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Public spending and growth: A model

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Claudio Sardoni*

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Abstract

The major crises that hit the world economy in the last 15 years have caused a growing presence of the state in the economy. Deep crises almost inevitably give rise to growing public interventions to avoid the collapse of the economic and social system. However, the demand for more state interventions does not make it less important to be concerned for the extension and quality of these interventions in order to contain their possible negative effects on the economy as a whole.

The paper is an attempt at dealing with these issues by using a simple growth model. Our main result is that growing state interventions, in the form of larger deficits, can produce positive effects on the economy by not simply increasing aggregate demand but, most of all, by contributing to raise the productivity of the economy. An objective that can be realized by mainly devoting public outlays to 'productive expenditures', i.e. investment in physical and human capital.

JEL Codes: E21; E62; H30; H54, H60

1 Introduction

The three major crises (the financial crisis, the COVID crisis and the energy crisis in consequence of the Russian invasion of Ukraine) that hit the world economy in the last 15 years have caused a growing presence of the state in the economy as well as a significant increase of the public debt all over the world. Although most admit that vast and deep crises almost inevitably give rise to growing public interventions to avoid the melting down of the economic and social system, opinions differ with respect to the nature that

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state interventions should have, their time extension and the implications for public deficits and debt.

The present paper looks at some of these issues from a theoretical perspective by trying to determine the ways in which the public sector can best intervene in the economy, without 'repressing' the private sector and the growth of the economy and without generating growing ratios of the public debt to GDP which can become unsustainable.

These issues are tackled by using a basic model of growth through which the conditions for the realization of a 'virtuous' economic role of the government in the economy are analyzed. The main conclusion drawn from the model is that the government, the state more generally, can contribute to the realization of such objectives by restructuring public spending to favor outlays that are directly conducive to the rising of the economy's productivity and, hence, of its rate of growth.

The government outlays that raise productivity are denoted *productive public expenditures* as opposed to *unproductive public expenditures*, which do not directly affect the economy's productivity. Productive expenditures can be seen as public investment in physical and human capital whereas unproductive expenditures can be defined as public consumption. An adequate ratio of public productive to unproductive expenditures can determine a rate of growth that makes the ratio of the public debt to the GDP stable and sustainable.

The model of section 2 below belongs to the class of the so-called Harrod-Domar models of growth. More precisely, it is an extension of the original Domar model in which the public sector is explicitly considered and the Domar's notion of productive and unproductive expenditures is adopted.

Harrod-Domar growth models have been criticized, from different perspectives, both by mainstream and non-mainstream economists. Section 3 focuses on some Keynesian and Post Keynesian criticisms as both Harrod and Domar belong to that tradition of thought. The paper puts forward an interpretation of the Harrod-Domar models which makes most of these criticisms unwarranted. More in particular, attention is paid to the role of saving in the process of growth in equilibrium models of growth that are essentially normative rather than positive representations of actual processes of growth.

2 A model of growth

The present model is an extended version of Domar's model of growth (Domar, 1946) as we introduce a government that spends and levies taxes. In the construction of the model we use the notions of *productive* and *unproductive* public expenditures, which were also adopted by Domar (1944) in dealing with the 'burden' of the public debt.

The two types of expenditures are defined in the following way: i) productive public expenditures are all those government expenditures that *directly* affect the economy's long-run growth rate; ii) unproductive public expenditures all those outlays that do not produce such a direct effect.

In general, productive public expenditures can affect the rate of growth by determining an increase in the rate of (physical and human) capital accumulation. They have an impact on the rate of capital accumulation either directly or through their effect on private investment and the economy's productivity. Public investment evidently contributes directly to the growth of the economy's productive capacity; but, more in general, productive expenditures can affect the productive capacity by determining a higher productivity of private investment, like for example it is the case of investment in infrastructures or expenditures on education.[1]

As to unproductive expenditures, they do not have a direct effect on accumulation and growth but, they might affect accumulation and growth *indirectly*. If private investment depends also on aggregate demand, an increase in unproductive public spending affects private investment through its impact on aggregate demand. In the model below, however, we do not consider any private investment function and, hence, the demand effect of unproductive expenditure is limited to their impact on aggregate demand in general.

