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DYNAMIC EFFECTS OF GOVERNMENT POLICIES IN AN OPEN ECONOMY

Robert J. HODRICK*

Carnegie-Mellon University, Pittsburgh, PA 15213, USA

The effects of three government policies, an increase in the provision of government services, an open market operation, and an increase in the rate of growth of government liabilities, are studied in a long-run model of a small open economy with flexible exchange rates. The government budget constraint, the degree to which government bonds are net wealth to the public, and the degree of substitutability of government services for private market purchases are all considered. The determination of the exchange rate and the adjustment of the accounts of the balance of payments to changes in government policy are explored.

1. Introduction

The government sector exerts a pervasive influence on the macroeconomic variables of an economy. The purpose of this paper is to consider a variety of ways in which these influences are manifest in a small open economy. The analysis is concerned with the perceptions of the public regarding government policies and with the long-run influence of the government sector.

The analysis is conducted in a neo-classical growth model to contrast it to the neo-Keynesian analyses of Blinder and Solow (1973) and Tobin and Buiter (1976) who develop closed economy models which characterize the effects of monetary and fiscal policy in the long run when all variables including the capital stock are allowed to adjust to their steady-state values.

Turnovsky (1976) has extended this analysis to consider a small open economy under the Keynesian assumptions that exports are exogenously determined and that the domestic bond is an imperfect substitute for the foreign bond. Since no consideration is given to growth, the long-run equilibrium requires that the government's budget be balanced and that the balance of payments on current account be balanced, i.e., the capital account must be zero. Within a neo-classical growth theory framework, Foley and Sidrauski (1971) analyze similar problems focusing on the effects of

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government policies on the value of capital per capita as the economy moves from one steady state to another. Brunner and Meltzer (1972, 1976) develop a series of models which address the influence of government policy on output and the price level in both the short run and the long run, first for a closed economy and then in a two country framework with fixed exchange rates.

Paralleling this development of the theoretical influence of government policies on macroeconomic variables has been the resurgence of interest in the determination of flexible exchange rates between countries. Recent papers by Frenkel (1976), Dornbusch (1976a, b), Kouri (1976) and Mussa (1976) develop the monetary or portfolio balance approach to exchange rate determination. Stated simply, the theory is that since the exchange rate is the relative price of two monies, it will be in equilibrium when the outstanding stocks of the two monies are willingly held. Bilson (1978) and Hodrick (1978) have examined the empirical content of the theory which appears to be a useful way to structure thoughts about the often volatile movements in flexible exchange rates.

This model analyzes the movement of the exchange rate over time, the path of the accounts of the balance of payments, and the changes in wealth which occur in response to government policies and the perceptions of these policies by the public. A change in the provision of government services, an open market operation, and a change in the rate of growth of government debt are considered. The model gives explicit consideration to the way in which people value the services of government, the degree to which government bonds are perceived as net wealth, the effects of expectations of inflation, and the effects of changing the production function of the government sector.

The model considers the case of the small country which takes prices of traded goods and assets as given. Three assets are introduced, a traded equity or title to capital, a nominal government bond which is non-traded, and money which is also assumed to be held only by domestic residents. Portfolio equilibrium is maintained throughout, and the movement of the exchange rate is seen to depend on changes in the values of the assets outstanding and in the anticipated rates of return associated with them. A three-sector production technology is introduced, and prices, wages, and factors of production are assumed to be sufficiently mobile that full employment maintains throughout. The population or labor force is assumed to grow at a constant rate n.[1] Consequently, the long-run equilibrium condition of the government's budget constraint and the balance of payments are changed reflecting the need to endow new individuals with the assets of

[1]Since the model is a long-run growth model, it is assumed that the small country's population growth rate is equal to that of the world. If it grew faster for a long enough period, it would outgrow its smallness.

the government and to keep ownership of titles to capital, by both domestic and foreign residents, constant in the steady state.

The plan of the paper is as follows. Section 2 develops the foundations of the model, and section 3 investigates the momentary equilibrium, the stability properties, and the steady state of the model. In section 4 effects of changes in government policies are examined in a dynamic context. Section 5 provides a conclusion.

2. The foundations of the model

In this section the building blocks of the model are explained. Production technology, individual behavioral functions, and the government sector are all developed in turn.

Production of goods and services in the small open economy is divided into three sectors, consumption goods, investment goods, and government services. Each sector uses capital and labor in different proportions in linear homogeneous production functions, and the government is assumed to pay the going wage and rental rates determined in the competitive sectors of the economy. However, the government is not assumed to necessarily minimize the cost of production of the chosen level of services.[2]

To keep the problem tractable, the traditional assumption that consumption goods are produced more capital intensively than investment goods will be employed. Production of government services will be assumed initially to be more labor intensive than either of the privately produced goods. Consumption goods are assumed to be traded while capital goods are assumed to be non-traded.[3] The population or labor force of the country grows at an exogenously given exponential rate n. Perfect mobility of labor and capital between the production sectors maintains full employment and

[2]It would be desirable to make the level of the provision of government services an endogenous variable of the model, but such an analysis is beyond the scope of this paper. In a full rational general equilibrium model without transaction costs or uncertainty, one would expect that the process of voting would result in the amount of government services desired by the median voter and that the production would be efficient, i.e., the minimum cost subject to the technological constraint. In this paper assumptions will be made about both the level of the provision of government services and the manner in which they are produced. See Meltzer (1976) for arguments which lead to the conclusion that the government sector may be too large and hence inefficient from an aggregate viewpoint and Meltzer and Richard (1977) for a model which generates growth in government endogenously.

[3]If investment goods were traded and perfect substitutes for foreign capital, it would be necessary to introduce an installation decision by firms since titles to capital are traded. This is necessary since individuals are concerned only with their command over permanent income streams and not with the location of the means of production. See Uzawa (1969) for a discussion of the Penrose effect which generates a determinant installation decision. Berglas and Jones (1977) develop a model in which capital in one country is not a perfect substitute for capital in the other country. Consequently, the location of the capital affects its rate of return.

equality of the wages and rental rates of labor and capital in terms of the consumption good, w and r, to the values of the marginal product of each factor in either sector. Using the full employment conditions, the linear homogeneity of the production functions, and the assumption that the consumption good is capital intensive allows the per capita outputs of the consumption, investment, and government goods, q_c, q_I, and q_g, to be written as

$$q_c = Q_c(\underset{(+)}{k - \lambda_{lg} k_g}, \underset{(-)}{1 - \lambda_{lg}}, \underset{(-)}{P_k}),$$

$$q_I = Q_I(\underset{(-)}{k - \lambda_{lg} k_g}, \underset{(+)}{1 - \lambda_{lg}}, \underset{(+)}{P_k}),$$

$$q_g = \lambda_{lg} \underset{(+)}{Q_g(k_g)}, \tag{1}$$

where k is the economy's overall capital–labor ratio, λ_{lg} is the proportion of the labor force employed in the government sector, k_g is the capital–labor ratio in the government sector, and P_k is the relative price of capital in terms of consumption goods.[4] Since consumption goods are capital intensive, an increase in capital available for private production per capita, $k - \lambda_{lg} k_g$, will increase per capita production of consumption goods and reduce per capita production of investment goods. Similarly, an increase in the proportion of the labor force not employed by the government, $1 - \lambda_{lg}$, will decrease the per capita output of the consumption good and increase the per capita output of the capital good. An increase in P_k increases investment good production and decreases consumption good production. Increasing k_g increases per capita output of government services.

Since titles to capital correspond one-to-one with physical capital, the value of output per capita can be written as the sum of the wage rate plus the rental rate times capital per head as in (2) where g is the value of government output in terms of consumption goods,[5]

$$q_c + P_k q_I + g = w + rk. \tag{2}$$

Because titles to capital are traded internationally, a distinction must be made between domestic ownership of titles to capital, k_d, and foreign ownership of domestic capital per capita, k_f, which can be negative if the

[4]Algebraic signs beneath the arguments of a function indicate the direction of the partial derivative of the function with respect to that argument.

