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Abstract

A model of a small open economy is used to analyse the behaviour of the current account and the real exchange rate in a regime of inflation targeting **B** la New Zealand. The steady state and the dynamic behaviour of the economy under various shocks are discussed. Major results include:

- In the steady state, the rate of potential output growth in the home country need not equal the rate of potential output growth in the rest of the world for PPP to hold.

- In the steady state, real money balances grow at the rate of potential output growth weighted by the income elasticity of money demand, and net of capital inflows.

- The duration of the shocks affecting the economy is important as permanent shocks do not alter the path of the equilibrium nominal exchange rate change under inflation targeting **B** la New Zealand.

- When lasting divergences from PPP are possible, a regime shift toward a lower average inflation rate can produce substantial current account imbalances until the new steady state is perceived to have been reached.

- Transitory expenditure-switching policies (eg, tariffs changes) affect the short-run convergence of the current account to equilibrium but not the long-run current account equilibrium.

- Permanent expenditure-switching policies do not affect the current account balance when there are zero costs of adjusting the capital stock to its equilibrium level.

- Permanent or transitory expenditure-changing policies such as fiscal policy are very powerful to affect the current account balance.

- Monetary policy does not affect the long-run equilibrium of the current account nor the long-run equilibrium of the real exchange rate under inflation targeting **B** la New Zealand; however, monetary policy does alter the short-run dynamics of the equilibrium real exchange rate when the monetary authority reacts to mean-reverting shocks.

- Transitory changes in output or the terms of trade affect the current account and in that sense justify current account imbalances.

*   Adviser
       Research, Economics Department
       Reserve Bank of New Zealand
       P O Box 2498
       WELLINGTON
       Telephone: +64 4 471-3786
       Fax: +64 4 473-1209
       Email: simonef@rbnz.govt.nz

I. Introduction

Recently a number of countries have introduced what has become known as "inflation targeting regimes". New Zealand was the first country in the list, which now includes at least Canada, the United Kingdom, Sweden and Finland. According to Leiderman and Svensson (1995), the essential feature of these regimes has been the determination of an explicit quantitative target in which the price index, the time interval and the tolerance interval have been predetermined. One key practical consideration motivating the move toward inflation targeting has been the increased dissatisfaction with the targeting of monetary aggregates in a global economy with significant integration of goods and services markets, high capital mobility, and low policy co-ordination across countries.

Nadal-De Simone (1996a and 1997) contrasts and compares the dynamic behaviour of price variables in a small open economy under inflation targeting, and under monetary targeting. The purpose of this paper is to expand that research and to answer the question of how inflation targeting affects the determinants of the current account balance, and the behaviour of the real exchange rate. The steady state and the dynamic behaviour of the economy are investigated.

At a normative level, although references to the sustainability of a current account deficit are limited in this paper, the analysis provides a framework within which the sources of current account imbalances under inflation targeting can be discussed. For example, the usual policy question of whether current account imbalances are "excessive" can only be addressed fruitfully in the context of a model that yields predictions about the equilibrium path of the real exchange rate and, of external imbalances. Unfortunately, the theoretical framework most widely used in policy circles continues to be the Mundell-Fleming model. This is not a satisfactory framework because it not only lacks microeconomic foundations but it does not contain the most basic intertemporal constraints and it assumes static expectations (Obstfeld and Rogoff, 1996). At a purely theoretical level, the Mundell-Fleming model does not have predictions about current account dynamics.

Without explicitly modelling consumers, firms and government behaviour in an intertemporal framework as in Stockman and Tesar (1995) or in Gertler and Rogoff (1990), the small open economy model used in this paper can be

viewed as a reduced form of a more basic model in which import demand elasticities reflect the properties of utility and production functions. Similarly, the desired excess of spending over income in the current model is consistent with an underlying model in which consumers maximise the present value of future utility with a Cobb-Douglas utility function that depends on domestic goods, foreign goods and on the level of foreign assets, and that uses the rate of time preference for discounting the future (Mussa, 1980). The model embodies growth, both at home and abroad. It imposes the natural rate hypothesis, rational expectations are pervasive, prices are sticky and the capital market is completely open. The monetary authority is ascribed a forward looking reaction function with a feedback, a feature that, unfortunately, most models of current account behaviour with less than fully flexible prices leave unspecified.[1]

The absence of two features in the model, not both equally relevant, makes its use for policy prescriptions about current account imbalances somewhat limited. First, borrower's incentives to pay and lenders' willingness to lend are not explicitly modelled (as, for instance, in Milesi-Ferretti and Razin, 1996), and, therefore, any policy implications remain within the realm of solvency or ability to pay. Discussions on the sustainability of current account imbalances are not feasible. Second, the model does not contain distortions to consumption and saving decisions by consumers nor distortions at the fiscal policy level or in capital markets. The intertemporal framework of the model lends itself only to analyse the decisions that lead to a current account position in the absence of distortions. However, this model can be viewed as the first step in the process of analysing the question of "excessiveness" of current account imbalances, as exemplified by the work of Glick and Rogoff (1995). At a policy level, this second feature of the model is presumably less of a problem to the extent that any identified distortions in the economy should be remedied on efficiency grounds rather than on the basis of their effects on the current account.

Important results include: (1) in the steady state, the rate of potential output growth in the home country need not equal the rate of potential output growth in the rest of the world for PPP to hold; (2) in the steady state, real money balances grow at the rate of potential output growth weighted by the income

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[1]   It can be shown that most models of current account dynamics and exchange rate determination are consistent with a monetary authority that targets a monetary aggregate (Nadal-De Simone, 1996a).

elasticity of money demand, and net of capital inflows; (3) the duration of the shocks affecting the economy is important as permanent shocks do not alter the path of the equilibrium nominal exchange rate change under inflation targeting **B** la New Zealand; (4) when lasting divergences from PPP are possible, a regime shift toward a lower average inflation rate can produce substantial current account imbalances until the new steady state is perceived to have been reached; (5) only transitory expenditure-switching policies (eg, tariffs changes) affect the equilibrium current account; (6) permanent or transitory expenditure-changing policies such as fiscal policy are very powerful to affect the current account balance; (7) monetary policy does not affect the long-run equilibrium of the current account nor the long-run equilibrium of the real exchange rate under inflation targeting **B** la New Zealand; however, monetary policy does alter the short-run dynamics of the equilibrium real exchange rate when the monetary authority reacts to mean-reverting shocks; and (8) transitory changes in output or the terms of trade affect the current account and in that sense justify current account imbalances.

The paper is organised as follows. Section II presents a model of a small open economy with an inflation targeting regime. Section III discusses the steady state behaviour of the system. Section IV addresses the behaviour of the system following unanticipated shocks stressing the dynamics of the current account and the real exchange rate. Section V concludes the paper.

II.   A model of a small open economy under inflation targeting

This section develops a model of a small open economy without capital controls inspired in Frenkel and Mussa (1985) and adapted to make it consistent with an inflation targeting regime **B** la New Zealand. The home economy produces domestic goods, some of which are exported; it also consumes foreign goods, all of which are imported. All variables are in logs except interest rates.

$$dd_t = \alpha\Omega_t + a_2 q_t - z_t \tag{1}$$

$$df_t = (1-\alpha)\Omega_t - a_2 q_t + z_t \tag{2}$$

$$dd_t^* = a_2^* q_t + a_3 y_t^* - z_t^* \tag{3}$$

$$\Omega_t = \theta_0(\rho - r_t) + \theta_1(f_t - \bar{f}) + w_t \tag{4}$$

$$r_t = r_t^* + \alpha E_{t-1}(q_{t+1} - q_t) \tag{5}$$

$$q_t = e_t + p_t^* - p_t \tag{6}$$

$$P_t = \alpha p_t + (1 - \alpha)(e_t + p_t^*) \tag{7}$$

$$e_t - e_{t-1} = [c - E_{t-1}(p_{t+1}^* - p_t^*)] - \lambda[E_{t-1}(P_{t+1} - P_t) - c]. \tag{8}$$

A portfolio balance equation could also be added;

$$m_t - P_t = b_0 + b_1 y_t - b_2 i_t + b_3 f_t + \chi_t. \tag{9}$$

where:

dd_t	=	excess demand for domestic goods (measured in units of foreign goods);
Ω_t	=	desired excess of domestic expenditure over domestic income (measured in units of foreign goods);
q_t	=	real exchange rate;
z_t	=	a stochastic process accounting for changes in the distribution of government expenditure between domestic goods and foreign goods, or for changes in commercial policy, or other policies that affect the distribution of domestic expenditure between domestic and foreign goods;
df_t	=	excess demand for foreign goods;
dd_t^*	=	foreign demand for domestic goods (measured in units of foreign goods);
y_t^*	=	foreign output;
z_t^*	=	same as z_t, but for the rest of the world;
ρ	=	rate of time preference ("natural" level of the real interest rate);
r_t	=	real interest rate;
f_t	=	net stock of domestically held foreign assets;
$\bar{f}$	=	desired level of domestically held net foreign assets;
w_t	=	domestic demand disturbance such as government spending or taxation;
r_t^*	=	foreign real interest rate;
E_{t-1}	=	mathematical expectation operator based on information at time (t-1);
e_t	=	nominal (effective) exchange rate[2];

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[2]   The exchange rate is defined as the domestic money price of a unit of foreign currency.

p_t^*	=	price of foreign goods;
p_t	=	price of domestic goods;
P_t	=	(capital letter P) general price level;
m_t	=	the money stock;
y_t	=	total domestic output;
i_t	=	nominal interest rate;
χ_t	=	a money demand disturbance;
α	=	share of domestic goods in the general price level;
a_2	=	relative price elasticities of domestic excess demands for foreign and domestic goods;
a_2^*	=	relative price elasticity of foreign demand for domestic goods;
c	=	the one-quarter proportional rate of inflation that gives the centre of the inflation target per annum;
λ	=	reaction coefficient of the monetary authority.

