Unbalanced growth and women's homework

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Abstract

This paper provides an explanation for five stylised facts concerning growth and structural change in the developed economies: *(i)* the rising share of service employment; *(ii)* the increase in the female employment rate; *(iii)* the deceleration of this increase while approaching the male employment rate; *(iv)* the rising share of female employment within the service sector; *(v)* the slight and uncertain rise in the share of service output. To this end the paper distinguishes between market services and women's homework, and studies the effects of technical progress on the externalisation of home services, which takes place through the interaction between demand for market services and supply of female labour. Baumol's (1967) result that aggregate labour growth declines in a service dominated economy is challenged when homework is considered. Finally, a policy to increase the overall employment rate by subsidising market services appears to be effective, and can be welfare improving, even if financed by an income tax.

J.E.L. code: D13, J21, J22, O41
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1 Introduction

Economic growth and structural change are widely recognised as closely linked together. Recently, much attention has been devoted to the increasing share of service employment, especially in the most developed economies. This has been seen as an interesting process because of its property of absorbing labour exactly when unemployment emerges as a widespread problem.

Less attention has been paid to the role of female labour in this process, although empirical evidence shows that it has greatly expanded in all countries, except where it was already similar to the role of male labour. Two single data can account for this. Whereas the male employment rate in the 15 members of the European Union dropped on average by 11.6 points from 1975 to 1999, the female employment rate *increased* by 9 points (European Commission 2000; 2001).

This paper is an attempt to provide an economic explanation for both expanding women's participation in the labour market and the rising share of service employment. For this purpose, a two-sector model of industry and services was extended by considering homework as a typical female activity. The crucial role of the different rates of technical progress among production activities was then studied. The extended model also enabled reconsideration of the pessimistic result obtained by the Baumol's (1967) well-known model on aggregate growth. Finally, the convenience of subsidising market services to expanding employment and increase welfare is briefly examined.

The paper is organised as follows: section 2 highlights the stylised facts to be explained, section 3 reviews the relevant literature, section 4 presents the model and its solution, section 5 proposes the explanation for the stylised facts and the reconsideration of Baumol's result, section 6 examines a policy opportunity, and section 7 concludes.

2 Stylised facts

In the most recent decades five stylised facts can be identified within the process of economic growth of the European Union and the US:

(i) the rising share of service employment;

(ii) the increase in the female employment rate, although the male employment rate has declined;

(iii) the slowdown in the increase in the female employment rate when it approaches the male employment rate;

(iv) the rising share of female employment in the service sector;

(v) a slight and uncertain rise in the share of service output.

These facts can be observed from the following Figures, which are based on Oecd statistics. The female employment rate over the total employment rate always appears on the x-axis, while on the y-axis appear the service employment share in Fig.1, the female employment share within the service sector in Fig.2,

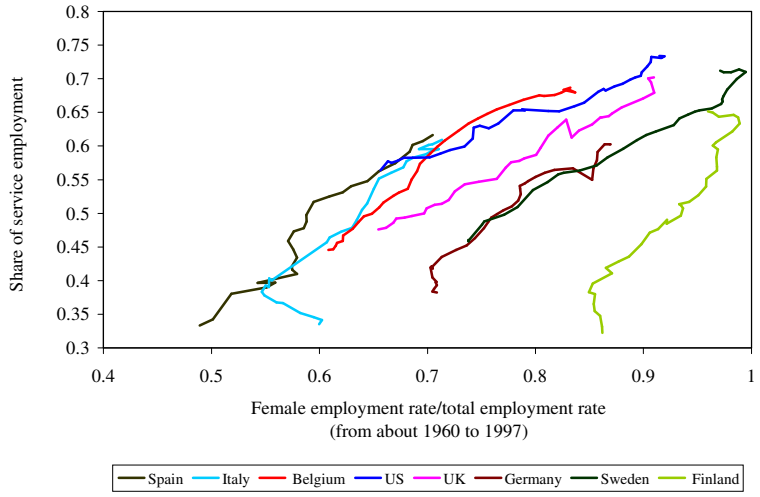


Figure 1:

and the expenditure share on services within the household budget in Fig.3. The EU countries for which data are available and the US are considered, while the time span covers about 30 years[1].

The relationships appear extremely close, especially in the first two Figures, and with some tendency towards convergence among countries. The US emerges as a leader, together with the Nordic countries, in employing women and in producing services.

The first four stylised facts also emerge from Table 1, which reports data for the whole EU-15, and data on Full Time Equivalent employment rates, but for a shorter time span.

[1] In Figs. 1-2 the data covers the following years: 1960-96 for Italy, Belgium and the UK; 1960-97 for the US, Germany and Finland; 1963-97 for Sweden; and 1970-96 for Spain. In Fig. 3 the data covers the following years: 1970-97 for Italy, France, and the US; 1970-96 for the UK and Finland; 1970-95 for Greece, the Netherlands, and Denmark; 1976-96 for Austria; 1980-96 for Sweden; 1986-95 for Portugal; and 1991-96 for Germany.

