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Long Run Effects of Public Consumption Composition in a Growing Economy

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ABSTRACT

We present a standard three sectors growth model both in the scale and non scale version, to analyze the long run effects of the composition of public consumption. Our main result is the following: if the composition of public consumption differs from that of the private sector, then changes in lump sum taxation affects the steady state real variables.

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1 Introduction

Within the debate concerning the effects of the fiscal policy in the process of economic growth has been particularly emphasized the role of composition of the public spending, considered under a functional perspective (education, health, efense spending ...) or under a more traditional distinction between public consumption and public investment.

In the neoclassical growth framework, it is a well established result that public consumption cannot affect the long run equilibria of the economy, except in case of distortionary taxation. In this paper our attention focuses precisely on this category of public expenditure, with particular reference to the following question: Can the composition of public consumption influence real variables in the long run ?

We answer the question with a standard model of growth presented in both in a traditional scale version and in a non scale version (Grossman and Helpman, 1991; Romer, 1990). On the supply side we consider a three sectors economy, producing in a competitive environment a homogeneous consumption good and a differentiated commodity available in many varieties within a merket of monopolistic competition, whose dimension can be incresed through R&D investment in the research sector. The only factor of production is labor, and in all industries constant returns to scale prevails.

On the demand side preferences are described by a standard Cobb-Douglas function, so that the composition of the private demand is given. The government discretionally purchases quantites of both consumption goods, financing its espenditure through non distortionary taxation. Therefore, the aggregate composition of demand depends on the behaviour of the public sector.

Our main results are the following. If the composition the public consumption is different from the composition of the private sector, changes in the public spending affects the steady state growth rate of output, in the scale exercise, or the level of output in the non scale framework. The direction of the effect is positive (negative) if the share allocated by the government to the composite commodity is higher (lower) than that of the private sector. The intuition behind this result of the result is straightforward A raise in taxation increases the demand of the composite commodity relatively to the homogeneous good. On the supply side, this rise in demand changes private incentives in two directions. Firstly, it increases the profitability of the firms operating within the monopolistic market. Each producer is then incentivated to increase production to satisfy the expansion of demand. Secondly, the profitability of innovating activity increases as well. Since any new invented variety promises now a higher flow of profits, the increases of demand in the manufacturing sector actively stimulates a greater research effort. Within a single consumption good model the raising labor demand in the manufacturing industry would have been exactly offset by the the increased demand of labor in the research sector, leaving the allocation of productive resources unchanged. In our setting, however, because of a perfectly elastic supply in the market for the homogeneous good, firms are completely indifferent to their scale of production. Therefore, the monopolistic and the research sectors do not need to compete for a common resource, since the labor employed in the competitive industry acts as a reserve storage of production factor. As a result of the reallocation of productive resources away from the traditional sector, the incouraged effort in the R&D stimulates greater growth (levels) of output.

2 The Demand Side

We assume a single household, whose size grows over time at the constant rate l:

$$\frac{\dot{L}(t)}{L(t)} = l \tag{1}$$

Each member of the family derives her utility from the consumption of two goods, a homogeneous good Z, and a composite commodity D, whose dimension can be increased through R&D activity. On the supply side, she provides labor services, allocating inelastically one unit of time endowment[1] among the three sectors, Z, D, and $R\&D$. Since labor is perfectly homogeneous, in equilibrium it must be paid the same wage rate w. The maximization problem can be stated as follow[2]:

$$\max U(0) = \int_0^\infty \exp[-(\rho - l)s]\left[\alpha \ln(c_D(s)) + (1-\alpha)\ln(c_Z(s))\right] ds \; ; \; d(s) = \left[\int_0^n c_X(i,s)^\epsilon di\right]^{\frac{1}{\epsilon}} \tag{2}$$

subject to the following dynamic equations and first conditions :

$$\dot{v}(t) = [r(t) - l]v(t) + w(t) - P_Z(t)c_X(t) - P_D c_D(t) + t; \;\; v(0) = given \tag{3}$$

Lower case letters c_i $(i = Z, D, X)$ indicate per capita quantities, whereas capital letters indicate aggregate quantities. $0 \leq \epsilon < 1$ measures the degree of substitution beteween any pair of varieties $c_X(i,s)$ in $c_D(s)$, t is lump sum taxation. P_Z and P_D are the price of Z and D. $v(s)$ represents net per capita asset holding and $r(t)$ is the instantaneous interest rate.