2.1 The equilibrium rate of growth

Following Domar's model, for the economy to be in equilibrium over time, it must be

$$Y' = \frac{dY}{dt} = \frac{dP}{dt} = P' \tag{1}$$

where Y is aggregate demand and P is the aggregate potential productive capacity.

If the productivity of investment I is denoted by σ, we have

$$\sigma = \frac{\frac{dP}{dt}}{I} = \frac{P'}{I} \tag{2}$$

i.e.

$$P' = \sigma I$$

Let us now consider an economy with a government that spends on goods and services and levies taxes. Public expenditures are distinguished between productive (I_g) and unproductive public expenditures (C_g). We denote productive expenditures as public investment, which includes expenditure

[1]Notice that the present distinction between public investment and consumption does not coincide with the standard distinction between capital and current public expenditures (see also Domar, 1944).

on both physical and human capital. Therefore total investment is $I_g + I_p$, where I_p is private investment. Unproductive public expenditures C_g are denoted as public consumption.

Then it is

$$G = I_g + C_g$$
and
$$G' = I'_g + C'_g$$

where G is total public expenditure.

Unproductive public expenditures are assumed to be a certain share u of the total fiscal revenue, tY (t is the average tax rate):

$$C_g = utY$$
and
$$C'_g = utY'$$

For now, let us assume that the productivity of private investment, σ_p, is independent of the public investment, and equal to its productivity, σ_g. $\sigma_g = \sigma_p = \sigma$. Therefore,

$$P' = \sigma(I_g + I_p) \tag{3}$$

The equilibrium condition (1) can be written as

$$Y' = (1-s)(1-t)Y' + I'_p + I'_g + utY' = P' = \sigma(I_g + I_p) \tag{4}$$

s (the private marginal propensity to save) and t are both taken as given and constant.

From (4) we obtain the equilibrium rate of growth

$$\gamma = [(1-t)s + t(1-u)]\sigma \tag{5}$$

γ is increasing in σ and it is decreasing in u: the larger is the share of fiscal revenue devoted to unproductive spending the lower is the economy's equilibrium rate of growth.

The rate of growth can be increasing also in the tax rate t; in fact it is

$$\frac{\partial \gamma}{\partial t} > 0 \text{ if } (1-s) > u \tag{6}$$

Since u can be interpreted as the public propensity to consume, condition (6) tells us that an increase in the tax rate is associated with a higher equilibrium growth rate if the public propensity to consume is lower than the private propensity to consume $(1-s)$.

If (6) holds, an increase in the tax rate t necessarily implies a higher overall (private and public) propensity to save and equilibrium requires a

higher growth rate of investment and, hence, a higher rate of growth of the economy.

From (5), it is clear that, given s and t, the equilibrium rate of growth reaches its maximum when $u = 0$, i.e. when there is no unproductive public expenditure. This, however, does not seem to be a realistic possibility because there are some public expenditures that must be necessarily made by the government. Therefore, we impose that

$$0 < \bar{u} \leq u < 1 \tag{7}$$

where $\bar{u}$ denotes the share of fiscal revenue that must be devoted to unproductive public expenditures.[2]

So far, we have assumed that the productivity of public and private investment is the same and that the productivity of private investment is independent of productive public expenditures. Now we remove these hypotheses.

If $\sigma_g \neq \sigma_p$, the average total investment productivity is

$$\sigma = \frac{I_p \sigma_p + I_g \sigma_g}{I_g + I_p} \tag{8}$$

i.e. it is the weighted average of σ_p and σ_g.

We make also the hypothesis that the productivity of private investment, σ_p, is never lower than the productivity of I_g and it is increasing in it, but at a decreasing rate:[3]

$$\sigma_p(I_g) = \sigma_g + h^{1/2} I_g \text{ with } 0 < h < 1 \tag{9}$$

Total productivity of investment now is

$$\sigma = \sigma_g + \frac{h^{1/2} I_g I_p}{I_g + I_p} \tag{10}$$

σ is increasing in I_g but at a decreasing rate.

