The service paradox and endogenous economic growth

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Abstract

"Stagnant services" (Baumol et al. 1989) are characterised by low productivity growth and rising prices, but also, and paradoxically, by output growth proportional to the rest of the economy, and hence by an expanding employment share, with a negative effect on aggregate productivity growth. This paper considers that many of these services, inclusive of education, health and cultural services, contribute to human capital formation, thus enhancing growth. This effect is distinguished according to whether it is a side-effect of spending on services or an intentional investment by households, as in Lucas' (1988) model. Preferences for services are assumed to rise with income. The main result is that the productivity of stagnant services and their quality displayed in raising human capital play a central role in opposing the negative Baumol effect on growth, and in reinforcing the explanation of the paradox. Therefore, the productivity and the quality of stagnant services must also be evaluated in terms of their long-run consequences.

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1 Introduction

The fact that the advanced countries are becoming "service economies" is now viewed by economists, after the rise and diffusion of information technology, with much less concern than at the time of the lively debate on "deindustrialisation" (Bluestone and Harrison 1982; Lawrence 1989; Rowthorn and Wells 1987). It is now recognised that services are increasingly used as intermediate inputs to production in the form of business services, with great benefits for productivity and quality throughout the economy (Fixler and Siegel 1999; Greenhalg and Gregory 2001; Oulton 2001; see also Baumol 2002).

However, the problems highlighted by Baumol (and collaborators) in the case of final services, thus considered household services, still remain. Baumol demonstrates with evidence and formal analysis that a large share of total services, inclusive of education, health care, cultural and personal services, hotel and repair services, called "stagnant services", suffers from "cost disease" and rising prices, because productivity growth in these sectors lags behind the rest of the economy (Baumol 1967; Baumol, Blackman and Wolff 1989; Baumol 2001), a finding which has been confirmed by other empirical works (Huther 2000; Fase and Winder 1999; Pellegrini 1993). Baumol further studies and predicts the consequences of rising service costs and prices. For some services, like performing arts and some municipal services, price elastic demand induces a relative (or even absolute) shrinkage of the sector, and a possible erosion in the quality of the service offered (Towse 1997). For total and stagnant services, instead, Baumol, followed by other authors, observes that demand grows roughly in proportion to the demand for production in the rest of the economy, with the consequence that the share of service employment increases (Baumol 2001; Echevarria 1997; Kongsamut et al. 2001; Rowthorn and Ramaswamy 1999; World Bank 1994). Baumol finally predicts from this analysis that the expansion of service employment has a negative effect on aggregate productivity growth through a change in sectoral composition (Baumol et al. 1989: Appendix to Chapter 6).[1]

Therefore, when considering stagnant services one encounters first the paradox that the rise in their prices does not discourage demand (ten-Raa and Schettkat 2001), and then the issue as to whether the uncomfortable

[1] A more general proof of this effect is given by Oulton (2001).

negative effect on overall growth prevails (Oulton 2001).

The first aim of this paper is to study a solution of the paradox along Engelian lines: i.e. as income increases, households' preferences shift to services, which can be regarded as "luxury" consumption. This idea was used by Clark (1940) to explain the increasing share of service employment, and it has been recently reprised by Appelbaum and Schettkat (1999) and Echevarria (1997). On the empirical side, the demand bias has been confirmed by Curtis and Murthy (1998) and by Moeller (2001), who estimate an income elasticity of services greater than one.

Clark's and Baumol's explanations of the expansion of service employment have been labelled "demand side" and "supply side" respectively, and they 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 towards services and the bias in productivity against services.[2]

The second aim of the paper is to consider the positive effect of stagnant services on overall growth through human capital accumulation (Spithoven 2000). This appears obvious in the case of education, as shown by the famous Lucas' (1988) one-sector model. But positive effects on human capital and growth also arise from the consumption of health care, which enables people to gain greater benefit from any learning activity, and from cultural services. However, since the model proposed retains the two-sector specification, i.e. one sector for stagnant services and another for production by the rest of the economy, stagnant services will be assumed to be a fixed basket, which thus enters both the utility function and the human accumulation function of households. More specifically, services will be considered to enter the accumulation function in two ways: as a positive side-effect in consuming services, and as an intentional investment by households.[3] Different values

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

For a more general setting where both demand and productivity growth are heterogeneous across sectors, and where income growth affects demand composition see Pasinetti (1981).

[3] Also Steger's (2002) model considers that the same good can enter both the utility function and the human capital accumulation function. However, it does not consider that other goods enter the utility function alone, and that human capital can be formed as a

in the parameters of the two functions can represent the role of different baskets of services. A particular restriction in the parameters will represent the Lucas case of formal education.