The necessary conditions for an efficient time path of consumption expenditures deliver the ususal dynamic relationships (we drop the time index, unless to avoid confusion):

[1] Therefore, $L(t)$ represents the aggregate labor input evailable in the economy et any time.

[2] In the specification of the composite commodity d we do not distinguish between "taste for variety" and "market power". In the present setting this extension of the traditional Dixit-Stiglitz framework does not convey relevant additional insights. For an application to an endogenous growth model of this CES refinement, originally proposed by Benassy [1996] see de Groot and Nahuis [1998].

$$\gamma_{c_Z} + \gamma_{P_C} = r - \rho \tag{4}$$

$$\gamma_{c_D} + \gamma_{P_D} = r - \rho \tag{5}$$

$$\gamma_e = r - \rho \tag{6}$$

with $e = P_Z c_Z + P_D c_D$ defining the per capita expenditure. Moreover, given the Cobb-Douglas specification of the utility function and the CES definition of the composite commodity, the following static demand relationships must hold:

$$c_Z = (1-\alpha)\frac{e}{P_Z} \quad ; \quad c_D = \alpha \frac{e}{P_D} \quad ; \quad P_D = \left[\int_0^n p(i)^{\frac{\epsilon}{\epsilon-1}} di \right]^{\frac{\epsilon-1}{\epsilon}} \tag{7}$$

$$\frac{c_X(i)}{L} = \frac{\alpha e}{P_D} \left(\frac{p(i)}{P_D} \right)^{\frac{1}{\epsilon-1}} \tag{8}$$

3 The Government

In the present context we adopt a specific concept for "public consumption". From national accounting, government consumption expenditures consists of compensation of general government employees, consumption of fixed capital and intermediate consumption of goods and services. In 2003 within the Euro-area (15 countries), final government consumption amounted to 20.6% as a percentage of GDP, which represents the 40% of total government expenditure. Specifically, 55% of total public consumption has been devoted to employees compensation, while a 33% share to goods and services purchases This latter trepresents the 6.8% as a percentage of GDP (599 euro billions)[3]. The national account aggregate corresponding to the concept of public consumption used here, is therefore the subset of government consumption, which refers to as "intermediate consumption". Our choice is motivated by the main concern of the paper, which focuses on the real macroeconomic effects of changes in the aggregate consumption expenditure shares, when the government directly purchases from the markets. The share of public consumption, that constitutes compensation to employees, represents a fraction of aggregate demand, that reflects the private sector spending composition. It follows that changes in this component of public expenditure does not modify the aggregate composition of consumption. On the contrary, intermediate consumption is a direct purchase of goods and services on the part of the goevernemnt, whose composition may differ from that of the private sector. As a result, the overall composition of consumption can be substantially altered by this category of public spending.

The government purchases discretional amounts of both Z and D. The purpose of public consumption is entirely "wasteful", in the sense that we neglect

[3]Source: EUROSTAT, Economy and Finance 41/2004.

the indirect effect, that intemediate government consumption might have on inidividuals' welfare through the provision of public services, such as justice, public order, security, national defense. Under this perspective, public consumption could merely be regarded as the necessary inputs for the government subsistence. In several endogenous growth models consumptive public spending is devised to externally increase households' utility (for example Bianconi and Turnovsky,1997; Devereux and Wen,1998). However, we deliberately depart from this kind of formulation since, we want the real effects of public spending, if any, to stem from a pure demand channel alone.To finance consumption, the government withdraws a fixed amount t of income from every individual. Therefore $T = tL$ represents the overall lump sum taxation T collected by the government. A fraction τ of T is allocated to the composite commodity D, and the remaining $(1-\tau)$ to the homogeneous good Z. This implies the following demand functions:

$$G_Z = \frac{(1-\tau)T}{P_Z} \quad , \quad G_D = \frac{\tau T}{P_D} \tag{9}$$

Moreover, we assume that the government percieves the composite commodity in the same manner as the private sector:

$$G_D = \left[\int_0^n G_X(i,t)^{\epsilon} di \right]^{1/\epsilon}$$

this assumption implies the same demand function for the single variety as that of the private sector:

$$G_X = \frac{\tau T}{P_D} \left(\frac{p(i)}{P_D} \right)^{\frac{1}{\epsilon - 1}} \tag{10}$$

