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A growth model with gender differences and socio-political participation

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Abstract

We propose a model of growth with human capital accumulation, in which individuals allocate their time among work, education and socio-political participation. There are two groups, women and men, whose values and targets are different; every individual engages in socio-political activities to socially establish the values of the group she/he belongs to; his utility will be greater the more the society has values similar to those of the belonging group. How participation in socio-political activities affects individual's utility depends on the relative presence of the individual's social group in employment.
The model predicts that economies with a more equal presence of females and males in employment and higher population growth rates converge to a stationary state where time allocated to working activities is lower and time for education is higher. We simulate the model on some European countries with different male/female employment rates, population growth rates and capital shares. Simulations confirm the empirical evidence: European countries with a more equal presence of women and men in the labour market experience higher education attainment rates, allocate a higher proportion of time to social participation, and work, on average, a lower number of hours than countries with a lower relative proportion of females in employment.

Keywords: human capital, growth, socio-political participation, social groups, gender.
JEL classification: O1, J22, J24

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1. Introduction

In this article we propose a model of growth with endogenous determination of time allocated to education, work, and socio-political activity, in which society is composed by two social groups, women and men, pursuing different social values. In this context, individual's utility depends also on the extent the society represents the values of the social group s/he belongs; values can be affirmed by participating in socio-political activities and depending on the relative weight of the reference group in society. The main objective of our contribution is to provide a theoretic framework to explain the relationship observed in developed countries, in particular in those belonging to the European Union, among relative presence of women in society, average time allocated to either education, work or socio-political activities and per capita income.

The empirical evidence shows that European countries are characterised by a negative relationship between female labour market presence relative to men and average time devoted to work; moreover, countries with the highest proportion of active females on working population perform also the highest levels of education attainment and per-capita income. On the other hand, we observe a positive relationship between time allocated to socio-political activities and proportion of women in the labour force. Therefore, countries with the highest levels of per-capita incomes record also the highest participation in politics and social activities, as proved in the pioneering studies of Lane (1966), Frey (1971) and Russell (1972).

An interesting fact emerges if we examine European countries as to the relationship between total employment by sex, fertility rates and growth rates of population. We find that countries with a more equal distribution of employment between males and females, are accompanied by higher fertility rates, growth rates of population and education attainment (*virtuous* countries). We may say that in the European Union there exist two different social models: a *Nordic model* where the proportion between female and male employment is practically equal; in addition to that, fertility and population growth rates are among the highest and working time is the lowest in Europe; a *Mediterranean model* where, on the contrary, the proportion of females in total employment is strongly lower than the proportion of men, working time is higher and average educational levels are

lower than in "virtuous" countries. In between the two social models we find the *continental model*.

Our model presents a theoretical framework to determine the degree of individuals' socio-political commitment, without assuming, however, that socio-political activity implies subtracting time from working activity, as suggested in other recent contributions (Antoci et al., 2007). Our agents choose how much of the available time to devote to education, work and socio-political activities, knowing that education allows to improve hourly productivity, while socio-political participation consents to take part in the determination of society's values, and to obtain a greater benefit the more the society's values are similar to those of the group the agent belongs to[1].

We assume that society is composed by two groups, precisely women and men, interested in different values; the largest is any group, the higher is the utility of individuals belonging to that group. Therefore, how participation in socio-political activities affects individual's utility depends on the relative incidence of the individual's social group −either men or women− in the whole society, e.g. on the relative size of the group.

Our assumption, that women and men constitute social groups opposed to each other, goes back to Hofstede (2001) and the idea that masculinity and femininity can be traits identifying different social roles. Referring to Hofstede's contribution, masculinity is seen to be the trait which emphasizes ambition, acquisition of wealth, and differentiated gender roles; femininity is seen to be the trait which stresses in general more fluid roles, caring and nurturing behaviours[2]. On the other hand, the recent economic literature applying the experimental approach shows the existence of robust gender differences in risk preferences, social preferences and competitive preferences[3].

In our framework, the coexistence of different social groups can have economic consequences (Akerlof and Kranton, 2000). Society is characterised by the traits of the predominant social group. Where women and men are not equally represented in the

[1] We assume that the representative agent shares completely the values of the group he belongs.

[2] In his categorization of countries, Hofstede (2001, p. 297) distinguishes between "feminine" and "masculine" countries. The former are societies in which social gender roles are clearly distinct: men are supposed to be assertive, and focused on material success; women are supposed to be more modest and concerned with the quality of life. The latter are countries in which social gender roles overlap and men have values similar to those of women. Hofstede reveals that women in feminine countries have the same modest, caring values as the men; in the masculine countries they are somewhat assertive and competitive, but not so much as the men, so that these countries show a gap between men's values and women's values.

[3] See Croson and Gneezy (2009) for a recent survey.

economic activity, the society will be dominated by the values of the largest social group. We predict that in countries where there is an equal proportion of women and men in economic activities, and therefore and equal incidence of feminine and masculine values in the society, educational levels are higher, average working hours are lower and socio-political commitment is greater than in countries where women and men are not equally represented.

