E C O N O M I C S   B U L L E T I N

From the Malthusian to the Modern Growth Regime in an OLG Model with Unions

Luciano Fanti
University of Pisa

Luca Gori
University of Pisa

Abstract

The passage from the Malthusian Regime to the Modern Regime has been theoretically investigated only in recent times and the understanding of this process is still incomplete. This paper develops a neoclassical OLG model of neoclassical growth which embodies a stylised fact emerged in the second half of the XIX century, especially in European countries, that is the unionisation of labour markets and the diffusion of unemployment insurance systems. The results of this paper suggest that, differently from the previous literature, the diffusion of trade unions - which, causing a simultaneous increase of wages and unemployment, on the one hand reversed the effects of wage on fertility and on the other hand enhanced savings, capital accumulation and output in the long-run - may have triggered or at least favoured the passage.

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1 Introduction

The passage from the Malthusian Regime to the Modern Regime[1] has been theoretically investigated only in recent times[2] and the understanding of this process is still incomplete.[3] This paper develops a neoclassical OLG model of growth (Diamond, 1965) which embodies a stylised fact emerged in the second half of the XIX century, especially in European countries, that is the unionisation of labour markets and the diffusion of unemployment insurance systems.[4] The features of the two regimes which are salient in our frame are: i) the Malthusian Regime is characterised by low economic growth and high fertility (which is positively linked with the wage rate); ii) the Modern Growth Regime is characterised by high economic growth[5] and low fertility (which is negatively linked with the wage rate).

Our paper belongs to the strand of the economic growth literature, aiming to explain the historical evolution of the relationship among population growth and, loosely speaking, the standard of living. Moreover the theoretical context is the neoclassical OLG growth theory, here extended for taking into account unions and unemployment insurance systems. The value added of this contribution – which suggests that, under realistic demo-economic conditions, the diffusion of trade unions and unemployment benefit systems may have favoured the transition from the Malthusian Regime to the Modern Growth Regime – lies in offering a possible new explanation of such a transition.[6]

The remainder of the paper is organised as follows: Section 2 presents the model together with the essential results; Section 3 illustrates such results through a qualitative analysis; finally, Section 4 bears the conclusions.

2 The Model

We characterise a basic dynamic general equilibrium OLG model of growth (Diamond, 1965)[7] extended to account for endogenous fertility decisions of households, and where the only departures from the standard textbook model are the hypotheses that workers are organised in a monopolistic trade union, who sets wages over the prevailing market-clearing level, and the existence of a simple

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[1] According to Galor and Weil (1999) three distinct regimes have characterised the process of economic development: the 'Malthusian' Regime, the 'Post-Malthusian' Regime, and the 'Modern Growth' Regime. In particular the distinctive features of the first and of the third regimes are: 1) for the Malthusian Regime: 1.1) low technological progress and roughly constant low income per capita; 1.2) high fertility, at least relative to modern standards, and a *positive* relationship between income per capita and population growth; 2) for the Modern Growth Regime: 2.1) steady growth in both income per capita and the level of technology; 2.2) *negative* relationship between the level of per-capita income and the growth rate of population.

[2] Different mechanisms triggering the transition have been argued by the literature: for example, Becker and Barro (1988), in the context of a model of intergenerational altruism, show that increased technical progress brings upon a higher growth rate of consumption and a lower rate of fertility, while a rapid decline in fertility accompanied by accelerated output growth is due to the interaction between capital accumulation, women's relative wage and fertility (Galor and Weil, 1996), and to the positive effect of technical progress on the return to education and the feedback effect of higher education on technical progress (Galor and Weil, 2000).

[3] "The underlying determinants of the stunning recent escape from the Malthusian trap have been shrouded in mystery and their significance for the understanding of the contemporary growth process has been explored only very recently." (Galor, 2005, p. 220).

[4] The fact that our attention is devoted to the European experience in the last part of the XIX century is in line with Galor and Weil (1999, p.152), who focused on "the experience of Europe and its offshoots, since these were the areas that went through the complete transition from the Malthusian Regime to Modern Growth". Notice also that the unionisation of labour markets as well as the diffusion of unemployment insurance systems, experienced in the most part of European countries, are only one of the possible different causes of labour market imperfections, and thus of higher wages than the market-clearing level. For instance, starting from the third decade of the past century (see, Hamermesh, 1993) national or statutory minimum wages, introduced mainly to increase income of low-paid workers and to reduce poverty, may also be thought as an alternative cause of increased wages in some European countries (e.g., Belgium, France and the Netherland), where labour markets are far from being competitive.