4 The Supply Side

We consider a three sectors economy. Each sector is characterized by a constant returns to scale technology, which employ labor as the sole facotr of production. There exists a traditional industry, producing a homogeneous consumption good in a perfectly competitive environment and a monopolistic sector manufacturing, ant any time, n differentiated varieties. New brands are introduced into the market through investments in the $R\&D$ sector.

4.1 The Traditional Sector

The undifferentiated good Z is produced by a single representative firm according to the following technolgy:

$$Z = B_Z L_Z; \;\; L_Z = L l_Z \tag{11}$$

where l_Z represents the share of total labor force L employed in the Z industry and B_Z is a productivity parameter. Profit maximization implies the following supply schedule:

$$P_Z = \frac{w}{B_Z} \tag{12}$$

4.2 The monopolistic Sector

Firms operate within a merket of monopolistic competition. Each firm manufactures a single brand, retaining a perpetual monopoly power over the variety it produces. Producer i maximizes profits, subject to a constant returns to scale technology, with labor as the only input. Thus the relevant marginal cost reflects only the unit wage rate payed to the fraction of time labor devoted by the representative individual to the i-th sector:

$$X(i) = L(i),\ i = 1, ...n, \text{ and } \int_i^n L(i)di = L_D = L(t)l_D \tag{13}$$

$L(i)$ represents the fraction of labor employed to manufacture the variey i, l_d the fraction of time allocated to the production of D. The optimal price rule implies a constant mark-up over marginal cost:

$$p(i) = \frac{w}{\epsilon} \tag{14}$$

4.3 The *R&D* Sector

The innovation sector is competitive. New blueprints are produced according to the following constant returns technology:

$$\dot{n} = B_n L_n n^{\phi}; \quad L_n = L(t)l_n \quad , \quad \phi \leq 1 \tag{15}$$

L_n represents the total amount of labor employed in the innovation sector, B_n measures productivity. A firm employing L_n units of labor for a time interval dt obtains a flow of new varieties $dn = (B_n L_n n)dt$, bearing a total cost $wL_n dt$. Thus, the average cost of inventing a new variety $(w/\ B_n n^{\phi})$ decreases as knowledge accumulates (proxied by n, the stock of past *R&D* effort) The parameter ϕ reflects the intensity of the externality, and crucially discriminates between two class of growth models. With $\phi = 1$ the model shows a traditional endogenous growth setup, substantially borrowed from the original contributions of Grossman and Helpman [1991, ch.3], Romer [1987] and Aghion and Howitt [1992]. However, this class of *R&D* based models has been strongly criticized due to the troublesome prediction of a growth rate proportional to the size of the economy. As pointed out by Jones [1995a, 1995b] and Barro and Sala-i-Martin [1995] this theoretical prediction does not find any supporting evidence.in the postwar period. As a consequence, the successive line of growth models has proposed several alternative setup, that avoid the "scale effect" prediction Following Jones [1999] and Eicher and Turnovsky [1999], the restriction $\phi < 1$, which implies that the positive externality will be extinguished as the size of the economy will get larger, represents the simplest device to eliminate the scale effect

As the industry is competitive, a zero profit condition (free entry condition) must hold. The cost of a single blueprint must be equal to the discounted perpetual flow of profit, generated by the new variety entering the D market:

$$\frac{w}{B_n n^{\phi}} = v \tag{16}$$

$$v = \int_s^{\infty} e^{-\int_s^{\xi} r(s')ds'} \pi(j,\xi)d \ ; \ \ \xi > s \tag{17}$$

A no arbitrage condition must hold between the riskless asset yealding the interest rate $r(t)$[4] and $v(t)$, the asset, which entitle the individual to the flow of profits generated by the typical firm operating in the monopolistic market.

$$vr = \dot{v} + \pi \tag{18}$$

with π defining the brand operating profits:

$$\pi(i) = p(i)X(i) - wX(i) \tag{19}$$

5 Partial Equilibrium

At any given point in time several equilibrium conditions on goods market and labor markets must hold.