Our model predicts correctly the empirical facts discussed previously: on the one hand the positive relation among the proportion of female to male workers in the economy (exogenous in our model) and average educational levels; on the other, the negative relation between the relative presence of females in the labour market and average hours of work. Economies where labour activity is equally distributed between men and women, are characterized by lower average working hours, higher educational levels and participation in socio-political activities than economies in which the relative presence of women in economic activities is lower.

The paper is structured as follows: Section 2 discusses some empirical evidence about the influence of gender participation on socio-economic variables; Section 3 provides the theoretical model; Section 4 presents our simulated results for some European countries; in Section 5 we conclude.

2. Empirical evidence

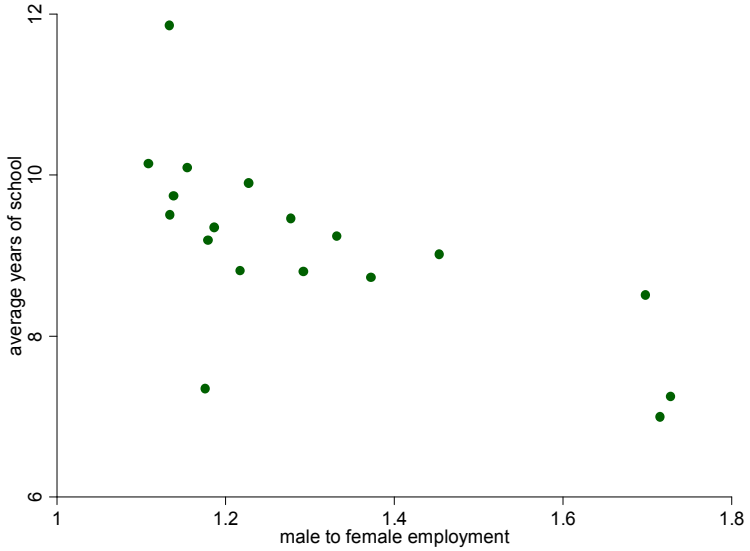
The model we are going to propose in next Section tries to explain the relationship between the relative presence of women in the labour market and some factors strictly related to countries' socio-economic performances. In particular, at the theoretical level, our framework predicts that a society characterised by an equal gender involvement in economic activity can achieve a redistribution of hours of work from men to women such that, on average, time spent to work is less than in countries where women are underrepresented in the labour market. Moreover, when work is equally distributed between genders, people reallocate their time in favour of other activities, such as education and socio-political participation.

Here, we provide a discussion of empirical facts related to the variables determined in the model, to give an empirical foundation to our theoretical predictions and a

benchmark to discuss the simulated results (next Section). Unfortunately, we do not have data for a single country on some of the variables of interest, and we have to resort to an inter-country comparison. Although we are aware that this alternative implies to compare economies characterised by different labour market structures and policies −especially to enhance female employment− and unlike fertility rates, migration flows and per-capita incomes, we anyway believe that the comparison can help to validate our theoretical approach; as it will be clear later, at least at the European level correlations between female-to-male employment ratios and some socio-economic indicators are supporting our theoretical predictions and the simulated results.

Our model determines the allocation of time among education, work, and socio-political activities. We first look at the relationship between education and relative presence of women in employment. In Figure 1, we plot data on the country's average years of school[4] versus male-to-female employment ratio[5].

Figure 1. Relationship between male-to-female employment ratio and average years of school



Source: Our elaborations on Eurostat data (male-to-female ratio) and Barro and Lee (2000)

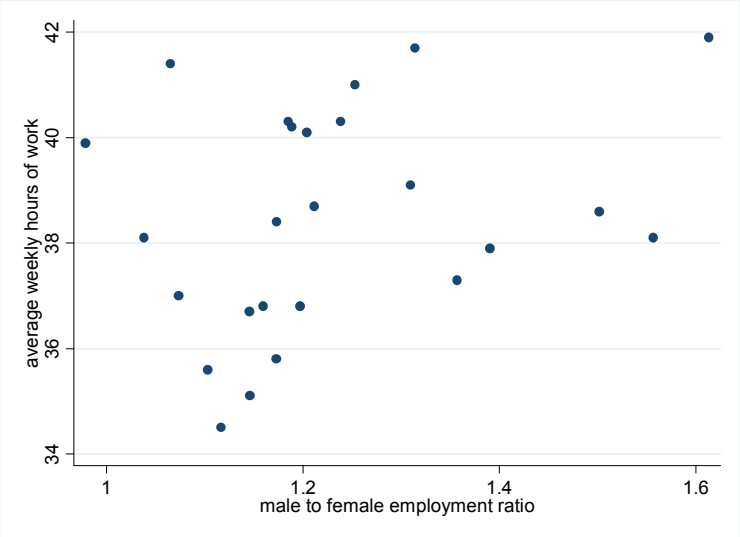
The highest proportion of males to females in employment, in Europe, is observed in Southern countries (Greece, Italy and Spain); on the other hand, the most equally

[4] Data are from Eurostat (2005). The percentage is calculated on total population aged 25-64.
[5] Barro and Lee (2000).

distribution of work between the two sexes is in Scandinavian countries, France, Germany, Portugal and some Eastern economies. Surprisingly, the Netherlands does not rank the first in equal division of labour (its male-to-female employment ratio is 1.23). Apart from a few observations, in Europe there appears to be a clear negative relationship between country's educational levels and female relative participation in employment.