[5] Since we adopt the neoclassical OLG frame, the term economic growth always refers to the level (rather than to the rate of growth) of the long run income, according to the terminology of the neoclassical growth theory (e.g., Solow, 1956 and Mankiw et al., 1992). In any case, needless to say, an increase in the long run level of output, implies a transitional increase in the rate of growth as well.

[6] We note that such an explanation may be additive (rather than substitutive) to the ones provided by the mainstream literature.

[7] Two reference textbooks are Azariadis (1993) and De La Croix and Michel (2002).

balanced budget policy with only two instruments: a lump-sum tax levied on the younger generation used to finance a (constant) unemployment insurance benefit. The model is outlines as follows.

2.1 Government. The government runs a balanced budget policy by equating unemployment benefit expenditures with tax receipts in every period. Therefore, the per-capita time-t government constraint is simply:

$$b u_t = \tau_t , \tag{1}$$

where $\tau_t > 0$ is a lump-sum tax levied on the younger generation (which is adjusted over time to balance out the budget in every moment), $b > 0$ represents a constant hourly unemployment benefit and u_t is the aggregate unemployment rate.[8]

2.2 Individuals. Agents have identical preferences and are assumed to belong to an overlapping generations structure with finite lifetimes. Following a standard way to endogenise fertility in a conventional OLG framework, by assuming for simplicity that every single young adult can have children, life is separated among three periods: childhood, young adulthood and old-age. During childhood individuals do not make decisions. Adult individuals belonging to generation t have a homothetic and separable utility function defined over consumption when young ($c_t^{\,y}$) and old ($c_{t+1}^{\,o}$) and from having children (n_t),[9] as in Galor and Weil (1996).[10] Only young-adult individuals (N_t) join the workforce assuming a unitary constant labour supply. As an adult each young agent earns a non-competitive wage (w_t) higher than the prevailing market-clearing level. Therefore, the labour market does not clear and involuntary unemployment does occur. To tackle the unemployment issue we assume that each young-adult individual receives a constant unemployment benefit, $0 < b < w_t$ – provided by the government – for the hours of unemployment. The aggregate unemployment rate, defined in terms of hours not worked, is $u_t = (N_t - L_t)/N_t$ where L_t is the labour demand.[11] The total income when young thus is given by the sum of labour income for the hours of work plus the unemployment benefit for the hours of unemployment, that is $W_t(w_t, b) := w_t(1-u_t) + bu_t$. This income is used to consume, to save, to raise children and to pay taxes.

Denote by η_t the amount of resources (current consumption) needed to take care of one child. Given the level of fertility, the total amount of resources needed for rearing children is $\eta_t N_t n_t$. A general definition of the child cost structure, capturing both the consumption and the monetary cost to raise a child, may be $\eta_t := e + qW_t(w_t, b)$, where $e > 0$ represents the fixed cost of raising one child

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[8] We have deliberately chosen this taxation scheme, because in this way the nature of unemployment benefits is purely redistributive, that is income taxed away from the young turned back to the same individuals as a benefit when unemployed. This feature is important because in OLG models, as known dating back to Bertola (1996) and Uhlig and Yanagawa (1996), taxing capital income or introducing any other form of transfer from dissavers to savers (that is, from the older to the younger generation) could lead to faster economic growth, since all savings are performed by young agents. Then, in the present context, taxation policy does not cause any transfer from the old-age to the young adulthood (as, instead, it would have been the case with capital income taxes); thus, the positive effect on economic growth – as described in this paper – should be entirely ascribed to the unionised wages (and, thus, to the unemployment occurrence) rather than to the intergenerational tax transfer channel.

[9] Note that n_t represents the number of children with $n_t - 1$ being the population growth rate.

[10] Since the scope of this paper is to isolate the relation between unionised wages and individuals' fertility behaviour, as a first attempt we ignore both the trade-off between child quantity and quality, and the assumption that parents maximise the utility of their offspring, which has been employed to explain economic growth and stagnation by – among others – Becker et al. (1990) and Ehrlich and Lui (1991).

[11] Notice that in our model there is no uncertainty. Therefore, each young agent is employed for $1 - u_t$ hours and unemployed for u_t hours.

