange rate.

'In the early stage of demographic transition per capita income growth is diminished by large youth dependency burdens and small working-age adult shares. There are relatively few workers and savers. As the transition proceeds, per capita income growth is promoted by smaller youth dependency burdens and larger working-age adult shares. There are relatively many workers and savers. The early burden of having few workers and savers becomes a potential gift later on: a disproportionately high share of working-age adults. Still later on, the economic gift evaporates, perhaps becoming a burden again, as elderly share rises' (Williamson 2001: 263). Thus a country, having larger share of elderly people in the population, lacks capital for investment, imports foreign capital and cause *RER* to appreciate.

The Model

In this section a model of real exchange rate is developed following Edwards (1988). The model also significantly draws on Drine and Rault (2003). We assume a small open economy, so the economy is a price taker in the international market. It is also assumed that the economy is in long-run equilibrium or full employment level; hence unemployment is at its natural level. There are three goods in this model: (i) exportables (X), (ii) importables (M), and (iii) non-tradables (N).

The economy produces two goods: non-tradables (N) and exportables (X) and the residents of the economy consume two goods: non-tradables (N) and importables (M). The nominal exchange rate (number of units of domestic currency per foreign currency), domestic price of exportables, price of non-tradables, world price of importables and world price of exportables are denoted by $E, P_{X,} P_N, P_M^*$, and P_X^* respectively.

It is assumed that the country follows a freely floating exchange rate policy. Domestic price of exportable goods is $P_X = EP_X^*$. The world price of exportable is normalized to one, that is, $P^* = 1$, so that $P_X = EP_X^* = E$. Domestic relative price of importables with respect to non-tradables is given by $e_M = \frac{P_M}{P_N}$ and domestic relative price of exportables with respect to non-tradables is given by $e_X = \frac{E}{P_N}$. The relative world price of importable with respect to

non-tradable is given by $e_M^* = \frac{EP_M^*}{P_N}$. Consistent with the current wave of globalization, it is assumed that the country imposes minimum tariff that can be ignored.

Total demand for private consumption (C) consists of consumption of importables (C_M) and non-tradables (C_N) and is given by

$$C = C_M(e_M) + C_N(e_M);\ \frac{\partial C_M}{\partial e_M} < 0, \frac{\partial C_N}{\partial e_M} > 0 \qquad (1)$$

On supply side total supply (Q) is the sum of the supply of exportables (Q_X) and non-tradables (Q_N) and is given by

$$Q = Q_X(e_X) + Q_N(e_X);\ \frac{\partial Q_X}{\partial e_X} > 0,\ \frac{\partial \mathrm{Q_N}}{\partial \mathrm{e_X}} < 0. \qquad (2)$$

Government consumption demand (G) is given by

$$G = P_N G_N + EP_M^* G_M \qquad (3)$$

where, G_N *and* G_M are government demand for non-tradables and importables, respectively. Total demand and supply of non-traded goods are given by $C_N(e_M) + P_N G_N$ and $Q_N(e_X)$ respectively.

Real exchange rate is defined as the relative price of tradables to non-tradables as follows:

$$rer = \alpha e_M + (1-\alpha)e_X = \frac{E\left[\alpha P_M^* + (1-\alpha)\right]}{P_N},\ \ 0 < \alpha < 1 \qquad (4)$$

It is assumed that capital is perfectly mobile. Interest on net foreign asset (NFA) of the economy is the world interest rate r^*. The current account of the country (CA) in a given year is equal to the sum of the net interest earning on NFA and the amount of trade balance in foreign currency which is defined as the difference between exports and the consumption of imports as shown in equation (5) below

$$CA = r^* NFA + Q_X(e_X) - P_M^* C_M(e_M) \qquad (5)$$

where r^* is world interest rate.

Assuming away any country and exchange rate risk the capital account balance *(CF)* can be expressed by the following equation:

$$CF = \overline{CF} + k(i - r^*) \quad (6)$$

where, i stands for domestic interest rate and k is the responsiveness of capital flow to the interest rate differential. When $i > r^*$, capital will flow in and when $i < r^*$ capital will flow out, both in unlimited amount until $i = r^*$ is restored. The change in NFA of the country is given by

$$\dot{NFA} = CA + CF \quad (7)$$

The real exchange rate is said to be in equilibrium if it leads to both external and internal equilibrium. A country is in external balance when its NFA does not change meaning that current account balance and net capital inflows in the long run sum to zero, that is, $\dot{NFA} = CA + CF = 0$. So, we can write the external equilibrium condition as follows:

$$r^* NFA + Q_X(e_X) - P_M^* C_M(e_M) + CF = 0 \quad (8)$$

Internal equilibrium is defined in terms of equilibrium in non-tradable goods market which is given by

$$C_N(e_M) + P_N G_N = Q_N(e_X) \quad (9)$$

In steady state, i.e., when both external and internal sectors are in equilibrium, equilibrium real exchange rate can be expressed, from (8) and (9) above, as a function of P_M^*, r^*, NFA, CF and G_N, i.e.

$$rer_o = f\left(P_{Mo}^*, r_o^*, NFA_o, CF_o, G_{N_o}\right) \quad (10)$$

The zero subscript implies that the values of the variables correspond to the long-run equilibrium state as both internal and external sectors are in equilibrium.