Therefore, the paper proposes a perspective alternative to that of services as intermediate inputs, but it also maintains a link with Baumol's model through crucial extensions. It in fact proposes an endogenous growth model based on a large fraction of household services, but it retains Baumol's problem of the expansion of a low-productive sector which is several times larger than the sector of business services (Russo and Schettkat 2001), and which produces distinctive goods, like education, health, and culture. As a consequence, the negative effect on aggregate growth through changes in sectoral composition cannot be ignored, and it can be studied in contrast with the positive effect through human capital. The net effect on growth will be further studied in interaction with the feedback onto the shift of preferences towards services. This may provide an explanation for the issue of causality between schooling and growth (Bils and Klenow 2000; Krueger and Lindahl 2001), and it may reinforce the solution of the paradox. Education, health care and cultural services are distinctive because households do not completely perceive the qualities and the long-run consequences of these services, so that problems of market failures typically arise (Blank 2000).

Finally, the paper helps evaluate the growth consequences of some unfortunate facts. The literature has shown that the quality of schoolteaching has dramatically deteriorated (Corcoran et al. 2002; Gundlach and Wossmann 2001; Gundlach et al. 2001; Simon and Woo 1995; Stoddard 2003). One explanation is similar to Baumol's, since it centres on greater technical progress in the rest of the economy (Lakdawalla 2001). This situation appears even more serious if one considers that education and health are strictly positively correlated (Feldman et al. 1989; Schoenbaum and Waidmann 1997). Furthermore, it is a well-known fact that the public provision of higher education and health care are increasingly difficult to sustain in the welfare programs of the advanced countries, while the private provision increases prices and restricts the people insured (Cutler 2002; Glied 2003; Ryan 1992).

The organisation of the paper is as follows: section 2 presents the model, thus laying out the parameters which allow the study of particular cases once suitably restricted; section 3 reformulates the Baumol case; section 4 shows the solution of the paradox, and the case of the side-effect of consuming ser-

side-effect.

vices on human capital and growth; section 5 considers both the particular Lucas case where households intentionally invest services in human capital, and the general case, where spending in services, growth, and shift in preferences interact; section 6 briefly discusses some policy implications; section 7 concludes; and an Appendix gives a formal proof.

2 The model

The production side of the model follows Baumol's (1967) model with an important extension to human capital. 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:

$$\begin{aligned} Q_{m,t} &= aL_{m,t}h_t e^{rt} \qquad \text{with} \quad L_{m,t} \geq 0 &(1)\\ Q_{s,t} &= bL_{s,t}h_t \qquad \text{with} \quad L_{s,t} \geq 0 &(2)\end{aligned}$$

where Q_t and L_t stand for output and employment respectively at time t, and s and m stand for stagnant services and the production of the rest of the economy, which for the sake of brevity will be called "services" and "manufacturing". Productivity is greater in manufacturing than in services ($a>b>0$), while the exogenous positive rate r captures technical progress, which regards manufacturing only. The variable h_t refers to labour's generic skill in producing, and thus defines a measure of human capital when attached to L.

Since full employment prevails, $L_{m,t}$ and $L_{s,t}$ also represent sectoral employment shares, with total employment (L) set equal to 1, that is:

$$L_{m,t} + L_{s,t} = L = 1 \tag{3}$$

The wage rate (w_t) is assumed to be equal in the two sectors, and is determined competitively. The usual FOCs for firms yield:

$$\begin{aligned} w_t &= ah_t e^{rt} &(4)\\ p_t &= \frac{a}{b}e^{rt} &(5)\end{aligned}$$

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

Baumol's first result follows straightforwardly: service relative prices indefinitely increase (at the rate r).

The demand side is specified according to an extended Cobb-Douglas utility function:

$$u(Q_{s,t}, Q_{m,t}, \lambda_t) = \lambda_t \ln Q_{s,t} + (1 - \lambda_t) \ln Q_{m,t} \tag{6}$$

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

$$w_t L \geq p_t Q_{s,t} + Q_{m,t} \tag{7}$$

The first novel feature of the model lies in the treatment of λ_t. By applying Engel's law to services as luxuries (Appelbaum and Schettkat 1999), consumer preferences can be considered to turn to services as income increases. Therefore, besides the standard assumption that λ_t is constant, i.e. $\lambda_t = \bar{\lambda}$ (A1), let us alternatively assume the following (A2):[4]

$$\lambda_t = \frac{1}{1 + \frac{1}{\mu w_t L}} \quad \text{with} \quad \mu > 0 \tag{8}$$

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

The second novel feature of the model is the assumption that the consumption of services may upgrade the skill index as follows:

$$\begin{aligned} \dot{h}_t &= \delta Q_{s,t} \qquad \text{with } \delta \geq 0 && (9) \\ h_{t=0} &= 1 && (10) \end{aligned}$$

where the dot stands for the time first derivative, and δ for effectiveness in upgrading.