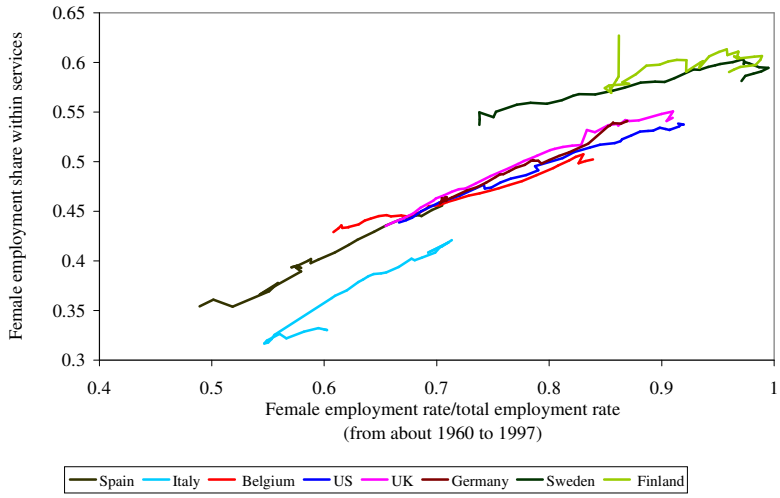


Figure 2:

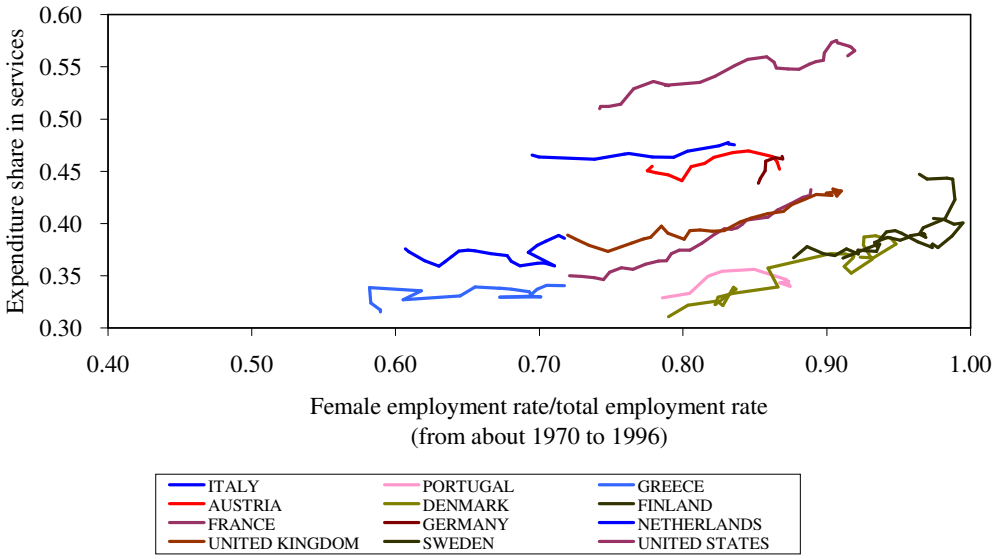


Figure 3:

			1985	1999
Share of service employment	EU-15		57.3	66.3
Employment rate (FTE)	Spain	Men	63.2	68.0
		Women	22.8	32.5
	Italy	Men	71.6	68.6
		Women	28.7	33.3
	France	Men	73.5	69.0
		Women	43.1	45.3
	Germany	Men	78.4	71.7
		Women	43.0	44.0
	UK	Men	77.4	75.9
		Women	37.8	45.1
Female employment share within services	EU-15		47.7	51.7

Tab.1 Total and female service employment, male and female Full Time Equivalent employment rates. European Union -15, selected members (1985 and 1999). *Source:* European Commission (2000)

3 Literature review

There is increasing evidence in the literature on the expanding role of women in the labour market, and especially in the service sector. In particular, official documents emphasise the potential for the economy due to a further expansion of female employment (Eurostat, 1998; European Commission 2000, Anxo and Storrie 2000). However, the underlying economic explanations are not adequately examined by the literature.

Many studies provide different explanations for women's underachievement in the labour market by referring to the demand side, or to the supply side, or to the internal labour markets of organisations (see the survey in Bagilhole, 1994). However, few studies attempt to explain the *increase* of female employment in the economy, and especially in the service sector. Oecd (1994) argues that female employment has increased because of a shortage of skilled labour. However, more recent data show that also unskilled female employment has substantially increased (European Commission, 2000:Graphs.48 and 49; Lombard, 1999:200-1). A second argument points to the flexibilisation of the labour market and, in particular, to part-time work as a reason for greater female participation in the labour market. However, the largest rise in female participation has occurred in the US, where the labour market has been flexible for many years, whereas part-time work remains substantially less widespread than in the Euro zone (European Central Bank, 2000:63; Lombard, 1999:202-3). Other arguments refer to changes in women's social identity both in the household and in the market. An improved culture and a better education are also cited (Drew et al.

1998)[2].

All these explanations may embody some truth. However, little attention has been paid to an indisputed phenomenon underlying the process of economic growth: the change in the terms of trade between working in the market and working at home, due to different rates of technical progress and to specialisation.

The trade-off between the two types of work has been studied by the home production models pioneered by Becker (1965), and then applied to microdata and further theoretically developed. Empirical findings generally confirm the trade-off not only on a historical basis (Gershuny and Robinson, 1988; Jenkins and O'Leary, 1997) but on a cross-household one as well (see the literature of 13 papers cited in Zick, McCullough and Smith, 1996)[3]. Juster and Stafford (1991) show that female homework decreased in the US from 41.8 hours per week in 1965 to 30.5 in 1981, while female paid work correspondingly increased from 18.9 to 23.9. In Denmark the corresponding figures from 1964 to 1987 are 30.1 and 23.1 for homework, and 13.3 and 20.8 for paid work.

Empirical analysis, which is usually based on the time diary method, concentrates on the closest substitutes, i.e. meals consumption, house cleaning, clothing care, time spent on shopping, personal care, child and elderly care. Note that when this consumption appears on the market, it is included in statistics on hotels, restaurants and catering, distributive trades and repairing, personal services, social services. Less substitute services, however, should also be considered. Expenditure on health care is a substitute in the case of care for non-self-sufficient family members, and even in many cases of "defensive consumption" (Hirsch, 1976), i.e. care of illnesses due to hard work in the marketplace. By contrast, domestic equipment does not seem to affect the amount of homework, according to many authors (Robinson 1985; the literature cited in Soberon-Ferrer and Dardis, 1991). Unfortunately, the data on service prices for calculating the dynamics in the terms of trade with home services over decades are largely unreliable. Changes in product quality cannot be disentangled from the dynamics of service prices. Moreover, changes in transport costs for both consuming market products and working in the marketplace must be considered.