As to the relationship between female relative participation in employment and average working time, in Figure 2 we observe that countries with a less equal distribution of work between genders experience, in general, higher levels of average weekly working time.[6] Countries with the highest levels of working time (more than 40 hours per week) are the new entrants Eastern and Baltic countries, and Greece, the country ranking first as to both male-to-female employment ratios and time allocated to work. Scandinavian countries plus United Kingdom, France, Portugal and Austria perform an almost equal allocation of work between females and males (coefficients are between 1.1 and 1.2) and an average commitment in working activities lower than 38 hours per week.

Figure 2. Relationship between male-to-female employment ratio and average weekly hours of work



Source: Eurostat (2005), LFS

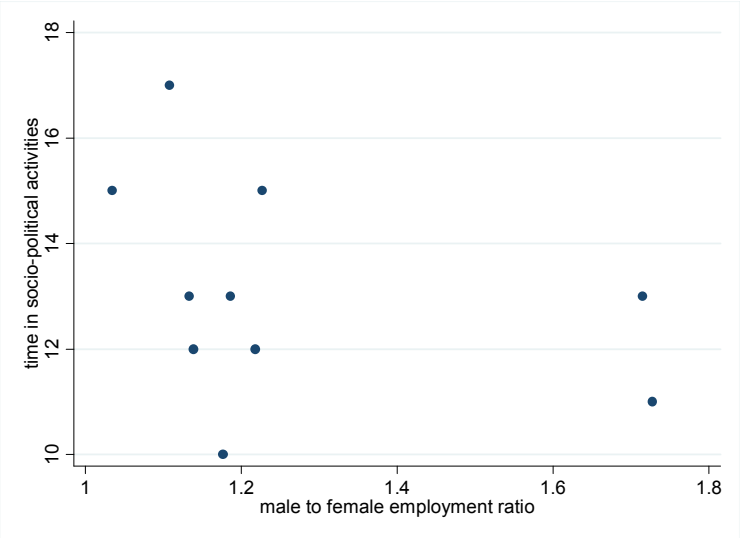
On a theoretical base, our framework predicts that when a country experiences an increasing participation of women in employment relative to men, then also time

[6] All data are from Eurostat (2005), LFS. Working time is referred to the main job.

allocated to socio-political activities should increase; the more employment is equally distributed between genders, the higher the proportion of time, on average, devoted to socio-political participation. On the other hand, if we also take into account the differences among countries in terms of population growth rates and capital shares, the result, on a theoretical base, is uncertain.

In the following Figure, we show how the relationship between the two variables behaves in some countries of the European Union. Unfortunately, the only available data on time allocated to socio-political activities have been collected through a special survey (Eurostat, European Social Survey-ESS) carried out only in some countries[7].

Figure 3. Relationship between male-to-female employment ratio and time allocated to socio-political activities



Source: Eurostat (2000), LFS and Eurostat: Time Use Survey

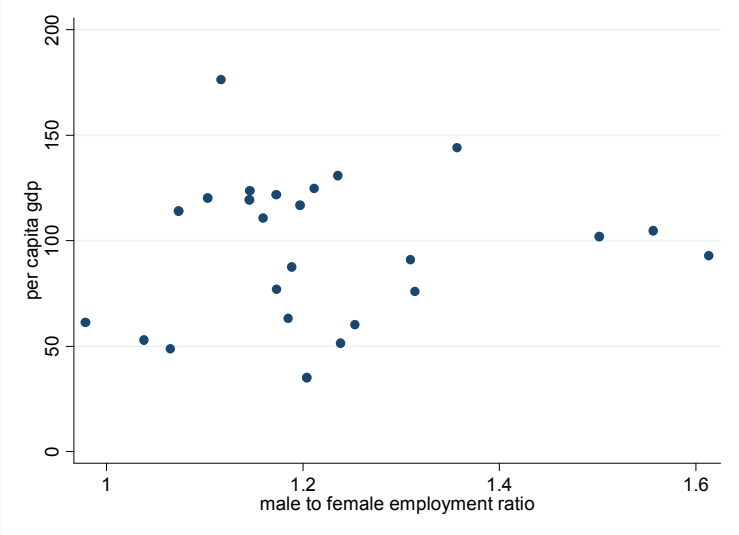
Figure 3 clearly illustrates the existence of a negative relationship, at least for the European countries included in the ESS, between the proportion of male-to-female employment and time spent in socio-political activities. Empirics seem to highlight a strong regularity: economies with an almost equal division of market labour between

[7] Data are available at the web address: http://ess.nsd.uib.no. Data have been collected across the period 1998-2002 in Belgium, Germany, Estonia, France, Hungary, Slovenia, Finland, Sweden, United Kingdom and Norway (for a summary of the results:Eurostat, 2005). For Spain, Italy, Latvia, Lithuania and Poland, data were collected across the period 2002-2004 ((for a summary: Eurostat, 2006). From the dataset we extrapolate information on time allocated to "volunteer activites" (the dataset containes an explicit entry) and "other participatory activities" (subheading of "leasure time").

men and women (at least in terms of heads), Estonia and Finland, also show a higher commitment, in terms of average time, in socio-political activities; on the other hand, Italy and Spain rank last in both female relative market employment and participation in socio-political activities. Once again, the Scandinavian versus Mediterranean countries' scheme emerges.