(measured in units of market goods) and $0 < q < 1$ is the percentage of child-rearing cost on total income.[12]
During old-age agents are retired and live on the proceeds of their savings (s_t) plus the accrued interest at the rate r_{t+1}.
The representative individual born at time t is faced with the problem of maximising the following logarithmic utility function:

$$\max_{\{c_t^y, c_{t+1}^o, n_t\}} U_t\left(c_t^y, c_{t+1}^o, n_t\right) = (1-\phi)\ln\left(c_t^y\right) + \phi\ln\left(c_{t+1}^o\right) + \rho\ln(n_t),$$

subject to inter-temporal budget constraint

$$c_t^y + c_{t+1}^o/(1+r_{t+1}) = W_t(w_t, b) - \eta_t n_t - \tau_t,$$

where $0 < \phi < 1$ represents the relative weight between consuming during young adulthood and old-age, with $\phi/(1-\phi)$ being the subjective discount rate, and $\rho > 0$ captures the weight of the parents' taste for children in the welfare evaluation. The higher ϕ the more individuals smooth consumption over time, and the higher ρ the more parents are children-interested.
Thus, using the first order conditions along with eq. (1), and rearranging terms, the demand for children and the saving path are the following:

$$n_t(w_t, u_t) = \frac{\rho}{1+\rho} \cdot \frac{w_t(1-u_t)}{\eta_t}, \tag{2}$$

$$s_t(w_t, u_t) = \frac{\phi}{1+\rho} w_t(1-u_t). \tag{3}$$

2.3 Firms. All the firms in the economy are identical and own a constant returns to scale Cobb-Douglas technology of production such that capital (K) and labour (L) are transformed into final goods and services, that is $Y_t = AK_t^{\alpha} L_t^{1-\alpha}$ where $A > 0$ represents a scale parameters and $0 < \alpha < 1$ the capital's weight in technology.[13] Given the labour demand, $L_t = (1-u_t)N_t$, the per-capita Cobb-Douglas production function is given by:

$$y_t = A(1-u_t)(k_t/(1-u_t))^{\alpha}, \tag{4}$$

where $k_t := K_t / N_t$ and $y_t := Y_t / N_t$ are capital and output per-capita respectively.
Assuming that final output is traded at a unit price, profit maximisation leads to the following marginal conditions for capital and labour:[14]

$$r_t = \alpha A(k_t/(1-u_t))^{\alpha-1} - 1, \tag{5}$$

$$w_t = (1-\alpha)A(k_t/(1-u_t))^{\alpha}. \tag{6}$$

The short-run (current) unemployment rate is endogenous. Thus, knowing that the representative firm has the right to hire as many workers as dictated by the perceived labour demand curve, using eq. (6) the rate of unemployment is given by:

$$u_t(k_t, w_t) = 1 - ((1-\alpha)A/w_t)^{\frac{1}{\alpha}} \cdot k_t, \tag{7}$$

which is positively related with the wage rate and strictly decreasing in the per-capita stock of capital.
It is important to note that once the wage has been fixed, the real rate of interest is exogenous (that is, capital returns are independent of the capital stock whatever the wage rate set by the union). Indeed, substitution of (7) into (5) yields:

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[12] This child cost structure is rather usual in literature, e.g. – among others – Boldrin and Jones (2002).

[13] Adding exogenous growth in labour productivity does not alter any of the substantive conclusions about fertility in the model and, hence, it is not included here.

[14] For simplicity, we assume that capital totally depreciates over time, i.e. $\delta = 1$. This assumption is not unrealistic in the present set-up, because as noticed by De La Croix and Michel (2002), p. 338 "even is one assumes a rather low annual depreciation rate of 5%, 79% of the stock of capital is depreciated after 30 years".

$$r(w_t) = \alpha A((1-\alpha)A / w_t)^{\frac{1-\alpha}{\alpha}} - 1, \tag{8}$$

so that any increase of the wage always pushes down the real interest rate below its competitive level. Inserting (7) in (2) to eliminate u_t and rearranging terms yields the fertility rate as a function of the wage rate and stock of capital, that is:

$$n_t(w_t, k_t) = \frac{\rho}{1+\rho} \cdot \frac{((1-\alpha)A)^{\frac{1}{\alpha}} w_t k_t}{w_t^{\frac{1}{\alpha}}(e+qb) + q(w_t - b)((1-\alpha)A)^{\frac{1}{\alpha}} k_t}. \tag{9}$$

2.4 Unions. We now briefly describe the union's behaviour who bargains over the wage rate (see, for instance, Booth, 2002 and Layard el al., 2005). In particular, we closely follow the structure developed by Daveri and Tabellini (1997, 2000).