The home production models has been recently developed by the economic literature in two main directions. Many studies concentrate on the internal economic workings of households: from Gronau (1973) to Chiappori (1988), to Manser and Brown's (1980) bargaining approach. However, these studies are of partial equilibrium, and pay little attention to the macroeconomy and to economic growth. Other studies concentrate on the role of home production in the macroeconomy, but their analysis does not distinguish gender specificities

[2] Close attention has been recently paid to the relationship between women's participation and fertility, but the latter has been usually studied as endogenous (see for a discussion Bettio and Villa, 1998).

[3] The cross-household evidence does not always support the trade-off (Horrell, 1994). However, this evidence is less important for our argument, which concerns the long run, because changes in service prices over time may affect the trade-off, and, moreover, cross imitation of preferences may be less important.

(Benhabib, Rogerson and Wright, 1990).

This paper proposes a model that attempts to capture both microeconomic features of household organisation and macroeconomic features of the labour market, of sectoral productions, and of the effects of technical progress. It does so at the cost of some simplification of all these aspects. The home production model is simplified especially in the utility function, which is adopted in a reduced form. No distinction has been made between male and female consumption preferences, thus reverting to Becker's "altruistic" assumption. Notwithstanding, income transfer within the household, and the gender division of labour is maintained. Consumption of goods and services is aggregated into three items only: "goods", which have low (unitary) substitutability with services, "market services", which have high (infinite) subsitutability with the third item, namely "home services". Sectoral productions do not explicitly employ capital but are characterised by different sectoral techniques[4].

Other simplifications of the model are backed by the evidence available. First, individual total working time, i.e. inclusive of marketwork and homework, is relatively constant over decades for both men and women[5]. This suggests that the income effect and substitution effect on leisure time due to rising income offset each other, so that, for a model that intends to study long run performance, leisure time can be left unexplained[6]. Secondly, although men have recently devoted more work to the household, female homeworking time is still much greater, as observed by many authors: from 3.8 times in the UK in 1987 to 5 times in Italy in 1985 (Jenkins and O'Leary, 1997; Istat 1985; see also Plantenga, 1997). This has suggested that men prefer to minimise homework relatively to total work. Thirdly, industrial production employs far more men than women, for a multiple of 3.3 in 1985 and 3.4 in 1999 in the EU (European Commission, 2000). This has suggested that women prefer to minimise working in industry relatively to total work[7].

[4] The "altruistic" assumption is not particularly restrictive if only three consumption items are considered. Dropping the capital variable is a fairly usual procedure in the preliminary version of a model like this. Moreover, considering both capital and different sectoral techniques usually makes the model so complex that the solution requires numerical simulations (Kongsamut, Rebelo and Xie, 1997).

[5] Survey data show that the total workweek in the UK reduced by 15 minutes for men and slightly increased for women between 1974 and 1987 (Jenkins and O'Leary, 1997). In Denmark the total workweek slightly increased for both men and women between 1964 and 1987, while in the US it diminished by 5 hours for men and 6.5 hours for women between 1965 and 1981 (Juster and Stafford, 1991). See also Gershuny and Robinson (1988).

[6] Benhabib, Rogerson and Wright (1990) include leisure time in their home production model to study how it varies over the cycle while remaining constant in the long run.

[7] These preferences for type of work will yield corner solutions in the model. A similar simplification for home production is assumed by Gronau (1973). In order to obtain interior solutions, a more elaborate theory would consider heterogeneity of individuals of the same sex, or the interaction between the preferences on the demand for, and some selection mechanism on the supply of, female labour with respect to men (see, e.g., Bulow and Summers, 1986; Goldin, 1986; Kuhn, 1993).

4 Model

Let us assume an economy with a constant population equally composed of men and women, normalised to 2. Men and women live in couples, thus forming households. Hence one man and one woman share a common utility function and a common budget constraint, which are also the same for all households. They consume industrial products and services, which can be bought in the market or produced at home. Both men and women are endowed with an equal and fixed amount of labour time, which can be divided into three parts: working time as employees in industry, in the services sector, and time spent working at home. The distinguishing feature between men and women is that men prefer to minimise homework, and women prefer to minimise working in industry, although, in general, working does not imply disutility.

In equations, the consumers' problem is:

$$\max\ U = \left[C_m^{\alpha}\left(C_h + C_s\right)^{\beta}\right] - m\left(\frac{\ell_m}{T}\right)^{\gamma} - h\left(\frac{l_h}{T}\right)^{\delta} \tag{1}$$

subject to:

$$C_m + C_s p_s(1-\theta) \leq \left[\left(\ell_s + \ell_m\right) w + \left(l_m + l_s\right) w\right](1+\tau) + R \tag{2}$$

$$T = \ell_m + \ell_s + \ell_h \tag{3}$$

$$T = l_m + l_s + l_h \tag{4}$$

where U is the utility of the couple, C is consumption, ℓ and l are the labour supply of women and men respectively, and the subscripts m, s, and h refer to industry, market services, and home services respectively. w is the wage rate, and p_s is the price index for services, while that for industrial products is taken as numeraire. T is total working time for each individual, R is the non-labour income of the couple. τ and θ are fiscal parameters for a tax and a subsidy respectively. All parameters are strictly positive, and all variables must be positive or zero[8].

