UNIVERSITÀ DEGLI STUDI DI TRENTO
DIPARTIMENTO DI ECONOMIA

THE SERVICE PARADOX AND ENDOGENOUS ECONOMIC GROWTH

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Discussion Paper No. 1, 2003

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The service paradox and endogenous economic growth

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November 2002

Abstract

Many empirical studies show the paradoxical fact that service output in proportion to industrial output does not tend to decline, in spite of rising service prices. Baumol's "cost disease" model well explains rising service prices, but it simply assumes that the output proportion remains constant. It concludes that service employment expands, and aggregate economic growth declines. The paper extends Baumol's model in two main directions: it endogenises households' preferences by assuming that they favour services insofar as income rises; it endogenises income growth by considering that several services contribute to the formation of human capital. Both the cases of rising human capital as a side-effect of consuming services, and as an investment purpose are studied. The conclusions in both cases are that the paradox can find an explanation; service employment expands, but Baumol's pessimistic conclusion on the decline of aggregate economic growth can be alleviated, or even reversed, and more promising policy implications can be drawn.

J.E.L. code: D11, J21, J24, O41
Keywords: service employment, human capital, unbalanced growth, Baumol

1 Introduction

The recent literature on economic growth and structural change has increasingly focused on the paradoxical fact that, in spite of rising service prices, the demand for services in proportion to the demand for industrial products in real terms has not generally declined in the long run. This paradox was first pointed out by Baumol (1967), who formally proved that service prices tend to rise without bound, but then *assumed* that the proportion of real demand for services remains unchanged.

The key explanation for rising service prices, according to Baumol, is that productivity in the service sector tends to lag behind that of manufacturing. This explanation is consistent with a large body of evidence (Baumol 2001; Baumol, Blackman and Wolff 1989; Huther 2000; Fase and Winder 1999; Pellegrini 1993), and it is theoretically well-founded. However, the *effects* of rising service prices on the entire economy crucially depend on the assumption made with regard to the service proportion of demand. If the proportion of service demand in real terms is held constant, then the nominal expenditure share for services rises, employment shifts from industry to services, thus giving rise to the much debated "deindustrialisation" problem, and consequently aggregate productivity growth declines. If instead the share of nominal expenditure on services is assumed to be unchanged, the proportion of real demand for services tends towards zero. However, the evidence shows that the proportion of overall service output across countries or over time, increases, or it is roughly constant (Baumol 2001; Baumol, Blackman, and Wolff 1989; Echevarria 1997; Kongsamut, Rebelo and Xie 2001; Rowthorn and Ramaswamy 1999; World Bank 1994).

This paper studies a solution of the paradox along Engelian lines: as income increases, households' preferences shift to services, which can be regarded as "luxury" consumption. This approach was already used by Clark (1940) to explain the increasing share of service employment, and it has been recently refreshed by Appelbaum and Schettkat (1999). It can be also justified by Maslow's (1970) argument that human aspirations increase once basic material needs have been satisfied. Finally, the approach has received recent empirical support from Curtis and Murthy (1998) and from Moeller (2001), who estimate an income elasticity of services greater than one.

Clark's and Baumol's types of explanation of deindustrialisation have been labelled as "demand side" and "supply side" respectively, and thus appear to be in competition with each other (Fuchs 1968; Inman 1985). In what follows a general equilibrium model is proposed which synthesises both Clark's and Baumol's intuitions, in that it considers both the bias in household preferences toward services and the bias in productivity against services[1].

A second original contribution of the paper lies in its analysis of growth. Baumol's model assumes exogenous rates of productivity in the two sectors; and, moreover, it assumes that the two sectors are final. However, recent and ample literature has shown that productivity growth can be endogenised by studying the interaction between sectors. In particular, it has been observed that many services are inputs for firms and trigger productivity advances, so that the demand bias may contribute to growth, and thus challenge Baumol's pessimistic conclusion (Oulton 2001). However, the evidence shows that the shift of demand for services from households to firms is not of particular importance (Russo and Schettkat 2001). By contrast, the evidence also shows that education and health care account for a large proportion of overall services. This observation suggests that serious consideration should be made of the character of investment in human capital attributed to education, health and other household service expenses (Baumol 2001; Spithoven 2000). The model will therefore propose that services do not simply enter the utility function; they also enter the accumulation function of human capital, which is then used as an input in all sectors[2]. Furthermore, a distinction will be drawn between the case where the effects of services on human capital accumulation are unintentional, and the case where these effects are included in the household decision problem.

