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ABSTRACT

Baumol's cost disease and the sustainability of the welfare state

If productivity increases more slowly for services than for manufactured goods, then services suffer from Baumol's cost disease and tend to become relatively more costly over time. Since the welfare state in all countries is an important supplier of tax financed services, this translates into a financial pressure which seems to leave policymakers with a trilemma; increase taxes (and hence tax distortions), cut spending or redistribute less. Under the assumptions underlying Baumol's cost disease, we show that these dismal implications are not warranted. The welfare state is sustainable and Baumol growth leaves scope for Pareto improvements.

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An economic specter haunts the democratic governments of the world's most prosperous economies. The rising cost of health care and education casts a shadow over virtually any election......ever more of gross national product will have to be channeled through the public sector, with all the problems we know that to entail (Baumol, 1993, p 17).

1   Introduction

Baumol (1967) raised the issue of how society would develop if there are ongoing productivity increases in the production of manufactured commodities and no (or lower) productivity increases in the production of services.[1] If wage increases are the same across sectors, it follows that the cost or price of services increases relative to manufactured commodities. A mechanism known as the Baumol's cost disease. Baumol predicted an ever declining employment level in manufacturing, increasing employment in the service sector, and eventually a stagnant economy. Although the Baumol cost disease applies to services in general, and not whether they are provided by the private or the public sector, a number of authors have pointed to the particular difficulties it raises for tax financed service provision. Baumol (1993) predicted that an ever increasing share of the gross domestic product would be absorbed by the public sector, and thus eventually lead to a tax rate in conflict with the Laffer bound. Similar arguments have been made in e.g. Lindbeck (2006) and van der Ploeg (2007).

There is empirical evidence in favour of Baumol's productivity assumptions and the implied structural changes. Empirical analyses show that services in general tend to have lower productivity growth than other goods and therefore their relative price tends to increase over time, see e.g. Nordhaus (2008). Structural changes leading to a declining employment share in manufacturing (in the broad sense of including primary and secondary) sectors and increasing employment shares in private and public services are observed for all OECD countries. It is also noteworthy that assessments of fiscal sustainability commonly point to Baumol's cost disease as an important expenditure driver (see e.g. IMF (2012) and European Commission (2013) as well as a long list of

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[1]See also Baumol and Bowen (1966), Baumol (1993) and Baumol et al. (2012).

specific country studies including Bates and Santerre (2013) on the US , Office of Budget Responsibility (2013) on the UK, New Zealand Treasury (2012) on New Zealand, and Regeringen (2013) on Sweden).

The implications of Baumol's cost disease seem to be dismal, stagnating economies and unsustainable public sectors. The stagnation implication has been reputed. Even accepting the premise that there are differences in productivity growth between manufactured goods and services as well as increasing employment shares in services, it does not necessarily follow that economies will stagnate. Ngai and Pissarides (2007) show that both facts are consistent with ongoing growth when account is taken of capital goods needed both for manufacturing and service production.

This paper considers the implications of the Baumol cost disease for the public sector or the welare state in more general terms. We interpret the welfare state broadly in the sense of tax financed provision of services (including education, health and care) as well as redistribution. All OECD countries have welfare states although obviously the size and structure differ. If the relative costs of producing publicly provided services increase over time, it seems to bring the welfare state into a financial squeeze leaving a trilemma for policy makers; increase taxes (at the cost of increasing tax distortion), cut spending on services or redistribute less. The latter two amount to a retrenchment of the welfare state.

We ask whether the welfare state is sustainable in the sense that the same principles for public provision of services can be maintained, and whether the same distribution of utility can be attained without comprising public finances. We accept the original Baumol assumptions on productivity growth and consider the implications for the welfare state under rather general assumptions on individual preferences and the social welfare function. It is shown that the welfare state is sustainable under Baumol growth. Maintaining unchanged principles for the supply of services and an unchanged distribution of well-being are not only consistent with a balanced budget, but leaves room for Pareto improvements.