The utility function is assumed to be Cobb-Douglas and of constant scale returns for consumption in industrial products and services. Changes in the parameters α and β will be studied in the next section in order to interpret the Baumolian case of constant consumption shares in real terms. The assumed specification of preferences for type of work is a shortcut taken in order to both capture a fact, as seen above, and to simplify analysis. In fact, it can be straightforwardly shown that minima under a non-negative constraint are corner solutions:

$$\ell_m = 0 \tag{5}$$

[8] There is no need to study the discounting of consumption through time because there is no capital in the model.

$$l_h = 0 \tag{6}$$

For an analogous purpose of simplification, the wage rate is assumed to be equal between men and women. Although a there is a large amount of evidence for a gender wage gap (Cain, 1986; Gunderson and Riddell, 1993), the explanations offered by the literature are partial equilibrium ones, and obviously none of them explains the gap by different thightness in the two sections of the labour market (see footnote 5).

In this model perfect mobility of the two different kinds of labour is instead assumed on the production side. The production functions of industry, market services, and home services, in fact, exhibit an infinite elasticity of substitution between ℓ and l:

$$c_m = A_m \left(\ell_m + l_m\right)^{\mu} \tag{7}$$

$$C_s = A_s \left(\ell_s + l_s\right)^{\varsigma} \tag{8}$$

$$C_h = A_h \left(\ell_h + l_h\right)^{\eta} \tag{9}$$

Market services are assumed to be more efficient than home services. More precisely:

$$0 < \eta < \varsigma < \mu < 1 \tag{10}$$

$$0 < A_h < A_s < A_m \tag{11}$$

Since labour is the only production factor, and with decreasing returns, firms can make non-zero profits. Nevertheless, free entry and exit from the market is assumed, so that the representative firms in industry and in market services must exhibit the same profit in the long run equilibrium. The formal assumptions are thus the following:

$$P_m \equiv c_m - w\left(\ell_m + l_m\right) = C_s p_s - w\left(\ell_s + l_s\right) \equiv P_s \tag{12}$$

$$C_m = N c_m \tag{13}$$

where P indicates firms' profit, and N is the number of industrial firms. The adjustment between the two kinds of firms is made possible by N, which is thus endogenous.

Note that also the production of home services is able to realise some sort of profit, but entry and exit from household is not possible by definition. Hence, no equalisation with firm's profits is required, and the number of service firms can be taken as fixed and, to simplify, as equal to 1.

Note that the same symbols for aggregate quantities supplied and demanded, as well as for labour supplied and demanded, are used, thus implying the equilibrium condition in the various markets. Note also that the model is of full employment, but "official" employment for women and men is measured by $\ell_m + \ell_s \leq T$ and $l_m + l_s \leq T$ respectively.

The FOCs for consumption give the usual marginal trade-off:

$$\frac{C_s + C_h}{C_m} = \frac{\beta}{\alpha} \frac{1}{p_s (1-\theta)} \tag{14}$$

The FOCs for sectoral labour supply, and the production function for home services (equation 9) give the labour pseudo-demand function for homework:

$$\ell_h + l_h = \left(\frac{p_s A_h \eta (1-\theta)}{w (1+\tau)} \right)^{\frac{1}{1-\eta}} \tag{15}$$

This is not a true demand function because it is rather placed on the supply side of the "official" labour market. A rise in wages would raise labour supply on this market by reducing homework.

Maximisation of profits in the sector of market services gives the standard labour demand function:

$$\ell_s + l_s = \left(\frac{p_s A_s \varsigma}{w} \right)^{\frac{1}{1-\varsigma}} \tag{16}$$

Analogously to the previous equation, service prices with respect to wages have a positive effect on labour demand, and to a greater extent in this case because homework is less efficient (inequalities 10-11).

To complete the model, labour demand in industry is obtained as usual:

$$\ell_m + l_m = \left(\frac{A_m \mu}{w} \right)^{\frac{1}{1-\mu}} \tag{17}$$

The following can thus be stated:

Proposition 1 *There exists a unique solution of the model, where all markets are in equilibrium.*

Proof. In order to prove this proposition, let us solve the model by steps. First, let us derive the relationship between total employment in the market service sector and homework, by substituting (p_s/w) of (16) with that derived from (15), having considered (6):

$$L_s \equiv \ell_s + l_s = \left(\frac{\varsigma (1+\tau) A_s}{\eta (1-\theta) A_h} \right)^{\frac{1}{1-\varsigma}} \ell_h^{\frac{\eta-1}{\varsigma-1}} \tag{18}$$

Note that the relationship is, maybe surprisingly, positive.

Secondly, let us derive a simple function for the level of wages (and for service price) from the equilibrium condition in the labour market:

$$2T - \ell_h = \left(\frac{p_s A_s \varsigma}{w} \right)^{\frac{1}{1-\varsigma}} + N \left(\frac{A_m \mu}{w} \right)^{\frac{1}{1-\mu}} \tag{19}$$

The substitution of (p_s/w) from (15) in this equation yields:

$$w = A_m \mu \left[\frac{1}{N} \left(2T - \ell_h - \left(\frac{\varsigma \left(1+\tau\right) A_s}{\eta \left(1-\theta\right) A_h} \right)^{\frac{1}{1-\varsigma}} \ell_h^{\frac{\eta-1}{\varsigma-1}} \right) \right]^{\mu-1} \tag{20}$$

To endogenise N, let us plug (17) and (16) into (7) and (8) respectively, and then into (12), and use (18) and the labour market constraint, so that:

$$N = \frac{2T - \ell_h - L_s}{L_s} \frac{\varsigma(\mu-1)}{\mu\left(\varsigma-1\right)} \tag{21}$$

The wage equation (20) can be rewritten thus:

$$w = A_m \mu \left[L_s \frac{\mu\left(\varsigma-1\right)}{\varsigma(\mu-1)} \right]^{\mu-1} \tag{22}$$