In the long run there is no tendency of these variables to deviate from their steady-state values. However, in the short to medium term different shocks to these fundamentals may cause the RER to deviate from its long-run value.

Therefore, an empirical model for RER can be expressed as follows:

$$rer_t = \beta_1 + \beta_2 P_{M\,t}^* + \beta_3 r_t^* + \beta_4 NFA_t + \beta_5 CF_t + \beta_6 G_{N_t} + \mu_t \quad (11)$$

where μ is a well behaved disturbance term.

The effects of the independent variables on real exchange rate are as follows:

(i) **World price of importables** $\left(P_{Mt}^{*}\right)$: Fall in P_{Mt}^{*} improves terms of trade and raises income of an economy and increases demand for non-tradables. This in turn raises price of non-tradables relative to tradables and appreciates real exchange rate. This can also be verified from equation (4). Lower P_{Mt}^{*} represents improvement in terms of trade this results in appreciation of real exchange rate, that is, $\frac{\delta rer}{\delta P_{Mt}^{*}} > 0$.

(ii) **World interest rate** $\left(r^{*}\right)$**:** Assuming the country in question is a creditor country, given the NFA position, an increase in world interest rate increases capital inflow and appreciates real exchange rate, that is, $\frac{\delta rer}{\delta r^{*}} < 0$.

(iii) **Net foreign asset (NFA) position:** For a given world interest rate, increase in NFA appreciates real exchange rate, that is $\frac{\delta rer}{\delta NFA} < 0$.

(iv) **Capital flows (CF):** Increase in capital flows will appreciate real exchange rate, that is, $\frac{\delta rer}{\delta CF} < 0$

(v) **Government expenditure on non-tradables** $\left(G_N\right)$: Government expenditure on non-tradable goods increases price of non-tradables and appreciates real exchange rate, that is, $\frac{\delta rer}{\delta G_N} < 0.$

Population Structure and real exchange rate

To consider the effect of demographic shock on real exchange rate, let us examine the external equilibrium from national income identity context. From national income identity, we know $CA = S - I$. From the Life Cycle Hypothesis (LCH) of saving, we know that saving is a function of the share of working-age population. So we can express the saving function as $S = S(L)$. Again investment is a function of interest rate, i.e. $I = I(i\ )$. So equation (8) can be re-written as follows:

$$r^* NFA + Q_X(e_X) - P_M^* C_M(e_M) + CF = S(L) - I(i = r^*) = 0 \qquad (12)$$

When saving decreases, $S(L) < I(i\ )$, and the supply of loanable fund decreases. This leads to increase in domestic interest above world interest, which, in turn, causes capital inflow and *rer* to appreciate. Capital inflows until domestic and world interest rates are equalized and saving-investment equality and hence external equilibrium is restored.

To examine how population structure affect saving of an economy, the behavior of private saving is analyzed using an overlapping generations model as discussed in Obstfeld and Rogoff (1996).

Let us consider an endowment economy with two generations-young and old. Each generation lives for two periods and a new generation is born in each period. An individual born in period t maximizes her lifetime utility U that depends on her consumption during young $\left(c_t^Y\right)$ and old $\left(c_{t+1}^o\right)$ as follows:

$$U\left(c_t^Y, c_{t+1}^o\right) = u\left(c_t^Y\right) + \beta u\left(c_{t+1}^o\right),\ 0 < \beta < 1 \qquad (13)$$

Here, β is the individual's time preference rate.

Let y_t^Y and y_{t+1}^o are the individual's income while young and old respectively and τ_t^Y and τ_{t+1}^o are net lump-sum taxes paid by the individual during her young and old ages respectively. Also assume that the individual can borrow or lend in the world market at the real interest rate r. Therefore, the budget constraint of the individual takes the following form:

$$c_t^Y + \frac{c_{t+1}^o}{1+r} = y_t^Y - \tau_t^Y + \frac{y_{t+1}^o - \tau_{t+1}^0}{1+r} \qquad (14)$$

The individual's problem is to maximize eq. (13) subject to eq. (14). The first order condition or the intertemporal *Euler* equation of this maximization problem is given by:

$$c_{t+1}^{o} = (1+r)\beta c_t^{Y} \tag{15}$$

Consumption demand of the young and old are obtained from Budget constraint (14) and Euler equation (15) as follows

$$c_t^{Y} = \left(\frac{1}{1+\beta}\right)\left(y_t^{Y} - \tau_t^{Y} + \frac{y_{t+1}^{o} - \tau_{t+1}^{o}}{1+r}\right) \tag{16}$$

$$c_{t+1}^{o} = (1+r)\left(\frac{1}{1+\beta}\right)\left(y_t^{Y} - \tau_t^{Y} + \frac{y_{t+1}^{o} - \tau_{t+1}^{o}}{1+r}\right) \tag{17}$$