An interesting general question economists have been debating for a long time is related to whether a country should pursue full employment at the expense of a lower individual working time and then a lower level of individual income. Our model predicts that, in the long run, economies with a more equal labour market participation between men and women achieve, on average, lower per-capita incomes than countries where work is mainly a male fact: as the female presence in market activities increases and converges to male's labour market participation, average time allocated to human capital accumulation decreases and so does per-capita income. Nonetheless, if we consider the existing differences among other parameters, this conclusion can fail to comply with evidence.

Figure 4. Relationship between male-to-female employment ratio and per-capita GDP



Source:Eurostat (2005), per-capita GDP in PPS (EU-27=100). Eurosat (2005), LFS.

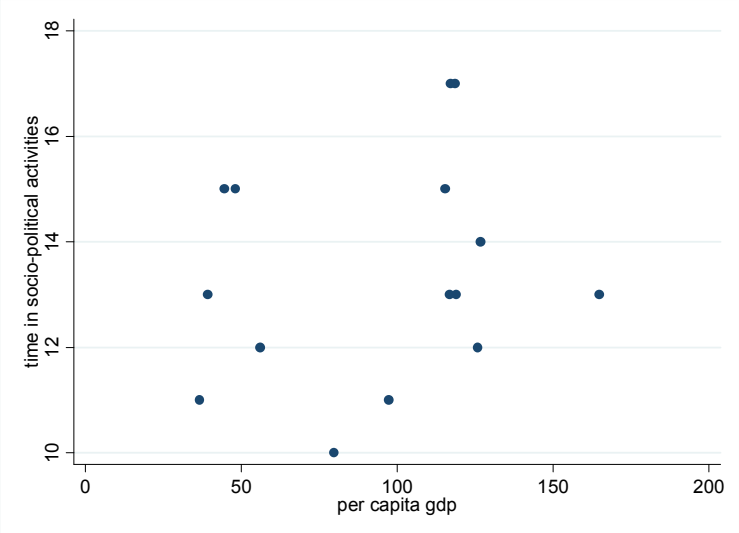
Figure 4 seems to confirm the positive relationship between male relative employment and per-capita income. The relationship between the two variables appears positive,

even though not exactly linear. As previously observed, countries with the highest male-to-female employment ratio are Greece, Italy and Spain.

We propose a last focus on the link between per-capita income and commitment in socio-political activities, in the wake of pioneering works, from the late 1960 and early 1970s, showing that countries with the highest levels of per-capita incomes record also the highest participation in politics and social activities (Lane, 1966; Frey, 1971; Russell, 1972). Our model does not predict a clear relationship between the two variables, in an inter-country comparison (supposing different capital shares, population growth rates and female-to-male employment ratios).

As to the relationship between the degree of development (per-capita GDP) and socio-political involvement, Figure 5 shows an uncertain pattern; indeed, the variability of time allocated to socio-political activities is rather high in correspondence to a few per-capita income levels. The limited availability of data on socio-political participation does not allow to dare the existence of a positive relationship.

Figure 5. Relationship between per-capita GDP and time allocated to socio-political activities*



Source: Eurostat (2000), per-capita gdp in PPS(EU-27=100). Eurostat: Time Use Survey

3. The Model

We consider a competitive, closed economy populated by identical and infinitely lived agents. Agents are perfectly rational and the production sector is subject to constant returns to scale. Agents belong either to social group *f* (females) or *m* (males) and at any time *t* group *s* (*f, m*) is made by $N^s(t)$ individuals working in the only production sector of the economy. Each population $N^s(t)$ is determined exogenously as well as *n*, the growth rate of population, which is equal for both groups.

In each instant, individuals allocate their no leisure time among three different activities: acquiring a formal education, $e^s(t)$; working in the productive sector, $u^s(t)$; and participating to socio-political life, $p^s(t)$. The representative individual of group *s* has the following preferences over per-capita consumption, $c^s(t)$, and socio-political participation[8]:

$$V^s(0) = \int_0^\infty e^{-(\rho-n)t}\left[\log c^s(t) + g^s\left(p^s(t)\right)\right]dt \qquad s = f,\ m \qquad (1)$$

Where $\rho > 0$ is a common discount rate.

Function $g^s(p^s)$ is defined as follows:

$$g^s(p^s) = \frac{N^s p^s}{N^s p^s + N^{-s} p^{-s}} Z \qquad (2)$$

N^m and N^f are the number of men and women in the labour market.

Z is total benefit.