From [7], [8], [9] and [10] we obtain the total market demand for the different consumption goods, Z, D, and $X(i)$ respectively:

$$\begin{aligned} Z &= c_Z L + G_Z = \frac{1}{P_Z}\left[(1-\alpha)E + (1-\tau)T\right] && (20) \\ D &= c_D L + G_D = \frac{1}{P_D}\left[\alpha E + \tau T\right] && (21) \\ X(i) &= c_X(i) + G_X(i)^G = \frac{[\alpha E + \tau T]}{P_D}\left(\frac{p(i)}{P_D}\right)^{\frac{1}{\epsilon - 1}} && (22) \end{aligned}$$

with $E = eL$ defining the total consumptioin expenditure of the private sector. [11] and [12] highlight how the discretionary composition of government spending can affect the share of aggregate expenditure allocated between the

[4]Individuals employ the riskless asset to intertemporally substitute. In a closed economy the sum of loans and debt mus be zero. Therefore, in the aggregate, the net asset of the representative individual is given by v.

two consumption commodities. Given $(E+T)$ the total market value of consumption, the share allocated to the composite commodity is $(\alpha E+\tau T)/(E+T)$, which equals to α only if the government consumption pattern exactly track the private sector composition of demand. Otherwise, with τ greater (lower) than α the aggregate expenditure share in the market for the differentiated commodity will be higher (smaller) than the percentage of the private sector. This should not be regarded as particularly surprisingly, given that the government shares the same specification of demand functions of individuals. Indeed, it is precisely this, that combined with the behaviour of firms, will give rise to permanent effects of the fiscal policy.

Since the wage rate w is uniform, from [14] we get that varieties are equally priced: $p(i) = p$ for $i \in [0, n]$. Given the optimal price rule and the demand function[22] , we derive the equilibrium quantity of each of the n varieties available in the market:

$$X(i) = X = \frac{[\alpha E + \tau T]\epsilon}{nw} \tag{23}$$

Substituting [23] in [19] we get the expression of the per brand profits.:

$$\pi = \frac{(1-\epsilon)[\alpha E + \tau T]}{n} \tag{24}$$

Given technology [13] and [21] it is immediate to obtain the static equilibrium labor requirement

$$L_D = \frac{[\alpha E + \tau T]\epsilon}{w} \tag{25}$$

Finally, turning to the traditional industry, from [11] and [20] we get the equilibrium labor share employed for the produciton of Z:

$$L_Z = \frac{(1-\alpha)E + (1-\tau)T}{w} \tag{26}$$

6 The Steady State $\phi < 1$

The restriction $\phi < 1$ implies that the positive externality on the research activity, due to the accumulation of non rivalry knowledge (proxied by the stock of existing patents) will eventually come to an end[5]. As pointed out by Jones [1999], this leads to a long run growth rate of innovation that is proportional to the population growth rate and not to the *level* of population (scale effect). We can summarize the steady state growth properties of the model proving the following results ($\dot{a}/a \equiv \gamma_a$).

Result 1
The steady state growth rate of innovation is

[5] See for example Jones [1995b], Kortum [1997] and Segerstrom [1998].

$$\gamma_n = l/(1-\phi) \tag{27}$$

PROOF

Consider the technology in the R&D sector:$\dot{n} = B_n L_n n^{\phi}$. Divide both sides by n and differentiate with respect to time. Considering that in steady state. γ_n must be constant result in [27] is obtained. The growth rate of innovation is proportional to population growth by the factor $1/(1-\phi)$, which measures the long run effect of the degree to which past innovatios raise the productivity of research effort.