Equations (1) and (2) represent the domestic excess demands for domestic goods and for foreign goods respectively. Equation (3) represents the foreign demand for domestic goods. Equation (4) is the desired excess of domestic expenditure over domestic income.[3] Equations (1) to (4) are expressed in terms of foreign goods. Equation (5) posits the real interest parity condition. The parameter α is necessary to measure the rates of return on domestic and foreign assets in the same units. In other words, " is needed because while the domestic real interest rate rt is measured using a basket of goods that includes both foreign and domestic goods, the foreign interest rate rt* is measured using a basket of goods that comprises only foreign goods. Equation (6) defines the real exchange rate, and equation (7) defines the overall price level in terms of prices of domestic and foreign goods.

Equation (8) is the Reserve Bank of New Zealand' (RBNZ) feedback function according to descriptions of actual practice (Grimes, 1989 and 1990, Tait and Reddell, 1991, Grimes and Wong, 1993, Schoefisch, 1993, Hansen and Margaritis, 1993, Archer, 1995, McCallum, 1995, Evans *et al*, 1995).[4] Once equation (8) is solved, it relates the instrument of monetary policy (or a proxy of

[3] As the government sector is not modelled explicitly, changes in wt due to changes in taxes or government expenditure give to the model, loosely speaking, a non-Ricardian flavour.

[4] According to McCallum (1995), the exchange rate although used as an instrument it is best viewed as an indicator or "operating target" due to the manner in which its path is influenced by the RBNZ.

Therefore, an increase in the exchange rate is a depreciation of the domestic currency. This is, in effect, the reciprocal of the way in which the TWI is quoted in New Zealand.

it) to the vector of state variables. The first term of equation (8) is the expected deviation of the forecast of foreign inflation - in practice, averaged over the next three years - and the midpoint of the inflation target band. The second term represents the fact that the RBNZ is not indifferent to forecast values of domestic inflation in different parts of the band. Thus, the nominal exchange rate path is adjusted downward (appreciated) from the previous quarter when expected annual inflation exceeds the midpoint of the band, with the reaction coefficient λ measuring the strength of the adjustment (proportional to the divergence between expected inflation and the target midpoint).

It is assumed: (1) that all agents' information set is dated at time (t-1) and (2), that market participants and the monetary authority share the same information. The dating of the information set is motivated by three factors: first, it is the most realistic dating of the information set for inflation forecasting in New Zealand given the frequency of the statistics used in the process. Second, the assumption is consistent with the setting of product prices at the beginning of the period at expected market-clearing levels. As unexpected demand and supply shocks will make actual market realisations to be different from expected values, the idea is that market participants find it optimal to pre-set prices at expected values and then satisfy demands that materialise at those prices. One reason for this behaviour could be the cost of gathering and processing information and taking action.[5] Finally, the simplification gained by assuming that the dating of the information set in financial markets is also (t-1) is obtained at the price of making the purely random component of nominal exchange rate fluctuations not greater than for domestic good prices.[6]

Finally, equation (9) is a portfolio balance equation in which, as in Frenkel and Mussa (1985), domestic money is a substitute for goods with an elasticity of b_1, a substitute for interest-bearing assets with a semi-interest elasticity of b_2, and also a substitute for net foreign assets as indicated by b_3. Notice that as the monetary authority does not target a monetary aggregate *directly*, equation (9) could be dropped from the system. However, it is included here for two reasons: first, because as shown in Nadal-De Simone (1997), the endogenisation of the money stock path that inflation targeting produces makes the behaviour of monetary aggregates mimic the conventional behaviour of the nominal exchange rate in

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[5]   See Brunner *et al* (1983) for a discussion of the effects of the costs of gathering and processing information on economic activity.

[6]   Nadal-De Simone (1997) contains a similar model that assumes stickiness in the domestic good market only.

models that assume some form of monetary targeting by the monetary authority. Second, in order to stress that the paths of domestic monetary aggregates, and net foreign assets under inflation targeting in a small open economy display a positive correlation.[7]

Uncovered interest parity (10) and the Fisher effect (11) are substituted into the system (1)-(9):

$$i_t = i^*_t + E_{t-1}(e_{t+1} - e_t) \tag{10}$$

$$i^*_t = r^*_t + E_{t-1}(p^*_{t+1} - p^*_t). \tag{11}$$

It is assumed that $r^* > \delta^*$ - the rate of foreign output growth - to avoid "Ponzi games" (ie, dynamically inefficient paths).

The excess demand for domestic goods, dd_t, and the foreign demand domestic goods, dd_t^*, must add up to zero if the domestic goods market is to clear. Using equations (1) and (3):

$$dd_t + dd_t^* = 0. \tag{12}$$

This equilibrium condition is used to express the excess of domestic expenditure over domestic income, Ω_t, as a function of the real exchange rate, foreign output and the processes z_t and z_t^*:

$$\Omega_t = -(1/\alpha)[(a_2 + a_2^*)q_t + a_3 y_t^* - (z_t + z_t^*)]. \tag{13}$$

The current account balance (measured in units of foreign goods), C_t, must be equal to the excess of foreign expenditure on domestic goods over domestic excess demand for foreign goods plus interest payments on net foreign assets; thus, from equations (2) and (3):

$$C_t = dd_t^* - df_t + r^*_t f_{t-1}. \tag{14}$$

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[7] It is generally accepted that for foreign exchange market intervention to be effective, it must be unsterilised. As a result, effective foreign exchange market intervention increases macroeconomic interdependence (Genberg and Nadal-De Simone, 1993). However, even without direct intervention in the foreign exchange market by monetary authorities, strong positive correlations among monetary and non-monetary asset growth rates across countries have been observed.

As shown by equation (14), the model is consistent with the *"absorption approach"* to the current account stressing how investment/saving decisions ultimately determine international borrowing and lending patterns. After some algebra,

$$C_t \quad = \quad -\Omega_t, \tag{15}$$

which can also be rewritten as follows:

$$C_t \quad = \quad (1/\alpha)[\ (a_2 + a_2^*)q_t + a_3 y_t^* - (z_t + z_t^*)\ ] + r^* f_{t-1}. \tag{15'}$$

Equation (15') reflects the *"trade balance approach"* or *"elasticities approach"* to the current account, familiar from those times in which countries' holdings of net foreign assets were limited making thereby net export balances, and relative prices the central determinants of the current account. This is clear from the sensitivity of the current account C_t to the real exchange rate q_t - weighted by the relative price elasticities of domestic and foreign import demands a_2 and a_2^*. Notice, as well, the presence of the inverse of the share of domestic goods in domestic consumption " in the structural equation for the current account; this is required to obtain equilibrium in the goods market and it is consistent with the absorption approach to the current account.

As there are no changes in official holdings of net foreign assets, the current account is the mirror image of changes in the private net foreign asset position of the home country. Thus, the excess of domestic spending over domestic income must also be consistent with the forces that determine desired excess in spending in the home country. This is what equations (4) and (15) describe. It is assumed that two basic forces are at work: first, the difference between the rate of time preference ρ and the real rate of interest r_t, and second, the excess of actual holdings of net foreign assets f_t over the desired level of such holdings $\bar{f}$.[8] Finally, as the country is small, the rest of the world willingly accepts changes in assets f_t at the interest rate r_t^* assumed henceforth fixed for simplicity.

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[8] This important feature of the model is consistent with a more basic model in which consumers maximise the discounted present value of future utility where the utility function is Cobb-Douglas, includes both domestic and foreign goods, and ρ is the rate of time preference used to discount the future utility flow.

Thus, the model is consistent with the intertemporal approach to the current account as it accounts for the macroeconomic determinants of relative prices and for the impact of current and future prices on agents' spending/saving decisions.[9]

Using the definition of the real exchange rate - equation (6) - equation (15') becomes:

$$C_t = (1/\alpha)[(a_2 + a_2^*)(e_t + p_t^* - p_t) + a_3 y_t^* - (z_t + z_t^*)] + r^* f_{t-1}. \quad (15'')$$

The (momentary) equilibrium price of domestic goods, p_t, is:

$$p_t = e_t + H\{ - \theta_0 \alpha E_{t-1} e_{t+1} + \theta_0 \alpha E_{t-1} p_{t+1} + [(a_2 + a_2^*)/\alpha] p_t^* -$$

$$\theta_0 \alpha E_{t-1} (p_{t+1}^* - p_t^*) + (a_3/\alpha)y_t^* + \theta_1(f_t - \bar{f}) - (1/\alpha)(z_t + z_t^*) +$$

$$r^* f_{t-1} + w_t \} \quad (16)$$

where $H = \alpha/(a_2 + a_2^* + \alpha^2 \theta_0)$.

Substituting in equation (8) the definition of the price level - equation (7) - and of the real exchange rate - equation (6) - the (momentary) equilibrium nominal exchange rate is:

$$e_t = J\{ e_{t-1} + c(1 + \lambda) - \lambda(1 - \alpha)E_{t-1} e_{t+1} - \lambda\alpha E_{t-1} p_{t+1} + \lambda\alpha p_t -$$
$$[1 + \lambda(1 - \alpha)]E_{t-1} (p_{t+1}^* - p_t^*) \} \quad (17)$$

where $J = 1/[1 - \lambda(1 - \alpha)]$.

The (momentary) equilibrium real exchange rate is, therefore, equal to:

$$q_t = H[\theta_0 \alpha E_{t-1} q_{t+1} - \theta_1(f_t - \bar{f}) - (a_3/\alpha)y_t^* + (1/\alpha)(z_t + z_t^*) - r^* f_{t-1} -$$
$$w_t]. \quad (18)$$

According to equation (18), the expectation of a higher exchange rate (a depreciation of the domestic currency) causes the expected return on domestic

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[9]   Investment decisions are not explicitly modelled. Thus, it is assumed that the capital stock is adjusted without costs so that its net marginal product is equated to the world interest rate. This unrealistic assumption was made to keep the model analytically tractable. It does not affect the major results discussed in the paper.

holdings of net foreign assets to rise and induces domestic agents to spend less. As a result, the price of domestic goods p_t falls, the real exchange rate q_t rises and the current account surplus increases.