For simplicity it is assumed that the time path of aggregate consumption is flat, that is, individual's time preference rate or subjective discount factor is equal to market interest rate, symbolically, $\beta = \frac{1}{1+r}$. Under this assumption eq. (16) and (17) reduce to eq. (18) as follows

$$c_t^{Y} = c_{t+1}^{o} = \left(\frac{1}{1+\beta}\right)\left(y_t^{Y} - \tau_t^{Y} + \frac{y_{t+1}^{o} - \tau_{t+1}^{o}}{1+r}\right) \tag{18}$$

The young in period t starts with no prior assets and their saving, S_t^{Y}, is given by the following equation

$$S_t^{Y} = y_t^{Y} - \tau_t^{Y} - c_t^{Y} \tag{19}$$

Substituting the value of c_t^{Y} from eq. (16) or (17), expression for private saving of the young takes the following form

$$S_t^{Y} = \left(\frac{\beta}{1+\beta}\right)\left(\left(y_t^{Y} - \tau_t^{Y}\right) - \left(y_{t+1}^{o} - \tau_{t+1}^{o}\right)\right) \tag{20}$$

Old generation in period t decumulates her saving in period $(t-1)$, that is, $S_t^Y = -S_{t-1}^Y$. Therefore, total private saving in period t is the sum of saving by young and old generation in period t, which is given by the following equation

$$S_t^P = S_t^Y + \left(-S_{t-1}^Y\right) = \left(\frac{\beta}{1+\beta}\right)\left(\Delta\left(y_t^Y - \tau_t^Y\right) - \Delta\left(y_{t+1}^o - \tau_{t+1}^o\right)\right) \qquad (21)$$

Equation (21) shows that total saving will rise if saving of the young in period t is greater than saving of the young in period *(t-1)*. Therefore, if the share of working age people in total population increases total private saving will rise. Conversely, declining share of working age people will cause private saving to fall. From the above discussion saving can be expressed as a function of the size of working age population, that is, $S = S(L)$, where L stands for share of working age population. Again investment is a function of interest rate, i.e. $I = I(i)$. Also from national income identity, we know $CA = S - I$. So equation (8) can be re-written as follows:

$$r^* NFA + Q_X\left(e_X\right) - P_M^* C_M\left(e_M\right) + CF = S(L) - I\left(i = r^*\right) = 0 \qquad (22)$$

Starting from an equilibrium situation, fall in the share of working age population results in lower saving relative to investment. This leads to increase in domestic interest above world rate, causing capital to flow in. Capital inflow results in nominal as well as real appreciation. Capital flows in until domestic and world interest rates are equalized and external equilibrium is restored. Since change in NFA must be zero [eq. (7)], increase capital inflow will be matched by higher trade deficit (or lower trade surplus.

Appreciation of or decrease in nominal exchange rate E causes $e_M\left(=\frac{P_M}{P_N}\right)$ to decrease. According to equation (1) this will lead demand for importable to rise. On supply side, decrease in E causes $e_X\left(=\frac{E}{P_N}\right)$ to fall. Thus higher demand for importable and lower supply of exportable results in trade deficit (reduction in trade surplus) equal to capital inflow and external balance is achieved.

On the other hand, lower e_M causes demand for non-tradable to fall and lower e_X causes supply of non-tradable to rise (eq.2). This higher supply and lower demand for non-tradable results in lower P_N. Lower demand for non-tradable will be matched by its lower price and internal equilibrium will be achieved.[3]

Therefore, from the above we can incorporate share of working age population (L) in the real exchange rate equation specified in (11) above as follows:

$$rer_t = \beta_1 + \beta_2 P^*_{M\,t} + \beta_3 r_t^* + \beta_4 NFA_t + \beta_5 G_{N\,t} + \beta_6 L_t + \mu_t \qquad (23)$$

In eq. (23) capital flow is omitted, because it is assumed that capital flow is influenced by the share of working age population. The appreciation or depreciation of *rer* depends upon the degree of capital mobility. When saving falls short of investment, import exceeds export and trade balance is in deficit. In the absence of capital mobility *rer* depreciates, which reduces import and increases export and finally equilibrium is restored with zero balance of payment. When capital mobility is allowed, domestic interest rises above world rate to attract capital to fill the saving-investment gap. Inflow of capital appreciates *rer*. On the other hand trade deficit depreciates it. The final impact hinges upon the relative magnitudes of these two effects. If capital mobility is relatively low, then the net effect is depreciated currency (Caves at el, 2002).

Data sources

The potential sources of data include *International Financial Statistics*, a publication of IMF, *World Development Indicator*, a publication of the World Bank and *The World Population Prospects*, also a publication of the World Bank. The time period to be covered by the study depends on the availability of data on each country.

[3] The fall in P_N must be relatively lower than, or at least equal to, that in E to ensure that e_X falls or at least does not change. This is so because if e_X increases then supply of exportable will rise and trade balance will improve, which is inconsistent with capital inflow.

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