The paper is organised as follows: section 2 sets out the benchmark model, which extends Baumol's model by explicitly specifying the demand for goods and services; section 3 considers the positive effects of household services on human capital, and hence on productivity and growth, as an unintentional

[1] Gundlach (1994) observes that in the case of a unitary income elasticity the sectoral gap in productivity growth is not consistent with the constant proportions in real demand. The consistency can be found by allowing income elasticity to change, as in the model proposed here, or by introducing homework as a third low-productivity sector, as in Pugno (2001).

[2] Steger (2002) assumes that the entire consumption enters both functions of utility and of human capital. He finds an interior solution because of the decreasing returns of the accumulation function. Therefore, in order to obtain permanent growth, he also assumes an "AK" model. In this paper the interior solution is due to the offsetting effects of rising service prices. The expenses for services will thus have growth effects.

feed-back; section 4 internalises these effects in household behaviour; section 5 discusses some policy implications; section 6 concludes.

2 A Baumolian benchmark model

The production side of the model strictly follows Baumol's (1967) model. It assumes in fact that a two-sector economy produces according to the following simple production functions which reproduce the microeconomic functions of a large number of identical firms:

$$\begin{aligned} Q_m &= aL_m e^{rt} \quad \text{with} \quad L_m \geq 0 & (1) \\ Q_s &= bL_s \quad \text{with} \quad L_s \geq 0 & (2) \end{aligned}$$

where Q_m and Q_s are the outputs of manufacturing goods and services respectively, L_m and L_s is employment in the two sectors. Productivity in manufacturing is greater than that in services ($a \geq b > 0$), while the exogenous positive rate r captures technical progress, which regards manufacturing only.

Since full employment prevails, L_m and L_s also represent sectoral employment shares, with total employment (L) set equal to 1, that is:

$$L_m + L_s = L = 1 \tag{3}$$

The wage rate (w) is assumed to be equal in the two sectors, and is determined as in Baumol's model. The usual FOCs for firms yield:

$$\begin{aligned} w &= ae^{rt} & (4) \\ p &= \frac{a}{b}e^{rt} & (5) \end{aligned}$$

where p is service price, while the manufacturing good is taken as the numeraire.

Baumol's first result follows straightforwardly: service relative prices grow without bound.

The demand side is specified according to a static Cobb-Douglas utility function:

$$u(Q_s, Q_m) = \lambda \ln Q_s + (1-\lambda) \ln Q_m \tag{6}$$

with $0 \leq \lambda < 1$. The budget constraint is simply:

$$wL \geq pQ_s + Q_m \tag{7}$$

The usual FOCs for consumers yield:

$$p = \frac{\lambda}{1-\lambda}\left(\frac{Q_s}{Q_m}\right)^{-1} \tag{8}$$

Baumol's second result is also straightforward: since p tends to infinity, $\frac{Q_s}{Q_m}$ asymptotically goes to zero, if λ remains constant. Specifically, Q_s remains constant, and Q_m rises indefinitely, since:

$$Q_m = w(1-L_s) = ae^{rt}(1-L_s) \tag{9}$$

$$Q_s = \frac{w}{p}L_s = bL_s \tag{10}$$

and, in this case, since $L_s = \lambda$.

This result is due to the Cobb-Douglas specification of the utility function. If a greater degree of substitutability between manufacturing goods and services were specified, Q_s would tend to disappear[3].

The case of *constant* λ as considered above would represent, according to Baumol, price elastic services like live performances and cultural services, which unfortunately appear to shrink dramatically. In order to represent the other case of "relatively income elastic and price inelastic" services, like education, health and retailing, Baumol alternatively assumes a *constant* $\frac{Q_s}{Q_m}$ (Baumol 1967; Towse 1997). Unfortunately, empirical studies are unable to identify the services in the two cases, especially because of the ambiguities of price elasticities (Falvey and Gemmell 1995; Moeller 2001; Summer 1985).

In the second case, it is evident from equation (8) that a rising p would require a rising λ, growing at the rate $r(1-\lambda)$. But in the model λ is a preference parameter, and it represents both the nominal service expenditure share and the service employment share. If, for a moment, we allow λ

[3]See on this point Bradford (1969) and Baumol (1972).

to adequately change, a further Baumolian conclusion can be drawn: that economic growth declines.