Note that in equation (9) a stock variable (h_t) changes only if a positive flow variable ($Q_{s,t}$) takes place. However, services are produced by using

[4] Echevarria (1997) obtains this demand bias in a growth model by assuming a Stone-Geary utility function, rather than an explicit link with per capita income.

[5] Equation (8) also exhibits the property that the growth rate of $\frac{Q_{s,t}}{Q_{m,t}}$, which will be obtained below, does not depend on time.

part of the existing human capital stock, so that a Lucas-like accumulation function ensues from (9) and (2):

$$\gamma_h = \delta b L_{s,t} \tag{11}$$

where γ_x stands for proportional growth rate of x, and it may change over time (thus dropping the subscript t for simplicity).

The dynamics of the model can thus be studied by studying how $L_{s,t}$ is determined, and how it changes. First, the dynamics of the proportion of service output over manufacturing output can be obtained by equations (1)-(3) as follows:

$$\gamma_{\frac{Q_s}{Q_m}} = \gamma_{L_s} \frac{1}{1 - L_{s,t}} - r \tag{12}$$

Secondly, the growth rates of sectoral productivity can be rewritten:

$$\gamma_{\frac{Q_m}{L_m}} = r + \delta b L_{s,t} \tag{13}$$

$$\gamma_{\frac{Q_s}{L_s}} = \delta b L_{s,t} \tag{14}$$

so that growth of aggregate productivity (γ_T) can be obtained as a weighted average of the sectoral growth rates, i.e.:

$$\gamma_T = \left(\gamma_{\frac{Q_s}{L_s}}\right) L_{s,t} + \left(\gamma_{\frac{Q_m}{L_m}}\right)(1 - L_{s,t}) = r + L_{s,t}(\delta b - r) \tag{15}$$

This also measures output growth, since total labour is constant. Thirdly, in the case of assumption (A2), also the dynamics of the preferences depend on $L_{s,t}$, as manipulation of equations (1), (2), (7), (8), and (11) can show:

$$\lambda_t = \frac{1}{1 + \frac{1}{\mu a e^{(\delta b L_{s,t} + r)t}}} \tag{16}$$

In order to determine $L_{s,t}$, the model will be solved as the usual representative agent's problem of maximisation under constraints. However, his information set must first be defined. Let us assume, for the sake of generality, that the representative agent is only partially aware that his consumption of services has positive effects on his human capital. More precisely, let us define v as the share of services which is *intentionally* devoted to increasing human capital, like education, and $(1 - v)$ the share of services which *unintentionally* increases human capital, like cultural services and a part of health care services. Therefore, his rational expectation concerning the future dynamics of his human capital, and hence of income, follows an equation different than the actual one (9), i.e.:

$$\begin{aligned} \dot{k}_t &= \delta v Q_{s,t} \qquad \text{with } \ 0 \leq v \leq 1 && (17) \\ k_{t=0} &= 1 && (18) \end{aligned}$$

The agent's decision problem can thus be stated as follows:

$$\max_{L_{s,t}} \int_0^\infty \left(\lambda \ln\left(bL_{s,t}k_t\right) + (1-\lambda) \ln\left(a\left(1-L_{s,t}\right)k_t e^{rt}\right)\right) e^{-\rho t} dt \qquad (19)$$

subject to the constraints (7),(17), (18), and the transversality condition:

$$\lim_{t\to\infty} \varphi_t k_t L = 0 \qquad (20)$$

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 δ still measures the average effectiveness of overall services in raising human capital.

Note that λ is assumed as given for the agent, i.e. equation (8) is not included in his information set (Broome 1993).

In the following sections the model will be analytically solved for particular values of the parameters δ, λ_t, v, so that interesting cases emerge. The general solution under (A2) will be obtained by numerical simulation in section 5.

3 Baumol's case

Baumol does not consider the effects of services on human capital and thus implicitly assumes $\delta = 0, v = 0$.

However, by observing different kinds of services, he distinguishes between price elastic services like performing arts, which unfortunately appear to shrink dramatically, and "relatively income elastic and price inelastic" services like education and health, which appear to expand employment (Baumol 1967; Towse 1997). He thus captures these difference by considering that relative outlays in services and manufacturing remain constant, or alternatively that real output proportions remain constant. This implies in the model that $\lambda_t = \bar{\lambda}$ (A1), or alternatively that λ_t adjusts so that $\frac{Q_{s,t}}{Q_{m,t}}$ remains constant.[6]

The static solution of the model firstly yields that:

$$p_t = \frac{\lambda_t}{1-\lambda_t}\left(\frac{Q_{s,t}}{Q_{m,t}}\right)^{-1} \tag{21}$$