Also according to equation (18), given that the change in net foreign assets is the counterpart of the current account balance, the change in the real exchange rate relative to the equilibrium real exchange rate is *negatively correlated* to the expected current account imbalance. For example, if domestic agents hold more net foreign assets than desired, ie, a current account surplus, they will want to spend more than their incomes. A portion α of that expenditure will fall on domestic goods and the exchange rate will appreciate with respect to its equilibrium value.

In contrast, the equilibrium real exchange rate is *positively correlated* with the expected current account imbalance - equation (15").[10] This could be a reason why observed correlations between the current account and the real exchange rate can be positive or negative: it depends on whether the factors explaining the equilibrium real exchange rate are constant or not (Figure 2).

The interaction between the current account and the real exchange rate in the model can be summarised in three points: first, the current account depends on the *level of the exchange rate*; second the current account determines the *rate of change of the real exchange rate* and; third, the level of the exchange rate depends on the divergence of the stock of net foreign assets from its long-run desired level. Figure 2 illustrates the behaviour of equations (15') and (18) when all the exogenous factors ($\xi_t = \xi_0$) affecting the current account and the exchange rate ($\phi_t = \phi_0$) are held constant respectively. In that case, the dynamic behaviour of the real exchange rate is governed by the process of convergence of the domestically held stock of net foreign assets f_t to its long run desired level $\bar{f}$. If the economy starts off with a $f_0 > \bar{f}$, the corresponding exchange rate is q_0. This is consistent with a current account deficit C_0. This deficit produces a reduction in the stock of net foreign assets available in the economy: the change in f determines the change in q. The new lower level of net foreign assets f_1 is consistent with a real exchange rate depreciation to q_1 and a current account

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10   This illustrates part of the difficulties in interpreting the dynamic behaviour of the current account and the real exchange rate as the correlation between them depends on whether the equilibrium real exchange rate is changing or not when the current real exchange rate changes.

deficit thereby reduced to C_1. This process of reductions in net foreign assets, exchange rate depreciation and ever smaller current account deficits continues until the current stock of net foreign assets f_t equals the desired level $\bar{f}$. The speed of convergence is determined by relative price elasticities a_2 and a_2^*, the share of domestic goods in domestic consumption α and the parameters of the basic forces motivating the desired excess of expenditure over income θ_0 and θ_1.

The model can be solved for the current account C_t, the price variables p_t, e_t, P_t, q_t, and for the domestic money stock m_t. The exogenous variables are: $\bar{y}_t$, y_t^*, p_t^*, z_t, z_t^*, w_t, and χ_t. The processes driving foreign prices p_t^*, foreign commercial policy z_t^*, the domestic excess demand disturbance w_t, and the money demand disturbance χ_t, are all assumed to be autoregressive of order one. Namely, those variables (X_t) are assumed to follow the process:

$$ X_t^i = \Gamma_i X_{t-1}^i + \varepsilon_t^i \tag{19} $$

where $0 < \Gamma_i < 1$ and ε_t^i is white noise. All other disturbances and exogenous variables are assumed to follow random walks with the exception of domestic potential output and foreign output which follow random walks with drift terms * and ** respectively. The choice of the stochastic processes has been motivated more by the need to illustrate the importance of the nature of the stochastic processes followed by the state variables than as a result of having taken a view on the nature of the data generating processes of those variables.

III. Fully anticipated shocks: the steady-state properties of the model

It is useful to concentrate first on the behaviour of the endogenous variables following *anticipated shocks* to the state variables, or the *steady state* behaviour of the model. It is assumed that the inflation targeting regime has been in effect for a long period of time.[11] The use of a structural model consistent with a more basic underlying optimising framework together with the assumption of rational

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[11] This crucial assumption is frequently disregarded in policy analysis using either estimated or calibrated models with the consequence that policy conclusions thereby obtained are invalidated. For a lucid and elegant discussion of the importance of this assumption see Sargent (1987) chapter XVII.

expectations, should make the conclusions reached entirely consistent with an inflation targeting regime (Lucas, 1976).

For simplicity, it is assumed in this section that (1) all exogenous processes equal zero; (2) that $\Delta p^*_t = \mu^*$ and; (3) that the realisations of the variables equal their expectations, ie, $E_{t-1}(X_{t+1} - X_t) = X_{t+1} - X_t$.

As expected changes in growth rates are zero in the steady state, it is straightforward to obtain - after rearranging terms - the growth rates of the endogenous variables. The current account is:

$$ C \quad = \quad (1/\alpha)(a_2 + a_2^*)q + (a_3 / \alpha)y^* + r^* f, \tag{20} $$

and the current account change is:

$$ \Delta C \quad = \quad (1/\alpha)(a_2 + a_2^*)\Delta q + (a_3 / \alpha)\delta^* + r^* C. \tag{20'} $$

Equation (20') shows that with zero net debt and no growth the change in the current account balance - the change in the net foreign asset position of the economy - is zero if the inflation differential between the home country and the rest of the world equals the nominal exchange rate change, ie, when purchasing power parity (PPP) holds. Notice that the openness of the economy (1-") is positively correlated with the current account balance. Similarly, the correlation between the current account and real exchange rate changes is directly proportional to the magnitude of the relative price elasticities.

The rate of change of the real exchange rate in the steady state is:

$$ \Delta q \quad = \quad - [1 / (a_2 + a_2^*)](a_3\delta^* + \alpha r^* C). \tag{21} $$

However, as r* is assumed to be fixed, it must be true that:

$$ \Delta q \quad = \quad 0, \tag{22} $$

unless the real interest rate differential between the home country and the rest of the world can grow for ever. Therefore, equations (21) and (22) suggest that, given a fixed foreign real interest rate and growth in the rest of the world, it is

possible for PPP to hold and for the home country to have a net foreign liability position in the steady state. That is:

$$a_3\delta^* \quad = \quad - \alpha r^* C. \tag{23}$$

Another insightful way of looking at equations (22) and (23) is to note that in the steady state inflation must equal its target value c (equation 24) and thus PPP must hold (equation 25):

$$\Delta P \quad = \quad c, \tag{24}$$

$$\Delta e \quad = \quad c - : *. \tag{25}$$

What does this imply for the change in the current account in the steady state? It is straightforward to show that equation (20') becomes:

$$\Delta C \quad = \quad 0. \tag{26}$$

The expected path of real money balances in the steady state is governed by equation (27):

$$\Delta m \quad = \quad c + b_1\delta + b_3 C. \tag{27}$$

Equation (27) shows that, in the steady state, the nominal money stock grows at the rate of growth of potential output - weighted by the income elasticity of money demand - and the rate of change of net foreign assets - weighted by the elasticity of the demand for money with respect to net foreign assets. It is noteworthy that positive shocks to productivity, eg, technical progress or credible structural reforms, may require higher real money balance growth in the new steady state.

Another appealing representation of equation (27) is:

$$\Delta m - c \quad = \quad b_1\delta + b_3 C. \tag{27'}$$

The growth of real money balances matches the sum of productivity growth and capital inflows.

Finally, using (22) and substituting (23) into (27'), obtains:

$$) \, m - c \qquad = \qquad b_1 \delta - (a_3 b_3 / \text{''}) \, \delta^* / r^*. \qquad (28)$$

The path of the real money stock under inflation targeting is determined by a weighted productivity growth differential between the home economy and the rest of the world. The rate of real money growth is positively correlated with the degree of openness of the economy $(1 - \text{''})$, with domestic money demand elasticity b_1, with the influence of foreign output on domestic demand a_3, and with the substitutability between domestic money and foreign assets b_3. Therefore, in this model, convergence of domestic growth with growth abroad (ie, $\delta = \delta^*$) is not necessary for $\Delta q = 0$.

In the steady state, (potential) output growth is:

$$\Delta \bar{y}_t \quad = \quad \delta. \qquad (29)$$

a.   Intertemporal solvency

Equation (20) can be put in terms of a ratio to GDP so as to look into the factors that explain the country's solvency in the steady state. By dividing both sides of the expression by real GDP in terms of foreign goods:

$$\Delta cy \quad = \quad (1/\alpha)(a_2 + a_2^* + \alpha)\Delta q + (a_3 / \alpha)\, \delta^* - \delta + r^* C \qquad (30)$$

where cy is the ratio of net foreign assets (liabilities) to GDP. This expression shows that foreign debt rises with the world rate of interest r^* and the world growth rate, while it falls with the rate of real exchange rate appreciation and the rate of growth of the domestic economy.[12]

If the change in the ratio of net foreign assets (liabilities) to GDP is to be kept constant, ie, $\Delta c = 0$, the desired excess of domestic expenditure over income can be positive *if and only if* the domestic country is a net creditor. *With economic growth*, current account deficits are consistent with solvency provided that trade surpluses are sufficiently large. *Without* economic growth, the current account must be balanced for the foreign assets (liabilities) to GDP ratio to remain constant.

IV.   Unanticipated random shocks

This section discusses the behaviour of the economy when shocks are random. The model is solved for the current account, for the price variables and for the monetary aggregate. The complete solution is in Appendix 1. Section A discusses the long-run equilibrium of the endogenous variables following unanticipated shocks to the economy while section B considers the short-run adjustment paths of the endogenous variables.