[5]Define $G = wL_g + rK_g$ since there is no market determined price for the government services. Then the per capita value of government services in terms of consumption goods is $g = (w + rk_g)\lambda_{lg}$.

country is a net creditor to the world. The rate of return on capital is given by the rest of the world since domestic and world capital are perfect substitutes. Consequently, the relative price of capital can be assumed to be constant throughout the analysis. The physical capital stock of the country can change, however, with changes in the size of the government sector.

The subjective real value of assets per capita in terms of the consumption good is given by

$$a=\frac{m}{P}+\gamma\frac{b}{P}+P_k k_d=z\frac{v}{P}+P_k k_d, \tag{3}$$

where the per capita stock of nominal government bonds and money is

$$v=m+b,$$

the ratio of total government bonds and money to money, which is controlled by open market operations of the monetary authority, is

$$x=v/m$$

and

$$z=[(1-1/x)\gamma+1/x].$$

The symbol γ is introduced to capture the degree to which government bonds are net wealth to the public.[6] Since the existence of government bonds implies future taxes which are necessary to pay the holders the interest and principal associated with the bonds, it has been argued that these assets are not net wealth to the public. Indeed, Barro (1974) has argued that the uncertainty associated with the distribution of future taxes to finance the bonds could imply that they were regarded as negative wealth by the public. In order to examine the consequences of alternative assumptions regarding the degree to which government bonds are net wealth, the γ term will be treated parametrically, varying from a possible negative value to unity.

[6]Patinkin (1965) introduces a similar term to γ in his analysis, and Barro (1974) presents an analysis of the issues involved in the degree to which government bonds are net wealth to the public. Of the authors mentioned in the introduction only Brunner–Meltzer allow for discounted future taxes by the inclusion of a human-wealth term in their asset demand functions.

Asset preferences are characterized by[7]

$$m^d/P = L(\underset{(+)}{a}, \underset{(+)}{R_m}, \underset{(-)}{R_b}, \underset{(-)}{R_k}), \tag{4}$$

$$\gamma b^d/P = H(\underset{(+)}{a}, \underset{(-)}{R_m}, \underset{(+)}{R_b}, \underset{(-)}{R_k}), \tag{5}$$

$$P_k k_d^d = J(\underset{(+)}{a}, \underset{(-)}{R_m}, \underset{(-)}{R_b}, \underset{(+)}{R_k}). \tag{6}$$

The three assets are assumed to be gross substitutes in that an increase in the rate of return on an asset holding wealth and the other rates of return constant increases the demand for that asset and decreases the proportion of wealth that is desired to be held in the form of the other assets. An increase in wealth is assumed to increase the demand for each asset.

Since money pays no interest, the anticipated real rate of return on money, R_m, is $-\pi$, the negative of the anticipated rate of inflation. From purchasing power parity the nominal price of the consumption good P will be equal to the exchange rate times the foreign price level, eP^*. With an assumed constant foreign price level, the anticipated rate of inflation of consumption good prices will be the anticipated rate of change of the exchange rate, $\pi = (\dot{e}/e)^A$.[8] The anticipated real rate of return on bonds is $R_b = i - \pi$, and the anticipated real rate of return on equity is $R_k = r/P_k$ where anticipated changes in the relative price of capital are assumed away.

Portfolio equilibrium is assumed to hold at each moment in time, therefore the demands for assets will equal the actual quantities in existence. Since these stocks are predetermined, the rate of return and real value of the nominal assets must adjust to allow equilibrium to obtain.

In aggregate economic analysis the many activities of the government sector are added together and only total expenditure on goods and services is considered. In Bailey (1971) it is noted that under full employment government expenditures reduce the total real resources currently available to the private sector for consumption and investment and that government services add to the welfare of private households. In this paper the government services are produced with capital and labor which could be used to produce private sector goods, and the value of government expenditures in terms of consumption goods is considered to be substitutable for private market purchases. Pure public goods like national defense

[7]Since government bonds are assumed to be non-traded, we abstract from a discussion of bonds issued by the individuals of the small country since in the aggregate they sum to zero. A fuller discussion of these issues would allow foreigners to hold the nominal debt of the government and private individuals. In this case exchange rate changes can have interesting wealth effects. See Girton–Henderson (1974) for a discussion of these effects.

[8]A dot above a variable indicates the derivative of that variable with respect to time, i.e., $\dot{X} = \partial X/\partial t$, and a superscript A denotes an anticipated value.

certainly have relatively poor substitutes in the private market. This is not true for police protection, fire fighting, education, or public operation of railroads, steel industries and many other activities which would be demanded by private individuals and supplied in private markets were they not provided publicly. It is also the case that perceptions of the value of government services may differ across individuals and may change over time in response to new information. If the implicit value of the government expenditures enters the utility function of individuals, changes in the perception of the value will affect market demands.

To capture these effects and without introducing an explicit utility function analysis, the term α will be used to represent the proportion of government expenditure which individuals regard as equivalent to private consumption and hence as disposable income.[9] The demand for consumption goods can consequently be represented by

$$c + \alpha g = c^d(\underset{(+)}{a}, \underset{(+)}{y_d}). \tag{7}$$

Market purchases of consumption goods are c, and consumption good demand is assumed to be a function of the real value of assets and disposable income.[10] Variations in α may occur over time if people reassess the value of a particular level of government services. If actual q_g is unobserved and only the cost of government, g, is observed, the value which individuals place on g will change as the information set changes. Large public scandals or revelations of fraud and corruption in government could consequently affect macroeconomic variables quite significantly.

Disposable income consists of wage income plus the anticipated rates of return on assets minus taxes plus the value which people attribute to government services minus the saving necessary to offset the implied future taxes inherent in changes in government debt,[11]

$$y_d = w + rk_d + \frac{ib}{P} - \pi\frac{v}{P} - \frac{t}{P} + \alpha g - (1-\gamma)\frac{\dot{b}}{P}. \tag{8}$$

[9]If the marginal utility of government services is positive, an increase in q_g the per capita provision of services will allow the consumer to reduce consumption purchases. Only in the case of a strictly efficient government when the ratio of the marginal utility of government services to the marginal utility of consumption good equals the implicit price of services in terms of consumption goods, g/q_g, would the consumer be as well off by reducing c one for one with increases in g. The presumption of the analysis is that $0<\alpha<1$ although this is not necessary.

[10]The specification of (7) is analogous to a Metzleric savings function in which savings is a function of the difference between actual and desired wealth with desired wealth a function of disposable income. Dornbusch (1976a) employs such an approach which implies that $\partial c^d/\partial y_d<1$.

[11]Disposable income in (8) includes the value of government services which offsets consumption demand since unless the consumer is driven to a corner solution he can always reallocate his consumption away from the goods being provided so as to offset the government action. The presumption is that $\alpha g < c^d(a, y_d)$.

The households must balance consumption market purchases and asset accumulations with actual income. Since actual capital gains are both income and savings, these terms do not appear in the household budget constraint given by[12]

$$w + rk_d + ib/P - t/P = c^d(a, y_d) - \alpha g + P_k(\dot{k}_d + nk_d) + (\dot{v} + nv)/P. \quad (9)$$

In order to pay the factors of production which produce government services, the government levies taxes and issues bonds and money. In addition, it must pay the interest on its outstanding government bonds. The government budget constraint is

$$g + ib/P = t/P + d/P, \quad (10)$$

where $d = \dot{v} + nv = \dot{m} + \dot{b} + n(m + b) =$ the deficit.

In discussing government policy only two of the three actions, government services, taxes, or the deficit, are independent. It will be assumed that taxes are continually manipulated so that the government budget constraint is satisfied to allow the discussion of independent policies regarding the amount of government service provided and the rate of growth of nominal government debt.[13] It should be noted that in the steady state with no inflation, the government deficit will be nv due to population growth; the budget will not be balanced in the traditional sense of taxes equalling government expenditure. In general, the deficit will be $(\theta + n)v$, where $\theta = \dot{v}/v$ is the rate of growth of per capita government debt.