If $\lambda_t = \bar{\lambda}$, then Baumol's second result is straightforward: since p_t increases indefinitely at the rate r, then $\frac{Q_{s,t}}{Q_{m,t}}$ decreases indefinitely at the rate r. Specifically, $Q_{s,t}$ remains constant, and $Q_{m,t}$ rises indefinitely, since:

$$\begin{aligned} Q_{m,t} &= ae^{rt}\left(1 - L_{s,t}\right) && (22) \\ Q_{s,t} &= bL_{s,t} && (23) \\ L_{s,t} &= \bar{\lambda} && (24) \end{aligned}$$

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, $Q_{s,t}$ would tend to disappear.[7]

If $\frac{Q_{s,t}}{Q_{m,t}}$ remains constant, it is evident from equation (21) that a rising p_t would require an adjustment of λ_t towards 1, i.e. an expansion of service employment at the rate $r\left(1-\lambda_t\right)$. Baumol's third conclusion can thus be drawn: namely that economic growth declines. In fact, substituting equations (13), (14), and (24) into (15), under δ=0, yields:

$$\gamma_T = r\left(1-\lambda_t\right) \tag{25}$$

A rise in λ_t implies a decline in γ_T (at the rate $-r\lambda_t$) towards the service growth rate, which is 0 since δ=0.[8]

[6] Unfortunately, empirical studies are unable accurately to identify services in the two cases, especially because of the ambiguities of price elasticities (Falvey and Gemmell 1995; Moeller 2001; Summer 1985).

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

[8] This is the reason for preferring the arithmetic average to the geometric average in (15).

4 The service paradox, and the side-effect on human capital

In his analysis of the "cost disease" problem, Baumol assumes that the demand for goods and services derives from households alone. 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.[9] Even 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 (Greenhalg and Gregory 2001; Miles 1993; Mattey 2001; Oulton 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). Moreover, it is difficult to define business services as stagnant even though their productivity may lag behind that of manufacturing (Fixler and Siegel 1999). Therefore, the rise of employment in business services will have a negligible negative effect, if at all, on aggregate growth through changes in sectoral composition.

By contrast, household services account for a substantial proportion of real output, and exhibit slow productivity growth. 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). In this interval the annual growth rate of productivity was around -0.5 for these services as a whole, while it was 3.1 for manufacturing. Baumol et al. (1989:133) obtain similar figures by estimating stagnant services more accurately.

Like business services, household services too can be considered as intermediate demand, insofar as they contribute to the formation of human capital which is used in production.[10] Formal education is the most obvious

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

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

service of this kind, followed by cultural services like libraries, and health services.

Formal education is generally perceived as an investment, rather than as a pleasant form of consumption, thus entering the agent's decision problem in a different way. This is confirmed by a large body of microeconomic literature that takes the Mincerian approach. However, formal education also stimulates spending on cultural services, which are mainly appreciated as a consumption. In the case of health services, the consumption aspect still appears substantial with respect to the investment aspect, but a longer and healthier life clearly allows more human capital to be accumulated.

In the present section, the effect of the consumption of service products on human capital is not included in the agent's 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 deliberate investment.

Let us consider the case in which $\delta > 0, v = 0$. The optimisation can thus be static, and yields:

$$\begin{aligned} L_{s,t} &= \lambda_t && (26) \\ \gamma_T &= \delta b \lambda_t + r\left(1 - \lambda_t\right) = \left(\delta b - r\right)\lambda_t + r && (27) \end{aligned}$$

If $\lambda_t = \bar{\lambda}$ (A1), then $\frac{Q_{s,t}}{Q_{m,t}}$ declines at the rate r, as in Baumol's case. Instead, under the alternative assumption, i.e. $\lambda_t = \frac{1}{1+\frac{1}{\mu a e^{(\delta b \lambda_t + r)t}}}$ (A2) which gives $\gamma_\lambda = \left(r + \delta b \lambda_t\right)\left(1 - \lambda_t\right)$, the proportion $\frac{Q_{s,t}}{Q_{m,t}}$ can be determined by the parameters of the model, and it grows at the rate $\delta b \lambda_t$. In fact:

$$\frac{Q_{s,t}}{Q_{m,t}} = \mu b e^{\delta b \lambda_t t} \tag{28}$$

Hence, the proportion of output services is greater, the greater the efficiency in producing and in using services (b and δ respectively), and the greater the sensitivity of preferences for services to income (μ).