The latter conclusion can be demonstrated by defining economic growth (γ_T) as a weighted average of the sectoral growth rates:

$$\gamma_T = \left(\gamma_{\frac{Q_s}{L_s}}\right) L_s + \left(\gamma_{\frac{Q_m}{L_m}}\right) (1 - L_s) \tag{11}$$

This represents both aggregate productivity growth and aggregate output growth, since employment is constant. A rise in λ, i.e. in L_s, implies a decline in γ_T toward the service growth rate, which is 0 from equation (2)[4].

A possible explanation of the change in λ is provided by the application of Engel's law to services, which can thus be regarded as luxuries (Appelbaum and Schettkat 1999). As income increases, consumer preferences turn to services. This assumption can be stated by the following equation:

$$\lambda = 1 - \frac{1}{1 + \mu w L} \quad \text{with} \quad \mu > 0 \tag{12}$$

This simple and rather general equation warrants us that λ is an increasing function of w, and that $0<\lambda<1$ for a positive and finite w. The parameter μ governs the slope of the function. More precisely, the elasticity of λ with respect to μ is equal to $\frac{\mu}{\mu+w} < 1$ [5].

Substituting (3) and (4) into (12), and then (12) and (5) into (8) yields:

$$\frac{Q_s}{Q_m} = \mu b \tag{13}$$

The result thus obtained is what Baumol assumed, i.e. the constancy of $\frac{Q_s}{Q_m}$. Secondly, this result highlights the determinants of $\frac{Q_s}{Q_m}$. The greater the efficiency in producing services (b), or the greater the sensitivity of preferences for services to income (μ), the greater the proportion of output services.

[4] This is the reason for preferring arithmetic average to geometric average.

[5] This equation also exhibits the property that the growth rate of $\frac{Q_s}{Q_m}$, which will be obtained below, does not depend on time.

3 The unintentional effects on human capital and growth

Baumol mainly considers the demand for goods and services by households in his analysis of the "cost disease" problem. By contrast, the demand for business services, specifically R&D services, has been studied by the recent theory of endogenous growth, which has furnished an optimistic picture of stable prices and rising productivity[6]. But also when a broader definition is given to business services, the literature has observed their productivity-enhancing role, especially in view of their effect on the adoption and diffusion of information technology (Abraham and Taylor 1996; Fixler and Siegel 1999; Miles 1993; Mattey 2001). This may help to explain the paradox of persistent demand for services while service prices are rising. However, the proportion of real output of business services is still very small: in the US, they accounted for 4% of real Gdp in 1977, rising to 7% in 1996 (Mattey 2001:91).

Attention should thus return to household services, in which case the proportion of real output is substantial. Even if some ambiguous items are excluded, like transportation, communications and other utilities, trade, finance, insurance and real estate, household services thus defined accounted for 30% of real Gdp in the US in 1977 and 25% in 1996 (Mattey 2001:90)[7].

Analogously to business services, also household services can be considered as intermediate demand, insofar as they contribute to the formation of human capital which is used in production[8]. Formal education is the most obvious service of this kind, followed by cultural services like libraries, and health services. A third line of reasoning considers the software component of high-tech consumption to be also important in forming human capital. Today a *curriculum vitae* which does not comprise basic skills in word processing and internet use no longer qualifies a candidate for white-collar employment. The consumption of goods also forms human capital, but services are the most effective means, and hardly substitutable to this end, since they are

[6]De Groot (2000) offers a rather comprehensive picture of endogenous growth models for an economy with a business and R&D sector, and a traditional industrial sector.

[7]Baumol, Blackman and Wolff (1989:133) obtain very similar figures by estimating the "stagnant sector", i.e. the low productivity growth sector of the economy.

[8]Spithoven (2000) extends the contribution of household services to include the formation of social and cultural capital.

closely connected with human relationships. Moreover, the public provision and regulation of education, health care and cultural services can be used as channels of policy intervention not only for welfare purposes but also to increase the economy's long run efficiency.