Hence, also prices can be obtained in terms of ℓ_h:

$$p_s = \left[\left(\frac{A_s \varsigma \left(1+\tau\right)}{A_h \eta \left(1-\theta\right)} \right)^{\frac{1}{1-\varsigma}} \frac{\mu\left(\varsigma-1\right)}{\varsigma(\mu-1)} \right]^{\mu-1} \frac{A_m \mu \left(1+\tau\right)}{A_h \eta \left(1-\theta\right)} \ell_h^{\frac{(1-\eta)(\mu-\varsigma)}{1-\varsigma}} \tag{23}$$

Thirdly, let us derive a function for the relative supply of $\frac{C_s}{C_m}$, and a function for the relative demand for $\frac{C_s}{C_m}$, both in terms of ℓ_h and L_s only. The former is obtained by using the production functions (7) and (8), the labour demand equations (16) and (17), and the equations for w and N:

$$\frac{C_s}{C_m} = \frac{A_s}{A_m} \frac{L_s^{1+\varsigma-\mu}}{\left(2T - \ell_h - L_s\right) \frac{\varsigma(\mu-1)}{\mu(\varsigma-1)}^{1-\mu}} \tag{24}$$

Let us then re-write equation (14) for $\frac{C_s}{C_m}$ by subsituting p_s from (15), and then w from (22):

$$\frac{C_s}{C_m} = \frac{A_h}{A_m} \left(L_s \frac{\mu\left(\varsigma-1\right)}{\varsigma(\mu-1)} \right)^{1-\mu} \left(\frac{\beta}{\alpha} \frac{\eta}{\mu\left(1+\tau\right) \ell_h^{1-\eta}} - \frac{\ell_h^{\eta}}{2T - \ell_h - L_s} \right) \tag{25}$$

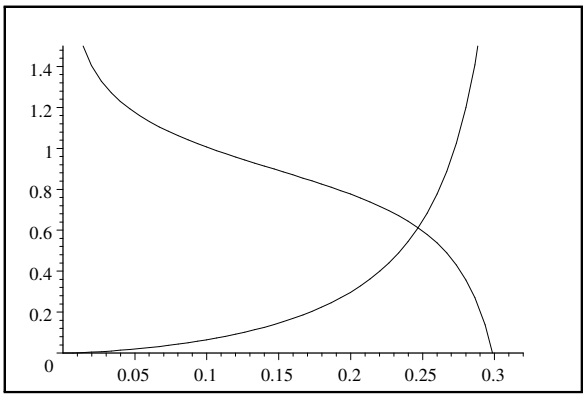
Equations (24)-(25) depend only on ℓ_h, directly or through (18), and can be represented as in Fig.4. Equation (24) is monotonically increasing in ℓ_h, with $\frac{C_s}{C_m} = 0$ for $\ell_h = 0$. In fact, all the first derivatives of (24) with respect to each term in ℓ_h appearing in the equation, also through (18), are positive. The economic meaning of the equation is that to higher service prices there correspond both a greater amount of homework (eq.(23)) and a greater convenience of producing market services with respect to industrial products.

Equation (25) is monotonically decreasing in ℓ_h, with $\frac{C_s}{C_m} \to +\infty$ for $\ell_h \to 0^+$. In fact, by substituting (18) into (25), and by rearranging the terms in ℓ_h, the derivatives of (25) with respect to each term are negative. The equation thus

states that corresponding to higher service prices are both a greater amount of homework and a lesser convenience of buying market services with respect to industrial products. Hence an intersection exists in the first quadrant, and this gives the equilibrium point $\left(\ell_h^*, \frac{C_s}{C_m}^*\right)$. ■

Equilibrium values can be thus obtained for all the endogenous variables. In particular, w is obtained from equation (18) and (22), and, in their turn, l_m from (17) and (22), l_s from equation (4), and ℓ_s from equations (18) and (4).

Fig.4



5 Tertiarisation and the feminisation of employment

In order to explain both the increasing tertiarisation of the economy and greater women's participation in the labour market, let us consider the effects of technical progress.

In this simple model technical progress can be represented by changes in the efficiency parameters As. If the same proportional change occurs in the parameters of all three sectors (A_m, A_s, A_h), the model exhibits steady-state growth, as is evident on observing equations (24), (25) and (18). Output by industry, by market services and by home services grows at that rate, and so do wages, but the structure of output, employment, and consumption does not change.

However, if a proportional change occurs for A_m only, then service prices increase, by (23), and industrial output and consumption expand. Output, employment and consumption of services remain unchanged, as can be seen by equalising equations (24) and (25), thus obtaining an equation where the

unknown ℓ_h is independent of A_m. This is a useful benchmark case, because when we study the effects of changes in A_s on services, we will know that these effects are independent of changes of A_m.

The stylised facts *(i)-(iv)* identified in section 2 can thus be explained by the model.

Proposition 2 *A positive proportional change of A_s, while A_h remains unchanged, has the following effects (where the stars are equilibrium values):*

(i) the share of official service employment $\left(\frac{\ell_s^*+l_s^*}{2T-\ell_h^*}\right)$ increases,

(ii) the female employment rate $\left(\frac{\ell_s^*}{T}\right)$ increases,

(iii) the rise of $\left(\frac{\ell_s^*}{T}\right)$ decelerates approaching unity,

(iv) the proportion of female employment in services $\left(\frac{\ell_s^*}{\ell_s^*+l_s^*}\right)$ increases.