Defining $\beta \equiv \frac{N^m}{N^f}$, function $g^s(p^s)$ becomes:

$$g^f(p^f) = \frac{p^f}{p^f + \beta p^m} Z \qquad \text{for women} \qquad (3)$$

[8] The utility function of the representative agent of group *s* depends on the level of consumption and on function $g^s(p^s(t))$, which summarises how socio-political participation affects the utility of consumption. We suppose that, at any time t, the representative individual of group *s* has an instantaneous utility function $U^s(t) = c^s(t)\exp g^s(p^s(t))$. Taking the logarithmic transformation, we obtain the expression that enters in the overall utility shown in Equation (1).

$$g^m(p^m) = \frac{\beta p^m}{p^f + \beta p^m} Z \qquad \text{for men} \qquad (4)$$

Individuals maximize function (1), with respect to c^s, p^s and u^s, subject to the laws of motion for *k* (per-capita capital) and *h* (per-capita human capital):

In Equations (2) to (4), Z represents the total benefit the two groups try to capture; the higher the proportion of Z any social group is able to capture, the more the values of the society correspond to the values characterizing that group**.** The proportion of Z that any social group is able to take depends on a function of the group's relative weight in the society −measured by the number of individuals belonging to that group relative to the other group's size− and on the time that each group's representative individual devotes to social activities. For simplicity, we impose Z equal to one.

For simplicity of notation, when possible and not confusing, we omit superscript *s*.

Individuals maximize the value function (1), with respect to c, p and u, subject to the following laws of motion for per-capita capital (Equation 5), and individual human capital (Equation 6):

$$\dot{k}(t) = f\big(k(t), u(t)h(t)\big) - (\delta + n)k(t) - c(t) \qquad (5)$$

$$\dot{h}(t) = B\big(1 - u(t) - p(t)\big)h(t) - \delta h(t) \qquad (6)$$

Initial levels of physical and human capitals, $k(0)$ and $h(0)$, are given.

Following Lucas (1988), human capital accumulation depends on the level of human capital already attained by our representative agent $h(t)$, and time devoted to education $(1 - u(t) - p(t))$ multiplied by parameter B, measuring productivity of the education sector. Differently from Lucas, we assume that human capital depreciates at the same rate of depreciation of physical capital.

The production function is assumed to be a Cobb-Douglas: $f\big(k(t), u(t)h(t)\big) = k(t)^{\alpha}\big(u(t)h(t)\big)^{1-\alpha}$.

The current value Hamiltonian we maximize to solve our model is:

$$H(c(t),k(t),u(t),p(t),\lambda_1(t),\lambda_2(t)) = \log c^s(t) + g\left(p^s(t)\right) + \\ + \lambda_1(t)[f\left(k(t),u(t)h(t)\right) - (\delta + n)k(t) - c(t)] + \\ + \lambda_2(t)[B\left(1 - u(t) - p(t)\right)h(t) - \delta h(t)]$$

The FOCs associated to the current value Hamiltonian are

$$c(t)^{-1} = \lambda_1(t) \tag{7}$$

$$g_{p(t)} = \lambda_2(t)Bh(t) \tag{8}$$

$$\lambda_1(t) f_{L(t)} h(t) = \lambda_2(t)Bh(t) \tag{9}$$

$$\frac{\dot{\lambda_1}(t)}{\lambda_1(t)} = \rho + \delta - f_{k(t)} \tag{10}$$

$$\frac{\dot{\lambda_2}(t)}{\lambda_2(t)} = \rho - n + \delta - Bu(t) - B(1 - u(t) - p(t)) \tag{11}$$

Since $u(t)$ represents the fraction of time the representative agent devotes to current production, $u(t)h(t)$ represents the fraction of time devoted to work in terms of efficiency units.

The transversality condition can be written as follows: $\lim_{t\to\infty} e^{-(\rho-n)t}[\lambda_1(t)k(t) + \lambda_2(t)h(t)] = 0$.

Deriving the values of $\lambda_1(t)$ and $\lambda_2(t)$ from (7) and (8) respectively and putting them into (9), we obtain

$$g_{p(t)} = f_{L(t)} \frac{h(t)}{k(t)} \frac{k(t)}{c(t)} \tag{12}$$

Equation (12) describes the relationship among state and control variables at time t and is crucial for future analysis.

The system of first order conditions is solved by imposing the steady state equilibrium.[9] In particular, considering that in the stationary state $\frac{\dot{c}}{c} = \frac{\dot{k}}{k} = \frac{\dot{h}}{h} = \frac{\dot{u}}{u} = \frac{\dot{p}}{p} = \frac{\dot{\lambda}_1}{\lambda_1} = \frac{\dot{\lambda}_2}{\lambda_2} = 0$[10], together with (12), system (7)-(11) becomes

$$\rho + \delta = f_{k^*} \tag{13}$$

$$\rho - n = Bu^* \tag{14}$$

$$\delta = B(1 - u^* - p^*) \tag{15}$$

$$\frac{c^*}{k^*} = \frac{f(k^*, u^* h^*)}{k^*} - \delta - n \tag{16}$$

As in the standard Lucas model without external effects, equation (14) implies that the steady-state equilibrium level of time allocated to work depends positively on the rate of intertemporal preference, negatively on the rate of population growth and inversely on productivity of the education sector. Moreover, individuals of both groups work, in per-capita terms, the same number of hours. This result may appear empirically unrealistic; however, this is because we do not model the choice between household work and market work. The model determines the distribution of time between education, work and socio-political participation.

By considering the Cobb-Douglas production technology, the solution to system (12)-(16) leads to the following (implicit) reaction functions for p^s ($s = f, m$):

For group *f*: $$\frac{\beta p^m}{\left(\beta p^m + p^f\right)^2} = \frac{1-\alpha}{u^*} \frac{\rho + B(1 - u^* - p^f)}{\rho - \alpha n + (1-\alpha)B(1 - u^* - p^f)} \tag{17}$$

[9] Given $\lambda_1(t)$ and $\lambda_2(t)$, if the current value Hamiltonian function is concave in k(t) and h(t), the Arrow's theorem implies that the FOCs, jointed to the transversality conditions, are necessary and sufficient to characterize a maximum solution.