Therefore, considering the unintentional growth effects of consuming services changes Baumol's conclusions, and yields interesting results. First, economic growth becomes endogenous. In fact, if r were zero, then $\gamma_T = \delta b \lambda > 0$. Secondly, economic growth is greater. In particular, if preferences to services rise with income (A2), then economic growth converges to the rate δb, and diverges from r. If $\delta b < r$, growth decreases towards a positive rate, rather than towards zero as in Baumol. Note that productivity growth rates increase in both sectors, while 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. Thirdly, the dynamics of the proportion of service output reverses from falling to rising. The service paradox is thus resolved. More precisely, the specific contribution of (A2) to Baumol's case (i.e. $\delta = 0, v = 0$) is to make the proportion constant at the level μb, and the side-effect on human capital accumulation thus reinforces the dynamics of service demand.

5 The general solution of the model

This section generalises the solution of the model by considering the positive effects on human capital formation of the agent's expenditure on services, both as unintentional side-effects of consuming services, and as intentional effects of investing by buying services. This generalisation would imply a heterogeneous basket of services, since households buy services for consumption or for investing, and since services may or may not exhibit effects on human capital formation. In order to simplify the analysis, the model has maintained a single kind of service (Q_s), which enters both the utility function and the human accumulation function, and it is intentionally devoted to the latter purpose for a share (v) only.

The analysis will also show that Lucas' growth model (Lucas 1988) can be seen as a special case.

The general solution of the model will be obtained analytically under assumption (A1), and by numerical simulation under assumption (A2).

By assuming that $\delta > 0$, $0 \leq \lambda_t = \bar{\lambda} < 1$, and $0 \leq v \leq 1$, the optimisation problem set out by the equations (17)-(20) can be solved by stating the Hamiltonian as follows:

$$H = \left(\bar{\lambda} \ln \left(bL_{s,t}k_t\right) + \left(1 - \bar{\lambda}\right) \ln \left(a \left(1 - L_{s,t}\right) k_t e^{rt}\right)\right) e^{-\rho t} + \varphi \delta v Q_{s,t} \quad (29)$$

and by obtaining the FOCs:

$$H_{L_s} = 0 \quad \Rightarrow \quad \varphi_t = \frac{e^{-\rho t}}{\delta v b k_t} \frac{L_{s,t} - \bar{\lambda}}{L_{s,t}\left(1 - L_s\right)} \tag{30}$$

$$H_h = -\dot{\varphi}_t \quad \Rightarrow \quad \frac{e^{-\rho t}}{k_t} + \varphi \delta v b L_{s,t} = -\dot{\varphi}_t \tag{31}$$

Deriving the growth rates of φ_t from these two equations, and then equating, yields, after some manipulations, the following non-linear dynamic equation:

$$\gamma_{L_s} = \frac{-\rho - \delta v b L_{s,t} \frac{1-L_s}{\bar{\lambda}-L_s}}{1 - L_{s,t}\left(\frac{1}{L_s-\bar{\lambda}} + \frac{1}{1-L_s}\right)} \tag{32}$$

Study of this equation allows us to state the following proposition.

Proposition 1 *(i) For given values of* $\bar{\lambda}$ *and* v*, such that* $\bar{\lambda} \in]0,1[$ *and that* $v \in [0,1]$*, one time-invariant solution* $L_{s,t} = L_s^*$ *exists within the interval* $]0,1[$*. This solution is a monotonic rising function of* δ, v, b*, and of* $\bar{\lambda}$*, and it is greater than* $\bar{\lambda}$*.*

(ii) If $\bar{\lambda} = 0$ *and* $v = 1$*, then* $L_s^* = 1 - \frac{\rho}{\delta b}$*, which lies in the interval* $]0,1[$ *if* $\delta b > \rho$*.*

Proof. See the Appendix. ■

The special case ($\bar{\lambda}$=0,v=1) assumes that services consist only of expenditure intentionally devoted to accumulating human capital, and it may be called the Lucas case. In Lucas' (1988) model the agent's key choice concerns time allocation between formal education and work, while in our case her/his key choice concerns spending allocation between investing in services like education, and consumption, which also means time allocation between working in the service sector and working in manufacturing.

Part *(ii)* of the proposition tells us that an interior solution exists in this allocation. Therefore, the production level of services is determined, human capital is accumulated, and growth is thus endogenised since:

$$Q_{s,t} = b L_s^* h_t \tag{33}$$

$$\gamma_h = \delta b L_s^* = \delta b - \rho \tag{34}$$

$$\gamma_T = \left(\delta b - r\right) L_s^* + r = \delta b - \rho \left(1 - \frac{r}{\delta b}\right) \tag{35}$$

A greater δb would increase human capital accumulation with positive effects on aggregate growth. If the exogenous productivity growth rate in manufacturing were dropped, i.e. r=0, the economy would endogenously grow at $\delta b - \rho$, which closely resembles Lucas' growth rate.[11] This case implies a balanced growth path, because, by assumption, both final output, i.e. manufacturing products, and the production of human capital, i.e. services, do not differ in productivity growth.