A.   The long-run equilibrium of the endogenous variables

The long-run equilibrium (ie, the deterministic part of the particular solution of the difference equations) for the endogenous variables is composed of non-linear combinations of the structural parameters. As a result, without a parameter-

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[12]   See Milesi-Ferretti and Razin (1996) for a similar expression.

isation of the model it is not always possible to determine the sign of the effects of the shocks to the system. However, the roles of some core parameters are clear at a purely analytical level. This section concentrates on the latter discussing in particular the long-run equilibrium of the current account, and the real exchange rate. The roles of six parameters in the behaviour of the current account, and the real exchange rate are stressed.

1. The relative price elasticities of excess demand for foreign and domestic goods at home and abroad (the a_2s)

Relative price elasticities have positive effects on the current account, and the real exchange rate (equations A.1 and A.2). High a_2s imply a large discounting rate for the expected future values of the exogenous variables that determine both the equilibrium current account $(f_t - f_{t-1})$, and the equilibrium real exchange rate. For example, following a small deviation of the real exchange rate from its equilibrium value, say, $q_t > \bar{q}_t$ because of a tax increase (an increase in w_t), given θ_0 and θ_1, a small weight will be given to the expected future path of taxation, and a high weight will be given to the current realisation of the fiscal variable. Thus, the current account effect will be large.

The real exchange rate long-run equilibrium is also less sensitive to the level of net foreign assets the higher the relative price elasticities are. This result is the counterpart of the expected large responsiveness of the current account to current disturbances (low sensitivity of the real exchange rate to the level of net foreign assets) produced by high relative price elasticities of excess demand.

2. The parameters of the desired excess of spending over income (the θ_2s)

A large value for $\theta_0\alpha$ implies a high responsiveness of the desired excess of spending over income to expected real exchange rate changes. This indicates a greater willingness to finance temporary shocks through a current account imbalance and thus, a low discount rate for the expected future path of the exogenous variables (alternatively, a high weight to current realisations of exogenous variables). This is consistent with a low sensitivity of the exchange rate to the level of foreign assets (a low θ_1 in equation 4). Again, a high tolerance

of deviations of f_t from its desired level $\bar{f}$ (low θ_1) implies a low discount rate for the future path of the exogenous variables.

The relevant point is that those parameters (ie, the a_2s and the θs) are interdependent. This is important in evaluating the combinations of them that play a critical role in the analysis of exchange rate and current account long-run equilibria as well as short-run dynamic adjustment.

3. Openness (1-" and a_3)

A third important parameter is the openness of the economy represented by the share of domestic goods in the CPI, ", and the degree of integration between the domestic economy and the rest of the world, a_3. The long-run equilibrium value of the current account, and the real exchange rate are both inversely related to the share of domestic goods in domestic consumption and to the degree of good market integration with the rest of the world.

4. Productivity growth in the rest of the world ($\star^{*}$)

Another significant component of the current account and the real exchange rate long-run equilibria is productivity growth in the rest of the world δ^*. Ceteris paribus, an asymmetric (permanent) positive productivity shock to the rest of the world appreciates the equilibrium real exchange rate q_t generating a current account deficit and a fall in the economy's long-run net foreign asset position.

5. Differential "impatience" between the home country and the rest of the world ($r - r^*$)

A key force explaining the long-run current account balance in the absence of distortions is the term ($\rho - r^{*}$). This term represents the differential in "impatience" between the home country and the rest of the world. If, for example, the home country economic agents are more impatient than the rest of the world's (ie, $\rho > r^{*}$), domestic expenditure will increase raising thereby the equilibrium price of domestic goods p_t, the equilibrium price level P_t, and the demand for money m_t (equations A.3, A.5 and A.6). The equilibrium real exchange rate q_t

will appreciate. There will be a secular tendency toward increasing foreign debt and declining consumption.

It should be stressed that the long-run equilibrium of the nominal exchange rate (equation A.4) is *not* affected by the differential in impatience under inflation targeting. Under inflation targeting, permanent shocks do not affect the path of the nominal exchange rate change. In this monetary policy regime, the path of the money stock mimics the path of the exchange rate. As the equilibrium nominal exchange rate cannot fall following an increase in the differential $(\rho - r^*)$, the long-run equilibrium demand for money is higher by as much as $\theta_0 \alpha^2 (\rho - r^*)/(a_2 + a_2^*)$. There is, however, an offsetting term: $-\theta_0 b_3 (\rho - r^*)$ which is a direct consequence of having assumed some substitutability between domestic money and net foreign assets as stores of value. Equilibrium in asset markets requires that if more domestic money is held in equilibrium, less net foreign assets be held in equilibrium, ceteris paribus.

6. The feedback parameter (**8**)

The monetary policy feedback parameter (λ) does not affect the long-run equilibrium of the current account nor the long-run equilibrium of the real exchange rate. However, it *does alter the long-run equilibria of the price variables and of the money stock.*

A.1 The foreign real interest rate

For simplicity, the foreign real interest rate r^* has been assumed constant in this model.[13] However, it is perhaps useful to perform a comparative static exercise concentrating on the *direct effect* of a foreign real interest rate change.[14]

For example, a higher foreign real interest rate requires a larger flow of payments received from, or made to, the rest of the world. If the home country is a net debtor, payments abroad rise. The net foreign liability position of the economy also increases (equation A.1). The demand for domestic goods falls and the

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[13]   Nadal-De Simone (1996a) contains a complete analysis of the implications of inflation targeting for the behaviour of the equilibrium endogenous variables of a similar model.

[14]   The effects of changes in r^* on domestic absorption are the mirror image of changes in the rate of time preference (ρ) and have already been discussed above.

equilibrium price of domestic goods drops accordingly (equation A.3). The equilibrium real exchange rate depreciates (equation A.2). Both changes in equilibrium prices are positively correlated with the share of domestic goods in domestic consumption.[15] The intuition behind this result is that the payment of the foreign debt requires an international transfer, which needs, in turn, a reduction in domestic absorption.

A higher foreign interest rate also needs a lower demand for money as indicated by the semi-interest elasticity of money demand b_2. However, a higher demand for domestic money is needed as b_3 indicates. Thus, the net effect depends on the relative sizes of b_2 and b_3. As the equilibrium nominal exchange rate does not change, the equilibrium price level must be lower (equation A.5).

B.   *The short-run adjustment of endogenous variables to unanticipated random shocks*

It is instructive to start this section by stating some significant general results applicable to the stochastic component of the particular solutions for all the endogenous variables in the model.

1.   <u>Monetary policy can only affect the short-run convergence of endogenous variables to equilibrium when the shocks affecting the system are transitory</u>

If the monetary authority reacts (ie, 8 is different from 0) to a temporary shock, the path of the nominal exchange rate is affected. However, given the form of the policy reaction function, temporary shocks to foreign prices will always affect the path of the exchange rate change, ie, even if the monetary authority decides not to respond (8 = 0).

In contrast, lasting changes in tastes, productivity, payments technology, natural disasters, and persistent changes in the terms of trade or supply shocks such as a permanent reduction in the cattle stock, can not be offset via engineering changes in the exchange rate path.[16] When shocks are *permanent*, the monetary authority

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[15]   This is a familiar result in the literature on international debt and transfer payments (eg, Cohen, 1995).

[16]   For instance, this is reflected in the current Policy Target Agreement (PTA) in New Zealand. The PTA allows only transitory deviations from the inflation target following

can only affect the *deterministic part* of the particular solution to the (nominal) price equations, and not the short-run dynamics. It is straightforward to see this point in Appendix 1 by making the autoregressive parameter of random shocks $'$ = 1.

To illustrate, when the autoregressive parameter of the shocks to the desired excess of domestic expenditure over income w_t or to the demand for money P_t becomes equals 1, the forecast of the change in the exchange rate becomes flat. Therefore, the change in the equilibrium exchange rate is constant. This result is not contingent on the operating instrument used in the policy reaction function (equation 8). The same result holds with an interest rate targeting instrument. This result is instead a feature of the intertemporal nature of the policy reaction function where permanent shocks affect both the spot and the equilibrium price level and, thus, do not affect the operating instrument.

2.   <u>Inflation targeting reduces the magnitude of the purely random component of nominal exchange rate fluctuations</u>

As the nominal effective exchange rate path is affected only by shocks to foreign prices, and by transitory shocks to which the monetary authority responds, the overall variance of its random component is reduced. Thus, the variance of the random part of the price of domestic goods can become larger than the variance of the random part of the nominal exchange rate, a feature only displayed by conventional models of exchange rate determination under the standard assumption of monetary targeting when the economy is very open (McKinnon, 1963).

3.   <u>*Permanent expenditure-switching* policies do not affect the current account balance because there are zero costs of adjusting the capital stock in the model</u>

As investment behaviour is not explicitly modelled, it is assumed that the adjustment of the stock of capital in order to make its marginal productivity match the foreign (constant) interest rate is instantaneous. Thus, consistent with the

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terms of trade shocks, shocks to potential output and aggregate demand shocks that are not under the control of the RBNZ. Thus, the caveats are best interpreted as applicable to unanticipated shocks perceived by the RBNZ to be non mean reverting.

intertemporal approach to the current account, permanent, expenditure switching shocks to the state variables such as an increase in protectionism abroad or a terms of trade change do not affect the short-run dynamic behaviour of the current account balance.

Consequently, the relative price elasticities, a_2s, the share of domestic goods in domestic consumption, α, and the responsiveness of the desired excess of domestic spending over income to the expected change in the real exchange rate, affect the dynamic behaviour of the current account *only when expenditure-switching shocks are mean reverting.*

4.   <u>Permanent expenditure-changing policies are quite effective in affecting the current account equilibrium</u>

This is clear from equation A.1. If, for example, the desired excess of spending over income is eliminated via a contractionary fiscal policy, ie, w_t falls, ceteris paribus, the stock of net foreign assets increases proportionately.

5.   <u>The monetary authority affects the stochastic component of the real exchange rate path</u>

Given the degree of openness of the economy, equation A.2 shows that the monetary authority affects the short-run convergence of the real exchange rate to its long-run equilibrium through the feedback parameter λ. When the feedback parameter λ is equal to 0 (ie, the central bank does not react), the last period nominal exchange rate has a one-to-one effect on the real exchange rate.