[10] It is easy to demonstrate that this economy does not reach, in the long-run, a balanced growth path, but a stationary state where per-capita growth rates are equal to zero. The stationary state is stable. See the Appendix for the analysis of stability.

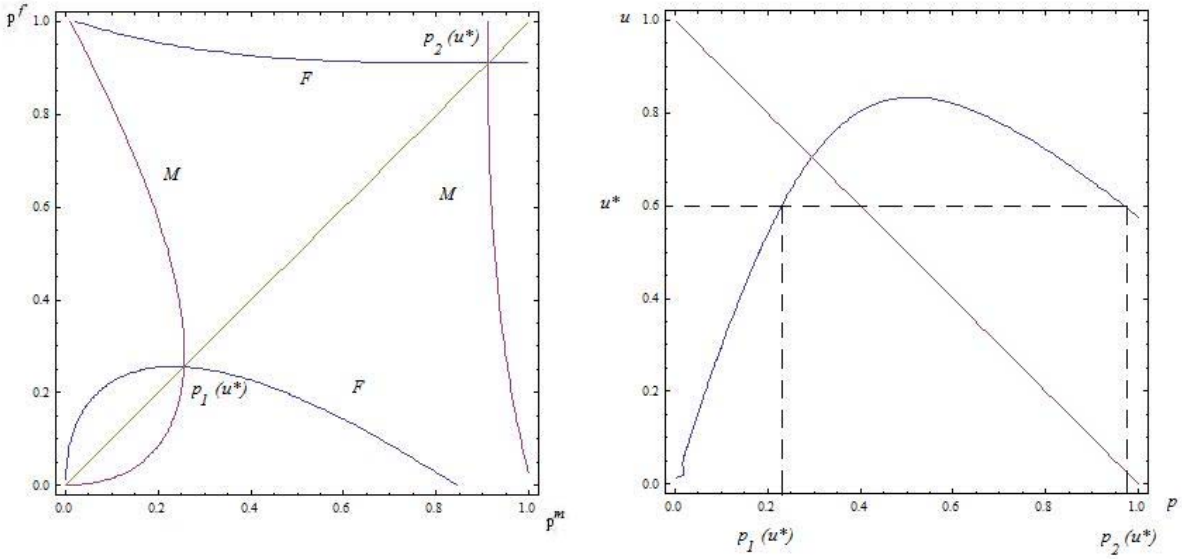
For group *m*

$$\frac{\beta p^{f}}{\left(\beta p^{m}+p^{f}\right)^{2}}=\frac{1-\alpha}{u^{*}}\frac{\rho+B(1-u^{*}-p^{m})}{\rho-\alpha n+(1-\alpha)B(1-u^{*}-p^{m})} \qquad (18)$$

The solution to system (17)-(18) is a Nash-Cournot equilibrium in which the fraction of time allocated to socio-political participation by both groups depends on the relative proportion of the two groups, β, as well as on the other parameters.

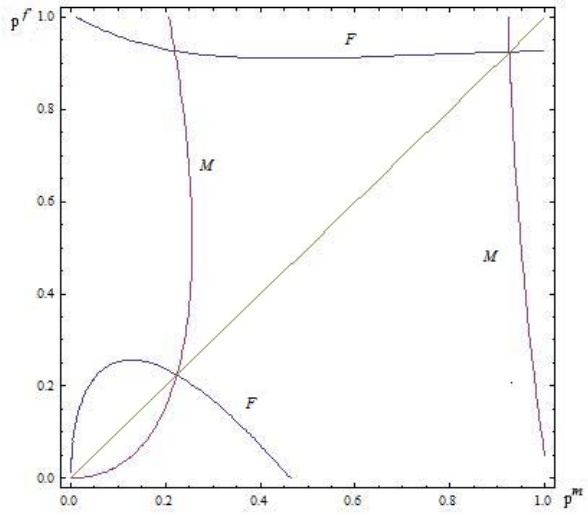
If the two groups have the same number of members ($\beta = 1$), the two reaction functions are drawn as in Figure 6; as the proportion of men in the labour market increases, relative to females (β >1), then the reaction functions flat towards the abscissas(Figure 7)[11]. Indeed, given any β, there exist two possible Nash-Cournot equilibriums; however, as the right-hand side of Figure 6 shows, the only reasonable equilibrium, due to time constraint, is in correspondence of the lowest allocation of time to socio-political participation.

Figure 6. Steady state equilibrium time allocated to socio-political participation when females and males are equally represented in employment (β=1)



[11] For realistic values of β, the Nash-Cournot equilibrium is stable.

Figure 7. Steady state equilibrium time allocated to socio-political participation when males exceed females in employment



Note: the plot is for $\beta = 2$.

The model predicts that the highest individual involvement in socio-political activities can be achieved (in steady-state) if social groups are equally present in the economy (specifically, in production[12]); as the relative importance of any group exceeds the egalitarian distribution, time allocated to social participation decreases and time for education rises, for individuals of both groups, ceteris paribus the other parameters of the model.