Proof. Let us first prove the intermediate points *(ii)* and *(iii)*. By equalising (24) and (25), and rewriting them, we obtain:

$$A-{\ell_h^*}^{\frac{\eta-1}{\varsigma-1}}\left(\frac{A_s}{A_h}\right)^{\frac{1}{1-\varsigma}}B-\ell_h^*C=0 \tag{26}$$

given that $A=2T\frac{\beta}{\alpha}\frac{\eta}{\mu(1+\tau)}>0$, $B=\left(\frac{\varsigma(1+\tau)}{\eta(1-\theta)}\right)^{\frac{1}{1-\varsigma}}\left(\frac{\beta}{\alpha}\frac{\eta}{\mu(1+\tau)}+\frac{\eta(1-\theta)}{\varsigma(1+\tau)}\right)>0$, and $C=\left(\frac{\beta}{\alpha}\frac{\eta}{\mu(1+\tau)}+1\right)>0$. Implicit derivation thus allows the calculation of elasticity:

$$\frac{\partial\ell_h^*}{\partial A_s}\frac{A_s}{\ell_h^*}=\frac{1}{(\eta-1)+\frac{C}{B}(\varsigma-1)\left(\frac{A_s}{A_h}\right)^{\frac{1}{\varsigma-1}}{\ell_h^*}^{\frac{\varsigma-\eta}{\varsigma-1}}}<0 \tag{27}$$

Since $\ell_m=0$ by (5), then $\ell_s=T-\ell_h$, and point *(ii)* is proved.

To prove point *(iii)* it is sufficient to observe that the elasticity (27) increases, i.e. becomes less negative, when ℓ_h^* diminishes. In fact, the numerator of its derivative w.r.t. ℓ_h^* is:

$$-BC\left(\varsigma-\eta\right)\left(\frac{A_s}{A_h}\right)^{\frac{1}{\varsigma-1}}{\ell_h^*}^{-\frac{\eta-1}{\varsigma-1}}<0 \tag{28}$$

To prove *(i)* let us consider that the elasticity

$$\frac{\partial\left(\frac{L_s^*}{2T-\ell_h^*}\right)}{\partial A_s}\Big/\frac{\frac{L_s^*}{2T-\ell_h^*}}{A_s}=\frac{\left(\frac{C}{B}\frac{1}{1-\eta}\left(\frac{A_s}{A_h}\right)^{\frac{1}{\varsigma-1}}{\ell_h^*}^{\frac{\varsigma-\eta}{\varsigma-1}}\right)(2T-\ell_h^*)-\frac{1}{1-\eta}\ell_h^*}{\left(1+\frac{C}{B}\frac{\varsigma-1}{\eta-1}\left(\frac{A_s}{A_h}\right)^{\frac{1}{\varsigma-1}}{\ell_h^*}^{\frac{\varsigma-\eta}{\varsigma-1}}\right)(2T-\ell_h^*)} \tag{29}$$

is positive if

$$2T-\ell_h^*>\frac{B}{C}\left(\frac{A_s}{A_h}\right)^{\frac{1}{1-\varsigma}}{\ell_h^*}^{\frac{\eta-1}{\varsigma-1}}=\frac{\left(\frac{\varsigma(1+\tau)}{\eta(1-\theta)}\right)^{\frac{1}{1-\varsigma}}\left(\frac{\beta}{\alpha}\frac{\eta}{\mu(1+\tau)}+\frac{\eta(1-\theta)}{\varsigma(1+\tau)}\right)}{\left(\frac{\beta}{\alpha}\frac{\eta}{\mu(1+\tau)}+1\right)}\left(\frac{A_s}{A_h}\right)^{\frac{1}{1-\varsigma}}{\ell_h^*}^{\frac{\eta-1}{\varsigma-1}} \tag{30}$$

This is true because $\frac{L_s}{2T-\ell_h} = \frac{l_s+\ell_s}{T+\ell_s} \leq 1$, so that:

$$2T - \ell_h^* > L_s^* = \left(\frac{\varsigma\,(1+\tau)\,A_s}{\eta\,(1-\theta)\,A_h}\right)^{\frac{1}{1-\varsigma}} \ell_h^{*\frac{\eta-1}{\varsigma-1}} \tag{31}$$

Inequality (31) implies inequality (30) since $\frac{\eta(1-\theta)}{\varsigma(1+\tau)} < 1$.

To prove point *(iv)* let us consider that the elasticity

$$\frac{\partial\left(\frac{\ell_h^*}{L_s^*}\right)}{\partial A_s} \Big/ \frac{\frac{\ell_h^*}{L_s^*}}{A_s} = \frac{\frac{1}{1-\eta}\ell_h^* - \left(\frac{C}{B}\frac{1}{1-\eta}\left(\frac{A_s}{A_h}\right)^{\frac{1}{\varsigma-1}} \ell_h^{\frac{\varsigma-\eta}{\varsigma-1}}\right)(T-\ell_h^*)}{\left(1+\frac{C}{B}\frac{\varsigma-1}{\eta-1}\left(\frac{A_s}{A_h}\right)^{\frac{1}{\varsigma-1}} \ell_h^{\frac{\varsigma-\eta}{\varsigma-1}}\right)(T-\ell_h^*)} \tag{32}$$

is positive if

$$T - \ell_h^* < \frac{B}{C}\left(\frac{A_s}{A_h}\right)^{\frac{1}{1-\varsigma}} \ell_h^{*\frac{\eta-1}{\varsigma-1}} \tag{33}$$

It will be remebered that $(T - \ell_h) \leq L_s$. However, as seen before, $L_s^* > \frac{B}{C}\left(\frac{A_s}{A_h}\right)^{\frac{1}{1-\varsigma}} \ell_h^{*\frac{\eta-1}{\varsigma-1}}$. Therefore, the elasticity is positive until $\frac{\ell_h^*}{L_s^*}$ is close to 1. The smaller $\frac{\eta(1-\theta)}{\varsigma(1+\tau)}$ is, the closer to 1 is the point that turns the sign. ■

The uncertain rise in the share of service output (stylised fact *(v)*) can also be accounted for by the model. In fact, having indicated growth rates by $g(\cdot)$:

Proposition 3 *The ratio* $\frac{C_s}{C_m}^*$ *increases if* $g(A_s) > g(A_m) \geq 0$*, or if* $g(A_m)$ *is moderately larger than* $g(A_s)$*.*