6.   <u>The relative price of imported goods exhibit a great deal of *persistence* in its fluctuations</u>

The real exchange rate behaviour in the model encompasses a stylised feature of the post-1973 exchange rate data, ie, that the relative price of imported goods exhibit a great deal of persistence in its fluctuations (Mussa, 1986). In this model, following Stockman (1987), permanent shocks to foreign potential output are assumed. These permanent disturbances affect the economy in such a way that the equilibrium real exchange rate meanders. The equilibrium real exchange rate

needs neither fluctuate from period to period about the deterministic part of the particular solution nor follow a smooth trend.

7. <u>Both permanent as well as transitory shocks affect the equilibrium real exchange rate</u>

In contrast to the nominal exchange rate, permanent as well as transitory shocks alter the equilibrium real exchange rate. Both types of shocks affect the equilibrium price of domestic goods. However, the nominal exchange rate helps accommodating shocks to foreign prices, and all other transitory shocks to which the monetary authority reacts.

8. <u>The inflation impact of a change in the exchange rate is unlikely to equal the share of foreign trade in GDP</u>

Inspection of equation A.5 should make it clear that the last period nominal exchange rate affects the equilibrium price level by a factor determined by the degree of openness of the economy $(1-\alpha)$ *if and only if* the monetary authority has not altered the path of the nominal exchange rate by reacting to a shock. Otherwise, the price level effect of last period nominal exchange rate will increase with the size of the monetary authority response. The *impact* effect of a change in foreign prices on the equilibrium price level is equal to the share of foreign trade in GDP. However, that impact change is (partly) offset the following period.

More generally, there is no one-to-one change in the equilibrium exchange rate following a change in the price of foreign goods (equation A.4). The magnitude of the change depends on the parameters describing the structure of the economy and on the perceived duration of the shock. Therefore, it is very unlikely that the equilibrium price level will change proportionately following a change in the exchange rate (equation A.5).[17]

B1.   Unanticipated permanent random shocks

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[17]   See Collins and Nadal-De Simone (1996) for a simulation of a similar model in which the pass-through coefficient is shown to vary depending on the duration of the shock affecting the nominal exchange rate.

In the remainder of this section, the behaviour of the endogenous variables following both permanent and transitory shocks will be analysed. Two permanent shocks will be studied: a shock to the rest of the world's commercial policy, and a shock to foreign output. Four temporary shocks will be studied: a foreign price shock, a shock to the desired excess of domestic spending over income, a home-country commercial policy shock, and a money demand shock.

1. A productivity shock that increases foreign output (y_t^*)

A permanent increase in foreign output (expenditure) increases the demand for domestic goods forcing thereby the equilibrium price of domestic goods upward. There is a corresponding appreciation (ie, a fall) of the equilibrium real exchange rate by the same amount [$-a_3/(a_2 + a_2^*)$]. In the New Zealand's inflation targeting regime, permanent shocks do not affect the nominal exchange rate path. This implies that the demand for money will increase, and the equilibrium price level will rise accordingly [$\alpha a_3/(a_2 + a_2^*)$].[18] Real money balances will not change.

The current account is not affected by a permanent asymmetric shock to foreign output. In an intertemporal framework, the current account balance is a manifestation of intertemporal trade. Therefore, without investment adjustment costs in the model, a permanent positive shock to foreign output (and expenditure) increases foreign wealth, and thus foreign consumption. Desired savings (given investment) do not change and, thus, the current account is not affected. The increase in foreign exports is matched by a similar increase in foreign imports. The increase in the demand for domestic goods as a result of the shock does not open new possibilities of intertemporal trade despite that the shock is asymmetric. There are no reasons to do today anything different from tomorrow in terms of consumption. It is in general true that asymmetry is a *necessary* condition for shocks to affect the current account but this is clearly *not a sufficient condition*.

These results are consistent with the intertemporal approach to the current account when an instantaneous adjustment of capital's marginal product to the world interest rate is assumed. The modelling of sluggish investment, however, would allow for the short-run dynamics to play a useful role and possibly provide insights on the observed countercyclical behaviour of the current account. This would go beyond the focus of this research, however.

2. An increase in protectionism in the rest of the world (z_t^*)

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[18] As a way of comparison, in a standard model of exchange rate determination--one assuming some form of monetary targeting--there would not be any effect on the price level because the nominal exchange rate would appreciate entirely offsetting thereby the inflationary impact of the shock on the price of domestic goods.

It is convenient to view this shock as an example of an *irreversible* (or credible) trade policy change. As z_t increases, the home country's volume of international trade in domestic goods, which includes tradables in this model, falls. The equilibrium price of domestic goods drops and the equilibrium real exchange rate depreciates by the same amount [$1/(a_2 + a_t^*)$]. Because the shock is viewed as permanent, the nominal exchange rate path is not affected. Thus, there is a fall in the demand for money and in the equilibrium price level by the same amount [$-\alpha/(a_2 + a_t^*)$].[19] The equilibrium price level falls and less money is demanded to buy domestic goods. Real money balances do not change. As stated above, the current account is not affected because no new intertemporal trading possibilities are open by a permanent shock.

B2.   Unanticipated transitory random shocks

With transitory shocks, the non-linear nature of the coefficients makes it more difficult to be specific about the effects of shocks without assuming definite values for the parameters of the model and performing a full-fledged stochastic simulation. Nevertheless, some general analytical results related to the *duration of the shocks* and the *degree of openness* of the economy are noteworthy.

First, in an inflation targeting regime, the ultimate effect of transient shocks on the equilibrium price level depends on the interplay between the feedback parameter, and the duration of the shock. These are positively correlated. As the duration of the shock increases, the likelihood of offsetting its effects on the path of the equilibrium price level falls; very large values of λ are likely to be necessary to offset the shock increasing thereby the likelihood of instability in the system.

Second, as the degree of openness of the economy increases, the value of the feedback parameter λ necessary for affecting the equilibrium price level path by a given amount also increases. As the perceived duration of the shock increases, the magnitude of the equilibrium price level effect is positively correlated with the degree of openness.

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[19]   Recall that in the standard model of exchange rate determination, the domestic currency would depreciate after the shock reducing thereby the real stock of money and as a result there would not be any effect on the price level.

1.   <u>A rise in the foreign-money price of foreign goods (p_t^*)</u>

Given the real exchange rate model and the structure of the policy reaction function, an increase in the foreign-money price of foreign goods can be usefully viewed as a deterioration in the home country's terms of trade.

The increase in the foreign-money price of foreign goods raises real income in the rest of the world. Thus, a real depreciation of the home country equilibrium real exchange rate in the current period becomes necessary. Similarly, the price level path is increased on impact by the shock. The increase in the relative price of foreign goods, however, raises the demand for domestic goods increasing thereby their price and appreciating the real exchange rate. That appreciation (partially) offsets the depreciation that occurred on impact.[20] It also reduces the price level (partially) offsetting its previous increase. The overall price level effect is positively correlated with the duration of the shock Γ_{p*} and, in general, it depends on the structure of good markets as represented by the a_2s.

The relative price change generates a current account surplus, which bears a positive correlation with the share of domestic goods in domestic consumption.[21] If the home country is a net debtor (creditor), there is a reinforcing (offsetting) effect on the current account surplus. The increase in the relative price of foreign goods increases the real value of foreign debt (recall that the internationally traded asset is measured in terms of foreign goods). Domestic (foreign) agents become relatively poorer (richer) reducing (increasing) their absorption.

2.   <u>A positive shock to the desired excess of domestic spending over income (w_t)</u>

This shock can be viewed as a tax cut or a rise in government expenditure. The expansionary fiscal policy shock increases the equilibrium price of domestic goods by a magnitude that depends positively on its perceived duration Γ_w. It is noteworthy that in contrast to the conventional result in models of exchange rate determination, the nominal exchange rate can *depreciate* following an

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[20]   In a small open economy, changes in foreign prices are one major source of real exchange rate variability when purchasing power parity does not hold (Frankel, 1989, Nadal-De Simone, 1996b).

[21]   If foreign goods are used as inputs in domestic production, the effect on the current account will be - at least partially - offset.

expansionary fiscal policy shock depending, ceteris paribus, on the combination of two key parameters: the monetary authority's response λ and the shock duration Γ_w.

The equilibrium real exchange rate unambiguously appreciates. The size of the appreciation is positively correlated with the duration of the shock and, it is negatively correlated with the degree of openness of the economy. The current account displays a deficit of a magnitude directly proportional to the duration of the shock. The overall effect on the equilibrium price level is inflationary. The monetary authority can, however, reverse that effect. For a given desired change in the price level path, the strength of the reaction is directly correlated with the shock duration.

Equation A.2 shows that the real exchange rate can have a sizeable variability if the variance of fiscal policy (σ^2_w) is large. Furthermore, if the fiscal shock w_t is a highly persistent process, the real exchange rate will display persistence as well. While the equilibrium nominal exchange rate will barely move, the equilibrium price of domestic goods will also display a highly persistent behaviour. The current account imbalance will be persistent as well.

Finally, there is an interesting implication for a policy maker wishing to target a lower inflation rate. A regime of *permanently* lower inflation could be viewed as requiring a *transitory* negative shock to w_t. Therefore, although a permanently lower inflation rate should not have any effect on the long-run equilibrium of the current account nor on the long-run equilibrium of the real exchange rate, in the transition to the lower inflation rate both variables are affected. The current account displays a surplus and the real exchange rate depreciates.[22] However, if the "shock" is viewed as reversible by some market participants, some offsetting effect is to be expected via an increase in expenditure - financed by savings. A *regime shift* toward a lower average inflation rate can therefore produce current account imbalances until the new steady state is perceived to have been reached.