The present paper is related to recent work on public provision of goods showing that the marginal cost of public funds and the efficiency loss from taxation may be

exaggerated when taking marginal tax rates at face value (e.g. Blomquist et al. (2010), Kaplow (2004), Kreiner and Verdelin (2012)). The basic idea follows by considering public provision financed by benefit off-setting and distribution neutral taxation (the benefit principle). If agents value the public provision – and possibly more with growth – then it is possible to increase their tax payment without lowering their utility and without impeding economic efficiency. In the case considered here, Baumol growth increases the price on the public service but changes also household income and thereby tax revenue and demand for public service. Using the benefit principle, we show that these effects, when taken together, always leave room for Pareto improvements.

The paper is organized as follows: The model featuring Baumol growth and a public sector engaged both in public provision of services and redistribution is set up in Section 2. Sustainability of the welfare state and the basic result on the effect of Baumol growth are provided in Section 3, while Section 4 offers a few concluding remarks.

2   A model of Baumol growth and public policies

The welfare state provides welfare services and redistributes. To capture both elements we formulate a model in which agents derive utility from a tax-financed public good or service[2] and have different earnings ability giving a motive for redistribution. We consider a standard two-goods model with a private good (labelled manufactured good) and a public good/service (labelled service). The productivity may increase for both types of production, but our main focus will be on the case of Baumol growth where productivity increases more in the production of manufactures than in service production.

2.1   Firms

The technologies available for production of manufactures (M) and services (S) are given as

$$Y_M = A_M L_M, \tag{1}$$

$$Y_S = A_S L_S, \tag{2}$$

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[2]Since the population size is constant, the public activity may be interpreted as either a collective good or an individualized service like health, care or education.

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where L_i denotes effective input of labour while A_i $(i = M, S)$ captures productivity.

We normalize the price of the manufacturing good to one, and let p_S denote the price on the service relative to the manufacturing good. The cost per unit of effective labour is denoted w (measured in units of the numeraire good), and assuming that labour is completely mobile between the two sectors implies a uniform wage across the sectors. The first-order conditions for the profit maximization problem of firms become[3]

$$w = \partial Y_M / \partial L_M = A_M, \tag{3}$$

$$\frac{w}{p_S} = \partial Y_S / \partial L_S = A_S. \tag{4}$$

We consider exogenous technological progress:

$$dA_M / A_M = g_M,$$

$$dA_S / A_S = g_S,$$

where *Baumol growth* is present whenever $g_M > g_S \geq 0$. From (3) and (4), we have

$$p_S = A_M / A_S \quad \Rightarrow \quad dp_S / p_S = g_M - g_S > 0, \tag{5}$$

showing that the Baumol effect makes the service more expensive relative to the manufactured good.

From eqs. (1), (2) and (5), we also have

$$\frac{p_S Y_S}{Y_M} = \frac{p_S A_S L_S}{A_M L_M} = \frac{L_S}{L_M},$$

showing that the service sector will use a larger fraction of labour if the value of service output increases as a fraction of GDP.[4]

2.2 Households

We consider a continuum of households which differ only with respect to abilities $n \in [\underline{n}, \overline{n}]$ distributed according to the density function $f(n)$ where $f(n) \geq 0$ and

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[3]Note that with perfect competition and constant returns there is no difference between a situation where the public sector acquires services in the market or is the producer of the service.

[4]The Baumol effect does not necessarily raise the fraction of income used on public services. This requires that the elasticity of substitution between the two types of goods in household demand is below one, cf. also Ngai and Pissarides (2007). We consider a general preference specification and do therefore not impose any restriction on the elasticity of substitution.

$\int_{\underline{n}}^{\overline{n}} f(n)dn = 1$. The effective labour input per hour of a type n individual is equal to n, implying that the wage per hour becomes

$$w(n) = w \cdot n = A_M n = p_S A_S n, \tag{6}$$

where we have used (3) and (4). Notice that technological progress does not influence the gross wage differential between different types of labour, $w(n'')/w(n') = n''/n'$. That is, we assume that *Baumol growth* does not affect the ability distribution and thus the wage distribution (we do not want to mix it up with skill-biased technological change).