Proof. Equation (24) can be re-considered in growth rates:

$$g\left(\frac{C_s}{C_m}^*\right) = g\left(\frac{A_s}{A_m}\right) + (1+\varsigma-\mu)\,g\left(L_s^*\right) - g\left(Nl_m^*\right) \tag{34}$$

A proportional rise in $\frac{A_s}{A_m}$ increases $\frac{C_s}{C_m}^*$ because, beyond its direct effect, a proportional rise of A_s, irrespective of changes of A_m, increases L_s^* (see proof of proposition 2*(ii)*), and reduces Nl_m^*, since:

$$\frac{\partial\left(Nl_m^*\right)}{\partial A_s} \Big/ \frac{Nl_m^*}{A_s} = \frac{\ell_h\left(1 - \frac{\frac{\beta}{\alpha}\frac{\eta}{\mu(1+\tau)}+1}{\frac{\beta}{\alpha}\frac{\eta}{\mu(1+\tau)}+\frac{\eta(1-\theta)}{\varsigma(1+\tau)}}\right)}{Nl_m\left((1-\eta)+\frac{C}{B}(1-\varsigma)\left(\frac{A_s}{A_h}\right)^{\frac{1}{\varsigma-1}} \ell_h^{\frac{\varsigma-\eta}{\varsigma-1}}\right)} < 0 \tag{35}$$

Alternatively, a rise in A_s may still have a positive effect on $\frac{C_s}{C_m}^*$ even if A_m rises at a greater rate, if its indirect effects through $g\left(L_s^*\right)$ and $g\left(Nl_m^*\right)$ prevail, as is evident from (34). ■

Therefore, the proof for a common explanation extended to the stylised fact *(v)* is conditional on the a moderate relative rise in A_m. As this condition may not always occur, the trend in service output share may not be definitely positive[9].

The explanation for an increasing service output share given here is also relevant to the debate on the income elasticity of demand for services. This is shown to be equal or vey close to 1 by substantial empirical evidence (Kravis et al., 1983; Summers, 1985, Falvey and Gemmell, 1995). However, it has also been proved using a two-sector model that this evidence, together with the fact that $g(A_m) > g(A_s)$, does not support a non-decreasing service output share (Gundlach, 1994; 1996). Our model adopts a Cobb-Douglas utility function, which implies homotetic demand and unitary elasticity, but the introduction of homework allows for the possibility of a non-decreasing service output share.

Baumol (1967) assumes, in his well-known model of unbalanced growth, that output shares of the "progressive" and "stagnant" sectors of the economy remain constant, and that growth in productivity by the "progressive" sector is greater. He also assumes that the wage rate is homogeneous across sectors, and it rises in line with the productivity of the progressive sector. As a relevant result, he concludes that aggregate output growth declines because labour out-migrates from the "progressive" sector. The present model, which includes homework as a hidden third sector, enables us to check this result.

Baumol's assumptions on wages are borne out here, since the wage rate is unique and is proportional to A_m. This is shown by equation (22), bearing in mind that, in equilibrium, a rise in A_m does not affect L_s^*.

Baumol's assumption of constant output shares while sectoral productivities increase requires an adjustment in the consumption elasticities of the model. In fact, if $\frac{C_s}{C_m}^*$ remains constant, and if $g(A_m) > g(A_s) \geq 0$, then $\frac{\beta}{\alpha}$ must adjust. To show this, observe the r.h.s. of equation (24), which must be constant. If $g(A_m) > g(A_s) = 0$, then ℓ_h^* must rise. But equations (25) and (18) tell us that if A_m and ℓ_h^* (and hence L_s^*) rise, then also $\frac{\beta}{\alpha}$ must rise to maintain $\frac{C_s}{C_m}^*$ constant. This might be regarded as the typical Baumolian case where market service employment increases.

However, the rise in ℓ_h^* contrasts with stylised fact *(ii)*, so that the assumption $g(A_m) > g(A_s) > 0$ holds. In this alternative case, equation (18) tells us that L_s^* still rises if $g(A_s)$ is sufficiently great. To maintain $\frac{C_s}{C_m}^*$ constant, $\frac{\beta}{\alpha}$ must rise to a lesser extent than it does in the Baumolian case.

It is interesting to find that in this alternative case Baumol's conclusion that aggregate output growth declines may not be true. To show this, let us define aggregate growth under constant population and full employment[10] as follows:

$$G = g(A_m)\frac{Nl_m^*}{2T} + g(A_s)\frac{L_s}{2T} + g(A_h)\frac{\ell_h}{2T} \tag{36}$$

[9] Some authors maintain that the stylised fact concerning service output share is either constant or, indeed, declining (Echevarria, 1997; Falvey and Gemmell, 1995). Unfortunately, the issue is blurred by the poor reliability of statistics on service productivity (Griliches, 1992).

[10] These are also Baumol's assumptions.

where sectoral output growth rates are weighted by the employment shares, *including homework*, which add up to unity[11]. Through time G changes even if sectoral growth rates (the $g(\cdot)$s) remain constant, because weights endogenously change. In the case of a sufficiently great $g(A_s) > 0$, ℓ_h^* and Nl_m^* diminish and L_s^* rises, and if, moreover, the positive gap $g(A_m) - g(A_s)$ is not too large, then aggregate growth (G) increases.

To exemplify these results, let us simulate the model. Table 2 shows three alternative cases as given by exogenous sectoral growth rates (in percentages), under the following (starting) values of the other parameters: $A_m = 1.2$, $A_s = 0.4$, $A_h = 0.3$, $\mu = 0.7$, $\varsigma = 0.6$, $\eta = 0.3$, $\alpha = 0.3$, $T = 1$, $\theta = \tau = 0$.

Table 2.