2.2 The public budget

So far we have not taken into any consideration public budget constraints; now it is time to turn to consider them and the impact that they have on public investment, the productivity of private investment and the equilibrium rate of growth.

[2] We can define these unproductive expenditures as necessary. Obvious examples are public spending on defense, public order, etc.

[3] $\frac{\partial \sigma_p}{\partial I_g} = \frac{h^{1/2} I_p^2}{(I_g + I_p^2} > 0$ and $\frac{\partial^2 \sigma_p}{\partial I_g^2} = -\frac{2h^{1/2} I_p^2}{(I_g + I_p)^3} < 0$.

The public budget B at any point along the equilibrium growth path is

$$B = G - T = I_g + (u-1)tY \tag{11}$$

with T denoting the total tax revenue.

If it is imposed that $B = 0$, i.e. that the public budget is in balance, it is

$$I_g + (u-1)tY = 0$$

which, from (4) and (11), implies that at equilibrium I_g takes on the value

$$I_g^b = \frac{I_p(1-u)t}{s(1-t)} \tag{12}$$

which is decreasing in u and, therefore, it is maximum when $u = \bar{u}$,

If $u = \bar{u}$, I_g^b is

$$_M I_g^b = \frac{I_p(1-\bar{u})t}{s(1-t)} \tag{13}$$

The productivity of private investment associated to $_M I_g^b$ is

$$_M\sigma_p^b = \sigma_g + h^{1/2}{}_M I_g^b$$

The total productivity of investment is therefore

$$_M\sigma^b = \sigma_g + \frac{h_M I_g^b I_p}{_M I_g^b + I_p}$$

which is the maximum that it can reach under the constraint of a balanced budget.

The corresponding equilibrium rate of growth is

$$_M\gamma^b = [(1-t)s + t(1-\bar{u})]_M\sigma^b \tag{14}$$

Since, in (14) u is at its minimum value $\bar{u}$ and σ is at its maximum value $_M\sigma^b$, the rate of growth $_M\gamma^b$ is the maximum that the economy can realize under the constraint of a balanced budget.

If it is now assumed that the government runs a primary deficit, the budget constraint can be written as

$$0 < B = \beta Y = G - T = I_g + (u-1)tY \tag{15}$$

where it is $0 < \beta = \frac{B}{Y} < 1$.

If u is set at $\bar{u}$, along the equilibrium path it is

$$I_g^d = \frac{I_p[\beta + t(1-\bar{u})]}{s(1-t) - \beta} \tag{16}$$

If it is imposed that both I_p and I_g must be positive, from (16) it derives that it must be[4]

$$0 < \beta < s(1-t) \tag{17}$$

For any positive value of β smaller than $s(1-t)$, I_g^d is larger than I_g^b in (12). Moreover, it is easy to verify that, within the interval $0 < \beta < s(1-t)$, I_g^d is increasing in β at an increasing rate.

The productivity of private investment is

$$\sigma_p^d = \sigma_g + h^{1/2} I_g^d$$

Total productivity is

$$\sigma^d = \sigma_g + \frac{h^{1/2} I_g^d I_p}{I_g^d + I_p}$$

which, from (16) can be written as

$$\sigma^d(\beta) = \frac{(h^{1/2} I_p)[\beta + t(1-u)]}{s(1-t) + t(1-u)} \tag{18}$$

The corresponding equilibrium rate of growth is

$$\gamma^d = [(1-t)s + t(1-\bar{u})]\sigma^d(\beta) \tag{19}$$

2.3 The stabilization of the public debt ratio

From the standard analysis of the ratio of the public debt to GDP we know that when the government runs a primary deficit the debt ratio can be stabilized if the rate of growth is larger than the interest rate on the debt.[5] Here we look for the possibility to realize the required condition for debt stabilization thanks to variations of the budget deficit, of which the rate of growth is an increasing function as shown above.

So far, no attention has been paid to the relation between budget deficits, public debt and the interest rate. It is now necessary to look at this relation. We do so by considering the functional relation between the budget deficit, or more precisely, between the ratio of the deficit to GDP (β) and the interest rate on the debt i. Two cases are contemplated: i) the case in which the interest rate i is independent of the deficit ratio β; ii) the case in which i is an increasing function of β.