The households have identical preferences which are represented by the following utility function

$$u = u(m, s, l), \tag{7}$$

where m denotes private consumption of the manufactured good, s is consumption of services supplied by the government, and l is hours-of-work. The utility function is twice continuously differentiable, $u_m > 0$, $u_s > 0$, $u_l < 0$, and the usual concavity and limit properties apply. The budget constraint of an individual equals

$$m \leq e - T(e), \tag{8}$$

where $e \equiv A_M n l$ denotes gross earnings (cf. eq. (6)), while $T(e)$ is a non-linear tax function defined over earnings. From eqs. (7), (8) and $l = e/(A_M n)$, we get

$$MRS_{me}(e, s, n) \equiv -\frac{u_l(e - T(e), s, l)}{u_m(e - T(e), s, l)} \frac{1}{A_M n} > 0, \tag{9}$$

$$MRS_{ms}(e, s, n) \equiv \frac{u_s(e - T(e), s, l)}{u_m(e - T(e), s, l)} > 0, \tag{10}$$

which measures the marginal rate of substitution between, respectively, m and e and m and s for a type n individual at the earnings level e. A household of type n chooses the earnings level $e(n)$ (or, equivalently, $l(n)$) and the consumption of manufacturing goods $m(n)$ that maximize (7) subject to (8), for a given level of public services s. The first-order condition gives

$$MRS_{me}[e(n), s, n] = 1 - \tau(e(n)), \tag{11}$$

where $\tau(e(n)) \equiv \partial T(e(n))/\partial e$ is the marginal tax rate at the income level $e(n)$. We follow the standard approach in optimal income taxation and contract theory and assume that the Spence-Mirrlees single-crossing condition is satisfied (e.g. Salanié, 2003):

$$\partial MRS_{me}(e, s, n)/\partial n < 0. \tag{12}$$

This assumption ensures that the tax system is implementable; i.e., that higher ability individuals always choose higher equilibrium earnings, implying that the government can use income as a signal of the underlying ability.

The indirect utility function of individual n when consumption of the manufactured good and labour supply are chosen optimally is defined as

$$v(n) \equiv u\left(e(n) - T(e(n)), s, \frac{e(n)}{A_M n}\right), \tag{13}$$

which also implies

$$v_n(n) = -u_l(\cdot)\frac{e(n)}{A_M n^2} > 0, \tag{14}$$

where we have used the Envelope Theorem.

2.3 Market Equilibrium

Market clearing in the factor market and in the market for the private good implies

$$L_M + L_S = \int_{\underline{n}}^{\bar{n}} nl(n) f(n) \, dn, \quad Y_M = \int_{\underline{n}}^{\bar{n}} m(n) f(n) \, dn.$$

2.4 Welfare State/Government

The government decides the level of public service $s = Y_S$ and the non-linear tax function $T(\cdot)$, and thereby also the degree of redistribution. Since the government cannot observe ability levels, taxes and transfers depend on observable income, and redistribution of income therefore generates an efficiency loss. Note that $T(\cdot)$ may be negative at certain income levels, reflecting that households at these income levels receive net-transfers. The policy choice of the government has to obey the budget constraint

$$R \equiv \int_{\underline{n}}^{\bar{n}} T(e(n)) f(n) \, dn - p_S \cdot s \geq 0. \tag{15}$$

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We consider a benevolent government having a social welfare function defined over individual utilities. Our result is general in the sense that we want to show that the welfare state is sustainable under *Baumol growth* for a large class of social welfare functions determining the level of public service provision and the extent of redistribution. We therefore only impose the mild condition that the policy choice of the government satisfies the Pareto Criterion; i.e., it is impossible to suggest another combination of s and $T(\cdot)$ which would generate a Pareto improvement. Using the Pareto Criterion, it is possible to show that an optimal level of public service satisfies (see Appendix A)

$$\int_{\underline{n}}^{\bar{n}} \left[MRS_{ms}\left(e\left(n\right),s,n\right) + \tau\left(e\left(n\right)\right) \frac{\partial MRS_{ms}\left(e,s,n\right)/\partial n}{\partial MRS_{me}\left(e,s,n\right)/\partial n} \right] f\left(n\right) dn = p_S, \qquad (16)$$

which is the modified Samuelson rule that has been derived elsewhere in the Public Finance literature (e.g. Kreiner and Verdelin (2012)). The RHS is the marginal rate of transformation of the manufactured good into the public service and the first term in the bracket on the LHS is the aggregate willingness to pay for the public good. These two terms alone constitute the original Samuelson rule, while the second term in the bracket stems from the incomplete information of the government concerning ability levels that give rise to tax distortions.[5]