The monopolistic union faces with the following constrained utility maximisation, where the unemployment benefit, b, and the fraction of young-adult individuals belonging to a union, ω, are assumed to be given, and the ratio $(1-u_t)/\omega$ represents the share of union members that find a job:[15]

$$\max_{\{w_t\}} U_t^{\,u} = \frac{1-u_t}{\omega} w_t + \frac{\omega - (1-u_t)}{\omega} b. \tag{10}$$

subject to (7).[16]

It is easy to show that the union's utility is maximised when:

$$w_t := w_u = \frac{b}{1-\alpha}, \tag{11}$$

that is the union sets the wage as a mark-up over the unemployment benefit, and it is positively linked to both b and α.

2.5 Equilibrium. We now combine all the pieces of the model to characterise the long-run equilibrium. Following the standard procedure, the equilibrium in goods as well as in capital markets is expressed by the equality between savings and investment, i.e. $n_t k_{t+1} = s_t$, and substituting out for n_t, s_t and u_t, capital evolves over time according to the following first order linear difference equation:

$$k_{t+1} = \theta(e+qb) + \theta q((1-\alpha)A)^{\frac{1}{\alpha}} w_t^{\frac{-1}{\alpha}} (w_t - b) k_t. \tag{12}$$

where $\theta := \phi / \rho$. Steady-state implies $k_{t+1} = k_t := k^*$.[17] Thus, the long-run per-capita stock of capital, unemployment rate and output per-capita are respectively given by:

$$k^*(w,b) = \frac{w^{\frac{1}{\alpha}} \theta(e+qb)}{w^{\frac{1}{\alpha}} - \theta q(w-b)((1-\alpha)A)^{\frac{1}{\alpha}}}, \tag{13}$$

$$u^*(w,b) = \frac{w^{\frac{1}{\alpha}} - \theta(e+qw)((1-\alpha)A)^{\frac{1}{\alpha}}}{w^{\frac{1}{\alpha}} - \theta q(w-b)((1-\alpha)A)^{\frac{1}{\alpha}}}, \tag{14}$$

$$y^*(w,b) = \frac{A((1-\alpha)A)^{\frac{1}{\alpha}} \theta(e+qb) w}{w^{\frac{1}{\alpha}} - \theta q(w-b)((1-\alpha)A)^{\frac{1}{\alpha}}}, \tag{15}$$

with w being determined by (11).

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[15] This holds under our assumption that all employed individuals belong to a union.

[16] The interpretation of the union's utility is straightforward: the first term in (10) is the wage times the probability of finding a job, while the second term is the unemployment benefit times the probability of being unemployed.

[17] Using (12), we can show that the steady-state equilibrium is always stable.

Combining, now, (13) with (9), the steady-state demand for children is determined by the following equation:

$$n^*(w) = \frac{\phi}{1+\rho} \cdot \frac{((1-\alpha)A)^{\frac{1}{\alpha}}}{w^{\frac{1-\alpha}{\alpha}}}. \qquad (16)$$

By looking at (16) it is easy to see that the higher the wage rate the lower the fertility rate (Modern fertility effect).

Finally, when the market-clearing wage prevails, i.e. $w_t = w_{t,pc}$, and thus the unemployment rate is zero eqs. (2) and (3) collapse to:

$$n_{t,pc} = \frac{\rho}{1+\rho} \cdot \frac{w_{t,pc}}{\eta_{t,pc}}, \qquad (17)$$

$$s_{t,pc} = \frac{\phi}{1+\rho} w_{t,pc}, \qquad (18)$$

where $\eta_{t,pc} = e + qw_{t,pc}$ is the total cost to take care of one child in the competitive-wage economy. Thus, the low of motion of capital modifies to:

$$k_{t+1} = \theta e + \theta q(1-\alpha)A(k_t)^\alpha, \qquad (19)$$

so that in steady-state:

$$k^* = \theta e + \theta q(1-\alpha)A(k^*)^\alpha. \qquad (20)$$

Since closed-form solution are prevented, the implicit solution of (20) for k^* gives the long-run per-capita stock of capital in the market-clearing wage frame as a function of preference, technology and child rearing cost parameters, i.e.:

$$k^*_{pc} = k^*_{pc}(\bullet). \qquad (21)$$

Thus, the steady-state number of children is given by:

$$n^*_{pc} = \frac{\rho}{1+\rho} \cdot \frac{w_{pc}(k^*_{pc})}{e + qw_{pc}(k^*_{pc})}. \qquad (22)$$

It is easy to see to show that in the case of competitive labour market, there exists a positive relationship between fertility rates and wages (Malthusian effect).