[4] If $\beta > s(1-t)$ and I_p is assumed to be positive, the equilibrium condition jointly with the budget constraint would imply a negative value for I_g^d. If instead it is imposed that I_g^d must be positive, the equilibrium condition jointly with the budget constraint would imply a negative value for I_p.

[5] For a critical exposition and examination of the standard analysis of the debt ratio, see Sardoni (2021).

If i is independent of β, from the analysis above it derives that it is possible that β takes on a value such that $\gamma > i$; Figure 1 below illustrates two possible cases. If the interest rate is i_1, in the interval $0 - \beta_1$ it is larger than the rate of growth, whereas in the interval $\beta_1 < \beta < s(1-t)$ the rate of growth γ is larger than i_1, so that the ratio of the public debt to GDP can be stabilized.

If, for example, it is $\beta = \beta^*$ the rate of growth is $\gamma^* > i$ and the debt ratio converges to

$$\bar{B} = \frac{\epsilon + \tau}{\gamma^* - i}$$

where ϵ is the ratio of public spending to GDP and τ is the ratio of taxes to GDP.

If the interest rate takes on a value like $i_2 > i_1$ in Figure 1, it is evident that it is impossible to stabilize the ratio of the public debt to GDP by increasing the budget deficit, which cannot be larger than $s(1-t)$.

If, instead, it is assumed that the interest rate is increasing in the budget deficit, say it is $i = l\beta^2$ $(l > 0)$, it is still possible to find a range of values of β for which the debt ratio can be stabilized as shown in Figure 2 below. The debt ratio can be stabilized only for values of β within the interval $\beta_1 - \beta_2$. Further increases of the deficit would cause an increase in the interest rate larger than the increase in the growth rate.

The budget policy implications of the analysis above are straightforward. In the simpler case of the interest rate independent of the budget deficit, the stabilization of the public debt ratio through increases of the deficit is possible, but only if the interest rate is not too high. In this latter case the debt stabilization can be achieved either through deficit reductions or through monetary policies that lower the interest rate.

The more realistic case in which the interest rate is increasing in the budget deficit, the conditions for the debt ratio stabilization through increases of the deficit are obviously more restrictive. If the economy is characterized by a relatively low ratio of the deficit to GDP ($0 < \beta < \beta_1$ in Figure 2), the debt ratio can be stabilized through increases of the deficit ratio, which can grow up to β_2. If the economy is experiencing a relatively large ratio of the deficit to GDP and the interest rate is higher than the growth rate, it is not possible to realize the debt ratio stabilization through further increases of the deficit ratio.