Result 2

The steady state must be characterized by constant per capita taxatinon (It $= T/L$, $\gamma_T = l$). The than the rate of interest equals the time discount rate.

PROOF

Differencing the rate of profit [24] we get:

$$\gamma_\pi = \frac{\dot{\Psi}}{\Psi} - \gamma_n; \; \frac{\dot{\Psi}}{\Psi} = \frac{\alpha\gamma_E E + \tau\gamma_T T}{\alpha E + \tau T}$$

since γ_E and γ_T have to be constant, we have that $\dot{\Psi}/\Psi$ constant too. Differencing we obtain:

$$\frac{d}{dt}\frac{\dot{\Psi}}{\Psi} = 0 \qquad \Rightarrow \qquad \alpha\dot{E}(r-\rho) = \tau(l-\gamma_T)$$

where $r = \rho$ follows from $l = \gamma_T$.

Result 3

The steady state growth rates of consumption goods: $\gamma_Z = l \;\; (\gamma_z = 0)$ and $\gamma_D = l + \frac{1-\epsilon}{\epsilon}\gamma_n$ $(\gamma_d = \frac{1-\epsilon}{\epsilon}\gamma_n = -\gamma_{P_D})$

PROOF

Given Result [2], from the first order conditions, with P_C constant, and time differencing the static equilibrium level of $D = n^{1/\epsilon}X$, with .$\gamma_X = -\gamma_n$.

6.1 The Steady State: Levels

The present non scale setting inherits the standard neoclassical prediction that, balanced growth rates cannot be affected by macroeconomic policy. This reflects the simple way of removing the scale effect, adopted here. The amount of labor resources devoted to research does not play any role in determining the economy's long run dynamics. It follows that, as in Segerstrom [1995] and Young [1998], the only line of action for enhancing growth are policies directly aimed at influencing the rate of population growth (i.e. the scale of the economy)[6]. Therefore, within this framework we'll explore the *levels* effects of the public spending composition. To derive a measure of real per capita income, we

[6] Several contributions have formulated alternative no scale framework, that retains an endogenous growht prediction. See for example Dinopoulos and Thompson [1998], Peretto [1998] and Young [1998].

need first to compute the steady state labor shares. The starting point is the equilibrium condition in the labor market:

$$L = L_Z + L_D + L_n \tag{28}$$

employing [15], [25] and [26] we rewrite [28] as follows:

$$\frac{LB_n}{n^{1-\phi}} = \frac{EB_n}{wn^{1-\phi}}(1-\alpha+\alpha\epsilon) + \frac{TB_n}{wn^{1-\phi}}(1-\tau+\tau\epsilon) + \gamma_n \tag{29}$$

Differencing the zero profit condition [16] we get $\dot{v}/v = -\phi\gamma_n$. Manipulating the equilibrium condition on the capital market [18] with [24] we obtain:

$$\frac{EB_n}{wn^{1-\phi}} = \frac{\rho+\gamma_n\phi}{(1-\epsilon)\alpha} - \frac{\tau}{\alpha}\frac{TB_n}{wn^{1-\phi}} \tag{30}$$

using $B_n/n^{1-\phi} = \gamma_n/Ll_n$ (from technology [15]) and [30] we solve [29] for l_n[7]:

$$l_n = \Omega\left(1+\frac{t}{w}\frac{\tau-\alpha}{\alpha}\right) \;,\; \Omega = \frac{(1-\epsilon)\alpha\gamma_n}{(\rho+\gamma_n\phi)(1-\alpha+\alpha\epsilon)+\gamma_n(1-\epsilon)\alpha} < 1 \tag{31}$$

[31] shows that taxation is completely neutral if the government consumption mirrors the composition of consumption exhibited by the private sector ($\tau = \alpha$). Ω represents the "natural" labor share allocated to research, i.e. the labor share arising in an economy without public sector. It reflects the underlying structure if the model economy. In particular, l_n will be higher the higher the exogenous rate of innovation γ_n, the higher the private share of expenditure allocated to the differentiated commodity α, and the higher the market power $(1/\epsilon)$ enjoied by firms in the monopolistic industry.