4. The model simulation

The model has been simulated for three European countries: Finland, Germany and Italy. The choice has been determined by the need to compare countries with different female-to-male employment ratios, and also unlike population growth rates (and fertility rates, although it is not of our interest) and capital shares. Finland is the European country, out of the ex 15-EU, with the highest percentage of women in employment relative to men; it is second, after Estonia, if we consider the recently constituted 27-EU (see Table 1). On the other hand, Italy performs among the last countries in terms of female relative presence in market activities, with a male-to-female employment ratio second only to Malta (dead heat with Greece). Germany is performing in between.

[12] Alike the Lucas (1988) model, we do not have unemployment. All individuals work.

Unsurprisingly, for economists studying the relationship between female labour market participation and fertility, Finland is also performing the highest fertility[13] and population growth rates in the European Union, despite the high proportion of women in employment. Italy, on the other hand, is the country with the lowest rate.

Table 1. Simulations' parameters

Country	Male-to-female employment ratio (β)	Population growth rate (n)	Capital share (α)
Finland	1.10826	0.0021	0.418
Germany	1.1969	0.0006	0.367
Italy	1.7153	0.0005	0.408

Source: see Section 2. Finland and Italy: data refer to year 2000. Germany: data refer to year 2005.

As to the parameter on capital share[14], Germany presents the lowest proportion of income distributed to capital, followed by Italy. The remaining parameters have been set at levels normally used in growth models' simulations[15].

In Table 2 we report the simulations' results. Simulations confirm our theoretical model's predictions: Finland, the country with the highest proportion of female to male employment, converges to a steady state where time allocated to education is higher and working time is lower than in all other countries. Moreover, socio-political commitment is more than in Germany and Italy. That result supports the empirical evidence previously discussed and provides a validation of the theoretical framework, whose predictions where uncertain as to the relationship between female relative presence in the labour market and time dedicated to socio-political activities.

Italy and Germany perform as expected due to their parameters.

Table 2. Simulations' results

[13] Do notice that we deal with a closed-economy model; then, our population growth depends on fertility and not on migration. However, since the "simulated" countries are not autarkic, in simulating our population growth parameter includes migration.

[14] Data are from Sturgill (2009).

[15] Following Ladròn-de-Guevera et al. (1997); time preference (parameter ρ) has been assumed equal to 0.05; productivity in the human capital sector has been valued: 0.0769.

	Finland	Germany	Italy
k/h	17.3788	11.5381	16.7547
c/k	0.131764	0.151254	0.135475
*u**	0.622887	0.642393	0.643693
*p**	0.244015	0.236573	0.235984
*e**	0.133099	0.121034	0.120323

5. Conclusions

In this article we provide a theoretic framework to explain the relationship, observed in the European Union, among relative presence of women in the labour market, educational levels and average time allocated to either work or socio-political activities. The considered economy is composed by two social groups, women and men, pursuing different social values; in this context, individual's utility depends also on the extent the society represents the values of the social group individuals belong to. Values can be affirmed by participating in socio-political activities and depending on the relative weight of the reference group in the labour market.

The model predicts that, in stationary state, as the relative importance of any group approaches the egalitarian distribution, time devoted to socio-political activities rises, whereas time for education decreases. This fact represents a possible explanation for the negative relationship between per-capita GDP and female participation observed in the data. Nonetheless, simulations show that countries may compensate the negative effect on education through an increase in population growth. Indeed, an increase in the rate of population growth causes a reduction in time devoted to work and consequently an increase in educational attainments.

Simulations confirm our theoretical model's predictions: the country with the highest proportion of female to male employment and the highest population growth rate converges to a steady state where time allocated to education is higher and working time is lower than in countries with lower female-to-male employment ratios. Moreover, average socio-political commitment is higher the more equally distributed is employment between the two genders. That results support the empirical evidence**.**

Appendix

Transitional dynamics

Here, we briefly examine the transitional dynamics of the economy. We must reduce the number of state variables by considering the following ratios: $x \equiv \frac{k}{h}$ and $q \equiv \frac{c}{k}$.

By deriving x and q with respect to time and considering equation (7), together with appropriate endpoint conditions, we obtain the following dynamic system:

$$\frac{\dot{x}}{x} = u^{1-\alpha} x^{\alpha-1} - q - B(1-u-p)$$

$$\frac{\dot{u}}{u} = \frac{B(1-p)}{\alpha} - B(1-u-p) + \frac{1}{\alpha} n$$

$$\frac{\dot{q}}{q} = (\alpha-1) u^{1-\alpha} x^{\alpha-1} - \rho + q$$

It is easy to see that the eigenvalues of this system are always less than 1 and do not depend on time devoted to social participation; then, for a given value of p, these three variables asymptotically converge to their stationary values. At the same time, u* does not depend on p*, therefore the fraction of time devoted to socio-political participation will be univocally determined as well as x* and q*.

Below, we provide the simulations, for Italy, Germany and Finland respectively.