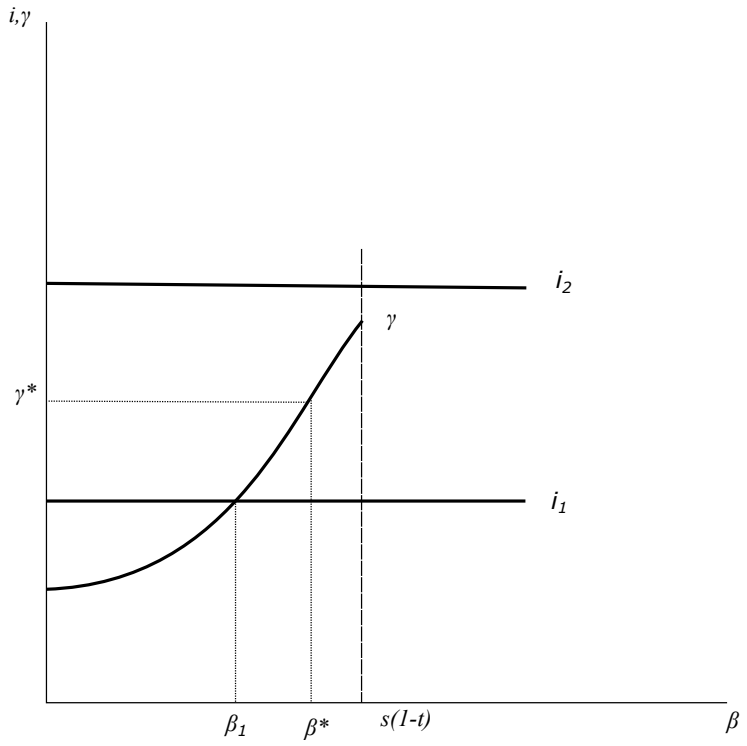

Figure 1: i independent of β

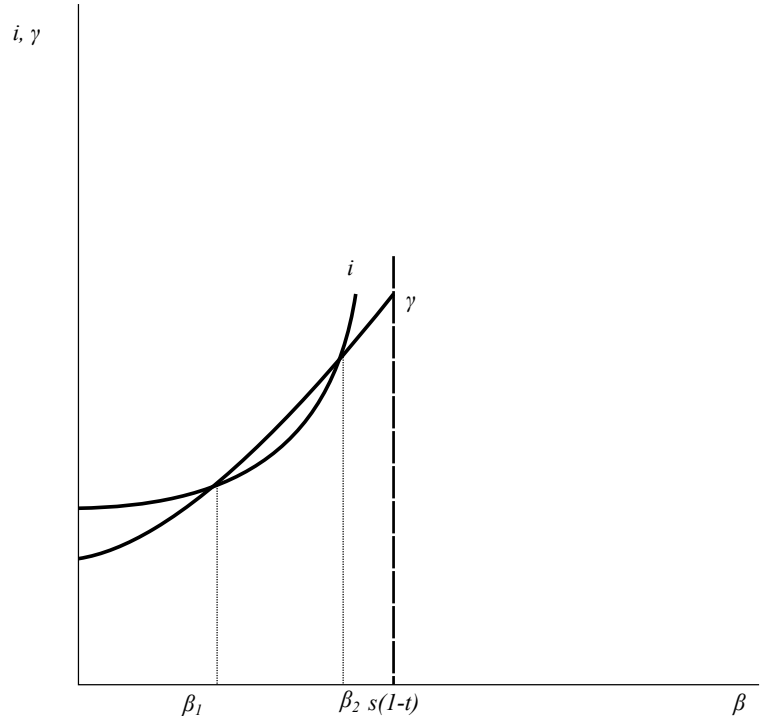

Figure 2: i increasing in β

3 Some general considerations

The model of the previous section is an extended version of Domar's model of growth. The equilibrium rates of growth determined by our model are generalizations of Domar's equilibrium rate, $\gamma = \sigma s$, once public spending and taxes are introduced.

As well known, Domar's equilibrium growth rate is the same of Harrod's, even though their models differ from several points of view. In particular, while Domar's model does not have any investment function, this is not the case for Harrod's model. We shall return to these differences later on after having briefly considered the attitude of some Keynesians and Post Keynesians toward such models.

It is universally acknowledged that Harrod and Domar were the two economists who first tried to develop the Keynesian theory by overcoming its short-period analytical framework and adopting a dynamic perspective to tackle the long-period problem of growth. However, among Keynesians and Post-Keynesians there is some critical dissatisfaction with the two pioneering economists (see, e.g., Hein, 2014, pp. 23-49). Harrod's and Domar's models are looked at with a sense of uneasiness for what is seen as an ambiguous, or wrong altogether, approach to saving and its role.

In both Harrod's and Domar's models, the equilibrium rate of growth is increasing in the propensity to save. For the critics, this positive role played by the propensity to save clashes with the Keynesian parsimony paradox, which implies that an increase in s has only a negative impact on the economy.

In our view, these criticisms are unwarranted as they are based on an interpretation of Harrod's and Domar's models that is at odds with their authors' main intent. Below we propose an alternative interpretation of these models, which is useful to better understand also the nature and the intents of the model presented in section 2.

There are two features of the Harrod-Domar models that are important to understand and interpret their main intents: i) they are equilibrium models; ii) they are essentially normative rather than positive.

3.1 Equilibrium models of growth

The aggregate equilibrium condition for a simple closed economy with no government is, of course, the equality between saving and investment. Consider two economies A and B which, at time t, are equal to one another in any respect other than their marginal propensity to save, with $s_A > s_B$.