3.   A reversible increase in domestic tariffs (a fall in z_t)

As shown in the Appendix, the effect of a temporary fall in z_t, say, due to the desire to curb a current account deficit, *does improve the net foreign asset*

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[22]   This was New Zealand's experience in the period between 1990 and 1992.

position of the economy: the excess demand for domestic goods rises. The ensuing increase in the equilibrium price of domestic goods appreciates the equilibrium real exchange rate. The nominal effective exchange rate depreciates instead but only if there is some feedback from the monetary authority, ie, λ is not zero. If λ is zero instead, the equilibrium nominal exchange rate path is not affected. The demand for money rises and the equilibrium price level increases as well.

This result may seem counterintuitive as commercial policy can be considered a case of expenditure-switching policy and, as such, it should not have any effect on the equilibrium current account (Genberg and Swoboda, 1989). However, that view is consistent with static or backward-looking expectations. With rational expectations, market participants reduce their current expenditure (increase their desired savings) at the ongoing real interest rate in anticipation of the future reversal of the trade restrictive practice. Had the trade policy change been perceived instead as permanent (ie, $\Gamma_z = 1$), the current account would not have been affected (equation A.1).

Notice, nevertheless, that expenditure-switching policies such as changes in tariffs and non-tariff measures only affect the short-run convergence of the current account to equilibrium but not the long-run equilibrium of the current account. This possibly explains the attraction of commercial policy as a tool in dealing with current account imbalances in the short run although it is known that commercial policy cannot correct secular imbalances that follow disequilibria between desired expenditure and income. Expenditure-changing policies are instead necessary.

4.   <u>An increase in the demand for domestic money</u> (χ_t)

Consistent with the "endogenisation" of the money stock path that the targeting of inflation implies, shocks to the demand for money produce a one-to-one change in the money stock. As a result, neither the equilibrium values of the price variables nor the equilibrium current account are altered. In contrast, the prediction of conventional models of exchange rate determination is that an increase in the demand for domestic money appreciates the currency and causes both the equilibrium price of domestic goods and the equilibrium price level to fall.

V.   Summary, conclusions and policy implications

The basic objective of this paper is to analyse the behaviour of the equilibrium current account and the equilibrium real exchange rate under inflation targeting **B**

la New Zealand. A small open economy model with rational expectations inspired in Frenkel and Mussa (1985), and encompassing the "elasticities approach" and the "absorption approach" to the current account is used.

In the tradition of the asset market approach to exchange rate determination, the exchange rate is modelled as an asset price that adjusts rapidly not only to current but to future expected changes in exogenous real and monetary factors.

When all the state variables that drive the economic system are expected to remain constant, the divergence of the stock of net foreign assets from its long-run desired level explains the *level* of the real exchange rate which, in turn, determines the current account balance. The current account balance determines instead the *rate of change* of the real exchange rate.

When the exogenous factors that drive the economic system are not constant instead, the dynamic behaviour of the current account, and the real exchange rate is more complicated. Unanticipated shocks to the economy affect the equilibrium current account, and the price variables of the economy not only because they produce unanticipated changes to the stock of net foreign assets, but also because they provide new information on economic conditions (present and future) that affect the long-run equilibrium real exchange rate and the current account.

Results obtained are in general consistent with the basic features of the more recent intertemporal approach to the current account (Obstfeld and Rogoff, 1996). Let us summarise the major results on the behaviour of the current account and the real exchange rate under a regime of inflation targeting **B** la New Zealand.

- In the steady state, the rate of potential output growth in the home country need not be equal to the rate of potential output growth in the rest of the world for PPP to hold.

- A model with intertemporal features and growth is necessary to discuss the link between the current account and fiscal policy and trade policy. For example, in the steady state, the desired excess of expenditure over income can be positive, ie, the current account can be in deficit, if and only the country is a net creditor. When there is economic growth, persistent current account deficits can be consistent with *solvency* even when the real interest rate is higher than potential output growth, provided trade surpluses are sufficiently large. Discussion of

issues of *sustainability* of current account imbalances requires, however, the consideration of the willingness to lend and to borrow.

- In the steady state, real money balances grow at the rate of domestic productivity growth, weighted by the income elasticity of the demand for money and net of capital inflows.

- The *duration of shocks* affecting the economy is important as permanent shocks do not affect the path of the equilibrium nominal exchange rate under inflation targeting **B** la New Zealand.

- When divergences from PPP are possible, a *regime shift* toward a lower average inflation rate can produce substantial current account imbalances until the new steady state is perceived to have been reached.

- If the home country becomes more impatient than the rest of the world, the current account displays a deficit as the equilibrium price of domestic good rises and the equilibrium real exchange rate appreciates. As the endogenous increase in the demand for domestic money is unlikely to be exactly offset by a capital inflow, the price level also increases.

- *Permanent (asymmetric) expenditure-switching policies* such as changes in the level of tariffs or other trade restrictive measures do not affect the equilibrium current account. However, *transitory expenditure-switching policies do affect the short-run convergence of the current account to equilibrium* suggesting that expected policy reversals can be a conspicuous reason why trade policy may be popular in certain circles as a way of coping with current account imbalances.

- *Permanent or transitory expenditure-changing* policies such as fiscal policy are very powerful to affect the current account balance. In an inflation targeting regime, as permanent shocks do not change the equilibrium nominal exchange rate path, a fiscal policy shock causes a once-and-for-all shift in the equilibrium price level which is directly proportional to the share of domestic goods in domestic consumption. If the fiscal shock is transitory, the price level effect depends on the interplay between the feedback parameter 8 and the perceived shock duration.

- Monetary policy does not affect the long-run equilibrium of the current account nor the long-run equilibrium of the real exchange rate. However, it does alter the long-run equilibria of the price variables, and of the money stock of the system. Similarly, it alters the short-run dynamics of the equilibrium real exchange rate when shocks are viewed as mean reverting and the monetary authority reacts to them, ie, δ is different from 0.

- Given the intertemporal nature of the model, transitory changes in, say, output or the terms of trade, affect the current account and in that sense justify current account imbalances.

References

Archer, D. (1995). "Rules for Monetary Policy: The Rationale Underlying the New Zealand Approach", *Working Paper*, March, with "Supplementary Remarks", Reserve Bank of New Zealand.

Brunner, K., A. Cuckierman and A. Meltzer (1983). "Money and Economic Activity: Inventories and Business Cycles", *Journal of Monetary Economics*, pp. 281-319.

Cohen, D. (1995). "The Sustainability of African Debt", mimeo, CEPREMAP.

Collins, S. and F. Nadal-De Simone (1996). "Selected Policy Issues under Inflation Targeting in a Small Open Economy", *12th Pacific Basin Central Bank Conference Proceedings*, Monetary Authority of Singapore (forthcoming).

Evans, L., A. Grimes, D. Teece, and B. Wilkinson (1995). "Economy Wide Reform: the Case of New Zealand 1984-1994", working paper.

Frankel, J. (1991). "Quantifying International Capital Mobility in the 1980s", in B. D. Berheim and J. B. Shoven (eds.) *National Saving and Economic Performance*, The University of Chicago Press.

Frenkel, J. A. and M. L. Mussa (1985), "Asset Markets, Exchange Rates and the Balance of Payments" in R. W. Jones and P. B. Kenen (eds.) *Handbook of International Economics*, North-Holland, ch. 14.

Grimes, A. (1989). "The Choice of Intermediate and Operating Targets for Monetary Policy", *Discussion Paper Series* G89/3, Reserve Bank of New Zealand.

Grimes, A (1990). "The Theoretical Basis for Monetary Policy", Reserve Bank of New Zealand, *Bulletin* 53, pp. 118-125.

Grimes, A. and J. Wong (1994). "The Role of the Exchange Rate in New Zealand Monetary Policy", in R. Glick and M. M. Hutchinson (eds.), *Exchange Rate Policy and Interdependence*, Cambridge University Press.

Hansen, E. and D. Margaritis (1993). "Financial Liberalisation and Monetary Policy in New Zealand", *Australian Economic Review*, pp. 28-36.

Genberg, H. and A. Swoboda (1989). "Policy and Current Account Determination under Floating Exchange Rates", *IMF Staff Papers*, pp. 1-30.

Genberg, H. and F. Nadal-De Simone (1993). Regional Integration Agreements and Macroeconomic Discipline", in K. Anderson and R. Blackhurst (eds.), *Regional Integration and the Global Trading System*, ch. 8.

Gertler, M. and K. Rogoff (1990). "North-South Lending and Endogenous Domestic Capital Market Inefficiencies", *Journal of Monetary Economics* 26, pp. 245-266.

Glick, R. and K. Rogoff (1995). "Global versus Country-Specific Productivity Shocks and the Current Account", *Journal of Monetary Economics*, pp. 159-192.

Leiderman, L. and L. O. Svensson, (eds.) (1995). *Inflation Targets*, Centre for Economic Policy Research, London.

Lucas, R. E. Jr. (1976). "Econometric Policy Evaluation: A Critique", in K. Brunner and A. Meltzer (eds.), vol 1 *Carnegie-Rochester Conferences on Public Policy*, Amsterdam, North-Holland Publishing Company, pp. 19-46.

McCallum, B. (1995). "New Zealand's Monetary Policy Arrangements: Some Critical Issues", *Discussion Paper Series* G95/4, Reserve Bank of New Zealand.

McKinnon, R. I. (1963). "Optimum Currency Areas", *American Economic Review* 53, pp. 717-725.

Milesi-Ferretti, G. M. and A. Razin (1996). "Sustainability of Persistent Current Account Deficits", *National Bureau of Economic Research*, working paper 5467.

Mussa, M. (1980). "The Role of the Current Account in Exchange Rate Dynamics", *Department of Economics and Graduate School of Business*, University of Chicago, mimeo.