3   Sustainability of the Welfare State

We define the welfare state to be sustainable under *Baumol growth* if it is possible to satisfy the demand for the public service according to the modified Samuelson rule and at the same time maintain an unchanged distributional profile of utility. With this definition, we have

Proposition 1 (*i*) *The welfare state is sustainable under Baumol growth; i.e., it is possible to satisfy service demand according to the modified Samuelson rule* (16) *and maintain an unchanged distribution of well-being* $v(n)$ *for all ability levels n without*

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[5] The denominator in the second term is negative due to the single-crossing condition (12), and the sign of the tax distortion effect is therefore determined by $\partial MRS_{ms}/\partial n$, which can be both positive and negative. In the special case of weak separability, where $u\left(m,s,l\right) = \tilde{u}\left(h\left(m,s\right),l\right)$, the tax distortion effect is zero, and the original Samuelson rule applies (see e.g. Christiansen (1981) and Kaplow (2004)).

violating the government budget constraint (15). (ii) It is always possible to obtain Pareto improvements from Baumol growth.

Proof: See Appendix B.

The proof of the proposition shows that it is possible under *Baumol growth* to keep everybody at their original utility level by an appropriate adjustment of the tax function, to maintain a supply of welfare services in accordance with the modified Samuelson rule (16), and at the same time obtain an increase in government revenue. Hence, the viability of the welfare state is not at stake, and the policy makers obtain degrees of freedom since the extra government revenue may, for example, be used to raise the well-being of everybody through a lump sum grant (this may reduce government revenue through an income effect on labour supply, but this effect would be of second order). This would give a Pareto improvement without increasing any measure of the inequality of well-being (on the contrary inequality would be reduced by most measures).

It is worth emphasizing that the above result is derived under reasonably weak assumptions; e.g., we have not imposed any strong assumptions on individual preferences such as weak separability as often done in related literature, nor on the social welfare function.

4 Concluding remarks

Baumol growth or Baumol's cost disease is widely perceived to lead the welfare state into the trilemma of either having to increase taxes or make retrenchment of the welfare state by cutting spending on services or redistribute less. We have shown this view to be false; it is possible to maintain principles for public provision of services and an unchanged distributional profile of well-being. Actually, Baumol growth leaves degrees of freedom since a government revenue gain is implied which creates scope for a Pareto improvement.

This paper has relied on the so-called benefit principle relying on the flexibility of non-linear taxation schemes making it possible to change tax payments at any income level to match the willingness to pay for public provision. It may be argued that this

assumes more flexibility in the taxation scheme than what is actually present (see e.g. Slemrod and Yitzhaki (2001)). While we recognize that there may be such a constraint in practice, the point of this paper is to show that Baumol growth does not inevitably lead to unsustainability of the welfare state.

The paper has adopted the key assumptions underlying Baumol's cost disease to show that an often asserted implication does not hold. In our investigation we have only focused on the efficiency loss from taxation. Another potential challenge may be on the expenditure side where the optimal allocation of resources may be hampered by the lack of clear price signals, implying that a larger public sector may be detrimental to economic efficiency.

A Derivation of equation (16)

Our derivation of the modified Samuelson rule follows the approach in Kreiner and Verdelin (2012). We consider a small (marginal) increase in s and a change in the tax function $T(\cdot)$ that keeps the utility level $v(n)$ fixed at all ability levels n. If such a change raises government revenue, then it is possible to make a Pareto improvement, implying that the initial level of s is socially suboptimal. If, on the other hand, government revenue decreases, then a Pareto improvement can be achieved by decreasing s. Hence, if the level of public service is set optimally, a Pareto improvement is not possible.

From the government budget constraint (15), we have

$$dR \equiv \int_{\underline{n}}^{\bar{n}} \left(dT\left(e\left(n\right)\right) + \tau\left(e\left(n\right)\right) de\left(n\right) \right) f\left(n\right) dn - p_S \cdot ds, \tag{A-1}$$

where $dT\left(e\left(n\right)\right)$ is the mechanical change in tax burden at the income level $e\left(n\right)$ while $\tau\left(e\left(n\right)\right) de\left(n\right)$ is the change in government revenue due to behavioural responses.