Combining [25] and [26] we get the relation between L_Z and L_D:

$$l_Z = \frac{1-\alpha}{\alpha\epsilon}l_D - \frac{t}{w}\left(\frac{\tau-\alpha}{\alpha}\right) \tag{32}$$

Given [32] and [31] the labor shares allocated to the production of the consumption commodities l_C and l_D are easily computed:

$$l_D = \frac{\alpha\epsilon(1-\Omega)}{1-\alpha+\alpha\epsilon}\left(1+\frac{t}{w}\frac{\tau-\alpha}{\alpha}\right) \tag{33}$$

$$l_Z = \frac{(1-\alpha)(1-\Omega)}{1-\alpha+\alpha\epsilon} + \frac{t}{w}\frac{\tau-\alpha}{\alpha}\left(\frac{(1-\alpha)(1-\Omega)}{1-\alpha+\alpha\epsilon}-1\right) \tag{34}$$

In the present context the price and the per capita quantity of the traditional good, as well as total per capita expenditure are constant in the steady state.

[7] Of course we implicitly assume that per capita taxation t does not completely crowds out private spending. It is easy to see that in the steady state this amounts to the constraint $t < w$.

The long run dynamics of real variables is diplayed by the increasing dimension of the composite goods d, or, equivalently, by the increasing purchasing capacity of any unit of expenditure, due to the declining of the aggegate price P_D (see Result [3]). Therefore, to capture this feature of the model with a measure of the aggregate output, we simply follow the national accounting procedure. We consider $t = 0$ the base period. Given Result [1] we can write:

$$P_D(t) = n(0)e^{\gamma_n t}\frac{w}{\epsilon} \tag{35}$$

Evaluating [35] in the base period, with the simplifying asssumption that $n(0) = 1$we get:

$$P_D(0) = \frac{w}{\epsilon} \tag{36}$$

Since the price P_Z is constant, we can set it equals to one. The real per capita output $y = z + \frac{w}{\epsilon}d$ in terms of labor shares is then defined:

$$y = B_z\left(l_z + \frac{1}{\epsilon}l_D\right) \tag{37}$$

6.2 Long Run Implication of Public Consumption Spending

The long run effect of public spending through non distortinary taxation are easily derived from the signs of the following derivatives:

$$\frac{\partial l_n}{\partial t} = \frac{\tau-\alpha}{w\alpha}\Omega \qquad \frac{\partial l_n}{\partial t} \gtreqless 0 \quad \text{if} \quad \tau-\alpha \gtreqless 0 \tag{38}$$

$$\frac{\partial l_Z}{\partial t} = \frac{\tau-\alpha}{w\alpha}\left(\frac{(1-\alpha)(1-\Omega)}{1-\alpha+\alpha\epsilon}-1\right) \quad ; \quad \frac{\partial l_Z}{\partial t} \lesseqgtr 0 \quad \text{if} \quad \tau-\alpha \gtreqless 0 \tag{39}$$

$$\frac{\partial l_D}{\partial t} = \frac{\tau-\alpha}{w\alpha}\left(\frac{\alpha\epsilon(1-\Omega)}{1-\alpha+\alpha\epsilon}\right) \quad .; \quad \frac{\partial l_D}{\partial t} \gtreqless 0 \quad \text{if} \quad \tau-\alpha \gtreqless 0 \tag{40}$$

$$\frac{\partial y}{\partial t}\frac{1}{B_Z} = \frac{(\tau-\alpha)}{\alpha w}\left[\frac{1-\Omega}{1-\alpha+\alpha\epsilon}-1\right] \quad : \quad \frac{\partial y}{\partial t} \gtreqless 0 \quad \text{if} \quad \tau-\alpha \gtreqless 0 \tag{41}$$

where te sign of the last derivative [41] is obtained under the condition $l < \rho$[8]. The effectiveness of fiscal policy crucially depends on the sign of $(\tau - \alpha)$ The traditional neutrality prediction of no distortionary taxation arises in the present setting as a particular case. When the government consumption exactly tracks the composition of demand of the private sector, then changes in public spending have no real effects in the long run, bur for the crowding out of private consumption.