Before passing to the extension of Baumol's model which will consider the effect of consumer services on human capital, a key issue must be briefly discussed: whether this effect is actually included in the consumer decision problem. The fact that formal education is generally perceived as an investment, rather than as a pleasant form of consumption, suggests that it is included in the consumer decision problem. This is confirmed by a large body of microeconomic literature that takes the Mincerian approach. However, this is not always the case, and nor is it as regards many other kinds of consumer service. Easterly (2001), for example, argues that education is under-incentivated in many less developed countries, and there is much room for policies in this field. In the case of health services, the potential for prevention is undoubtedly far from being fully exploited by households. Finally, some services are perceived as pleasant and currently form part of informal education.

In the present section, the effect of the consumption of service products on human capital is not included in the consumer decision problem but is instead considered to be a side-effect. In the next section, however, it will be included, and services will also be considered as a kind of investment.

Let us assume that the consumption of services upgrades a skill index (h) which starts from unity, as follows:

$$\dot{h} = \delta Q_s \tag{14}$$

where the dot stands for the time first derivative, and δ (>0) for efficiency in upgrading. This index refers to labour's generic skill in producing, and thus defines a measure of human capital when attached to L. The above equations (1)-(2) and (9)-(10) thus appear in this case as:

$$Q_m = a\left(L_m h\right)e^{rt} = ahe^{rt}\left(1 - L_s\right) \tag{15}$$

$$Q_s = b\left(L_s h\right) = bhL_s \tag{16}$$

Note that in equation (14) a stock variable (h) changes only if a positive flow variable (Q_s) takes place. However, services are produced by using part of the existing human capital stock, so that a Lucas-like accumulation function ensues from (14) and (16):

$$\gamma_h = \delta b L_s \tag{17}$$

The growth rates of sectoral productivity can thus be obtained:

$$\gamma_{\frac{Q_m}{L_m}} = r + \delta b L_s \tag{18}$$

$$\gamma_{\frac{Q_s}{L_s}} = \delta b L_s \tag{19}$$

so that the economic growth equation becomes:

$$\gamma_T = \delta b L_s + r\left(1 - L_s\right) \tag{20}$$

Baumol's conclusions must herefore be significantly modified, and interesting results emerge. In the case of constant λ, the economy grows at a higher rate than it does in Baumol's model, to an amount of $\delta b L_s$. If instead $\frac{Q_s}{Q_m}$ is held constant for some reason, and λ is allowed to change adequately, then a rising p induces economic growth to converge on the rate δb, and to diverge from r. If $\delta b < r$, growth decreases toward a positive rate, rather than zero as in Baumol. Note that both sectoral growth rates increase, while the overall economic growth decelerates because of the composition effect. But if $\delta b > r$, economic growth accelerates, although the gap between the sectoral growth rates still remains.

If λ changes according to equation (12), then equation (13) becomes:

$$\frac{Q_s}{Q_m} = \mu b h \tag{21}$$

The proportion of services tends to rise in accordance with the rise of human capital, i.e.:

$$\gamma_{\frac{Q_s}{Q_m}} = \delta b L_s \tag{22}$$

Therefore, the service paradox is resolved, while the human capital channel adds a significant positive effect on growth.

4 Internalising the effects on human capital and growth

Household services include services consumed for their pleasant current content, which may affect human capital, as studied in the previous section. Household services also include expenses explicitly devoted to the formation of human capital without any pleasant current content. In general, household services are expenses for purposes of both consuming and investing to different extents, while also the former purpose may have side-effects on human capital. This section sets out the general case in two steps. It first studies the general case by assuming household preferences (i.e. λ) as given and then considers the effects of their endogenisation.

The decision problem by households is represented as follows:

$$\max U_{t=0} = \int_0^\infty \left(\lambda \ln Q_s + (1-\lambda) \ln Q_m\right) e^{-\rho t} dt \tag{23}$$

subject to:

$$\begin{aligned} \dot{k}_t &= \delta d Q_{s,t} && (24) \\ k_{t=0} &= 1 && (25) \\ \lim_{t\to\infty} \varphi_t k_t L &= 0 && (26) \end{aligned}$$

and to the constraints (3) and (7). The parameter $\rho(>0)$ is the rate of time preference and φ_t is the shadow price of an extra unit of human capital in terms of present utility. The parameter d denotes the share of services which is intentionally devoted to increasing human capital, while $(1-d)$ denotes the share of services which unintentionally increases human capital. The parameter δ still measures the average efficiency of overall services in raising human capital, so that equation (14) again governs the actual increase of human capital, which then feed-backs to the production functions. In particular, if d=0, then services are consumed without any investment purpose, although they may have some unintentional investment effects, and to this extent they affect future growth. This particular case requires the restriction λ>0.