$g(A_m)$	$g(A_s)$	$\frac{Nl^*_{m(t=0)}}{2T}$	$\frac{Nl^*_{m(t=4)}}{2T}$	$\frac{L^*_{s(t=0)}}{2T}$	$\frac{L^*_{s(t=4)}}{2T}$	$\frac{\ell^*_{h(t=0)}}{2T}$	$\frac{\ell^*_{h(t=4)}}{2T}$	$G_{(t=0)}$	$G_{(t=4)}$
5.7	0	.374	.324	.502	.547	.123	.130	2.13	1.85
4.34	1	.374	.347	.502	.533	.123	.121	2.13	2.04
3	2	.374	.370	.502	.518	.123	.112	2.13	2.15

Each of the three rows represents a case as characterised by sectoral growth rates, which are given in the first two columns. The six columns in the middle show the weights of equation (36) as calculated by the model, i.e. the sectoral employment shares at the starting point ($t = 0$) and after four (discrete) periods ($t = 4$). The last two columns show the changes in the aggregate growth rate. In the first case $g(A_s) = 0$ and the gap $g(A_m) - g(A_s)$ is wide; hence employment out-migrates from industry to market services and, counterfactually, to home services, so that aggregate growth sharply declines. In the second case, $g(A_s)$ is positive but small, and the gap $g(A_m) - g(A_s)$ is fairly wide, hence employment out-migrates both from industry and, to some extent, from homework to market services. Aggregate growth slightly declines. In the third case $g(A_s)$ is greater but the gap $g(A_m) - g(A_s)$ is narrow, hence employment mainly out-migrates from homework to market services, so that aggregate growth can increase.

The consideration of homework as a third hidden sector and the increased efficiency of market services are the necessary and sufficient conditions for explanation of the stylised facts identified above, and for disputing Baumol's conclusion on growth. One could observe, however, that technical progress in industrial production should play a key role in explaining overall growth and structural change. But the model can be easily modified in various ways to allow for a rise in the efficiency of market services $g(A_s)$ as linked to industrial technical progress $g(A_m)$.

[11] The geometric average, which would be a more correct measure of aggregate growth, cannot be applied because $g(A_h) = 0$. If $g(A_h)$ takes a small positive value, the qualitative results obtained below do not change.

6 Policy

The potential for a further increase in female employment is still substantial in many European countries, if compared to the US and the Nordic countries. Microeconomic studies reveal that women still tend to resist buying market services and to shift their work to the market, because they regard service prices as still too high with respect to the opportunity wage [12]. Hence, among the policies devised to expand female participation in the labour market (Oecd, 1994), regarded as particularly important is subsidising the market services most substitutable with homework and which can most attract female work (Anxo and Fagan, 2000).

The subsidy parameter θ, as already considered in the model, is a subsidy for the consumption of market services. It is thus easy to check that it has a positive effect on female employment. In fact, $\frac{\partial \ell_h}{\partial \theta} < 0$ from the implicit derivation of (25), and hence $\frac{\partial (2T - \ell_h)}{\partial \theta} > 0$.

A more appealing result would be that the subsidy inducing an increase in female employment is exactly financed by some tax. If the tax rate τ on labour income is assumed, then it must be:

$$\theta C_s^* p_s^* = \tau \left(\ell_s^* + l_s^* + l_m^* \right) w^* \tag{37}$$

to balance the budget, thus endogenising τ. Since the model becomes analytically intractable with the addition of this equation and this unknown, numerical simulations are applied.

Row 1 in table 3 shows the benchmark case of no subsidy, and hence no tax, with values of the parameters as seen in the simulation of the previous section. Row 2 shows the case of a positive θ, thus raising τ, to balance the budget. In this case "official" employment is greater. However, row 2 also shows that utility diminishes. This result is due to the introduction of a distortion into the model, which is of general equilibrium and of market clearing, with no increasing returns, nor externalities.

Tab.3

θ	A_{s1}	$2T - \ell_h$	U
0	0	1.75	.649
0.1	0	1.80	.640
0.1	0.1	1.84	.698

This approach can be questioned on the ground that externalisation of homework into the market implies a Smithian specialisation of labour (Locay, 1990). To keep the model simple, this fact can be captured by assuming an externality, as follows:

$$A_s = A_{s0} + A_{s1}(T - \ell_h^*) \tag{38}$$

[12] See the literature cited in Anxo and Fagan, 2000. These authors also point out that the "integration of women into the economy would also provide income security in periods of male unemployment and household dissolution due to divorce or widowhood, thus reducing the demands on public expenditure for unemployment and poverty assistence".

This assumption implies the substitution of parameter A_s with another two: $A_{s0} = 0.4$ and $A_{s1} = 0.1$. Row 3 shows the effects: not only has "official" employment increased further, but also utility has increased with respect to the benchmark case.

7 Conclusions

Slow economic growth and high unemployment are major problems for economists. The present paper deals with these problems, albeit indirectly, because it identifies a way to make the economic system more efficient: increase women's participation in the labour market. In fact, women are concentrated in home production, which is a hidden and low-efficient sector also in the developed countries.

The model proposed provides a simple economic explanation for greater female employment by calling for the decreasing relative convenience of home work and home production with respect to market work and market services due to the different sectoral growth rates in efficiency. It also shows the positive effects on the development of the service sector, and on female employment in that sector. Moreover, it disputes Baumol's (1967) prediction of declining aggregate growth rates, because labour migrates in the long run to market services not only from industry but also from home production. Finally, it finds that a (balanced budget) subsidy for the consumption of market services may increase employment, and, by considering a specialisation effect in leaving homework, also welfare.

A future development of the model should first allow for different wages by gender, not only because the gender wage gap is an important stylised fact, but also because women's wages have risen more than men's, especially in the US (Smith and Ward, 1989). This reinforces the unfavourable change in the terms of trade of homework with respect to market work. Another interesting development of the model would be the inclusion of a bias in household utility toward market services due to the income contribution by wives to the household budget, as claimed by the most recent literature on the household production model (Lundberg and Pollak, 1996).

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