Subtracting the government budget constraint from the household budget constraint, using the definition of factor income (2), and employing the fact that $\dot{k} = q_I - nk$ results in the balance of payments,

$$\{q_c - [c^d(a, y_d) - \alpha g]\} + P_k(\dot{k}_f + nk_f) - rk_f = 0. \quad (11)$$

The first term is the surplus on the trade account, the second is the surplus on the capital account, and the third is the surplus on the service account. The trade balance is determined by the production technology, the value of

[12]Since b, m, and k_d represent assets per capita, savings of money is $\dot{m} + nm$, the change in per capita money holdings plus the savings due to population growth necessary to keep money balances per capita constant.

[13]In Blinder–Solow, Tobin–Buiter, Turnovsky, and Brunner–Meltzer taxes are a function of income and in some cases other variables like the price level. In Kouri, Dornbusch, and Foley–Sidrauski, taxes are exogenous. In the short run treating taxes as an endogenous variable seems correct, yet to suggest instability of the model due to the inability to alter the functional form of taxation seems to imply an irrational political market. Allen (1977) reaches a similar conclusion in her analysis of the effects of alternative budget specifications on real income.

assets, the level of government expenditure and the degree to which people find it substitutable for private consumption, and the fact that consumption demand is assumed satisfied. The service account is predetermined depending on whether the country is a net creditor or debtor, hence, the capital account is the residual which clears the balance of payments in a portfolio balance model.

In the models of Kouri and Turnovsky or in any model where growth is not considered, the steady-state condition of the balance of payments is that the capital account surplus must be zero implying that the trade account surplus balances the deficit on the service account. In this model, if the small country is a net creditor, the capital account must supply the new population with titles to capital to keep per capita titles to capital constant. These considerations of the steady-state properties of the model will be discussed in greater detail when changes in the steady state are examined.

The final aspect of the household sector and the model is the specification of the formation of expectations. The anticipated rates of return on assets and in particular the anticipated rate of inflation are important variables which can dominate the effects of many exogenous variables. However, without an explicit and complicated introduction of uncertainty, modeling an expectation is very difficult. Hence, it is assumed that expectations of the rate of inflation are formed adaptively as in the work of Cagan (1956) and others. This allows expectations to have an impact on the model without excessively complicating it.[14] The adaptive expectations mechanism implies that the change in the expected rate of inflation, i.e., the anticipated rate of change in the expected exchange rate, is proportional to the difference between the actual rate of change of the exchange rate and its expected rate of change as in (12) where λ is a positive constant indicating the speed of adjustment,

$$\dot{\pi} = \lambda(\dot{e}/e - \pi). \tag{12}$$

3. Monetary equilibrium, stability, and the steady state

At any moment in time the rate of return on capital and the anticipated rate of inflation are given as are the stocks of assets owned by private individuals. The latter follows from the facts that the economy can only

[14]Much of the criticism of adaptive expectations is due to the advent of rational expectations which requires that expectations of future values of a variable be formed by using the reduced form of the model and all available information. Adaptive expectations will be rational only if the exogenous variables follow certain restrictive processes, cf. Mussa (1975). A different kind of criticism has been generated by Sjaastad (1974). He reasons that in a portfolio balance model with adaptive expectations, money is not a shock absorber, i.e., real balances fail to increase following a change in the rate of growth of money. Frenkel (1975) has offered an expectations mechanism which is consistent with this phenomenon by combining regressive and extrapolative elements.

accumulate titles to capital overtime, either by buying titles to newly produced capital or by buying titles to capital from abroad when running a deficit on the capital account, and that the government only increases the aggregate of government money and bonds when running a budget deficit. Consequently, the interest rate on government bonds and the domestic price level or in this case the exchange rate are the variables that adjust to allow portfolio balance to obtain. To determine these two variables any two of the three asset equilibrium conditions can be used since the wealth constraint implies the satisfaction of the third asset market condition given the other two. The exchange rate and the interest rate can consequently be shown to be functions of the per capita stock of government liabilities, v, the ratio of total government liabilities to money, x, the degree to which government bonds are perceived as net wealth, γ, the per capital ownership of titles to capital, k_d, and the anticipated rate of inflation, π.

An increase in v causes excess demand for capital and excess supply of money and bonds. Since the system is homogeneous of degree zero in v and P, the price level rises equiproportionately to the increase in v causing the exchange rate to rise equiproportionately thereby offsetting the excess supplies and leaving the interest rate unaffected. Alternative assumptions about the formation of expectations can generate different effects on the exchange rate from an increase in nominal government assets. In Dornbusch (1976c), the long-run position of the exchange rate is presumed to be known and interest rate parity is used to determine the current spot exchange rate. In Mussa (1976), expectations are rational and the influence of an increase in the money stock on the exchange rate depends on the stochastic process which the money stock is known to follow. Whether or not the proportionate change in the exchange rate overshoots or undershoots a proportionate change in the money stock depends on how the change affects expectations of the rate of inflation. Here the anticipated rate of inflation is held constant.

The effect of an increase in x, i.e., an open market sale of bonds for money, is to create excess demand for money and excess supply of bonds. The interest rate rises to induce individuals to hold the increase in government bonds and reduce the demand for money; this causes excess supply of capital which is offset by a decrease in the exchange rate which increases the real value of the financial assets increasing the demand for all assets including capital.

A decrease in γ, the degree of which government bonds are perceived as net wealth, ceteris paribus, has an ambiguous effect on the exchange rate since it creates excess supply of money and capital, and excess demand for bonds. The interest rate falls to offset these market reactions, but the exchange rate may rise or fall depending on the magnitudes of the wealth elasticities and the degree of substitution among various assets. However, perceptions of future taxes which must be paid to finance government bonds

or government commitments like social security often change in response to fundamental analysis of the problems the government sector is likely to experience in financing the programs with taxes. Individuals will realize that an increase in future taxes may be accompanied by an increase in the rate of growth of government debt and money. This change in the expected rate of growth of government nominal debt would increase expected inflation in a fully rational model.

An increase in π, the expected rate of inflation, creates excess supply of nominal assets and excess demand for capital assuming that the effect on the own rate of return dominates the effect from the cross rate of return. The exchange rate will unambiguously rise to cut the excess supplies thereby reducing the real value of assets and decreasing the demand for capital. The effect on the interest rate is ambiguous unless it is assumed that bonds and titles to capital are sufficiently close substitutes in which case i will rise with π.

The effect of an increase in domestic ownership of capital is to create excess demands for money and bonds and an excess supply of capital since real wealth has increased. The exchange rate will fall to increase the real value of assets to offset the excess supply of capital, and if, as above, bonds are sufficiently substitutable for capital, the interest rate will fall. Otherwise the effect is ambiguous.

Using the results generated above, the reduced form equations for the exchange rate and the interest rate can be written as

$$e=\underset{(+)}{\phi}(\underset{(-)}{r},\ \underset{(?)}{x},\ \underset{(+)}{\gamma},\ \underset{(-)}{\pi},\ k_d), \tag{13}$$

$$i=\underset{(0)}{\Psi}(\underset{(+)}{r},\ \underset{(-)}{x},\ \underset{(?)}{\gamma},\ \underset{(?)}{\pi},\ k_d). \tag{14}$$

The movement of the exchange rate over time depends on the movement over time of the variables in (13). The government directly controls how the stocks of money and bonds change over time. The change in ownership of titles to capital depends on the amount of new capital being produced in the economy and the balance of payments which determines the flow of capital to and from foreigners. The anticipated rate of inflation depends on the adaptive formulation, and the degree to which bonds are perceived as net wealth is being treated parametrically.