The Hamiltonian is thus:

$$H = (\lambda \ln Q_s + (1-\lambda) \ln Q_m)\, e^{-\rho t} + \varphi \delta d Q_{s,t} \tag{27}$$

which, by introducing $(aL_m h e^{rt})$ for $Q_{m,t}$, and $(bL_s h)$ for $Q_{s,t}$, yields the following FOCs:

$$\begin{aligned} H_{L_s} &= 0 \quad \Rightarrow \quad \varphi_t = \frac{e^{-\rho t}}{\delta d b h_t} \frac{L_s - \lambda}{L_s (1-L_s)} && (28) \\ H_h &= -\dot{\varphi}_t \quad \Rightarrow \quad \frac{e^{-\rho t}}{h_t} + \varphi_t \delta d b L_s = -\dot{\varphi}_t && (29) \end{aligned}$$

Taking logs and differentiating (28), and then equating with (29) after substituting for φ_t, yield, after some manipulations, the following non-linear dynamic equation:

$$\gamma_{L_s} = \frac{-\rho - \delta b L_s \left(1 + \frac{d(1-\lambda)}{\lambda - L_s}\right)}{1 - L_s \left(\frac{1}{L_s - \lambda} + \frac{1}{1-L_s}\right)} \tag{30}$$

Note that each household solves the dynamic maximisation problem taking λ as given, even if, as it will be shown below, λ can be made endogenous (Broome 1993).

Study of equation (30) allows us to state the following proposition.

Proposition 1 *(i) For given values of λ and d, such that $\lambda \in]0,1[$ and that $d \in [0,1]$, one equilibrium value L_s^* is obtained within the interval $[0,1]$. The equilibrium value L_s^* is a monotonic rising function of λ and of d, and it is strictly greater than λ.*

(ii) If $\lambda = 0$ and $d = 1$, then $L_s^* = 1 - \frac{\rho}{\delta b}$.

Proof. The equilibrium values of L_s can be obtained by imposing γ_{L_s}=0 on equation (30), which will be labelled (30'). The solutions included in the relevant interval under *(i)* are $L_{s,0}^*$=0, $L_{s,1}^*$=1, and:

$$L_s^* = \frac{1}{2\delta b}\left(-\rho + \delta b \lambda + \delta b d - \delta b d \lambda + \sqrt{\Delta}\right) \tag{31}$$

where:

$$\Delta = \left(\rho^2 + 2\delta b \rho (\lambda - d + d\lambda) + \delta^2 b^2 \left((\lambda + d)^2 - \lambda d (2\lambda + 2d - d\lambda)\right)\right)$$

and where $0<L_s^*<1$. This last property of L_s^* can be proved as follows. Let us first obtain the first derivative with respect to L_s of the r.h.s. of (30'). The derivatives calculated at the solutions $L_{s,0}^*=0$, $L_{s,1}^*=1$ thus, respectively, appear:

$$\begin{aligned} -\rho &< 0 \\ -\frac{(\delta b(1-d)+\rho)(1+\lambda(\lambda-2))}{(1-\lambda)^2} &< 0 \end{aligned}$$

Since (30') is a continuous function within the defined interval, L_s^* must lie between $L_{s,0}^*=0$ and $L_{s,1}^*$, and the derivative at L_s^* must be positive. Hence, an initial general value $L_s \in]0,1[$ different from L_s^* would move toward 0 or 1. However, these extreme solutions must be discarded, because of the transversality condition (26). This in fact thus appears when the appropriate substitutions are made:

$$\lim_{t\to\infty} \frac{e^{-\rho t}}{\delta db} \frac{L_s-\lambda}{L_s(1-L_s)} \frac{k_t}{h_t} = 0$$

This condition is fulfilled if L_s does not tend either to 0 or to 1, while $\frac{k_t}{h_t}$ does not increase as time runs, because:

$$\gamma_{\frac{k}{h}} = \delta db L_s \frac{h}{k} - \delta b L_s \leq 0$$

if $dh_{t=0} \leq 1$, which is easily satisfied (see below).