Mussa, M. (1986). "Nominal Exchange Rate Regimes and the Behaviour of Real Exchange Rates", *Carnegie-Rochester Conference Series on Public Policy* 25, pp. 74-104.

Nadal-De Simone, F. (1996a). "Inflation Targeting and Monetary Targeting in a Small Open Economy: the Behaviour of Price Variables", *working paper WP96/4*, Reserve Bank of New Zealand.

Nadal-De Simone, F. (1996b). "Capital/output Ratio, Risk Premia, Capital Income Share and Related Issues", R*esearch Memorandum* M96/16, Reserve Bank of New Zealand.

Nadal-De Simone (1997). "Monetary Targeting **B** la Friedman and Inflation Targeting **B** la New Zealand: the Behaviour of Price Variables", working paper WP97/6, Reserve Bank of New Zealand.

Obstfeld, M. and K. Rogoff (1996). *Foundations of International Macroeconomics*, MIT Press, Cambridge, MA.

Sargent, T. (1987). *Macroeconomic Theory*, (2nd ed.), Academic Press.

Schoefisch, U. (1993). "The Reserve Bank's Approach to Inflation Forecasting", Reserve Bank of New Zealand, *Bulletin* 56, pp. 343-359.

Stockman, A. C. (1987). "The Equilibrium Approach to Exchange Rates", Federal Reserve Bank of Richmond, *Economic Review* 73, pp. 12-30.

Stockman, A. C. and L. L. Tesar (1995). "Tastes and Technology in a Two-Country Model of the Business Cycle: Explaining International Comovements", *American Economic Review* 85, pp. 168-185.

Tait, J. and M. Reddell (1991). "The Operation of Monetary Policy", Reserve Bank of New Zealand, *Bulletin* 54, pp. 44-57.

Figure 1
New Zealand current account/GDP ratio
and real exchange rate changes
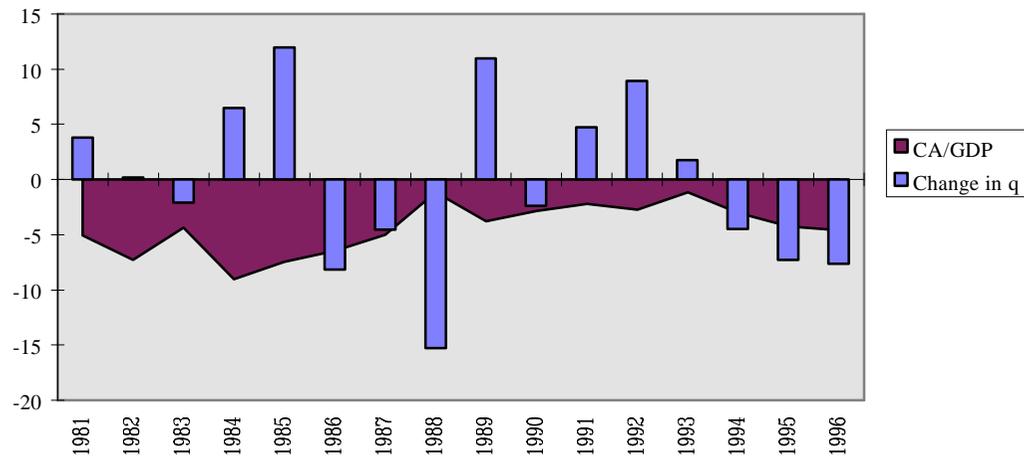
Figure 2
Current account and real exchange rate dynamics

$$C_t = \frac{a_2 + a_2^*}{a} q_t + \boldsymbol{x}_t$$

$$q_t = \bar{q}_t + \frac{\boldsymbol{q}_1 \boldsymbol{a}}{a_2 + a_2^* + \boldsymbol{q}_0 \boldsymbol{a}^2}\left(\bar{f} - f_t\right) + \emptyset_t$$
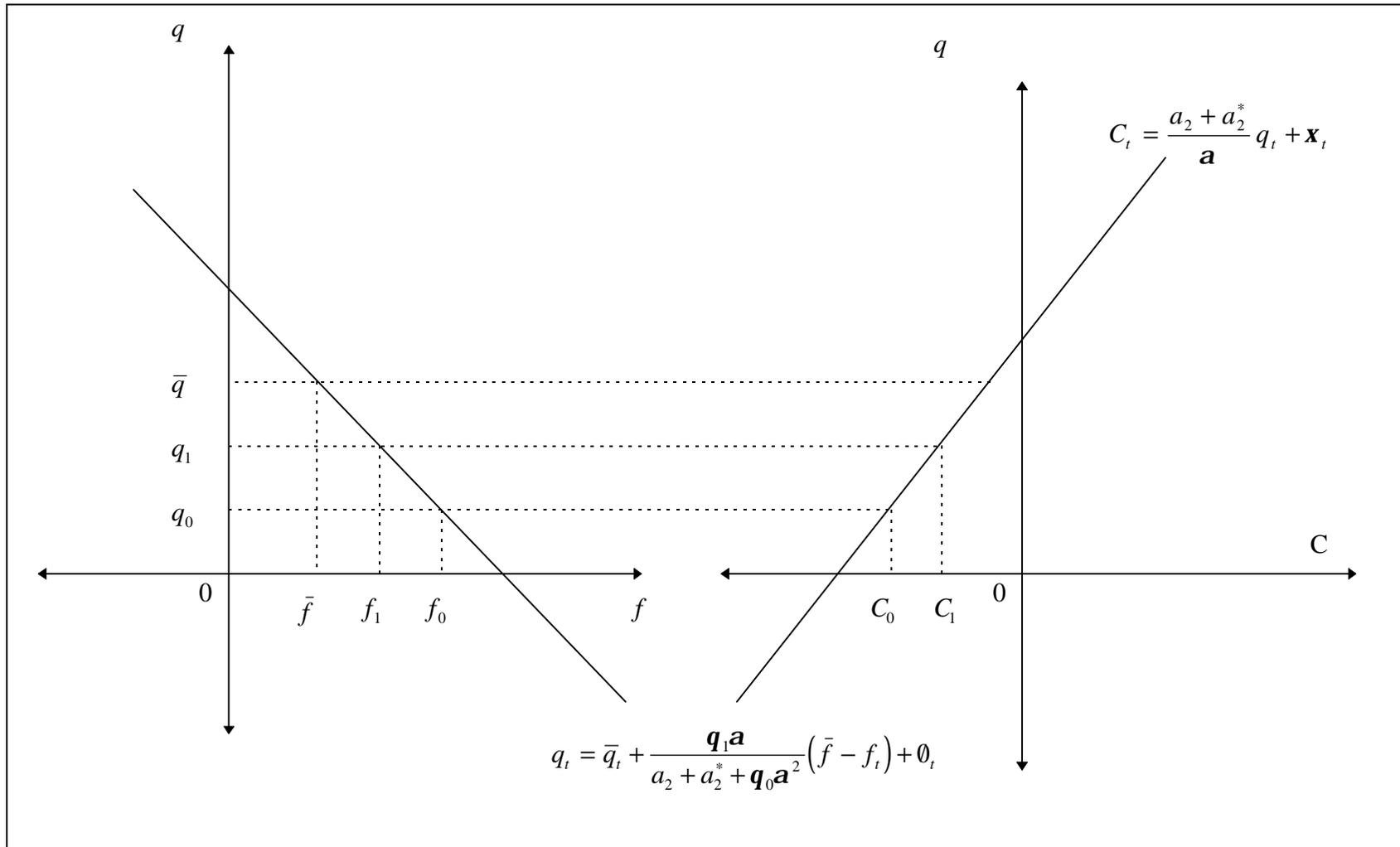
Appendix 1

$$f_t = f_{t-1} + r^* f_{t-1} - \frac{\boldsymbol{a}a_3\boldsymbol{q}_0\boldsymbol{d}^*}{a_2+a_2^*} - \frac{\boldsymbol{q}_0\left(\boldsymbol{r}-r^*\right)}{a_2+a_2^*} + \frac{\boldsymbol{a}\boldsymbol{q}_0\left(a_2+a_2^*\right)\left(1-\Gamma_{p*}\right)\Gamma_{p*}^2}{a_2+a_2^*+\boldsymbol{q}_0\boldsymbol{a}^2\left(1-\Gamma_{p*}^2\right)}p_{t-1}^* - \frac{\left(a_2+a_2^*\right)\Gamma_w}{a_2+a_2^*+\boldsymbol{q}_0\boldsymbol{a}^2\left(1-\Gamma_w^2\right)}w_{t-1} - \frac{\boldsymbol{a}\boldsymbol{q}_0\left(1-\Gamma_z^2\right)\Gamma_z}{a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_z^2\right)}z_{t-1} \tag{A.1}$$

$$q_t = -\frac{\left(a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\right)a_3\boldsymbol{d}^*}{\left(a_2+a_2^*\right)^2} - \frac{\boldsymbol{a}\boldsymbol{q}_0\left(\boldsymbol{r}-r^*\right)}{a_2+a_2^*} + \frac{1}{1-\boldsymbol{l}(1-\boldsymbol{a})}e_{t-1} + p_t^* - \frac{\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_{p*}\right)\right]\Gamma_{p*}}{\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_{p*}^2\right)\right]}p_{t-1}^* - \frac{a_3}{a_2+a_2^*}y_{t-1}^* - \frac{\boldsymbol{a}r^*}{a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0}f_{t-1}$$

$$-\frac{\boldsymbol{a}\Gamma_w}{\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_w^2\right)\right]}w_{t-1} + \frac{\Gamma_z}{\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_z^2\right)\right]}z_{t-1} + \frac{1}{a_2+a_2^*}z_{t-1}^* \tag{A.2}$$