The fundamental dynamic equations of the system are therefore

$$\dot{k}=q_I-nk, \tag{15}$$

$$\dot{k}_f=-(q_c-c^d(a,y_d)+\alpha g)/P_k+(r/P_k-n)k_f, \tag{16}$$

and

$$\dot{\pi} = \lambda(\dot{e}/e) - \pi). \tag{17}$$

The stability of the linearized system is investigated in the appendix where it is shown that negative values for $\partial\dot{k}/\partial k$, $\partial\dot{k}_f/\partial k_f$, and $\partial\dot{\pi}/\partial\pi$ are sufficient but not simultaneously necessary for stability. Intuitively, these conditions require first that an increase in the per capita physical capital stock slows the rate of growth of the capital stock, implying the existence of a steady-state physical capital stock per capita, second, that an increase in per capita ownership of domestic equity causes a decrease in the rate at which foreigners acquire domestic titles to capital implying steady-state ownership by domestic residents of some domestic capital, and third, that an increase in the anticipated rate of inflation causes a reduction in the rate of change of anticipation, the standard Cagan-type stability condition implying the possibility of steady-state inflation.

The steady state of the system is described by setting (15)–(17) equal to zero. The steady-state value of physical capital per capita is

$$\bar{k} = (q_I(\bar{k} - \lambda_{lg}k_g, 1 - \lambda_{lg}, P_k))/n. \tag{18}$$

The level of the provision of government services and the capital intensity with which they are produced affect $\bar{k}$ as do the rate of population growth n and the relative price of capital that is given from abroad. The effect of a change in the government parameters on the steady-state physical capital per capita can be investigated independently of their effects on k_f and π since these terms do not affect $\dot{k}$. The effect on $\bar{k}$ of an increase in the provision of government services at the same capital intensity k_g is given by

$$\partial k/\partial\lambda_{lg}|_{\dot{k}=0} = \frac{\partial\dot{k}/\partial\lambda_{lg}}{-\partial\dot{k}/\partial k} = \frac{q_{I_1}(-k_g) - q_{I_2})}{-\partial\dot{k}/\partial k}. \tag{19}$$

The sign of (19) depends on the capital intensity with which government services are being produced.[15] If k_g is less than the capital–labor ratio in the consumption good sector, increasing government services with k_g constant decreases output in the investment goods sector causing $\dot{k}<0$ and leading to a fall in the steady-state value of k, the fall in k being larger the more labor intensive the government sector. This occurs because the capital–labor ratios in consumption goods and investment goods are fixed by the relative price of capital which remains unchanged, and the greater the decrease in labor relative to the decrease in capital available to the private sector the larger

[15]The partial derivative of the q_I function with respect to the ith argument is given by q_{I_i}.

must be the contraction of the labor intensive industry to maintain full employment of the factors of production.

In Foley–Sidrauski (1971) the government produces with the same capital intensity as the consumption goods sector in which case expansion of government services does not affect the production of investment goods except through the effect on the relative price of capital which falls to offset the excess demand for consumption goods implying a lower steady-state capital stock per capita as government expands. Tobin–Buiter (1976) find that an increase in government expenditure leads to an increase in the steady-state capital stock per capita since income must rise to finance the taxation necessary to balance the government budget. This 'capital deepening' will not occur in an open economy in which the ownership of capital is distinct from the physical capital used in production. Indeed, the size of the government sector and the capital-intensity of its production process will affect the physical capital and wealth of the country, but as will be demonstrated in section 4.3, an increase in government expenditures does not imply a larger capital stock.

The steady-state level of ownership of capital by foreigners is found from (16) by setting $\dot{k}_f = 0$ and solving for $\bar{k}_f$ as

$$\bar{k}_f = \frac{q_c - c^d(a, y_d) + \alpha g}{P_k(r/P_k - n)}. \tag{20}$$

The denominator is positive since we can assume the real rate of return on capital, r/P_k, is greater than the rate of population growth implying that physical capital in the world is less than the 'golden rule'. Consequently, $\bar{k}_f$ will be positive when the trade balance is in surplus, and the factors which influence the sign of the trade balance have been previously noted.

The steady-state level of anticipated inflation is found by solving (13) for the rate of change of the exchange rate and recognizing that in the steady state, r will be the only variable that has a non-zero rate of change. The government can choose to set a rate of growth of total per capita government liabilities, $\dot{b}/b = \theta$, in constant proportion of money to bonds implying $x = \bar{x}$, and the degree to which bonds are net wealth, the anticipated rate of inflation, and the ownership of capital domestically will all settle to steady-state values. Consequently, from (17) with $\dot{\pi} = 0$, the steady-state level of anticipated inflation will be θ, the rate of growth of nominal per capita government liabilities.

Having determined the long-run equilibrium of the system, the next section will examine how this equilibrium responds to changes in the governmentally controlled parameters and how the economy adjusts to new policies and perceptions of them over time.

4. Dynamic effects of government policies

In the previous section it was demonstrated that the rate of accumulation and steady-state level of physical capital per capita depend only on the relative price of capital given from the world and the capital intensity and magnitude of government services. Consequently, when analyzing other policies, physical capital per capita can be assumed to be at its steady-state value without loss of generality. Fig. 1 describes a stable system where the slopes of $\dot{k}_f=0$ and $\dot{\pi}=0$ are investigated in the appendix.

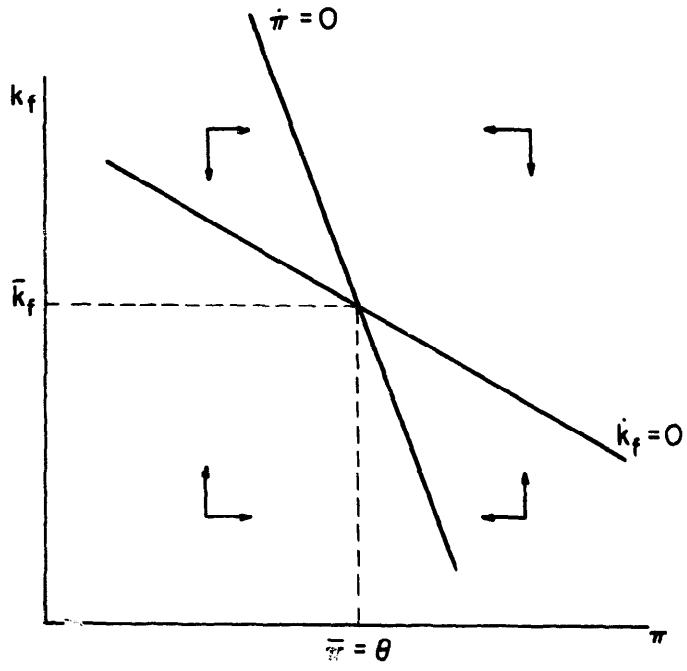

Fig. 1. Stability and the steady state.

The effects of government policies on the steady state of the system and the dynamic movement of the economy can be found by examining how $\dot{\pi}=0$ and $\dot{k}_f=0$ shift in response to various actions.