The story behind these results is easily explained. In the present context, changes in taxation operate through a modification of the aggregate composition of consumption spending. In particular, assuming $\tau - \alpha > 0$, an increase in

[8] The restriction $l < \rho$ is necessary to avoid unbounded utility.

t raises the demand jof the composite commodity relatively to the homogeneous good. On the supply side, this rise in demand changes private incentives in two directions. Firstly, it increases the profitability of the firms operating within the monopolistic market. Each producer is then incentivated to increase production to satisfy the expansion of demand. As a result , the demand of labor L_D increases. Secondly, the profitability of innovating activity increases as well. Since any new invented variety promises now a higher flow of profits, the increases of demand in the manufacturing sector actively stimulates a greater research effort. Therefore, also the labor demand L_n in the *R&D* sector increases. Within a sinle consumption good model the raising labor demand in the manufacturing industry would have been exactly offset by the the increased demand of labor in the research sector, leaving the allocation of productive resources unchanged[9]. In our setting, however, because of a perfectly elastic supply in the market for the homogeneous good Z, firms are completely indifferent to their scale of production. As a result, the monopolistic and the research sectors do not need to compete for a common resource, since the labor employed in the competitive industry acts as a reserve storage of production factor.

7 The Steady State: $\phi = 1$

This section explores the long run effects of public spending within a traditional endogenous growth setup. Within this context population is assumed constant at level L. The structure of the model remains unchanged, except for equations [15] and [16], which turn into the following:

$$\dot{n} = B_n L_n n \tag{42}$$

$$\frac{w}{B_n n} = v \tag{43}$$

The procedure to solve for the steady state growth rates is the same as before. We start from the labor market equilibrium [28] and solve for γ_n:

$$\gamma_n = LB_n - \frac{EB_n}{w}(1 - \alpha + \alpha\epsilon) - \frac{TB_n}{w}(1 - \tau - \epsilon\tau) \tag{44}$$

We manipulate the no arbitrage condition [18] to get:

$$\frac{EB_n}{w} = \frac{1}{(1-\epsilon)\alpha}\left[\rho + \gamma_n - \frac{(1-\epsilon)\tau TB_n}{w}\right] \tag{45}$$

To obtain the steady state growth rate of innovation, substitute for $\frac{EB_n}{w}$ in the labor market equilibirum condition [44], and solve for γ_n:

[9] See Grossman and Helpman [1992 ch.3].

$$\gamma_n = LB_n(1-\epsilon)\alpha - \rho(1-\alpha+\alpha\epsilon) + T\frac{B_n}{w}(\tau-\alpha)(1-\epsilon) \tag{46}$$

We get a measure of output growth rate following the same argument outlined in the previoud section. Let $[P_Z, P_D(0)]$ the price vector in the base period $t = 0$. The level of real output is then $Y(t) = P_Z Z + P_D(0)D(t)$. The growth rate of the homogeneous good is zero, as in steady state it must verified that $r = \rho$. Differentianting D with respect to time, we get $\gamma_D = \gamma_n(1-\epsilon)/\epsilon$. Thus the real output growth rate γ_Y:

$$\gamma_Y = \left[\frac{P_D(0)D(t)}{P_Z Z + P_D(0)D(t)}\right]\frac{1-\epsilon}{\epsilon}\gamma_n$$

As the growth rate of D is positive and $P_Z Z$ is constant, the term in brackets tends to one as t becomes larger. Therefore, within the stady state perspective we can write:

$$\gamma_Y = \frac{1-\epsilon}{\epsilon}\gamma_n \tag{47}$$

8 Concluding Remarks

This paper outlines the long run effects of the fiscal policy, when the consumption activity on the part of the government may affect the global composition of demand. The results obtained encourages further research in at least two directions: First, it would be desiderable to explore the mechanics of changes in the demand composition within a more complex theoretical setting, where the non scale effect does not prevent endogenous growth. Second our findings provide new arguments to the debate on the stabilization policies. Indeed, considering our results it would be possible to implement an active policy of stabilization without changing the level of the government expenditure, but simply varying the composition of a given level of public consumption.

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