Let us summarise the essential results of the paper in the following remarks:[18]

Remark 1*. The positive relationship (in the short-run) between wage rate and population growth (Malthusian effect) prevailing in the competitive-wage economy is reversed, and the Malthusian effect vanishes (Modern fertility effect), when there exists a labour market imperfection.*

Remark 2*. In the union's wage economy the long-run population growth rate is always lower than in the market-wage economy (i.e.* $n^*(w) < n^*_{pc}$ *) and the higher the union's wage the lower the fertility rate.*

Remark 3*. In the union's wage economy the long-run capital per-capita,* $k^*(w,b)$*, may be higher than in the competitive-wage economy (independently of the technological parameter,* α *) provided that the policy maker fixes an appropriate unemployment benefit (*b *).*

Remark 4*. In the union's wage economy the long-run per-capita income,* $y^*(w,b)$*, may be higher than the market-wage economy provided that* $\alpha > 0.5$.

[18] The proofs of all the remarks are straightforwardly obtained by differentiating with respect to w and subsequently manipulating the appropriate equations (that is, eqs. (17), (9), (16), (13), (15), respectively) and for brevity are here omitted, but, as usual, they are available on request.

The former two remarks state that the unionisation of the labour market reduces fertility and reverses the relationship wage-fertility, which is one of the two salient features of the transition between regimes.
The latter two remarks, instead, state that the unionisation may enhance economic growth, which is the second feature of the transition.
The basic idea behind our results may be rationalised in the following way: a labour market imperfection which gives rise to a wage hike, will increase the income of the currently young generation on one side, but on the other side, it will lead to unemployment as the hourly wage is fixed at too high a level for the labour market to be cleared. In the short-run, this brings about a decrease in the overall income of the younger generation (despite the presence of unemployment insurance benefits) and, given the constant propensity to save, a decrease in saving as well. However, since a negative correlation among fertility and unemployment is established, a higher wage ultimately increases both unemployment and the opportunity cost of child-rearing, and it will dramatically reduce fertility rates. In particular, fertility reduces more than savings. In the light of the latter effect, the pace of accumulation of capital per-capita (which depends on the ratio between savings and the demand for children, and it will result to be a positive function of the wage rate despite unemployment) is higher than the capital accumulation path in the competitive-wage economy. This, in turn, leads to a higher steady-state per-capita stock of capital.
However, for the long-run income to be improved by the diffusion of unions and unemployment benefit systems, a necessary condition is that the positive effect on the induced increase in the capital stock input should be greater than the negative effect of the induced labour input reduction on the final output. Whether (transitional) economic growth and long-run output will be reduced or increased will depend ultimately on the weight of the capital input relative to the weight of the labour input in the production function.
Therefore, if the unemployment benefit is high enough and production is relatively capital oriented, the long-run economic growth, that is the transitional rate of growth as well as the long run level of per-capita income, is higher in a union's wage economy than in the standard competitive-wage economy.
In the long-run thus the higher unionised wage increases, despite the unemployment occurrence, savings, capital stock and, provided a capital's weight in technology sufficiently high, the output level; on the contrary, fertility rates will be dramatically reduced, and this contributes to raise the level of capital and output per-worker. This positive feedback loop generates the main typical features of the passage between the Malthusian to the Modern era.