4.1. An open market operation

If the government purchases government bonds with money, i.e., decreases x, while keeping the level of government services, the total liabilities of the government and their rate of growth constant, there will be an excess supply of money and unless future taxes are perfectly discounted an excess demand for bonds. Both effects cause the interest rate to fall which would create an excess demand for capital unless the real value of assets falls through a rise in the exchange rate. To determine the change in the steady-state value of k_f and the movement over time of the economy in response to the decrease in

x, partially differentiate (16) with respect to x and k_f as in (21),

$$\partial k_f/\partial x\Big|_{\dot{k}_f=0} = \frac{\partial \dot{k}_f/\partial x}{-\partial \dot{k}_f/\partial k_f} = \frac{P_k^{-1}[(\partial c^d/\partial a)(\partial a/\partial x)+(\partial c^d/\partial y_d)(\partial y_d/\partial x)]}{-\partial \dot{k}_f/\partial k_f} \tag{21}$$

The sign of (21) depends on the effect of x on the real value of assets and disposable income since the denominator is positive. The effect of x on a is

$$\partial a/\partial x = (1/x^2)(\gamma - 1)(v/P) - (zv/eP)(\partial e/\partial x). \tag{22}$$

When future taxes on government bonds are not considered by the private sector, $\gamma = 1$, and $\partial a/\partial x$ is unambiguously positive. When taxes are fully discounted and government bonds are not considered net wealth, $\gamma = 0$, and $\partial a/\partial x$ is zero since the exchange rate merely offsets the change in the amount of money outstanding to leave the real value of assets unchanged. The effect of x on y_d is more complicated and is investigated in (23) where the government budget constraint has been used with (8),

$$\begin{aligned}\partial y_d/\partial x = {} & (-nv/eP)(\partial e/\partial x) + (1-\gamma)(1-1/x)(v/eP)\theta(\partial e/\partial x) \\ & -(1-\gamma)(1/x^2)(v/P)\theta.\end{aligned} \tag{23}$$

When $\gamma = 1$, future taxes are ignored, and $\partial y_d/\partial x = (-nv/eP)(\partial e/\partial x) > 0$. An open market purchase of bonds increases the exchange rate and the price level implying that for a given level of government purchases and rate of growth of nominal government liabilities, taxes must be raised to balance the budget which decreases disposable income. However, when $\gamma \neq 1$, the second and third terms in (23) are negative representing the reduced real value of the current deficit due to the increase in the exchange rate and the reduction in income that must be saved since less of the deficit is being financed by bonds. Consequently, for a sufficiently high rate of growth of debt and degree of discounting of future taxes, a decrease in x could possibly result in an increase in disposable income. Under the traditional assumption that government bonds are net wealth, the sign of (21) is positive, and a decrease in x decreases k_f. The following analysis in this section will use the traditional assumption, but the reader should remember that the reverse results are plausible under the assumption that bonds are not net wealth. The decrease in x under the adaptive expectations hypotheses, causes the exchange rate to jump but does not affect the expected rate of change of the exchange rate. However, as individuals consume less and begin to accumulate titles to capital, the exchange rate rises at a rate less than the anticipated rate of inflation causing $\dot{\pi} < 0$. To see that for any π, the k_f that

now makes $\dot{\pi}=0$ will be lower, partially differentiate (17) with respect to k_f and x,

$$\partial k_f/\partial x|_{\dot{\pi}=0}=\frac{-\partial\dot{\pi}/\partial x}{\partial\dot{\pi}/\partial k_f}=\frac{\partial\dot{k}_f/\partial x}{-\partial\dot{k}_f/\partial k_f}>0. \tag{24}$$

Fig. 2 depicts the adjustment of the economy in this case. As titles to

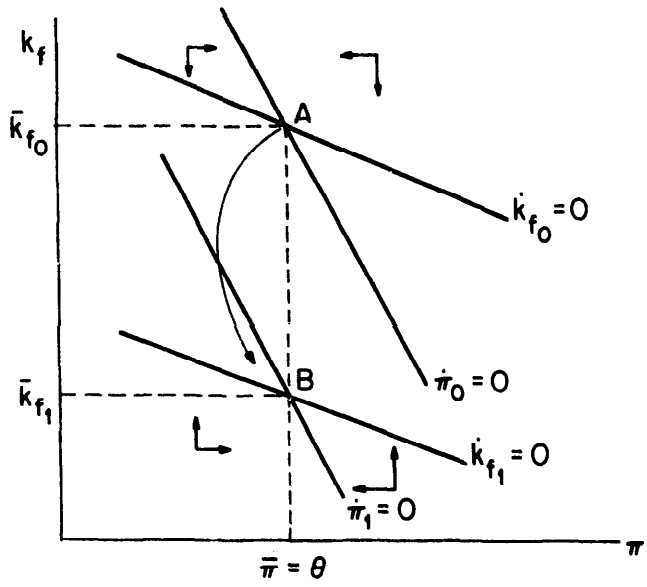

Fig. 2. Dynamic effect of an open market purchase.

capital begin to accumulate and the expected rate of inflation falls, both income and the real value of assets are increasing which increases consumption moderating the increase in capital. In the long run the expected rate of inflation must rise again to the level θ. In the process of adjusting to the new ratio of debt to money, the economy moves from A to B. The real value of nominal government assets grows since the exchange rate rises less rapidly than θ. Both income and assets grow so the new equilibrium will be characterized by higher consumption per capita and a lower value of foreign ownership of capital.

The trade balance surplus initially increases when consumption demand falls, but as assets accumulate the trade balance surplus eventually declines to its new lower level. Since the approach to the lower $\bar{k}_f$ is direct, the capital account surplus and the debt service deficit decline monotonically to their new equilibrium levels. Fig. 3 depicts the path of the accounts of the balance of payments following an open market purchase.

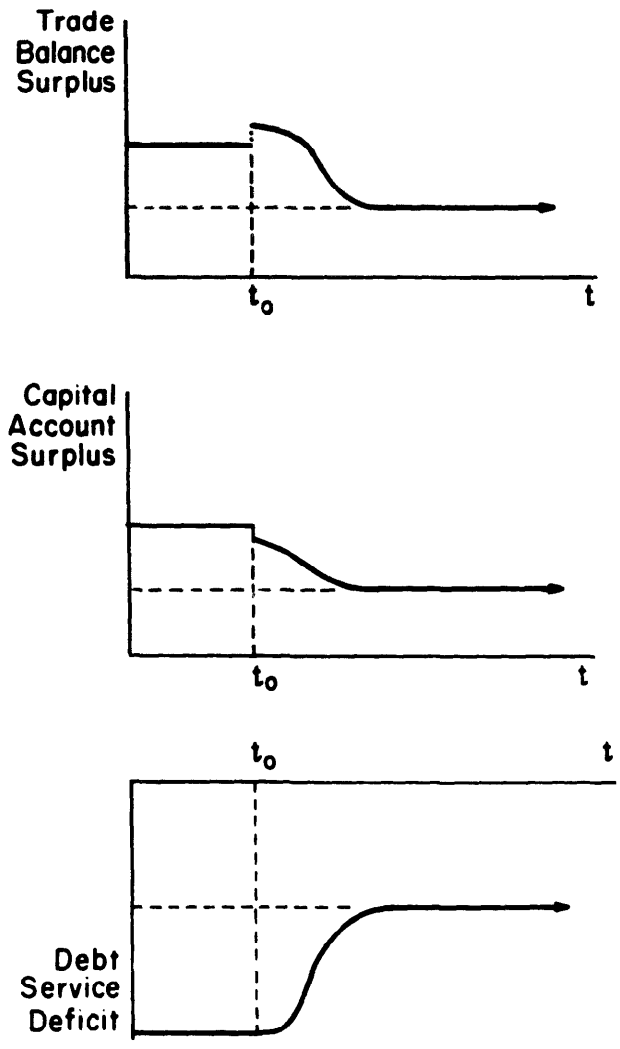

Fig. 3. Movement over time in the accounts of the balance of payments following an open market purchase.

4.2. A change in the deficit policy

Given per capita government expenditure, an increase in the rate of growth of nominal government liabilities, θ, increases disposable income to a greater extent the less future taxes are discounted. When y_d increases, the demand for consumption goods rises, which in turn causes a trade balance deficit and a decumulation of titles to capital, $\dot{k}_f > 0$. To see that for a given π the value of k_f that now makes $\dot{k}_f = 0$ has risen, examine

$$\partial k_f/\partial\theta\,|_{\dot{k}_f=0} = \frac{\partial\dot{k}_f/\partial\theta}{-\partial\dot{k}_f/\partial k_f} = \frac{P_k^{-1}(\partial c^d/\partial y_d)(v/P-(1-\gamma)(1-1/x)(v/P))}{-\partial\dot{k}_f/\partial k_f} > 0. \tag{25}$$

The increase in θ and the positive response of $\dot{k}_f$ both contribute to an increase in the rate of change of the exchange rate which will cause the anticipated rate of inflation to begin rising. For any k_f, the π that makes $\dot{\pi} = 0$ will now be increased since

$$\partial\pi/\partial\theta|_{\dot{\pi}=0} = \frac{\partial\dot{\pi}/\partial\theta}{-\partial\dot{\pi}/\partial\pi} = \frac{\left(\dfrac{\lambda}{1-(\lambda/e)(\partial e/\partial\pi)}\right)(1+(1/e)(\partial e/\partial k_d)(-\partial\dot{k}_f/\partial\theta))}{-\partial\dot{\pi}/\partial\pi} > 0 \tag{26}$$

The increase in the anticipated rate of change of the exchange rate contributes to the actual rate of change of the exchange rate causing it to rise faster than the new rate of growth of nominal government liabilities, θ_1. Consequently, the real value of these nominal assets is reduced which is a response to the decrease in their anticipated real rates of return.