The fact that L_s^* is a monotonic rising function of λ and of d can be proved by observing the positive equilibrium value L_s^* as suitably rewritten:

$$\begin{aligned} L_s^* &= \frac{1}{2\delta b}\left(-\rho+\delta b\lambda(1-d)+\delta bd+\sqrt{\Delta}\right) \\ L_s^* &= \frac{1}{2\delta b}\left(-\rho+\delta b\lambda+\delta bd(1-\lambda)+\sqrt{\Delta}\right) \end{aligned}$$

and the derivatives of Δ:

$$\begin{aligned} \frac{\partial\Delta}{\partial\lambda} &= 2\delta b\rho+2\rho\delta bd+2\delta^2b^2(d(1-d)+\lambda(1-d)^2)>0 \\ \frac{\partial\Delta}{\partial d} &= 2\delta b((1-\lambda)(\delta b(\lambda+d(1-\lambda))-\rho))>0 \end{aligned}$$

¿From the above, $L_s^*>\lambda$ follows.

Part *(ii)* of the proposition can be simply proved by substituting the particular values of λ and d into (31). ■

The special case ($\lambda = 0, d = 1$) is interesting for growth theorists, although it is not realistic, because it assumes that services consist only of expenses intentionally devoted to accumulating human capital. It closely resembles Lucas' (1988) well-known model, where growth is determined by human capital accumulation. The similarity is perhaps disguised by the fact that in Lucas' model the key choice of households concerns time allocation between formal education and work, while in our case their key choice concerns spending allocation between education services and other expenses[9]. Part *(ii)* of the proposition tells us that an equilibrium exists in this allocation, which is in terms of sectoral labour. Therefore, human capital is accumulated through equation (17), and growth is ensured through equation (20), and would be even if no exogenous technical progress were assumed, i.e. if r were zero. The interest of our model is that the allocation is determined by variables which may be affected by policy makers: namely, efficiency in producing education (b), which is a quantitative measure of service output, and efficiency in increasing human capital (δ), which is rather a qualitative measure of input. Long-run growth policies may thus be identified.

However, the model specifies the sector of services as characterised by a low level and growth rate of labour productivity, and thus includes important services for consumption. The realistic case is hence ($0 < \lambda < 1, 0 < d < 1$). Also in this case the equilibrium value L_s^* can be still determined, and, moreover, a greater preference for consuming services (λ) or a greater share of intentional investment in human capital (d) implies a larger service labour share. The same effect may be due to a smaller time preference (ρ). In the case $\rho = 0$ intentional spending on human capital may go to zero, thus giving rise to the case in the previous section.

Moreover, having determined a constant L_s^*, two other conclusions follow: that aggregate growth, at a given λ, is thus determined (see equation (20)), and that the proportion of service output ($\frac{Q_s}{Q_m}$) diminishes at the rate r toward zero.

[9]Our case may also consider the fact that individuals distinctly spend their time on producing and on absorbing services like education, besides the time spent on producing the other products. The conclusions do not significantly change if the ratio of time spent on the production and absorption of services is held constant.

The endogenisation of household preferences that links λ to income induces L_s^* to grow insofar as income grows. But the rate of income growth also depends on the level of human capital accumulation, and hence on the level L_s^*. An effective bound on this dynamic is that L_s cannot exceed unity, but approaching unity may be not a necessary outcome. An interesting case would be that in which the dynamics converge by leading L_s^* toward a higher level but below unity. Moreover, the dynamics of the proportion of service output $(\frac{Q_s}{Q_m})$ depends on the dynamics of L_s^*. The rise in L_s^* may be not sufficient to increase $\frac{Q_s}{Q_m}$. If it is sufficient but tends to cease before L_s has approached unity, then $\frac{Q_s}{Q_m}$ eventually declines and falls toward zero.

These dynamics can be studied by substituting equation (12) into the equation (31), and then differentiating with respect to time. Unfortunately, the new equation becomes analytically intractable, so that numerical simulations must be employed.

Before running simulations, numerical values must be given to the parameters. This preliminary excercise is interesting on its own account, since it allows us to check the consistency of the parameters of the model. Stated more clearly: a starting value for L_s must be given in order to obtain L_s^* from the model. We expect reasonable parameters to give a theoretical L_s^* close to the starting L_s, which can be usually observed in economies.