Figure A1. Transition path for Italy

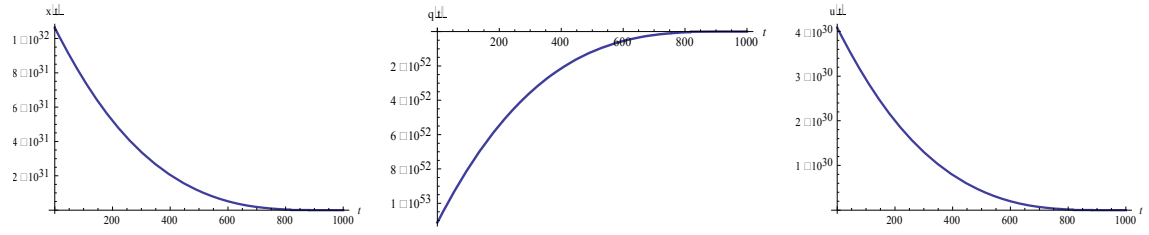


Figure A2. Transition path for Germany

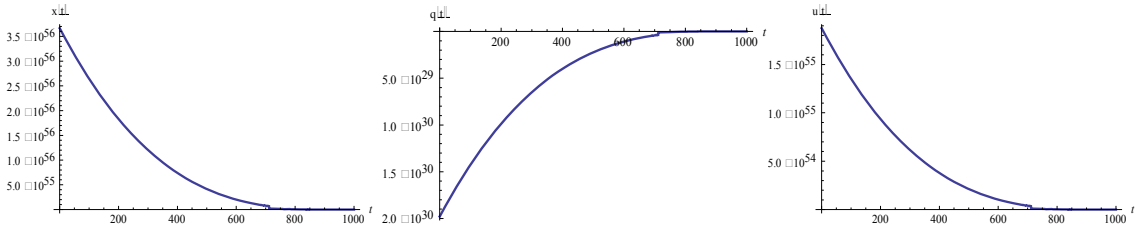
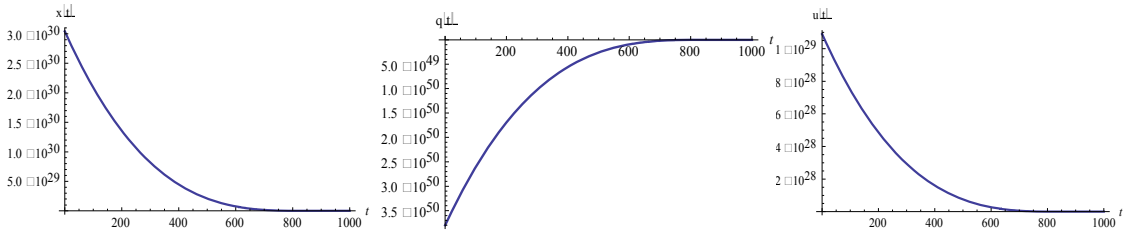


Figure A3. Transition path for Finland



Stability analysis. The response of the economy to shocks on physical capital

Assume the economy is at the steady-state equilibrium $\{\frac{c^*}{k^*}, \frac{k^*}{h^*}, u^*, p^*\}$, following Ladrón-de-Guevara et al. (1997), we study the behavior of our economic variables by considering a small, positive shock on physical capital.

Time devoted to socio-political participation

When k increases time devoted to social participation cannot decrease, while u cannot increase.

From (14), we have that $B(1-u^*-p^*) = B(1-p^*) - \rho + n$, that is, $\rho + \delta = B(1-p^*) + n$. Now, considering (13), we have $p^* = B^{-1}[B + n - \alpha(\frac{u^* h^*}{k^*})^{1-\alpha}]$, and then $\frac{\partial p^*}{\partial k^*} > 0$.

The above dynamic system implies that, during the transition process, an increase in p causes a decrease in u, while the effect on education is ambiguous.

Consumption

Immediately after the shock, consumption jumps up and subsequently decreases.

If an increase in k causes an increase in p, through equation (12) we can conclude that c increases as well. Nonetheless, as shown in Ladrón-de-Guevara et al. (1997), the following equation must hold

$$\frac{\partial \lambda_1}{\partial k}\frac{k}{\lambda_1}+\frac{\partial \lambda_2}{\partial k}\frac{h}{\lambda_1}=-1$$

Thus,

$$-\frac{\partial \lambda_1}{\partial k}\frac{k}{\lambda_1}\leq 1$$

Given (7), the elasticity of consumption with respect to physical capital is $\frac{\partial c}{\partial k}\frac{k}{c}\leq 1$.

Now, since (10) states that an increase in k leads to $\dot{\lambda}_1 > 0$, we will have $\dot{c} < 0$.

Physical and human capital

After a positive shock, k will decrease, while the effect on human capital is ambiguous.

We can show this result by using a contradictory argument. As shown in Caballé and Santos (1993) $\frac{\partial c}{\partial k}\frac{k}{c}\leq 1$ only if $\frac{\partial \lambda_1}{\partial h}\leq 0$. Now, let us assume that k increases along the transition path, therefore we will have $\frac{\partial \lambda_1}{\partial k}\leq 0$, but since $\dot{\lambda}_1 > 0$, this will imply $\frac{\partial \lambda_1}{\partial h} > 0$. This result contradicts the fact that the elasticity of consumption with respect to physical capital is less than 1.

Human capital may go up or down, it depends on the values of parameters.

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