Fig. 4 depicts the adjustment of the economy in response to the increased rate of growth of government bonds and money.

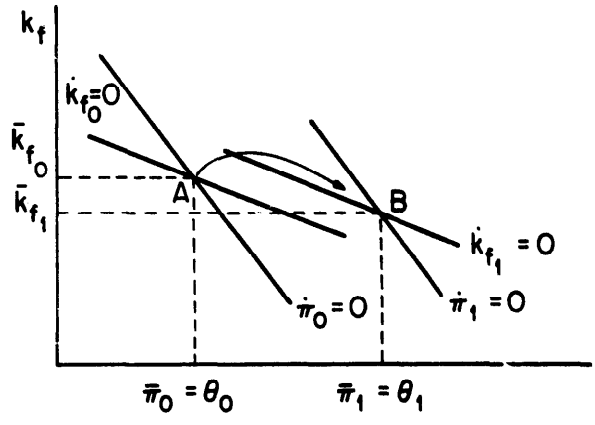

Fig. 4. Dynamic effect of an increase in the rate of growth of nominal government assets.

With an initial equilibrium at A, the increase in θ initially causes the economy to decumulate titles to capital since consumption demand increases with the initial increase in disposable income. As the actual and anticipated rates of inflation increase and the real value of nominal assets falls, consumption demand falls and the economy accumulates titles to capital. It can be demonstrated using the implicit function theorem that the level of capital owned by foreigners will fall in the new steady state.[16] The increase in the expected rate of inflation causes accumulation of titles to real assets in response to the decrease in the rate of return on nominal assets.

[16]The proof that $\bar{k}_f$ declines in the new steady state is available from the author upon request.

The time paths of the balance of payments are shown in fig. 5. Since foreigners initially have an increase in their holdings of domestic capital, the capital account surplus initially increases and the trade balance surplus decreases. Eventually, the capital account surplus and the trade balance

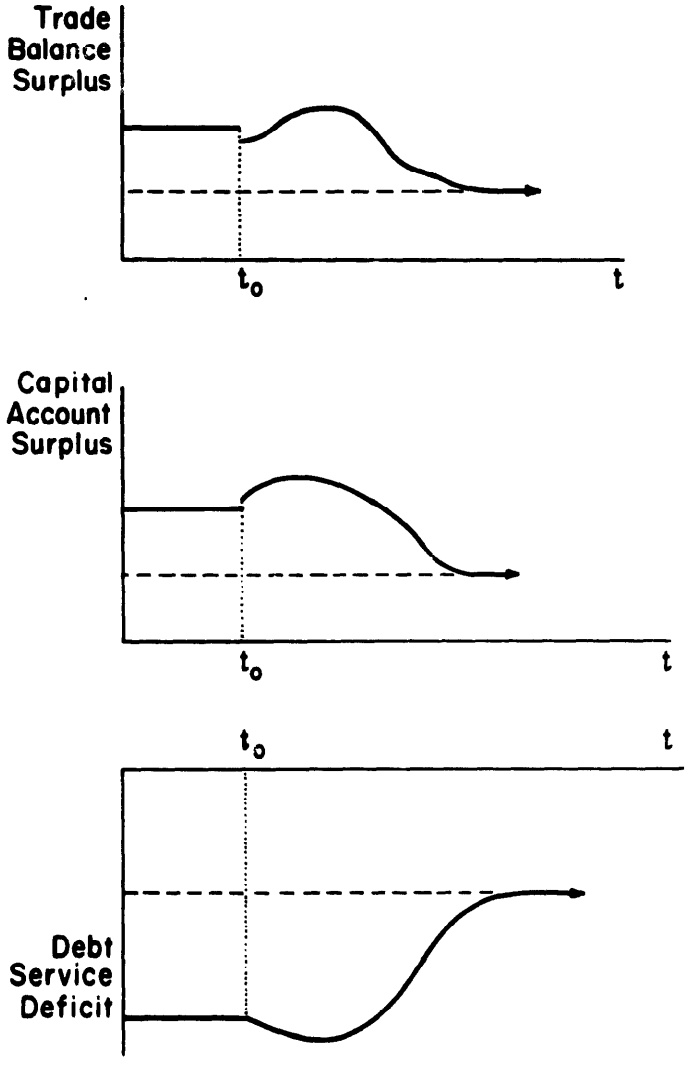

Fig. 5. Movement over time in the accounts of the balance of payments following an increase in the rate of growth of nominal government assets.

surplus must be less than their previous steady-state values since k_f decreases. This implies that consumption per capita must increase following the increase in θ, decrease for some time below the previous steady-state level while the capital owned by foreigners is repatriated, and eventually increase

to a new higher level. Whether or not the discounted present value of the consumption stream under the higher rate of inflation is greater or less than the value of the consumption stream at the old steady-state level is uncertain.

4.3. A tax-financed increase in government service

In the general case in which government services are produced with an arbitrary capital–labor ratio an increase in the provision of government services keeping the capital intensity of its production constant affects the demand for and supply of consumption goods as well as the flow supply of new titles to capital. All three effects influence the movement of the economy over time.

Unless government services are evaluated as equivalent to consumption goods, disposable income falls when taxes are increased which decreases the demand for goods. The increased demand for capital and labor by the government will also influence consumption good production, and in section 3 it was determined that q_c would fall unless $k_g < k_I$ under the assumption that investment goods are relatively more labor intensive than consumption goods. It was also determined that if $k_g < k_c$ the output of the investment goods sector, and consequently the flow supply of new titles to capital to the economy, falls with an increase in government services.

If the increase in government services creates excess supply for consumption goods which is possible but quite unlikely, investment goods production must fall. The flow supply of titles to capital from domestic source falls, and the increased trade balance surplus increases titles to capital from abroad. Over time the output of the consumption goods sector declines since less capital is being produced and the flow supply of capital from abroad decreases while the flow supply of titles to capital from domestic sources also decreases. The new steady state will have a lower level of k and probably a lower level of consumption goods production although without additional restrictions, this cannot be demonstrated. It is highly unlikely that k_f would decrease sufficiently to allow k_d to increase since the initial trade balance surplus is offset by the decline in q_c. Consequently, real wealth falls and consumption of goods falls in the new steady state. In order to simplify the formal analysis that follows, it will be assumed that consumption goods and government services have the same capital intensity in which case the analysis is unambiguous and the steady-state level of physical capital per capita is constant.