The case ($0<\bar{\lambda}<1, 0\leq v \leq 1$) considered in part *(i)* of the proposition is a far more general case. But once again the interior solution L_s^* can be determined. Moreover, a greater preference for consuming services ($\bar{\lambda}$) or a greater share of intentional investment in human capital (v) implies a larger L_s^*. The same effect may be due to a smaller time preference (ρ).

The determination of L_s^* allows the dynamics of the model to be determined. In particular, $Q_{s,t}$ and human capital increase at the rate $\delta b L_s^*$, the proportion of service output $(\frac{Q_{s,t}}{Q_{m,t}})$ decreases at the rate r, and the aggregate growth rate remains constant at $(\delta b - r)\, L_s^* + r$.

Exercises in comparative dynamics yield the following conclusions. A rise in δ has not only the obvious direct positive effect on human capital accumulation (eq.(9)), and hence on sectoral growth rates, but it also has the indirect effect through the rise in L_s^*. A rise in b has the same final effect, but through a different channel: it increases human capital accumulation since it makes service production more productive (eq.(2)) and, again, since it increases L_s^*. The effect of δ and of b on overall growth positively depend on sectoral growth rates, but negatively on the changes in sectoral composition. The net effect is positive if $\delta b > r$, and it is very likely to be positive if $\delta b < r$, since it depends on the sign of the following expression:

$$(\delta b - r)\,\frac{\partial L_s^*}{\partial\,(\delta b)} + L_s^*$$

A rise in v has a growth effect only through the rise in L_s^*. Hence, the effect on sectoral growth rates is positive, and it is also positive for overall growth only if $\delta b > r$.

[11] In our notation Lucas' competitive solution of the model without externality is $\gamma_T = \frac{\delta-\rho}{\theta}$, where θ is the intertemporal elasticity of substitution.

By assuming that δ>0, $\lambda_t = \frac{1}{1+\frac{1}{\mu w_t}}$, and 0$\leq v \leq$1 (A2), the two key extensions of the model, i.e. the endogenisation of the agent's preferences and the intentional accumulation of human capital, become interdependent. When the agent attempts to fix his optimal level of $L_{s,t}$, he also affects the growth rate of λ_t (see eq.(16)), which is $(r + \delta b L_{s,t})(1 - \lambda_t)$. But a change in λ_t induces the agent to fix a different optimal level of $L_{s,t}$.

This interdependence can be reduced to a first-order differential equation in $L^*_{s,t}$. One may expect $L^*_{s,t}$ to grow according to this equation and converge to 1. But an interesting case would be that in which $L^*_{s,t}$ grows and converges to a level below unity.

The rise in $L^*_{s,t}$ may be not sufficient to increase $\frac{Q_{s,t}}{Q_{m,t}}$(see eq.(12)). If it is sufficient but tends to cease before $L^*_{s,t}$ has approached unity, then $\frac{Q_{s,t}}{Q_{m,t}}$ eventually declines and falls towards zero. If it is sufficient and approaches unity, then $Q_{m,t}$ shrinks toward zero and $\frac{Q_{s,t}}{Q_{m,t}}$ tends to infinity.

These dynamics can be studied by substituting equation (16) for λ_t in the equation for L^*_s (equation (36) in Appendix), and then differentiating with respect to time. Unfortunately, the new equation, which is differential and non-linear, becomes analytically intractable, so that numerical simulations must be employed.

Before running simulations, numerical values must be given to the parameters. This preliminary exercise is interesting on its own account, since it allows us to check the consistency of the parameters of the model. For example, let us take the estimates of the stagnant sector and the rest of the economy in the US given by Baumol et al. (1989:133) so that: $L_{s,t=0}$=0.38, $\frac{Q_{s,t=0}}{Q_{m,t=0}}$=0.25, $\gamma_{\frac{Q_m}{L_m}}$=2.6%, $\gamma_{\frac{Q_s}{L_s}}$=0.8%.[12] The following parameters can thus be calculated: δb=2.1%, from equation (14), r=1.8% from equation (13), γ_T=1.9% from equation (15), μa=0.61 from equation (16) at t=0. Let us further assume that ρ=2%, v=0.2, and $\lambda_{t=0}$=0.33. These three assumptions not only should be reasonable, but they must also be consistent with equation (36) of the Appendix, and with the constraint $\rho < \delta b$.

The simulation using these values of the parameters gives interesting dynamics of $L^*_{s,t}$ and $\frac{Q_{s,t}}{Q_{m,t}}$. The stagnant service labour share tends to rise substantially, so that the service output proportion rises as well. However, it does not approach the unitary bound but tends to a lower constant level.

[12]Baumol's estimates are slightly modified for removing business services from "stagnant services".