For example, the US in 1990 exhibited an employment share of household services[10] over total employment, i.e. L_s, of about 45%. Let us assume the following values. If productivity growth in manufacturing is 3%, and if it is twice productivity growth in services, then $r = \delta b L_s = 1.5\%$, and $\delta b = 3.3\%$. The parameter μ can be obtained from the initial value of λ (see equation (12)), which is the nominal service share in the household budget, i.e. $\lambda_{t=0} = \left(\frac{pQ_s}{pQ_s+Q_m}\right)_{t=0} = L_s$. Hence, $\mu = 1.2$, while $\left(\frac{Q_s}{Q_m}\right)_{t=0} = 0.4$. The parameter d can be obtained by considering that the proportion of value added in education with respect to total household service value added in the US in 1990 is about 17%. Finally, let us assume that ρ=2.5%. Equation (31) thus yields $L_s^* = 48.7\%$, which is close to the starting L_s =45%.

The simulation using these values of the parameters gives interesting dynamics of L_s and $\frac{Q_s}{Q_m}$. The service labour share tends to rise substantially, so that the service output proportion rises as well. However, it does not

[10]These may be roughly approximated by the sum of public services, education, health, hotels and restaurants, personal and related services, and half of internal trade.

approach the unitary bound but tends to a lower constant level, so that the service output proportion turns to decrease (see Fig.1).

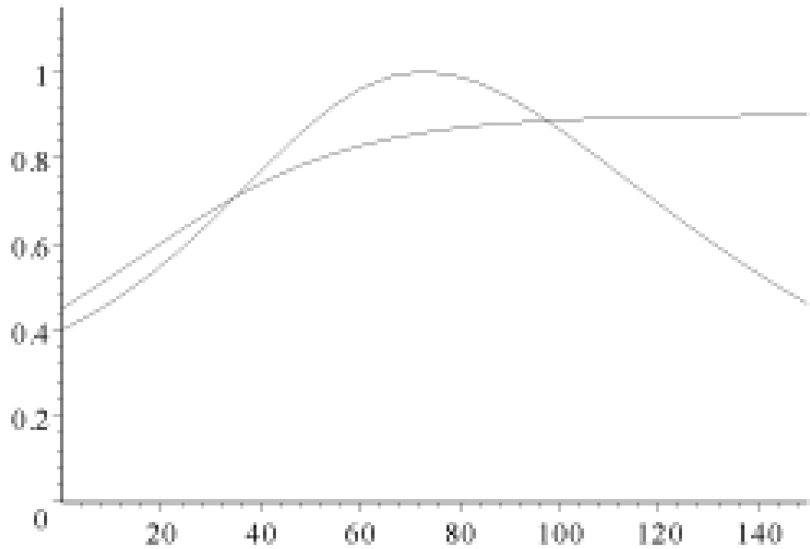

Figure 1:

The rise in L_s affects overall growth through sectoral composition effects and by raising sectoral productivity growth rates. In this simulation the effect on overall growth is positive, since $\delta b > r$.

These results do not change significantly if the initial L_s is set at 35%, and if the other parameters adequately change to maintain their consistency. In order to have an increase of L_s that approaches unity, household preferences must react extremely to income growth. Also changes in r do not have significant effects on the dynamics of L_s, while they directly affect the dynamics of $\frac{Q_s}{Q_m}$ in a negative manner.

5 Policy implications

Since rising service prices appear at the origin of the problems of "deindustrialisation" and reduced overall productivity growth, a policy to improve the efficiency of service production is usually recommended (Baumol 1985). When the problem is the tendency for demand for services to decline instead, as in the typical case of live performing arts, the recommended policy is simply to transfer an amount of resources through taxes and subsidies to services (Towse 1997). However, both policies are viewed as insufficient because of their temporary effects.

The model above allows us to view the problems less pessimistically. It in fact highlights a further effectiveness of old policies, and it indicates a further kind of policy.

The model shows that the pursuit of efficiency in service production is particularly effective, especially in the case of those services that contribute most to human capital formation (parameter b in the model). It can be shown, in fact, that a once-and-for-all jump in this efficiency yields a permanent growth effect in both manufacturing and services, by raising the rate of human capital accumulation.

Exactly the same effectiveness is found when pursuing efficiency in human capital formation (parameter δ in the model). In the previous case, service is observed as an output; in this one it is observed as an input.

Both b and δ raise the allocation of labour in favour of the less efficient sector, i.e. services, thus reducing the previous effect on overall growth. This reduction has a positive net effect if $\delta b > r$.