When $\alpha < 1$ government services are less than perfectly substitutable for private expenditures, and an increase in g financed by taxation reduces disposable income which reduces consumption demand. Since privately produced consumption goods fall one for one with the increase in g, excess demand for consumption goods results, and the economy begins to dissave titles to capital. To see that for any π, the k_f that makes $\dot{k}_f = 0$ is now

increased, examine

$$\partial k_f/\partial g|_{\dot{k}_f=0}=\frac{\partial \dot{k}_f/\partial g}{-\partial \dot{k}_f/\partial k_f}=\frac{-P_k^{-1}((\partial q_c/\partial g)-(\partial c^d/\partial y_d)(\partial y_d/\partial g)+\alpha)}{-\partial \dot{k}_f/\partial k_f}$$

$$=\frac{P_k^{-1}(1-\alpha)(1-(\partial c^d/\partial y_d))}{-\partial \dot{k}_f/\partial k_f}>0. \tag{27}$$

As foreigners begin to accumulate titles to capital, real wealth falls creating an excess supply of money which causes the exchange rate to rise faster than θ and increases the expected rate of inflation. To see that for any k_f, the value of π which makes $\dot{\pi}=0$ is increased, examine (28)

$$\partial \pi/\partial g|_{\dot{\pi}=0}=\frac{\partial \dot{\pi}/\partial g}{-\partial \dot{\pi}/\partial \pi}=\frac{\left(\dfrac{\lambda}{1-\lambda \partial e/e\partial \pi}\right)((1/e)(\partial e/\partial k_d))(-\partial \dot{k}_f/\partial g)}{-\partial \dot{\pi}/\partial \pi}>0. \tag{28}$$

Fig. 6 depicts the path of the economy in this case. With an initial

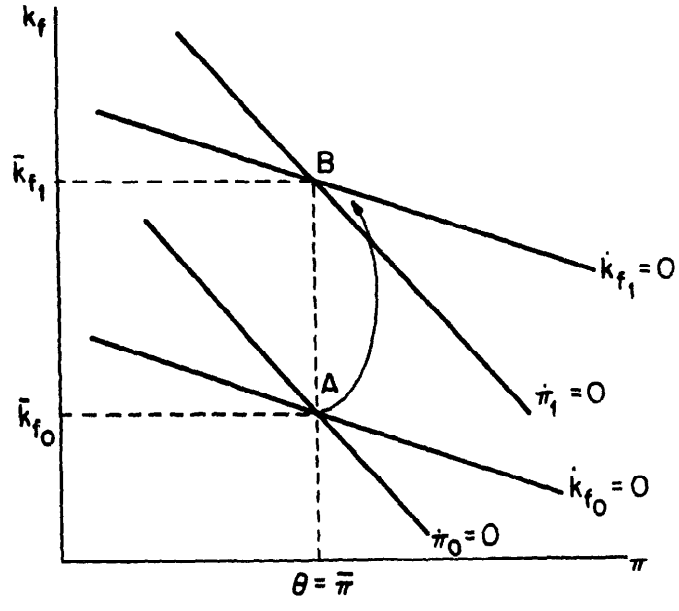

Fig. 6. Dynamic effect of an increase in government expenditure.

equilibrium at A, the increase in government expenditure causes the economy to decumulate titles to capital as it dissaves. The rise in the expected rate of

inflation will be moderated by the decrease in the real value of assets which causes the economy to converge to the new steady state with an expected rate of inflation again equal to θ but with lower real stocks of nominal government liabilities and real titles to capital.

In a very real sense, the government expenditure increase creates a dynamic 'crowding out' effect. The private sector attempts to maintain its level of consumption overtime in face of the new higher taxes and government expenditure, but in the process they must sell titles to capital to foreigners becoming less wealthy and eventually consuming at a new lower steady-state level. Such a result indicates the importance of considering the size of the public sector as well as its budget deficit in determining the welfare of the private sector.

As the economy adjusts to the new higher level of government expenditure in moving from A to B, the surplus on the trade account must decline initially to allow k_f to increase. After some time the trade balance must begin monotonically rising to its new steady-state level higher than before. Fig. 7 implies that the approach to the new steady state will result in a monotonically increasing surplus on the capital account and a corresponding direct movement of the deficit on the debt service account to its higher value.[17]

5. Conclusions

This paper has demonstrated the theoretical effects of government policies on the exchange rate and the accounts of the balance of payments. The analysis considered the portfolio balance view to the determination of the exchange rate and integrated into the model important characteristics of the provision of government services which are often ignored.

In particular, the degree to which government bonds are net wealth was an important determinant of the effects of changing the composition of government liabilities between money and bonds by open market operations. Significant discounting of the future tax liabilities of the public was possibly sufficient to reverse the conclusions of the analysis implying that an open market purchase of bonds for money could increase domestic ownership of titles to capital if consumption demand increases less than the reduction in saving that is available since fewer bonds are outstanding. The reduced form for the determination of the exchange rate was also shown to contain the degree to which bonds are net wealth which indicates that rapid depreciation

[17] In Dornbusch (1976a) a tax-financed increase in government expenditure causes a current account deficit, an increase in foreign ownership of securities, and a decline in real balances. These effects coincide with the case considered here in which the government services are not fully valued by the private individuals. In Dornbusch the savings function depends only on disposable income and not directly on the supply of government service.

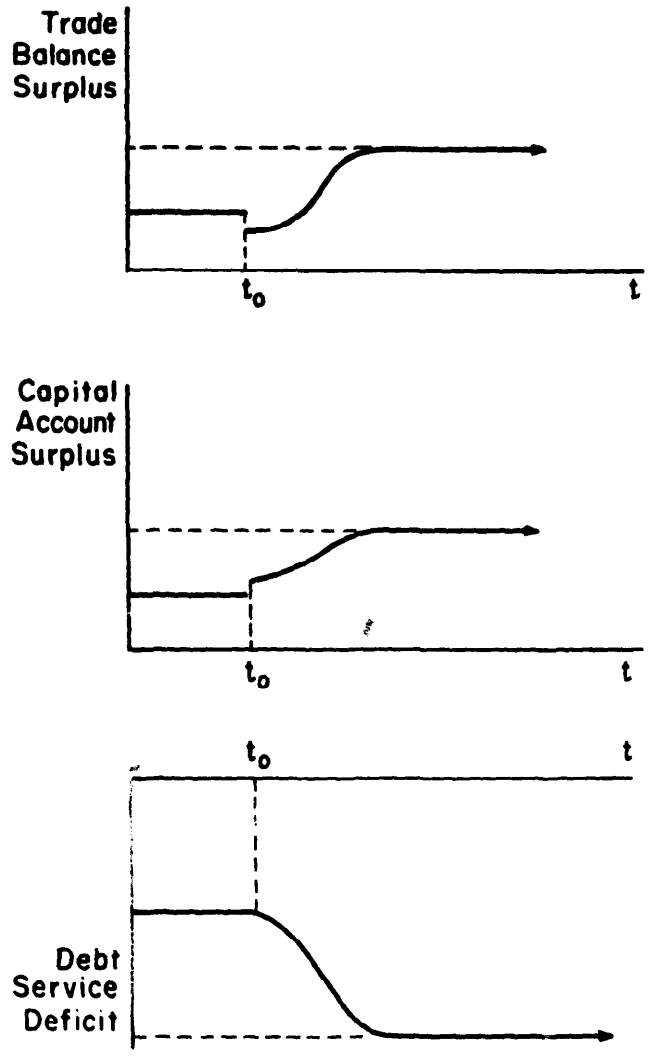

Fig. 7. Movement over time in the accounts of the balance of payments following an increase in government expenditure.

of the exchange rate may be tied to changes in expectations of inflation which are influenced by changes in the sensitivity of the private sector to the government debt outstanding.

A second government parameter which was introduced, the capital intensity of the production of government services, was shown to affect the steady-state physical capital per capita as well as to significantly affect the net outcome of changes in the production of government services. By not considering this issue or the degree of substitutability of government services for private consumption goods, many authors writing in macroeconomics can be accused of analyzing a government that buys goods which it then throws into the ocean. By making these parameters explicit, the assumptions of the model can be more easily varied to suit the particular purpose of the reader.

Finally, the model demonstrates that steady-state policies of actual governments need not be directed to balancing government expenditure with taxation or securing a trade balance of zero. To the extent that growth occurs in the economy, the government must equip the new individuals with money and bonds to keep the per capita nominal magnitudes constant implying the need to run a deficit. Similarly, unless the country is not a net creditor or debtor to the rest of the world, a policy designed to secure a zero balance of trade will be socially suboptimal since even without growth the service account will balance the trade account while with growth in population, the capital account must supply the new individuals with titles to capital to keep per capita wealth constant.