Their equilibrium at t is realized when

$$Y^*_{A,t} = \frac{1}{s_A} I_{A,t}$$
$$Y^*_{B,t} = \frac{1}{s_B} I_{B,t}$$

(I_A and I_B denote investment in A and B respectively.)

Since it is $Y^*_{A,t} = Y^*_{B,t}$ by assumption, it necessarily follows that it must be $I_A > I_B$, which in turn implies that the economy A grows faster than B from t to $t+1$, the productivity of investment σ being the same in both economies.

However, from the trivial algebra above and from comparative statics, it is not legitimate to infer that the economy B could grow as fast as the economy A by simply raising its marginal propensity to save from s_B to s_A. A higher propensity to save requires indeed a higher level of investment to realize equilibrium, but there is *no guarantee that an increase of the marginal propensity to save brings automatically about an increase in investment.* It could instead produce perverse effects with a decrease in aggregate demand and, possibly, in investment.

This is the essence of the 'thrift paradox', which however does not impinge on the logic and consistence of Harrod-Domar growth models: the higher is the marginal propensity to save, the larger must investment be to ensure the macroeconomic equilibrium and, hence, the higher is the resulting equilibrium rate of growth. If the notion of natural rate of growth is introduced the logic of such models can also be expressed as follows: given the natural rate of growth, it can be realized only if investment grows at that rate, which necessarily implies a certain propensity to save.

3.2 Normative vs. positive models of growth

Equilibrium models of growth are useful tools to analyze logically necessary connections among variables. They could be regarded as theoretical representations of actual process of growth by arguing that, at least in the long period, there are endogenous forces at work that bring the economy to its equilibrium growth path. But this is not the only possible interpretation of such models.

Both Harrod and Domar held that the understanding of the capitalist process of growth cannot be exclusively based on the construction of analytical models. Such a task can be accomplished only by following a more general approach, which implies recourse to the interpretation of data, history and other social sciences.[6]

[6]For Domar, it requires, most of all, 'that breadth of vision and imagination and that degree

Models are useful not only to illustrate and analyze the causal connections among variables. They are useful also from a normative point of view. From them it is possible to derive the sort of policy measures necessary to obtain certain results. Both Harrod's and Domar's models are to be interpreted as essentially normative models.

The normative character of Domar's model of growth is revealed by the fact that it does not contain any investment function describing the firms' behavior. Given the technology and the propensity to save, the model establishes which investment ensures a balanced growth. Harrod's model, which contains an investment function, might however be interpreted in a positive sense.[7] But, in our view, rather than from the presence of an investment function, the essentially normative character of Harrod's model can be deducted from his interpretation of his equilibrium rate of growth and the difference from that determined by *laissez-faire* neo-classical models.

Harrod acknowledges that his model might be considered as expressing the idea that what people choose to save determines the rate of growth as it is the case in neo-classical models. But, for Harrod, in his model 'the saving ratio is the servant, not the master. It assumes that the "natural" growth rate is determined by population increase and technological progress, *and specifies what saving ratio is required in consequence of that. It is up to the authorities to ensure that this amount of saving is made.*' (Harrod, 1973, p. 28, emphasis added). In other words, the model determines which is the equilibrium rate of saving (equal to the equilibrium rate of investment) and it is up to the policy-maker to ensure that it is realized.

3.3 The present model

The above considerations concerning Harrod-Domar growth models evidently apply also to our model of section 2. There are, however, analytical differences between the present model and standard Harrod-Domar models. First, variations of the overall marginal propensity to save, $s_o = [(1-t)s+t(1-u)]$, are exclusively due to variations of the two fiscal variables (taxes and public spending) rather than to variations of the private sector's inter-temporal preferences (s is given and constant). Second, the productivity of investment σ depends also on the composition of public spending as it is postulated that it is increasing in productive public expenditures.

These two specific features of our model have an important implication concerning the overall marginal propensity to save and its possible varia-

of understanding which is called "wisdom". In short it is a job for sages.' (Domar, 1957, p. 12); see also Harrod (1973, pp. 1-5). For a useful recent survey of the multifaceted factors that determine growth see, for example, Koyama and Rubin (2022).