This is evinced by the fact that the service output proportion turns downwards. Figure 1 shows the dynamics of the two variables over time.

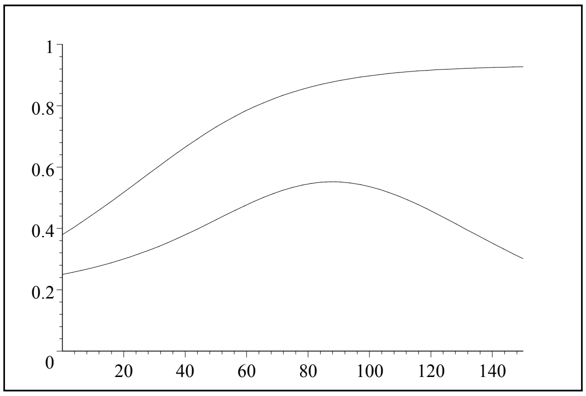

Fig.1: The rising dynamic of the services labour share and the hump-shaped dynamic of the proportion of service output over time.

The rise in $L^*_{s,t}$ affects overall growth through sectoral composition effects and by increasing the productivity growth rates of each of the two sectors by an extra 1.8%. The net effect is positive, since $\delta b > r$, and overall growth increases by an extra 0.2%. The proportion of service output eventually declines because service output grows less than manufacturing output.

These patterns do not alter significantly if the parameters change within the limits of the restrictions, and if the starting values of the variables do not greatly differ. For example, if the simulation with a greater δb of 1% is run, thus attributing a positive effect to the starting values of $L_{s,t=0}$, $\gamma_{\frac{Q_m}{L_m}}$, $\gamma_{\frac{Q_s}{L_s}}$, and μa, then the rise in $L^*_{s,t}$ is steeper, but still approaching a less-than-unitary bound. Also the hump-shaped dynamic of $\frac{Q_s}{Q_m}$ is maintained.

6 Policy implications

Since rising service prices appear to be at the origin of the problems of expanding service employment and reduced overall productivity growth, a policy to improve the productivity of service production is usually recommended (Baumol 1985). When the problem is instead the tendency for the demand for services to decline, 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.

A further problem emerges from the recent literature: that of the dramatic decline of productivity and quality in schooling in the advanced countries. These two concepts cannot be clearly distinguished, so that various measures have been used to estimate them: student achievement tests, teachers' skill achievement, teachers' relative wages, the excess of unitary costs of education deflated by Gdp prices with respect to TFP. All measures give the same poor results, which are especially worrying for Europe (Corcoran et al. 2002; Gundlach and Wossmann 2001; Gundlach et al. 2001; Stoddard 2003).

The model proposed allows us to view these problems from a different perspective, since it adds endogenous dynamics. For example, a once-and-for-all increase in the productivity of stagnant services, as represented by the parameter b, or in their quality, as captured by the parameter δ, adds to the temporary positive effect on prices and overall output a permanent growth effect on both manufacturing and services by raising the rate of human capital accumulation. Furthermore, if the rise in b and δ regards services which are intentionally devoted to increasing human capital, and/or if the rise in b and δ occurs when household preferences for stagnant services rise with income, then $L_{s,t}$ increases. This magnifies the effects on sectoral growth rates, while it likely yields a net positive effect on overall growth despite the adverse composition effect.

Therefore, a policy aimed at increasing b and δ is particularly effective, since it has long-run consequences; and, for the same reason, the decline that has occurred in b and δ becomes a particularly serious problem.

A policy aimed at increasing v may mean a policy of information on the positive long-run effects for households of some services. The definite positive effect regards sectoral growth only, since it works through the expansion of service employment, which may worsen overall growth. However, v is strictly linked to δ. For example, information on preventive and diagnostic health services may induce their substitution with less effective health care services. Expenditure on cultural services may extend educational training, so that both v and δ increase. A policy of information is especially convenient for public authorities when services are publicly provided, because it facilitates their financing through taxes.

7 Conclusions

Whereas business services have been largely recognised as effective in enhancing economic growth, household services have been viewed more as a burden for growth. By contrast, this paper considers that education but also health care and cultural services, which form a large fraction of household services, contribute to human capital formation, and hence to growth.

It is a stylised fact that service output grows roughly in line with the output of the rest of the economy, despite the fact that, as Baumol has shown, service prices increase because of lagging service productivity. The consequence of this paradox is the expansion of service employment, and a negative effect on overall productivity growth.