Unchanged utility at all ability levels implies from eqs. (13) and (14) that the change in the allocation satisfies

$$dv\left(n\right) = u_m dm + u_s ds + u_l \frac{de(n)}{A_M n} = 0, \tag{A-2}$$

$$dv_n\left(n\right) = -\left[u_{ml} dm + u_{sl} ds + u_{ll} \frac{de(n)}{A_M n} \right] \frac{e(n)}{A_M n^2} - u_l \frac{de(n)}{A_M n^2} = 0, \tag{A-3}$$

for all n.[6] By isolating dm in the first of these equations and substituting the result into the second equation, we obtain

$$de(n) = \left[\frac{u_{sl} - u_{ml}\frac{u_s}{u_m}}{u_{ml}\frac{u_l}{u_m}\frac{1}{A_M n} - u_{ll}\frac{1}{A_M n} - u_l\frac{1}{e}} \right] ds. \tag{A-4}$$

From eqs. (9) and (10), we have

$$\frac{\partial MRS_{ms}(e,s,n)}{\partial n} = -\frac{e}{u_m A_M n^2} \left[u_{sl} - u_{ml}\frac{u_s}{u_m} \right]$$

$$\frac{\partial MRS_{me}(e,s,n)}{\partial n} = -\frac{e}{u_m A_M n^2} \left[u_{ml}\frac{u_l}{u_m}\frac{1}{A_M n} - u_{ll}\frac{1}{A_M n} - \frac{u_l}{e} \right].$$

By inserting these two derivatives in (A-4), we obtain

$$de(n) = \frac{\partial MRS_{ms}(e,s,n)/\partial n}{\partial MRS_{me}(e,s,n)/\partial n} ds. \tag{A-5}$$

The household budget constraint $m = e - T(e)$ implies that $dm = (1 - \tau) de - dT(e)$. This expression and the first order condition (11) enable us to write condition (A-2) as

$$dT(e(n)) = \frac{u_s(\cdot)}{u_m(\cdot)} ds = MRS_{ms}(e,s,n) \cdot ds. \tag{A-6}$$

This equation shows that the increase in the tax burden of an individual with earnings e is exactly equal to the extra benefit from the expansion of government consumption.

By inserting eqs. (A-5) and (A-6) into (A-1), we obtain

$$\frac{dR}{ds} = \int_{\underline{n}}^{\bar{n}} \left(MRS_{ms}(e(n),n) + \tau(e(n)) \frac{\partial MRS_{ms}(e,s,n)/\partial n}{\partial MRS_{me}(e,s,n)/\partial n} \right) f(n)\, dn - p_S.$$

If $dR/ds > 0$, then it is possible to make a Pareto improvement by increasing s, and if $dR/ds < 0$, then it is possible to make a Pareto improvement by reducing s. Hence, a Pareto optimum is characterized by $dR/ds = 0$, which gives the result in eq. (16).

B   Proof of Proposition 1

We use a dual approach to prove the proposition. Technological progress raises wages and changes the relative size of the public sector. To maintain an unchanged distributional profile, we consider an adjustment in the non-linear income tax that keeps

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[6]These two conditions also ensure that the post-reform allocation is incentive compatible (see Kreiner and Verdelin, 2012).

everybody at the pre-change utility level. At the same time public provision should satisfy (16). If the increase in tax revenue is larger than the extra costs on government-provided services, then the government is able to fulfil all requirements in the definition of sustainability. According to the dual approach, at every income level both the direct change to the tax burden and the change in the marginal tax rate are determined endogenously by the requirement that the utility of all individuals is unchanged (the benefit principle), implying that $v(n)$ and $v_n(n)$ are fixed. Following a change in productivity and a change in public service, we consider a change in the tax function $T(\cdot)$ such that for all n, we have $dv(n) = 0$ and $dv_n(n) = 0$. Using (13) and (14), these two conditions give

$$dv(n) = u_m dm + u_s ds + u_l \frac{de}{A_M n} - \frac{u_l e}{A_M n} g_M = 0, \tag{B-7}$$

$$\begin{aligned} dv_n(n) &= -u_{ml}\frac{e}{A_M n^2}dm - u_{sl}\frac{e}{A_M n^2}ds - u_l\frac{de}{A_M n^2} - u_{ll}\frac{e \cdot de}{A_M^2 n^3} \\ &+ \frac{u_l e}{A_M n^2}g_M + u_{ll}\frac{e^2}{A_M^2 n^3}g_M = 0. \end{aligned} \tag{B-8}$$