[7]For example, Gandolfo (1971, p.187) holds that Harrod's is a positive model whereas Domar's is a normative one.

tions. Like any Harrod-Domar model, also the present model can be legitimately used in comparative dynamics: an economy with a larger s_o grows faster than one with a smaller s_o. However, in the case of our model inferences about the consequences of a variation of s_o in the same economy are more easily justifiable.

While an increase of the private marginal propensity to save does not guarantee that it translates into a larger investment, in our model the increase in the overall propensity to save is due to the government's decision to reduce its unproductive expenditures and augment productive expenditures. In other words, saving and investment decisions are interconnected and interdependent on one another.

Consequently, if the government's 'propensity to consume' (to spend unproductively) is lower than the private propensity to consume, any increase of the tax rate determines an increase of its rates of investment and growth. Moreover, a decrease of the government's propensity to consume does not only make public investment increase; it also affects positively the productivity of private investment, with its beneficial effects on the equilibrium rate of growth.

Thus, the policy implications of our model are more direct than those that can be deducted from standard Harrod-Domar models with no specific consideration of the public sector.

4 Conclusions

The last 15 years of the 21st century have been characterized by a series of critical events that have caused the increase of state interventions in virtually all market economies. This is a significant inversion with respect to what had been happening since the the 1970s of the last century, characterized instead by the retrenchment of the state in most Western economies.

A growing presence of the state at the economic level during critical phases is, so to say, somewhat 'physiological'. While a reduced role of the public sector during phases of expansion and growth is searched for and realized by most economic, social and political actors, when the economies are hit by major critical episodes it becomes evident to most the need for some forms of coordinated interventions that markets alone are hardly able to guarantee. Put in other terms, economic crises always represent, in a way or another, a coordination failure of markets which requires some sort of 'superior' coordinator.

Such acknowledgment should be accompanied, however, by two important qualifications. First, the growing demand for state economic interventions during critical phases does not imply that such public interventions are always and necessarily preferable to a greater reliance on markets, even though it does not mean accepting an uncritical acceptance of *laissez*

faire.[8] Historical experience eloquently shows that market economies generally work better and more successfully that those with a pervasive presence of the state in the economic sphere.

Second, accepting that, during critical phases, a larger economic role of the state is required does not make it less important to be concerned for the extension and quality of state interventions in order to contain their possible negative effects on the economy as a whole. Although, from and short and medium-run viewpoint, state interventions are necessary, they should not be detrimental in a longer-run perspective. The most serious and evident deleterious effect of a growing state intervention is when its expenditures are largely deficit financed and determine a rise of the ratio of public debt to GDP to unsustainable levels, which in turn produce negative effects on the economy as a whole.

The approach proposed in this paper, explicated by the model of section 2, is an attempt at dealing with these issues. The main implication of the present approach is that growing state interventions, in the form of larger deficits, can produce positive effects on the economy by not simply increasing aggregate demand but, most of all, by contributing to raise the productivity of the economy as a whole. An objective that can be realized if public spending is primarily devoted to productive expenditures, that is to say public investment in physical and human capital.

This 'optimistic' view of productive public interventions comes, however, with important provisos. As we saw in section 2, virtuous expansion of budget deficits can generally occur when the initial situation is characterized by levels of deficits–and presumably debts ratio–relatively low, whereas in opposite situations it is more difficult, if not impossible altogether, to promote growth through further deficit spending, The implication is that during crises policy-makers should be very careful to limit as much as possible the expansion of deficits to finance unproductive expenditures, which may be necessary to a certain extent and, quite often, more 'popular', but they are likely to produce negative effects in the longer run if not kept under control and converted into productive public expenditures as soon as possible.

Another important proviso is that it is not enough to call for larger state interventions finalized to promote growth. In order that the public sector is able to accomplish such a task, it is also necessary that it is able to carefully detect which sort of productive expenditures are required and to ensure that expenditure plans are carefully and timely implemented. In other words, state interventions which actually promote a more efficient and productive working of the economy also require that the state apparatus functions efficiently. If this is not the case, also expenditures that are conceived as growth-promoting turn to be ineffectual with a negative impact on the public deficit and debt.

[8]Markets are institutions whose functioning is always regulated in some forms by the state.

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