The link between household preferences for services and income growth magnifies the sectoral reallocation of labour, with an adverse effect on overall growth.

Therefore, policies aimed at favouring both b and δ appear to be particularly effective.

Parameter d does not have any sectoral growth effect, but it induces more labour to transfer to services, thereby hampering overall growth. However, if a rise in d is not simply due to households' realisation that some currently produced service is effective in raising human capital, but induces new production of that kind of service, for example higher education, then also δ rises. Therefore, the future benefits accruing from expenditure on services, like preventive and diagnostic health services, should be emphasised, and a policy of information could be effective in changing household behaviour. If, on the contrary, those future benefits are not properly appreciated by households, demand for services may decline insofar as prices increase. Or, if services are financed by public revenues, unwillingness to pay taxes may increase.

6 Conclusions

This paper has provided a model to explain the service paradox, i.e. the non decreasing proportion of service output in spite of rising service prices. It is based on the idea, which is not new in the literature, that households raise their preferences for services as their income rises, i.e. that the income elasticity is larger than one. The main contribution of the paper is the endogenisation of economic growth, at least partially, by considering that some important services enter human capital accumulation. Therefore, household behaviour affects growth, and growth changes household behaviour.

Sections 3 considered the case in which household behaviour affects human capital and growth, but not intentionally. In other words, households maximise the consumption of services and non-service products by adopting a standard static utility function. The ensuing rise in human capital thus allows resolution of the service paradox, since the output proportion of services rises. Moreover, Baumol's pessimistic conclusion on the declining aggregate growth is alleviated and may be even reversed[11]. This different outcome depends on two parameters: efficiency in producing services, and efficiency of services in raising human capital.

Section 4 studied a rather general case in which household behaviour takes consideration of the effects of a variable part of services on human capital and growth. In other words, households maximise the consumption of services and non-service products by adopting a dynamic utility function under the constraint of raising human capital, and hence income, insofar as they buy some services. If the feedback of growth on preferences were ignored, a fixed amount of labour would be employed in services. The greater the preference

[11] One wonders whether in the very long run Baumol's conclusion should be reversed, insofar as technical progress is essentially due to human capital, and hence to specific services.

for consuming services, or the greater the part of services intentionally devoted to increasing human capital, the larger the service employment share. The proportion of service output would hence diminish. However, the feedback of income growth to preferences for services appears to increase both relative service employment and output. More precisely, for realistic values of the parameters, the model predicts that the service employment share rises sufficiently to induce the output proportion to rise as well, but ceasing to rise before approaching unity, so that the output proportion eventually decreases.

The policy implications to be drawn from this analysis are less pessimistic than those ensuing from Baumol's original model. Pursuing a once-and-for-all rise in efficiency in the service sector exhibits not only a temporary effect but also a permanent growth effect. Moreover, pursuing efficiency in service production can be flanked by a second aim with exactly the same effectiveness: pursuing efficiency in human capital formation. The quality of services that is so hard to observe when these are produced becomes more observable when they are embodied in people and then employed for further production.

The model has also highlighted the importance of information about the future benefits of expenditure on services that contribute most to human capital formation. This kind of information, in fact, may more effectively counteract the decline in demand for some services than subsidies.

The literature has mainly viewed business services as important for growth, and household services as a burden on the economy. A more balanced view should explore the properties and the effects of households services more deeply.

Baumol (1985:302) distinguishes *stagnant personal services* within the service sector as those activities which "undoubtedly constitute the basis for the contention that services in general resist productivity-enhancing change". He also adds that in these services "quality is highly correlated with labor-time expended", and "frequently there must be direct contact between consumers and those who provide the labor". Therefore, a crucial property of these services is that they often involve human relationships, which affect the quality of the service provided.

A second frequent property of stagnant personal services is that they change consumers themselves, as regards their ability in production processes, their preferences regarding consumption and the supply of labour, and their evaluation of the future. Hence, a measure for the quality of these service might be the extent of this "intrinsic" change in consumers.

Acknowledgement *I wish to thank Luigi Bonatti for comments which have helped me to substantially improve a previous version of the paper. The participants at the XVII Aiel conference of Labour Economics (Salerno, 26-27 Sept. 2002) are also thanked. The research has been financed by the University of Trento.*

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