From (B-7), we get

$$dm = \frac{u_l}{u_m}\frac{e}{A_M n}g_M - \frac{u_l}{u_m}\frac{e}{A_M n}\frac{de}{e} - \frac{u_s}{u_m}ds, \tag{B-9}$$

and from (B-8), we have

$$0 = -u_{ml}dm - u_{sl}ds - \left[u_l + u_{ll}\frac{e}{A_M n}\right]\frac{de}{e} + \left[u_l + u_{ll}\frac{e}{A_M n}\right]g_M.$$

After substituting dm from eq. (B-9) into this expression, we obtain

$$de = \frac{\frac{u_{ml}u_s}{u_m} - u_{sl}}{\frac{u_l}{e} + u_{ll}\frac{1}{A_M n} - \frac{u_{ml}u_l}{u_m}\frac{1}{A_M n}}ds + e \cdot g_M. \tag{B-10}$$

From eqs. (9) and (10), we have

$$\begin{aligned} \frac{\partial MRS_{ms}(e, s, n)}{\partial n} &= \frac{e}{u_m A_M n^2}\left[u_{ml}\frac{u_s}{u_m} - u_{sl}\right], \\ \frac{\partial MRS_{me}(e, s, n)}{\partial n} &= \frac{e}{u_m A_M n^2}\left[\frac{u_l}{e} + u_{ll}\frac{1}{A_M n} - \frac{u_{ml}u_l}{u_m}\frac{1}{A_M n}\right]. \end{aligned}$$

By inserting these two derivatives in (B-10), we obtain

$$de = \frac{\partial MRS_{ms}(e, s, n)/\partial n}{\partial MRS_{me}(e, s, n)/\partial n}ds + e \cdot g_M. \tag{B-11}$$

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Insertion of this expression into (B-7) gives

$$dm = -\frac{u_s}{u_m}ds - \frac{u_l}{u_m}\frac{1}{A_M n}\frac{\partial MRS_{ms}(e, s, n)/\partial n}{\partial MRS_{me}(e, s, n)/\partial n}ds. \qquad \text{(B-12)}$$

The household budget constraint (8) implies

$$dm = (1 - \tau)\,de - dT(e),$$

where $dT(e)$ denotes the change in the total tax burden at the earnings level e. After using eqs. (B-11) and (B-12) to substitute for de and dm, we obtain

$$
\begin{aligned}
dT(e) &= \left(1 - \tau + \frac{u_l}{u_m}\frac{1}{A_M n}\right)\frac{\partial MRS_{ms}(\cdot)/\partial n}{\partial MRS_{me}(\cdot)/\partial n}ds + (1 - \tau)\,e \cdot g_M + \frac{u_s}{u_m}ds \\
&= (1 - \tau)\,e \cdot g_M + \frac{u_s}{u_m}ds, \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \text{(B-13)}
\end{aligned}
$$

where the last equality follows from the optimum condition of the household (11). The above expression measures the compensating increase in the tax burden of a type n individual compared to the existing system; i.e., the benefit principle implies that the tax function is adjusted to capture the benefits of individual n from a higher public service and a higher productivity. If the net effect on government revenue of the changes in productivity and public service and the required change in taxation is positive, then the welfare state is sustainable. In order to show that this is the case, we differentiate the government revenue (15). This gives

$$dR = \int_{\underline{n}}^{\bar{n}} [dT(e(n)) + \tau(e(n))de(n)]\,f(n)\,dn - dp_S \cdot s - p_S \cdot ds.$$

Using eqs. (5), (B-11) and (B-13), we obtain

$$dR = \int_{\underline{n}}^{\bar{n}} \left[e \cdot g_M + \frac{u_s}{u_m}ds + \tau(e(n))\frac{\partial MRS_{ms}/\partial n}{\partial MRS_{me}/\partial n}ds\right] f(n)\,dn - (g_M - g_S)\,p_S s - p_S \cdot ds,$$

which, after using the modified Samuleson rule (16), becomes

$$dR = g_M \int_{\underline{n}}^{\bar{n}} ef(n)\,dn - (g_M - g_S)\,p_S s > 0,$$

where the inequality follows from the fact that $\int_{\underline{n}}^{\bar{n}} ef(n)\,dn > p_S s$. $\square$

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