Appendix

The local stability of the linearized system of eqs. (15)–(17) is investigated in (A.1) where the equations are expanded in a Taylor's Series around the steady-state values $\bar{k}$, $\bar{k}_f$, $\bar{\pi}$,

$$\begin{bmatrix} \dot{k} \\ \dot{k}_f \\ \dot{\pi} \end{bmatrix} = \begin{bmatrix} \partial\dot{k}/\partial k & 0 & 0 \\ \partial\dot{k}_f/\partial k & \partial\dot{k}_f/\partial k_f & \partial\dot{k}_f/\partial\pi \\ \partial\dot{\pi}/\partial k & \partial\dot{\pi}/\partial k_f & \partial\dot{\pi}/\partial\pi \end{bmatrix} \begin{bmatrix} k-\bar{k} \\ k_f-\bar{k}_f \\ \pi-\bar{\pi} \end{bmatrix}. \tag{A.1}$$

Local stability of the system requires that the roots of the characteristic equation have negative real parts. The Routh–Hurwitz theorem implies that the following restrictions are necessary and sufficient for this criterion:

$$\frac{\partial\dot{k}}{\partial k}+\frac{\partial\dot{k}_f}{\partial k_f}+\frac{\partial\dot{\pi}}{\partial\pi}<0, \tag{A.2}$$

$$\left(\frac{\partial\dot{k}_f}{\partial k_f}+\frac{\partial\dot{\pi}}{\partial\pi}\right)\left[\left(\frac{\partial\dot{k}_f}{\partial k_f}\frac{\partial\dot{\pi}}{\partial\pi}-\frac{\partial\dot{\pi}}{\partial k_f}\frac{\partial\dot{k}_f}{\partial\pi}\right)+\frac{\partial\dot{k}}{\partial k}\left(\frac{\partial\dot{k}}{\partial k}+\frac{\partial\dot{k}_f}{\partial k_f}+\frac{\partial\dot{\pi}}{\partial\pi}\right)\right]<0, \tag{A.3}$$

$$\frac{\partial\dot{k}}{\partial k}\left(\frac{\partial\dot{k}_f}{\partial k_f}\frac{\partial\dot{\pi}}{\partial\pi}-\frac{\partial\dot{\pi}}{\partial k_f}\frac{\partial\dot{k}_f}{\partial\pi}\right)<0. \tag{A.4}$$

The partial derivatives evaluated at the steady-state conditions are given in (A.5) to (A.9) where disposable income has been rewritten as

$$y_d=w+rk_d-(1-\alpha)g+(\theta-\pi+n)(v/p)-(1-\gamma)(1-1/x)\theta(v/p)$$

by substituting the government budget constraint (12) into (10),

$$\partial\dot{k}/\partial k = q_{I_1} - n < 0, \tag{A.5}$$

$$\frac{\partial\dot{k}_f}{\partial k_f} = \frac{1}{P_k}\left\{\frac{\partial c^d}{\partial a}\left(\frac{zv}{eP}\frac{\partial e}{\partial k_d} - P_k\right) + \frac{\partial c^d}{\partial y_d}\left(-r + \left(n - (1-\gamma)\left(1-\frac{1}{x}\right)\theta\right)\frac{v}{eP}\frac{\partial e}{\partial k_d}\right)\right\} + \left(\frac{r}{P_k} - n\right). \tag{A.6}$$

$$\frac{\partial\dot{k}_f}{\partial\pi} = \frac{-1}{P_k}\left\{\frac{\partial c^d}{\partial a}\frac{zv}{eP}\frac{\partial e}{\partial\pi} + \frac{\partial c^d}{\partial y_d}\left[\left(n - (1-\gamma)\left(1-\frac{1}{x}\right)\theta\right)\frac{1}{e}\frac{\partial e}{\partial\pi} + 1\right]\frac{v}{P}\right\}. \tag{A.7}$$

$$\frac{\partial\dot{\pi}}{\partial\pi} = \left(\lambda\Big/\left(1 - \frac{\lambda}{e}\frac{\partial e}{\partial\pi}\right)\right)\left[\frac{1}{e}\frac{\partial e}{\partial k_d}\left(\frac{-\partial\dot{k}_f}{\partial\pi}\right) - 1\right], \tag{A.8}$$

$$\frac{\partial\dot{\pi}}{\partial k_f} = \left(\lambda\Big/\left(1 - \frac{\lambda}{e}\frac{\partial e}{\partial\pi}\right)\right)\left[\frac{1}{e}\frac{\partial e}{\partial k_d}\left(\frac{-\partial\dot{k}_f}{\partial k_f}\right)\right]. \tag{A.9}$$

Only the sign of (A.5) can be determined from the assumed structure of the model. Consider (A.10) which is (A.4) rewritten using $\emptyset = \lambda/(1 - \lambda de/e\partial\pi)$ and after dividing through by $\partial\dot{k}/\partial k < 0$,

$$\frac{\partial\dot{k}_f}{\partial k_f}\emptyset\left(\frac{1}{e}\frac{\partial e}{\partial k_d}\left(-\frac{\partial\dot{k}_f}{\partial\pi}\right) - 1\right) - \emptyset\left(\frac{1}{e}\frac{\partial e}{\partial k_d}\left(-\frac{\partial\dot{k}_f}{\partial k_f}\right)\right)\frac{\partial\dot{k}_f}{\partial\pi} > 0. \tag{A.10}$$

This simplifies to

$$\frac{\partial\dot{k}_f}{\partial k_f}\emptyset < 0. \tag{A.11}$$

From (A.11) it follows that $\partial\dot{k}_f/\partial k_f$ and $\emptyset$ must have opposite signs if the stability conditions are to be satisfied. A positive $\emptyset$ indicates that

$$\lambda < \left(\frac{1}{e}\frac{\partial e}{\partial\pi}\right)^{-1}$$

which is the standard Cagan-type condition that constrains the speed of adjustment of expectations. When $\emptyset$ is positive, the sign of $\partial\dot{\pi}/\partial\pi$ depends on

the sign of $\partial \dot{k}_f/\partial \pi$ which is ambiguous in (A.7). The term

$$\left[1+\left(n-(1-\gamma)\left(1-\frac{1}{x}\right)\theta\right)\frac{1}{e}\frac{\partial e}{\partial \pi}\right]$$

may be negative which would be an influence contributing to a positive $\partial \dot{k}_f/\partial \pi$. There is nothing about the model which prohibits parameter values which would dictate that $\partial \dot{k}_f/\partial \pi$ is negative. Indeed, the larger θ, the rate of growth of government bonds and money, the larger x, the ratio of total government bonds and money to money, and the smaller γ, the degree to which government bonds are net wealth of the population, the more likely $\partial \dot{k}_f/\partial \pi$ will be positive.

However, making $\partial \dot{k}_f/\partial \pi > 0$ by increasing the above term also contributes to make $\partial \dot{k}_f/\partial k_f > 0$ in (A.5). In (A.3) we see that at least one of $\partial \dot{k}_f/\partial k_f$ and $\partial \dot{\pi}/\partial \pi$ must be negative for the stability condition to be satisfied since both terms inside the square brackets are positive. Consequently, rather than develop conditions under which one or the other could be positive, the model will be restricted to have $\partial \dot{k}_f/\partial \pi < 0$.

Both $\partial \dot{\pi}/\partial \pi$ and $\partial \dot{k}_f/\partial k_f$ will be negative if $\partial \dot{k}_f/\partial \pi$ is restricted to be negative. Restricting the model in this way can be justified by appealing to an argument that the response of consumption demand to disposable income is sufficiently small relative to the response of consumption demand to the real value of assets that the possible negative influence of

$$\left[1+n-(1-\gamma)1-\frac{1}{x}\theta\frac{1}{e}\frac{\partial e}{\partial \pi}\right]$$

cannot dominate. Since the traditional approach to stability requires that $\partial \dot{\pi}/\partial \pi$ and $\partial \dot{k}_f/\partial k_f$ are negative and since this is consistent with the model and sufficient for stability, these signs are used in the text.

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