3 A Numerical Illustration

A simple "calibration" exercise for this highly stylised OLG model may help us in evaluating how after the introduction of "unionised" wages 1) the positive relation between fertility and wage turns to be negative; 2) economic growth is increased. We take the following parameter values: $A = 100$ (simply a scale parameter when the production function is Cobb-Douglas), $\alpha = 0.75$,[19] $\phi = 0.10$, $\rho = 0.50$, $q = 0.20$, $e = 0.10$.
In Figure 1 we depict the short-run behaviour of population as a function of the wage, in the case of both competitive-wage and unionised-wage economies. It is easy to see that, 1) if the labour market is competitive, positive shocks on wages always increase the fertility rate and 2) if the labour market is unionised, the higher the union's wage the lower the fertility rate. This figure clearly depicts the first salient feature of the transition: the rate of fertility turns out to be negatively correlated with wages when the labour market from competitive becomes unionised.
Figure 2 depicts the fertility behaviour as a function of the wage in the long run, showing that under unionised labour market, the rate of fertility is always lower than that of the competitive-wage frame; this is coherent with the second feature of the transition. Note that a positive shock on competitive wages shifts upward both curves.

[19] Note that this high value of the capital's weight in technology is in line with Barro and Sala-i-Martin (2003) once we consider labour to be only unskilled and capital to include also human components.

Finally, Figure 3 depicts the long run output in the case of both competitive-wage and unionised-wage economies as a function of the wage rate. It is easy to see that if the wage is set by the monopolistic trade union, the long run output is higher than that of the competitive-wage frame. Figure 3 clearly shows the other salient feature of the transition: while fertility is reduced and becomes negatively linked with wages, economic growth is increased.

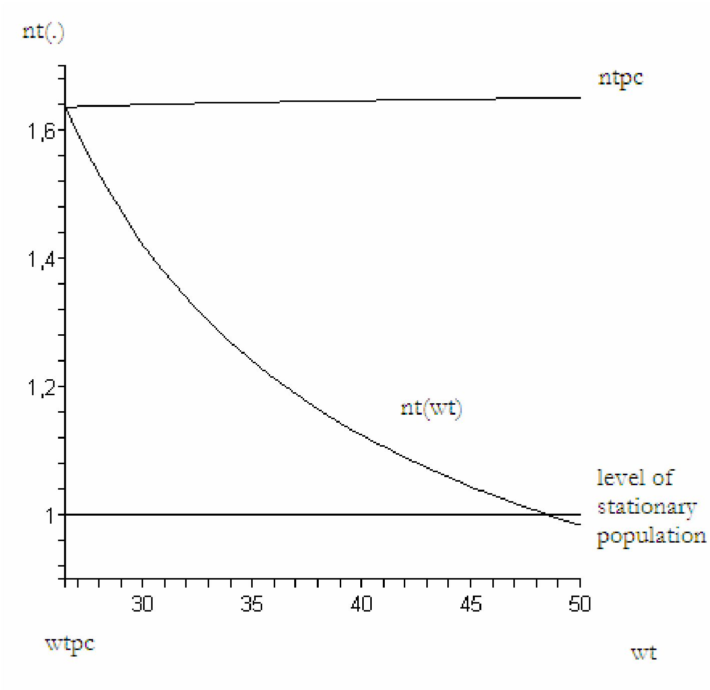

Figure 1. *The short-run fertility rates in both the non-competitive-wage,* $n_t(w_t, k_t)$*, and competitive-wage,* $n_{t,pc}$*, economies for a given stock of capital. The starting point of the horizontal axis is the steady-state market-clearing wage, that is* $w_{pc} = 26.4$ *corresponding to which the per-capita stock of capital is* $k_t = 1.07$*. Parameter values:* $A = 100$*,* $\alpha = 0.75$*,* $\phi = 0.10$*,* $\rho = 0.50$*,* $b = 25$*,* $q = 0.20$ *and* $e = 0.1$.