$$p_t = \frac{\left(a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\right)a_3\boldsymbol{d}^* + \left(a_2+a_2^*\right)\left[c(1+\boldsymbol{l})\left(a_2+a_2^*\right)-\boldsymbol{a}\boldsymbol{l}a_3\boldsymbol{d}^*\right]}{\left(a_2+a_2^*\right)^2} + \frac{\boldsymbol{a}\boldsymbol{q}_0\left(\boldsymbol{r}-r^*\right)}{a_2+a_2^*} + \frac{\boldsymbol{a}r^*}{a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0}f_{t-1}$$

$$+\frac{\left\{\left[1-\boldsymbol{l}(1-\boldsymbol{a})\left(1-\Gamma_{p*}^2\right)\right]\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_{p*}^2\right)\right]+\left[1+\boldsymbol{l}(1-\boldsymbol{a})\right]\left(1-\Gamma_{p*}\right)\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_{p*}\right)\right]\right\}}{\left[1-\boldsymbol{l}\left(1-\Gamma_{p*}^2\right)\right]\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_{p*}^2\right)\right]}\Gamma_{p*}p_{t-1}^* \tag{A.3}$$

$$+\frac{a_3}{a_2+a_2^*}y_{t-1}^* + \frac{\left[1-\boldsymbol{l}(1-\boldsymbol{a})\left(1-\Gamma_w^2\right)\right]\boldsymbol{a}\Gamma_w}{\left[1-\boldsymbol{l}\left(1-\Gamma_w^2\right)\right]\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_w^2\right)\right]}w_{t-1} - \frac{\left[1-\boldsymbol{l}(1-\boldsymbol{a})\left(1-\Gamma_z^2\right)\right]\Gamma_z}{\left[1-\boldsymbol{l}\left(1-\Gamma_z^2\right)\right]\left[a_2+a_2^*+\boldsymbol{a}^2\boldsymbol{q}_0\left(1-\Gamma_z^2\right)\right]}z_{t-1} - \frac{1}{a_2+a_2^*}z_{t-1}^*$$

$$e_t = \frac{1}{1-\mathbf{l}(1-\mathbf{a})}e_{t-1} + \frac{(a_2+a_2^*)c(1+\mathbf{l})-\mathbf{al}a_3\mathbf{d}^*}{a_2+a_2^*} - \frac{\{(a_2+a_2^*)[1+\mathbf{l}(1+\mathbf{a}\Gamma_{P*})]+\mathbf{a}^2\mathbf{q}_0(1+\mathbf{l})(1-\Gamma_{P*}^2)\}(\Gamma_{P*}-1)\Gamma_{P*}}{[1-\mathbf{l}(1-\Gamma_{P*}^2)][a_2+a_2^*+\mathbf{a}^2\mathbf{q}_0(1-\Gamma_{p*}^2)]}p_{t-1}^*$$

$$\text{(A.4)}$$

$$+\frac{\mathbf{a}^2\mathbf{l}(1-\Gamma_w^2)\Gamma_w}{[1-\mathbf{l}(1-\Gamma_w^2)][a_2+a_2^*+\mathbf{a}^2\mathbf{q}_0(1-\Gamma_w^2)]}w_{t-1} - \frac{\mathbf{al}(1-\Gamma_z^2)\Gamma_z}{[1-\mathbf{l}(1-\Gamma_z^2)][a_2+a_2^*+\mathbf{a}^2\mathbf{q}_0(1-\Gamma_z^2)]}z_{t-1}$$

$$P_t = \frac{c(1+\mathbf{l})(a_2+a_2^*)^2+\mathbf{a}a_3\mathbf{d}^*[(a_2+a_2^*)(1-\mathbf{l})+\mathbf{a}^2\mathbf{q}_0]}{(a_2+a_2^*)^2} + \frac{\mathbf{a}^2\mathbf{q}_0(\mathbf{r}-r^*)}{a_2+a_2^*} + \frac{1-\mathbf{a}}{1-\mathbf{l}(1-\mathbf{a})}e_{t-1} + (1-\mathbf{a})p_t^*$$

$$-\frac{\{(a_2+a_2^*)\{\Gamma_{p*}[1+\mathbf{l}(1-\mathbf{a})]-(1+\mathbf{a})-\mathbf{l}(1-\mathbf{a})\}-(1+\mathbf{a})[\mathbf{a}^2\mathbf{q}_0(1-\Gamma_{p*})]-(1-\mathbf{a})\mathbf{a}^2\mathbf{q}_0\Gamma_{p*}[1-\Gamma_{p*}(1-\mathbf{l}\Gamma_{p*})]+\mathbf{a}^2\mathbf{q}_0\Gamma_{p*}^2[1-\Gamma_{p*}+\mathbf{l}(1-\mathbf{a})]\}\Gamma_{p*}}{[1-\mathbf{l}(1-\Gamma_{P*}^2)][a_2+a_2^*+\mathbf{a}^2\mathbf{q}_0(1-\Gamma_{p*}^2)]}p_{t-1}^*$$

$$\text{(A.5)}$$

$$+\frac{\mathbf{a}a_3}{a_2+a_2^*}y_{t-1}^* + \frac{\mathbf{a}^2r^*}{a_2+a_2^*+\mathbf{a}^2\mathbf{q}_0}f_{t-1} + \frac{\mathbf{a}^2\Gamma_w}{[1-\mathbf{l}(1-\Gamma_W^2)][a_2+a_2^*+\mathbf{a}^2\mathbf{q}_0(1-\Gamma_w^2)]}w_{t-1} - \frac{\mathbf{a}\Gamma_z}{[1-\mathbf{l}(1-\Gamma_Z^2)][a_2+a_2^*+\mathbf{a}^2\mathbf{q}_0(1-\Gamma_z^2)]}z_{t-1} - \frac{\mathbf{a}}{a_2+a_2^*}z_{t-1}^*$$

$$m_t = \frac{\left(a_2 + a_2^*\right)\left[c(1+\mathbf{l}) + b_0 + b_1\mathbf{d} - b_2 r^*\right] + \mathbf{a}a_3\mathbf{d}^*\left(1 - \mathbf{l} - \mathbf{q}_0 b_3\right)}{a_2 + a_2^*} + \frac{\mathbf{a}^3\mathbf{q}_0 a_3\mathbf{d}^*}{\left(a_2 + a_2^*\right)^2} + \frac{\mathbf{q}_0\left[\mathbf{a}^2 - b_3\left(a_2 + a_2^*\right)\right]\left(\mathbf{r} - r^*\right)}{a_2 + a_2^*} + b_1\bar{y}_{t-1}$$

$$+ \frac{\left\{\left\{2\left[1 + b_2\left(1 - \Gamma_{p*}\right) - (1+\mathbf{l})\Gamma_{p*} + \mathbf{a}\mathbf{l}\Gamma_{p*}(1+b_2) + \mathbf{a}b_2\mathbf{q}_0(1-\mathbf{l}) - \Gamma_{p*}^2\left[b_2(1+\mathbf{a}\mathbf{l}) - \mathbf{l}(1-\mathbf{a})\right] + \Gamma_{p*}^3 b_2 - \mathbf{a}\mathbf{l}\Gamma_{p*}^3(1-\mathbf{l})(b_2 - b_3\mathbf{q}_0)\right]\right\}\left(a_2 + a_2^*\right)}{\left[1 - \mathbf{l}\left(1 - \Gamma_{p*}^2\right)\right]\left[a_2 + a_2^* + \mathbf{a}^2\mathbf{q}_0\left(1 - \Gamma_{p*}^2\right)\right]}$$

$$\frac{2\mathbf{a}^2\mathbf{q}_0(1+b_2) - \mathbf{a}^2\mathbf{l}\Gamma_{p*}(1+\mathbf{a}+2b_2) - \mathbf{a}^2\Gamma_{p*}^2\mathbf{q}_0\left[2 - \mathbf{a} + 3b_2 - \mathbf{l}(1-\mathbf{a})\right] + \mathbf{a}^2\Gamma_{p*}^3\mathbf{q}_0(1-\mathbf{a}+\mathbf{l}+3b_2) + \mathbf{a}^2\Gamma_{p*}^4\mathbf{q}_0\left[b_2\left(1-\Gamma_{p*}\right) - \mathbf{l}(1-\mathbf{a})\right]\right\}\Gamma_{p*}}{\left[1 - \mathbf{l}\left(1 - \Gamma_{p*}^2\right)\right]\left[a_2 + a_2^* + \mathbf{a}^2\mathbf{q}_0\left(1 - \Gamma_{p*}^2\right)\right]}p_{t-1}^*$$

$$(A.6)$$

$$+ \frac{\mathbf{a}a_3}{a_2 + a_2^*}y_{t-1}^* - \frac{\left(a_2 + a_2^*\right)b_3\left[1 + \mathbf{l}\left(1 - \Gamma_w^2\right)\right] - \mathbf{a}^2\left\{1 + b_2\mathbf{l}\left[1 - \Gamma_w^2\left(2 - \Gamma_w^2\right)\right]\right\}\Gamma_w}{\left[1 - \mathbf{l}\left(1 - \Gamma_{p*}^2\right)\right]\left[a_2 + a_2^* + \mathbf{a}^2\mathbf{q}_0\left(1 - \Gamma_{p*}^2\right)\right]}w_{t-1}$$

$$- \Gamma_x x_{t-1} - \frac{\mathbf{a}\left\{1 + b_2\mathbf{l}\left(1 - \Gamma_z^2\right)^2 + b_3\mathbf{q}_0\left[1 - \mathbf{l}\left(1 - 2\Gamma_z^2\right) - \Gamma_z^2\left(1 + \Gamma_z^2\right)\right]\right\}\Gamma_z}{\left[1 - \mathbf{l}\left(1 - \Gamma_z^2\right)\right]\left[a_2 + a_2^* + \mathbf{a}^2\mathbf{q}_0\left(1 - \Gamma_z^2\right)\right]}z_{t-1} - \frac{\mathbf{a}}{a_2 + a_2^*}z_{t-1}^*$$