The paper has provided a model that studies this service paradox, and the net effect of household services on overall productivity growth. It has assumed that household preferences shift to services as income grows. It emerges, in fact, from evidence and studies offered by various authors that household services contribute to human capital accumulation, as in Lucas' (1988) model, and that this contribution may be either a side-effect of consuming services or an intentional purpose of investment. The two-sector specification is maintained, so that household services as a whole enter both the utility function and the human accumulation function. The model is thus able to perform different dynamics depending on the parameters representing the shift in households' preferences, the effectiveness in accumulating human capital, and households' propensities to intentionally invest in human capital. In particular, a cumulative dynamic may ensue from interaction between human capital accumulation, growth and shift of preferences.

The main result of the paper is that both the productivity and the quality of service production are crucial for long-run economic performance, insofar as productivity can be captured by the labour productivity parameter in the service production function, and the quality by the efficiency parameter in the human capital accumulation function. First, the effectiveness of service productivity and quality on sectoral growth rates is positive, and it is likely to be positive also for aggregate productivity growth, despite the possible adverse composition effect. Secondly, service productivity and quality can be easily affected by a change in the share of services intentionally devoted to human capital accumulation. Thirdly, they reinforce the explanation of the service paradox. In fact, the decline of the proportion of output services due to rising service prices can be halted by the shift of household preferences, if manufacturing productivity growth maintains an exogenous differential with service productivity, but it can be reversed into growth by human capital accumulation.

However, shift of preferences and human capital accumulation do not necessarily yield a cumulative dynamic of expansion of the share in stagnant service employment and of the proportion of stagnant service output. The paper shows that households' ability to anticipate future benefits from investing in human capital can effectively dampen this dynamic.

Unfortunately, as recent evidence shows, the productivity and quality of primary and secondary education have dramatically declined, especially in Europe. A more well-known fact is that the public provision of health care services in the advanced countries has run into serious difficulties in maintaining high quality for large part of the population. Policy intervention to stimulate and to regulate productivity and quality thus becomes particularly urgent. Market failures which typically characterise education, health, and other social services are not only a problem of static allocation of resources, but can have long-run consequences.

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8 Appendix: Proof of the Proposition 1 of section 5

The solutions for $L_{s,t}$ can be obtained by imposing $L_{s,t}\gamma_{L_s}$=0 on equation (32). This particular equation will be labelled (32'). The solutions included in the interval [0,1] are $L0^*_s$=0, $L1^*_s$=1, and:

$$L^*_s = \frac{1}{2q}\left(q-\rho+\sqrt{\left((q-\rho)^2+4q\rho\bar{\lambda}\right)}\right) \tag{36}$$

where $q \equiv \delta vb$, and where $0<L^*_s<1$. This last property of L^*_s can be proved by observing that: for $\bar{\lambda}\to 0$, then $L^*_s \to 0$ if $\rho > q$ and $L^*_s \to \frac{q-\rho}{\rho}$ if $\rho < q$, and for $\bar{\lambda} \to 1$, then $L^*_s \to 1$; and that:

$$\frac{\partial L^*_s}{\partial \bar{\lambda}} = \frac{\rho}{\sqrt{\left((q-\rho)^2+4q\rho\bar{\lambda}\right)}} > 0 \tag{37}$$

$$\frac{\partial^2 L^*_s}{\partial \bar{\lambda}^2} = -\frac{2\rho^2 q}{\sqrt{\left((q-\rho)^2+4q\rho\bar{\lambda}\right)^3}} < 0 \tag{38}$$

The inequality $L^*_s > \bar{\lambda}$ is thus also proved.

$L0^*_s$=0, $L1^*_s$=1 are stable solutions because the first derivative with respect to L_s of the r.h.s. of (32') at these solutions yield $-\rho$ in both cases. The solution L^*_s is thus unstable, since (32') is a continuous function within the defined interval, so that the derivative at L^*_s must be positive. Hence, an initial general value $L_s \in]0,1[$ different from L^*_s would move towards 0 or 1 according to (32). However, these extreme solutions are discarded by the agent, because they violate the transversality condition (20). This in fact appears when the appropriate substitutions are made:

$$\lim_{t\to\infty} \frac{e^{-\rho t}}{\delta vb} \frac{L_{s,t}-\bar{\lambda}}{L_{s,t}\left(1-L_{s,t}\right)} = 0$$

This condition is fulfilled if $L_{s,t}$ does *not* tend either to 0 or to 1, nor it is equal to 0 or to 1.

The fact that L^*_s is a monotonic rising function of δ, v, b, and of $\bar{\lambda}$ can be proved by the following:

$$\frac{\partial L^*_s}{\partial q} = \rho\frac{\sqrt{\left((q-\rho)^2+4q\rho\lambda\right)}+\rho-q+2q\bar{\lambda}}{2q^2\sqrt{\left((q-\rho)^2+4q\rho\bar{\lambda}\right)}} > 0$$

and by the inequality (37) above.

Part *(ii)* of the proposition can be simply proved by substituting the particular values of $\bar{\lambda}$ and v into (36).

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