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Journal of Monetary Economics 6 (1980) 213- 239. © North-Holland Publishing Company DYNAMIC EFFECTS OF GOVERNMENT POLICIES IN AN OPEN ECONOMY 1 Robert J. HODRICK* 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 . *I wish to acknowledge helpful comments on an earlier draft from Robert Aicrq'. Walter Dolde. Dennis Epple. Jacob Frenkel. Peter Garber. Lars Hansen. Milton Harriv. Dale Henderson. and Allan Meltzer. Any remaining errors are those of the author. Financial support was provided by Carnegie-Mellon Institute of Research. 214 R.. '. Hodrick, Dq'namic ef, crs of goue, vnme, It policies 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 conte: nr of the theory which appears to be a useful way to structure thougi; ts 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 d . 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 ' 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. To keep the problem tractable, the traditional 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.

The population or labor force of the country grows at an exogenously given exponential rate λ . Perfect mobility of labor and capital between the production sectors maintains full employment and “ 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. "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 (1963) 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,

$q_t = Q(k_t^{1-i_t}, k_{g,t}^{i_t})$, where k_t is the economy's overall capital-labor ratio, i_t is the proportion of the labor force employed in the government sector, $k_{g,t}$ is the capital-labor ratio in the government sector, and P_k is the relative price of capital in terms of consumption goods. Since consumption goods are capital intensive, an increase in capital available for private production per capita, $k - k_{g,t}$, 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, $1 - i_t$, 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 $k_{g,t}$ 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 (21) where g is the value of government output in terms of consumption goods,

$$y_t + P_t g_t = w_t + r_t k_t. \quad (2)$$
 Because titles to capital are traded internationally, a distinction must be made between domestic ownership of titles to capital, k_t , and foreign ownership of domestic capital per capita, k_t^* , which can be negative if the 'Algebraic signs beneath the arguments of a function indicate the direction of the partial derivative of the function with respect to that argument. Define $G = wL + rK$, 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 $g = (w' + r/i)$ and 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 W (3) where the per capita stock of nominal government bonds and money is the ratio of total government bonds and money to money, which is controlled by open market operations of the monetary authority, is $z = [(1 - \lambda) + \lambda s]$. The symbol Q is introduced to capture the degree to which government bonds are net wealth to the public. " 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 Q term will be treated parametrically, varying from a possible negative value to unity. " Patinkin (1965) introduces a similar term to Q 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 and Meltzer allow for discounted future taxes by the inclusion of a human-wealth term in their asset demand functions. 218 R. J. Hodrick, Dynamic Q and government policies Asset preferences are characterized by $U = U(c, R, W)$

$\frac{dR_k}{R_k} = \frac{dR}{R} + \frac{dR_k}{R_k} = \frac{dR}{R} + \frac{dR_k}{R_k}$ (4)

$\frac{dP}{P} = \frac{dR}{R} + \frac{dR_k}{R_k} = \frac{dR}{R} + \frac{dR_k}{R_k}$ (5)

$\frac{dP}{P} = \frac{dR}{R} + \frac{dR_k}{R_k}$ (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 $-n$, 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, $\frac{de}{e}$. The anticipated real rate of return on bonds is $R_b = i - n$, and the anticipated real rate of return on equity is $R_e = r/P$, 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 ' 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. \dot{X} above a variable indicates the derivative of that variable with respect to time, i. e., $\dot{X} = dX/dt$, 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.' The demand for consumption goods can consequently

be represented by 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. Variations in c may occur over time if people reassess the value of a particular level of government services. If actual y 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 o , government debt, " "

If the marginal utility of government services is positive, an increase in q_y the per capita provision of services will allow the consumer to reduce consumption purchases. Only in the case of 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_e , would the consumer be as well off by reducing c' one for one with increases in g . The presumption of the analysis is that $O) >$

0. An UP : S open market purchase of bonds increases the exchange rate $a r_4$ the prime 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 $;$ +

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 s could possibly result in an increase in disposable income. Under the traditional assumption that government bonds are net wealth, the sign of (2.1) is positive, and a decrease in s decreases k . 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 s 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 $\dot{\tau} < \pi$. The increase in δ and the positive response of k 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 , the τ that makes $\dot{\tau} = 0$ will now be increased since 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, δ . 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. $\dot{\tau} = \delta$, $\dot{\tau} = \pi$, 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 δ 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? 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. The proof that k^* declines in the new steady state is available from the aut!, or upon request. R. J. Hodrick, Dynamic effects of government policies 231

The time paths of the balance of payments are shown in fig. 5. Since of domestic capital, the trade balance surplus and the trade balance Trode Balance Surplus $-p_{t-1} - p_t - a_{t-1}$) t_0 t Capitol Account Surplus Debt Service Deficit 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^* decreases. This implies that consumption per capita must increase following the increase in δ , 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 services 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 , O $X/\&r$ 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 $\gamma_i/c'n \sim 0$. Both $Sti/c'z$ and $c'!\$Zk$, will be negative if $\&J\&r$ 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 $1 - i - (i - y)l - O[l? v - r _Y e(' TI 1 1$ cannot dominate. Since the traditional approach to stability requires that $\gamma@' z$ and $2k, lc7k$, are negative and since this is consistent with the model and sufficient for stability, these signs are used in the text. References Alien. P. R.. 1977, Financing budget deficits: The effects on income in closed and open economies, *European Economic Review* 10, 345 373. Bailey, ML. 1971,

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