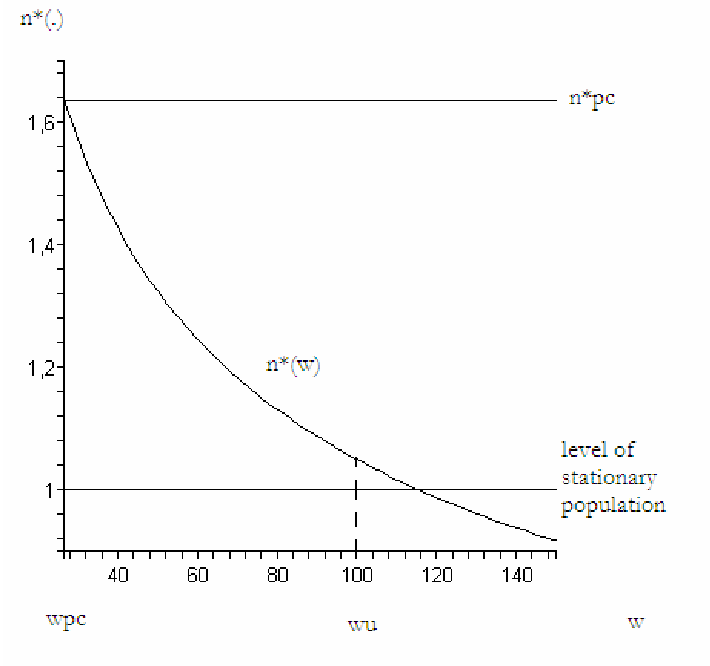

Figure 2*. The long-run fertility rates in both the non-competitive-wage,* $n^*(w)$*, and competitive-wage,* $n^*{}_{pc}$*, economies. The starting point of the horizontal axis is the steady-state market-clearing wage, that is* $w_{pc} = 26.4$*. The union's wage is* $w_u = 100$*. Parameter values:* $A = 100$*,* $\alpha = 0.75$*,* $\phi = 0.10$*,* $\rho = 0.50$*,* $b = 25$*,* $q = 0.20$ *and* $e = 0.1$.

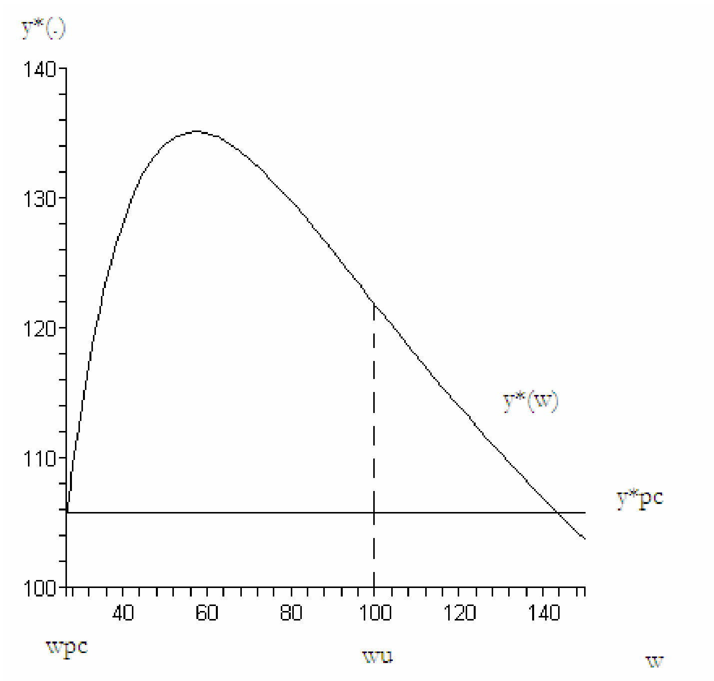

Figure 3*. The long-run per-capita income in both the non-competitive-wage,* $y^*(w)$*, and competitive-wage,* $y^*{}_{pc}$*, economies. The starting point of the horizontal axis is the steady-state market-clearing wage, that is* $w_{pc} = 26.4$*. The union's wage is* $w_u = 100$*. Parameter values:* $A = 100$*,* $\alpha = 0.75$*,* $\phi = 0.10$*,* $\rho = 0.50$*,* $b = 25$*,* $q = 0.20$ *and* $e = 0.1$.

4 Conclusions

This paper examines a novel mechanism which can have contributed to the transition from the Malthusian Regime to the Modern Regime of growth (according to the terminology used by Galor and Weil, 1999), by developing a standard OLG model which embodies a stylised fact emerged in the second half of the XIX century, especially in European countries, that is the unionisation of labour markets and the resulting diffusion of unemployment insurance systems. On the one side higher unionised wages, creating unemployment and increasing the opportunity cost of childrearing, reduce fertility, and on the other side may increase, despite the unemployment occurrence, the long-run per-capita income; the lower demand for children contributes to raise the level of income per worker. The interaction between higher unionised wages and fertility generates the main typical features of the passage from the Malthusian to the Modern era: a decline in population growth accompanied by the inversion of the relationship income-fertility and an increased per capita output.[20]

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[20] Obviously, we note that this paper abstracts from several other factors that are relevant for economic growth such as, for instance, technical progress, education policies, commodity trades and migrations.

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